FINAL REPORT

Trade & Climate Change

Quantitative Assessment of the Best Policy Tools to Achieve Climate Neutrality and Competitiveness

afep

FRENCH ASSOCIATION OF LARGE COMPANIES

Contents

Figures

Tables

Foreword

by Laurent Burelle, President of Afep

Under the « Green deal », the European Union is showing the way in taking up the challenge of climate neutrality by 2050 in its own territory and in incentivizing its key trading partners to make a similar shift towards massive reduction of greenhouse gas emissions. This is resulting in an unprecedented reshuffling of the entire EU policy framework: inter alia further review of the Emission Trading Scheme (ETS), ambitious taxonomy, greening of the EU trade policy and work on a carbon border adjustment mechanism (CBAM) to possibly price the carbon content of foreign products.

Large French companies are fully supportive of this move towards a greener economy and the climate neutrality target. However, in addition to huge efforts to devise new production processes up to this level of ambition, regulatory changes at the EU level will come along with real challenges to their competitiveness on the EU and foreign markets.

French companies are wary, as most of their counterparts in other Member States, of the risk of further carbon leakage – increased competitiveness of third countries based on lower carbon pricing and production shift outside of the EU. At the same time, they fear that ill-designed measures could fail to curb down this carbon price edge and trigger additional concerns, such as new trade tensions in an already strained situation.

In this context, Afep, the French association of large Companies, decided in 2019 to **investigate further on the implications of the climate neutrality scenario underpinning the Green deal** and the Climate law for companies and **find concrete solutions to tackle this possible competitiveness gap**. Our membership clearly expected an objective and independent expertise to enlighten French companies on risks and ways forward, based on solid macro-economic modelling.

This is why we commissioned a comprehensive quantitative study measuring the-economic and environmental impact of climate neutrality and **researching a vast array of internal and international instruments, with a view to finding the best policy tool(s)to combine worldwide carbon emission reductions, growth and enhanced competitiveness**. A possible version of a CBAM has been tested and, at the request of Afep companies, the point was to **compare this CBAM to possible alternative or complementary measures, to determine the most efficient solution, without any preconception on the outcome**.

The study also aims at assessing the **likely impact of several trade agreements being already under discussions or simply considered** and help French companies in determining which of them are really fit for boosting sustainable development and achieving positive economic results.

After thorough analysis, the report first **objectivises the very likeness and the scale of carbon leakage if the EU does not maintain or adopt policy measure(s) accompanying the transition toward climate neutralit**y (dismantlement of free allowances under ETS and absence of alternative measures). **This clarifies that EU companies' concerns are grounded and should be echoed by an adequate political framework, the « competitiveness » pillar of the Green Deal**.

The study report also provides EU stakeholders with a very detailed picture on how a large set of measures (CBAM in seven variants, final consumption tax, reduction of industrial or fossil fuel subsidies, custom tariff reduction on « green goods ») can perform, taken individually or in combination.

Taking into inherent limitations of such modelling exercise (lack of certain data, hypothesis selection etc), a carbon border adjustment **mechanism proves an efficient instrument to both tackle increased carbon leakage threats, boost EU growth, and improve EU trade balance if it comes along with adequate supporting measures such as WTO compatible subsidies**, funded by a partial recycling of the revenues it would generate.

Another significant lesson to be drawn from the report is the **positive impact of trade disciplines assessed in the study**, with a strong emphasis on the **reduction of industrial subsidies, or at least the most harmful, as well tariff erosion on low-carbon goods and products enabling climate change mitigation**. As they could well perform on their own, **they also could noticeably improve CBAM performance and could therefore be envisaged as an adequate complementary measure**.

Based on these various elements, Afep recommends that the European Commission further explores **the possibility of a CBAM** - in the shape of either levies on imported products or ETS market for imported goods- **focusing first on sectors mainly concerned by carbon leakage** subject to their acceptance, while other sectors could keep the benefit of free allowances and **would be offered the possibility to join later the CBAM still on a voluntary basis**.

In parallel, Afep supports the European Commission to join forces with major trading partners towards the negotiation on the **strengthening of the Agreement on subsidies and countervailing measures** (ASCM) as well as the relaunch of negotiations on **a plurilateral agreement on environmental goods**, with an extension to non-tariff barriers to upgrade the level of environmental standards.

In any event, I trust that this study report will be a significant contribution to the public debate and the awareness that trade and environmental policies could be combined to best mitigate climate change and improve EU companies' competitiveness.

I wish you an interesting reading!

Laurent Burelle

1

Executive Summary

Executive Summary

The European Union (EU) has taken a leading position among major economies in terms of its outlook for greenhouse gas (GHG) emissions reductions and climate change mitigation. Having exceeded its 2020 target for reduction of GHG emissions, the EU is now poised to adopt a more ambitious trajectory for 2030 and carbon neutrality by 2050, if current proposals are approved.

Outside of the EU, the outlook for decisive action on climate change is mixed. Even among the EU's largest trading partners, starkly different approaches to climate change are apparent. For the first time in 2020, China became the EU's largest trading partner. At the same time, China's government has recently announced its intent to move forward its peak in GHG emissions under the 2015 Paris Climate Agreement to before 2030, while reaching carbon neutrality by 2060. China has replaced the United States (US) as the EU's largest trading partner where, conversely, there is currently no centralised policy on climate change.

The EU's economy is inherently trade-oriented. Trade in goods and services form 43% of the EU's GDP and, overall, the EU accounts for more than 15% of global trade despite having only 5% of global population[1]. The position and reliance of the EU's economy on trade, coupled with the non-ambitious commitments of its trading partners on mitigating climate change, requires a holistic strategy to ensure that reduction of GHG emissions is not at the expense of economic competitiveness of energy intensive industries.

This study assesses the economic, environmental and legal dimensions of various policy instruments that the EU may consider for meeting both its climate and economic objective. Two main objectives are pursued within this study, which form the basis for the two tiers of the analysis that occurs within the body of the report:

1. **development of an analytical framework for empirically assessing the interaction between international trade and climate change; and**
2. **evaluation of the environmental and economic impacts associated with various policies that may be pursued by the EU (domestically, unilaterally and cooperatively with other countries) towards achieving its climate goals and strengthening competitiveness.**

To accomplish these objectives, the study relies on the General Equilibrium Model (GEM-E3[2]) for quantifying the overall balance of carbon emissions due to international trade and investment and, by contrast, carbon emission avoidance due to the same trade and investment flows (Tier 1/Objective 1). The methodology used includes an analytical framework that allows for the measurement of potential competitiveness gaps that emerge between the EU (as a production site) and its key trading partners due to divergence in carbon prices over in the medium-to-long term.

Two scenarios are modelled within Tier 1, which vary only with respect to the level of GHG emissions pursued by the EU.

- **Existing NDC Commitments Scenario** (Baseline Scenario): which assumes that the EU adheres to current targets and reduces greenhouse gas (GHG) emissions by 40% in 2030 and 80% in 2050 (compared to 1990 levels)[3].

- **EU Carbon Neutrality Scenario:** which assumes that the EU adopts a more ambitious approach to GHG emission reductions that includes targets of 55% in 2030 and 90% in 2050 (compared to 1990 levels)[4] and net zero emissions.

Across each scenario, non-EU countries are assumed to implement their Nationally Determined Contributions (NDCs) agreed to under the 2015 Paris Climate Agreement up to the year 2030. The implementation of these policies by 2030 requires an equivalent carbon price to be determined, which is held constant until 2050.

The results derived from the modelling of the EU Carbon Neutrality Scenario play an important role in meeting the study's second objective. Within Tier 2, the methodological framework developed in Tier 1 is extended to include six potential policies that may be pursued by the EU in its efforts to confront climate change and meets its GHG emission reduction targets, while also seeking to ensure robust economic performance.

The policies explored within Tier 2 of this study include EU-wide domestic measures, unilateral trade defence measures as well as multilateral measures pursued in cooperation with trade partners. The results obtained from the modelling of these scenarios are reported in comparison to the estimates derived from the EU Carbon Neutrality Scenario and highlight the potential impact of a policy in comparison to a counterfactual scenario where the EU attempts to meets its GHG emission reduction targets by relying solely on tools currently in use (principally the ETS). This comparison provides a basis for understanding the extent to which the adoption of a new policy tool may improve upon the status quo in terms of environmental and economic indicators and allows for stakeholders to better understand the best path forward.

The policy instruments chosen for the analysis include the following:

Unilateral trade instruments	**EU-wide Domestic instruments**	**Multilateral trade instruments**
• EU-wide carbon border adjustment mechanism (CBAM) on imports	• EU-wide subsidisation in support of low-carbon technologies (financed by ETS revenues), in addition to CBAM • EU-wide final consumption tax on carbon content (domestic & imported products)	• a multilateral agreement that awards preferential tariffs for limiting the carbon embodied in goods and which eliminates tariffs on trade in 'Environmental Goods' • a plurilateral agreement on the reduction of industrial subsidies • a plurilateral agreement on the reduction of fossil fuel subsidies

1 European Commission (2020): DG TRADE Statistical Guide – August 2020. Available at: https://trade.ec.europa.eu/doclib/docs/2013/may/tradoc_151348.pdf.
2 For more information, see: https://e3modelling.com/modelling-tools/gem-e3/.
3 For the purposes of this study, the Baseline Scenario provides a point of reference for the assessment of greater emissions reductions efforts under the EU Carbon Neutrality Scenario
4 These targets are in-line with the recently adopted EU 55% target for 2030 and the long term energy strategy objective for 2050. The model does not capture reduction in GHG emissions due to land-use change, therefore the 90% reduction applies to the remainder of the economy including hard-to-abate sectors.

The quantitative assessment of these policies is, in turn, complemented by a review of these policies' potential feasibility with respect to their compatibility with international law in order to arrive at a determination of the relative costs and benefits of each policy with respect to the EU's environmental and economic objectives. The study concludes with an overall evaluation of the policies analysed in terms of their comparative effectiveness with respect to environmental and economic indicators.

Tier 1: Interaction between international trade and climate change

The results from the study's first tier project that the carbon price required to achieve the targets under the baseline scenario (40% reduction in GHG emissions by 2030 and 80% by 2050) will range **from a low of 25€ ($33) in 2020 to a high of 176€ ($234) per tonne of CO_2 in 2050**. These differ from the carbon prices projected under the EU Carbon Neutrality Scenario, where more ambitious targets (55% in 2030 and 90% by 2050) **require carbon prices of 56€ ($74) in 2030 and 444€ ($590) in 2050**.

The more ambitious reductions included in the EU Carbon Neutrality Scenario are, moreover, estimated to result in **additional** 14% carbon leakage **compared with carbon leakage resulting from the baseline scenario** over the 2025-2050 period, with the model highlighting the key role played by the increased production costs that will occur in the EU due to these higher carbon prices. Leakage is expected to be geographically dispersed, with the greatest concentration occurring in **Russia (22% of production relocation), United States (11%), China (9%), and India (9%)**.

At the sectoral level, the model estimates that (under the EU Carbon Neutrality Scenario) the greatest exposure to leakage will occur **in chemicals (35% of all leakage), metals (33%), cement (14%) and air transport (12%). Russia is projected to be the main destination for production relocation of metals, chemicals and equipment manufacturing, while the United States is estimated to capture a significant share of air transportation. Cement production, meanwhile, is expected to increase predominantly in China, India and North Africa.**

Tier 2: EU Policy Measures & International Agreements for Reaching Climate Objectives and Improving Economic Competitiveness

Under the context of more ambitious GHG emission reduction targets, EU energy intensive firms may find themselves confronting reductions in competitiveness in comparison to international competitors located in jurisdictions with less costly environmental regulations. This in turn can increase pressures to shift production outside the EU.

At the same time, as the EU is actively signalling its intention to adopt additional climate measures, it has become apparent that their GHG emission reduction targets will be achieved by a potentially diverse set of policies. In terms of both economic and environmental considerations, it is therefore becoming increasingly important for stakeholders to understand the relevant costs and benefits of the policies that may be pursued at the EU-level so that the most effective path forward can be determined.

This is the objective of the second tier of this study. At the outset of the study, a wide range of different unilateral and plurilateral instruments were considered for their potential to deter lost competitiveness and carbon leakage, as well as their political feasibility within the EU and expected compatibility with international trade rules. A shortlist of up to nine possible instruments was compiled, culminating in a final selection of the six that are presented below[5].

Across the different options examined, two features are universally applied:

(i) use of a carbon price determined by taking the difference between the prices calculated in the Baseline and EU Carbon Neutrality scenarios from Tier 1; and

(ii) functional implementation of the measure beginning in 2025.

The goal of this exercise is to arrive at an objective, methodologically-rigorous understanding of the relative costs and benefits of the various policies analysed so as to assist Afep members (as well as broader EU industry and other stakeholders) in determining their preferred policy positions in discussions with French, EC and other Member State governments.

Carbon Border Adjustment Mechanism (CBAM)

With the European Commission targeting a potential CBAM as one of the measures under consideration for reaching greater GHG emissions reductions by 2030 and 2050, a natural departure point for Tier 2 is to model the potential impact of such a policy. Given that a number of potential approaches could be taken with respect to the CBAM's design and implementation, the study simulated a total of 7 variations of an EU-wide CBAM[6]. These include variants on whether CBAM revenues are recycled, whether trading partners apply retaliation, sectoral coverage, and whether the United Kingdom is included in the EU.

In the model's design of the policy, the CBAM is aligned with the EU ETS carbon pricing and applies only to those products subject to the ETS. Imported goods are taxed according to their carbon content. To calculate their carbon content only the direct GHG emissions are accounted for[7]. In this way, the model simulates a tax-based CBAM, where the adjustment paid by importers is purely financial, although the same mechanism for determining the carbon intensity of imported goods relative to those produced in the EU would also apply to a CBAM based on allowances.

In modelling this policy, the CBAM has been designed to vary across the following three dimensions:

a) full passing of costs of the CBAM onto consumers;

b) recycling of revenues to subsidise energy efficiency technologies and research and development (R&D) into renewable energy and battery technologies[8];

c) retaliation by non-EU countries on a symmetrical set of EU imports countries that is equivalent to the border adjustment levied on those countries' imports into the EU[9].

The results from each of these variations is presented in Table 1. **The key finding from these simulations is that the overall impact of the CBAM is estimated to be heavily contingent on whether revenues are recycled back into the economy**.

Regardless of whether retaliation against the EU occurs as a result of the CBAM, the results suggest that **the long-term impact on EU GDP, employment and carbon leakage will be positive** (compared to a scenario where the EU relies solely on the current set of tools and adopts more stringent GHG reduction targets) **provided that revenues are recycled in a way that effectively supports acquisition and development of energy efficiency technologies.** When this is not the case, the CBAM is expected to worsen GDP and employment, with its principle benefit being its ability to reduce carbon leakage.

Table 1: Estimated impact of CBAM variations on GDP, Unemployment and Cumulative non-EU GHG Emissions, 2025-2050 (in comparison to results from the EU Carbon Neutrality Scenario

	No recycling, No retaliation	**With recycling, With retaliation**	**With recycling No retaliation**	**No Recycling, With Retaliation**	**3 sectors, No recycling, No retaliation**
GDP	-0.08%	0.09%	0.10%	-0.09%	-0.07%
EU Exports	-1.53%	-1.81%	-1.60%	-1.75%	-1.45%
EU Imports	-1.85%	-2.02%	-1.81%	-2.06%	-1.73%
Employment rate	-0.11%	0.06%	0.07%	-0.11%	-0.09%
Change in non-EU GHG (Mt, 2025-2050)	-4 642	-4 328	-4 819	-4 153	-4 499

Source: GEM-E3

Overall, **the most advantageous version of a CBAM is the one that includes recycling and does not lead to retaliation**. In this instance, the model calculates the greatest gains in GDP and employment among all variations of the CBAM modelled as well **as the largest reduction in carbon leakage to third countries**.

As noted, the most positive outcome in terms of GDP and employment appear to be derived from the presence of revenue recycling, but it is similarly worth noting that the factor that most strongly influences carbon leakage is retaliation – with the model projecting that an absence of retaliation will generate greater reductions in leakage regardless of whether revenues are recycled.

Together, these results suggest that a CBAM can be a policy tool that effectively balances environmental and economic objectives over the long-term provided that it is designed effectively. While there may be various ways to achieve this, the modelling simulations point to the importance of considering how revenues will be used as well as ensuring that it is ultimately designed in a way that ensures WTO compliance so as to limit the scope for retaliation[10].

__5__ The full list of policy measures considered but not included in the final study can be found in the Annex.
__6__ These consist of the following: (i) a CBAM with no recycling of revenues and no retaliation from major trade partners; (ii) a CBAM with recycling of revenues toward development of clean energy technologies and with retaliation from major trade partners; (iii) a CBAM with recycling of revenues and no retaliation from major trade partners; (iv) a CBAM with no recycling of revenues and with retaliation; (v) a CBAM that is applied solely on the 3 sectors of metals, chemicals and cement (with no recycling of revenues and no retaliation); (vi) a CBAM with recycling of revenues and with retaliation from major trade partners, but which excludes the UK from the EU; and (vii) A CBAM with recycling of revenues and no retaliation from major trade partners, but which excludes the UK from the EU.
__7__ 'Direct' GHG emissions means all GHG emissions at the site of production, also referred to as Scope 1.
__8__ In the variations that include recycling of CBAM revenues back into the economy, it is modelled in the following way: (i) 60% of the revenues are used to subsidise energy efficiency technologies; and (ii) 40% are used to subsidise R&D in renewable energy and battery technologies.
__9__ It is well-understood that any retaliation that may occur as a result of the CBAM would not be undertaken in such a fashion and would almost certainly be levied against a politically strategic set of products exported from the EU. However, determining what this set of products might be in the future is a largely imprecise and subjective exercise. As such, it was determined that the most straightforward way of proceeding with retaliation would be to apply it in a symmetrical fashion.
__10__ The modelling results suggest that the recycling of the CBAM towards R&D and energy efficiency improvements increases the economy's productivity and lowers production costs and energy expenditures. It should be noted, however, that the benefits from increasing R&D expenditure are uncertain and the specific results should be treated with caution.

EU-wide Subsidies in Support of Low-carbon Technologies

The second policy modelled in order to further understand the potential actions that the EU may consider to meet its climate objectives is that of an EU-wide subsidies programme for supporting low-carbon technologies.

This scenario is designed as a policy intervention to lower the cost of energy transition for households and producers and to address potential disadvantages to EU producers that result from being subject to costlier environmental regulations. It is composed as a complement to the CBAM scenario which recycles ETS revenues back into the economy, in addition to those raised by the CBAM. However, while the CBAM attempts to equate the carbon cost of imported goods with those produced in the EU, the EU-wide domestic subsidies policy seeks to lower the costs that EU firms face in transitioning to less carbon-intensive forms of production.

Within the model, the granting of these subsidies is designed so as to be neutral to the public budget: Half of ETS revenues are recycled back[11] into the economy to subsidise low-carbon technologies, while the remaining half go to EU public budgets. These subsidies are then assumed to be used in the same ways as modelled in the CBAM scenarios that incorporate revenue recycling: (i) 60% of the revenues are used to subsidise energy efficiency technologies; and (ii) 40% are used to subsidise R&D in renewable energy and battery technologies. It should be noted that the use of the ETS revenues to promote research and development on clean energy technologies and promote energy efficiency cannot be considered as a direct subsidy to industries and are conceived of as being compliant with WTO rules.

For comparative purposes, the results of this scenario are presented in Table 2 alongside those from the CBAM scenario that includes recycling and no retaliation. As observed, the model estimates that combining this version of a CBAM with an EU subsidies policy that recycles the ETS revenues into low-carbon technologies would lead to significant improvements in the projected gains for GDP and employment while also generating further reductions in carbon leakage.

Table 2: Estimated impact of the EU-wide subsidies policy together with CBAM on GDP, Unemployment & Cumulative Change in non-EU GHG Emissions, 2025-2050 (in comparison to results from the EU Carbon Neutrality Scenario)

	EU-wide subsidies in support of low-carbon technologies & CBAM (with recycling, no retaliation)	**CBAM only (with recycling, no retaliation**
GDP	0.29%	0.10%
Employment rate	0.18%	0.07%
Change in non-EU GHG (Mt, 2025-2050)	- 5 019	- 4 819
Revenues Recycled into EU economy ($ billion)	1 288	915

Source: GEM-E3

On its surface, these results suggest that the EU may benefit immensely from incorporating a CBAM that recycles revenues in conjunction with a subsidies programme that uses ETS revenues toward acquisition and development of clean energy technologies. While this may be the case regardless, it is important to note that the size of the benefits estimated by the model are heavily contingent on the future price of carbon allowances within the EU. With carbon prices estimated to increase significantly by 2050 under both the Baseline and EU Carbon Neutrality scenarios, the model therefore projects sizeable increases in ETS revenues (281€ billion recycled between 2025-2050). To the extent that this does not materialise, the size of the gains estimated by the model could be notably reduced. Furthermore, regardless of the ultimate amount recycled, the effectiveness of this policy will be heavily contingent on the success and performance of any R&D subsidised through the ETS recycling.

EU-wide Final Consumption Tax on Carbon Content (domestic and imported products)

The third potential policy evaluated within Tier 2 assesses the potential impact from adoption of an EU-wide final consumption tax on the carbon embodied in goods regardless of origin (EU and imports). In this scenario, the level of taxation on goods is calculated using EU ETS carbon pricing as well as the carbon intensity profiles of all final consumption products[12]. This policy covers both direct and indirect emissions capturing the complete carbon footprint of the product. Two variants of the policy have been evaluated: (i) with recycling of the Final Consumption Tax revenues as a lumpsum transfer to households and to promote clean energy investments; and (ii) without recycling, where revenues from the instrument are kept as a credit to the public budgets of EU Member States.

Modelling of the **Final Consumption Tax on Carbon Content is found to be effective in reducing carbon leakage by 1,077 mega-tonnes of CO2 over the period of 2025-2050. However, a small but negative impact on economic activity and welfare in the EU is observed in the form of higher consumer prices and reduced of real disposable income**. Indeed, among all policy scenarios modelled, **the EU-wide Final Consumption Tax policy is projected to result in the most detrimental outcome for the EU's GDP and employment by 2050**. These results remain negative however are partially offset by increased demand stimulus in the instance where half of the revenues generated from the tax are recycled back into the economy by upporting households income.

Carbon content-modulated Tariffs & Zero Duties on Environmental Goods List

Beyond domestic and unilateral measures, the study also models a series of potential multilateral approaches that the EU may pursue in order to encourage its trading partners to bring their environmental policies and production methods further in line with those found in Europe. The first of these considers the impact of a potential multilateral agreement designed

11 The difference of ETS revenues between the Baseline and EU Carbon Neutrality Scenarios are recycled back to the economy.
12 The applied tax rates vary by sector, ranging from 0% to 2% in 2030 and rising to a peak rate of 12.4% in 2050 (for air transport). In order to avoid double-taxation of EU products for which carbon content is already accounted for under the ETS, the scenario assumes that ETS allowances are freely allocated in a way that firms are still directed to meet emissions reductions requirements in a cost-optimal way.

to incentivise producers to reduce their carbon footprint by providing preferential tariffs to goods manufactured with lower levels of carbon. This instrument presumes that a global agreement to this effect would be reached and would additionally eliminate all tariffs on an agreed list of environmental goods[13].

According to the modelling results, **the reduction and removal of these tariffs is estimated to have a beneficial effect on EU trade although it is not projected to have a significant impact on either GDP or employment by 2050** in comparison to a counterfactual scenario where such an agreement does not exist and the EU continues to rely principally on the ETS to meet its GHG reduction targets (i.e., the EU Carbon Neutrality Scenario). Further, while the scenario is projected to reduce carbon leakage by 1,116 mega-tonnes of CO_2 between 2025 and 2050, this is similarly less than what is estimated to result from both the CBAM.

These muted results appear to be due to several factors, including the fact that existing tariffs are not currently based on a product's carbon content; that the overall level of tariffs is relatively low to begin with; and the relatively limited scope of the list of environmental goods used in the scenario. To the extent that these factors change, the results could become more significant. However, it is worth noting that because an agreement of this scale would require significant shifts in the global political landscape in order to be realised (and would lead as well to notable increases in compliance costs), the limited gains projected to emerge from this agreement suggest that efforts may be better directed towards other policies.

Plurilateral Agreement on the Reduction of Industrial Subsidies

Recent publications and statements through the G20, Organisation for Economic Co-operation and Development (OECD), WTO, and other fora indicate a growing awareness of the harmful economic and environmental impact of industrial subsidies. Most recently, the EU, Japan, and US announced their intent to initiate a reform of the WTO Agreement on Subsidies and Countervailing Measures (ASCM). The study has applied such a reform as the basis for an international agreement which leads to a reduction in the incidence of industrial subsidies to industry.

In the scenario, China is taken to be the focus of the instrument and is where the reduction in applied subsidies is imposed. Data on industrial subsidies is inherently limited, as governments have an incentive to conceal the extent to which they support their domestic industries. However, through a review of existing literature, the study has developed a profile of sectoral subsidy rates in China. In turn, these subsidies are eliminated within the model so as to reflect increased costs for Chinese producers.

The scenario is unique in that it is based on a plurilateral agreement but has an outsized impact on one country, China. **According to the results, the removal of subsidies in China is projected to reduce its GHG emissions to a larger extent than the EU's carbon leakage to China**. For the EU, however, the results suggest that the removal of industrial subsidies in China would not be expected to lead to any meaningful economic impact in the EU with respect to GDP or employment.

While there is growing momentum for WTO reform and a platform for updating the provisions of the ASCM to more effectively target trade-distorting subsidies, achieving such a policy ultimately requires commitment and substantial domestic reforms by not only the Chinese govern-

13 The APEC list of 54 environmental goods is used in the model, though in practice any such agreement could include a significantly larger list of products (such as observed in the EGA negotiations).

ment, but also a significant tranche of G20 members to effect a critical mass for most favoured nation application of the revised subsidy rules.

Plurilateral Agreement on the Reduction of Fossil Fuel Subsidies

As with the reduction of industrial subsidies, this scenario assumes the implementation of a plurilateral agreement that would broaden restrictions on the use of fossil fuel subsidies across all countries. The International Energy Agency (IEA) estimates that more than €340 billion are spent globally on fossil fuel subsidies, although competing estimates from the International Monetary Fund (IMF) place the figure at more than €4 trillion.

Given this scale, but also due to the variation in fossil fuel subsidies between different energy types, two configurations of the scenario have been carried out. The first simulation reflects a full phasing-out of subsidies on coal, oil, and gas, while the second applies a full phasing-out on oil and gas subsidies (but only a partial phase out on coal subsidies). The reason for separating out coal subsidies is to counteract the substitution that occurs when subsidies for oil and gas are removed, where energy production shifts to coal-based sources leading to an increase in GHG emissions.

The removal of fossil fuel subsidies is found to produce no meaningful impact on EU GDP, employment or trade. Overall reductions in carbon leakage are equivalent to 660 megatonnes of CO_2 between 2025 and 2050, which is significantly less than in other policies examined. Nominal interest in and advocacy for the reduction and removal of fossil fuel subsidies has existed for some time, both in the EU and internationally. Within the EU, there is diversity in the extent and composition of fossil fuel subsidies between Member States, and the lack of a compelling plan for their removal. EU leadership on fossil fuel subsidies reduction through an international agreement could establish credibility through a first round of unilateral reductions to fossil fuel subsidies, particularly if coupled with measures to reduce leakage arising from any increase in production costs.

Policy instrument Combinations

Given the scale of ambition in the EU's GHG emissions reduction targets, it is assumed that multiple instruments will be pursued to reach the stated targets. Further to the standalone policy scenarios outlined above, the study therefore considers four potential combinations of instruments and compares their relative effectiveness.

The first combination consists of all three of the international trade disciplines (the international agreements on preferential tariffs based on carbon content and for environmental goods, reduction of industrial subsidies, and fossil fuel subsidies) plus the CBAM as an anti-leakage measure. **As noted in Table 3, this combination is estimated to produce the best performance in reducing GHG emissions globally and increasing employment and GDP**. GHG emissions are reduced by nearly 9,000 mega-tonnes of CO_2 compared with the EU Carbon Neutrality Scenario, while EU employment and GDP improve by 0.22% and 0.33%, respectively.

Table 3: Estimated impact of Policy Instrument Combinations on GDP, Unemployment & Non-EU GHG Emissions 2025-2050 (in comparison to results from the EU Carbon Neutrality Scenario)

	CBAM, all int'l trade disciplines	All int'l trade disciplines	CBAM, Tariffs + ENG's, Industrial Subsidies	CBAM, Industrial Subsidies, Fossil Fuel Subsidies	All int'l trade disciplines & EU-wide final consumpt. tax
Change in GDP	0.33%	0.04%	0.32%	0.31%	-0.01%
Change in employment rate	0.22%	0.03%	0.21%	0.20%	-0.10%
Change in Non-EU GHG (mt CO2, 2025-2050)	-8 708	-3 731	-7 995	-7 460	-5 290

Source: GEM-E3

The second combination consists in an alternative mix of CBAM and international trade disciplines, combining CBAM with international agreements on preferential tariffs based on carbon content and for environmental goods and reduction of industrial subsidies but excluding the reduction of fossil fuel subsidies. This presumes that, at the international and WTO level, the reform of the ASCM and the possible relaunch of the plurilateral agreement on green goods could raise more support than the reduction on fossil fuel subsidies. **The performance of the combination results in only modest reductions in the gains estimated in the first combination.**

The third combination mixes CBAM with plurilateral agreements on the reduction of industrial subsidies and the reductio of fossile fuel subsidies but excludes excludes the plurilateral agreement on preferential tariffs and elimination of tariffs on environmental goods. This reflects the potential difficulties of reaching such an agreement as well as it being at odds with an EU-wide CBAM. **The performance of the combination remains strong but below the performance of the two first combinations**.

The fourth combination considers a scenario where all three international trade disciplines are implemented. The prerequisite for this combination is global, concerted action on GHG emissions reductions. Over the period 2025 to 2050, the model estimates that this arrangement would correspond with a nearly 4,000 mega-tonne decrease in CO_2 emissions as compared with the EU Carbon Neutrality Scenario alone. Likewise, both EU employment and GDP are projected to increase modestly under this scenario.

Finally, **a fifth combination is considered which includes all international trade disciplines as well as the EU final consumption carbon tax as an anti-leakage measure**. While this combination is estimated to reduce leakage by around 5,300 mega-tonnes of CO_2 between 2025 and 2050, **it is projected to lead to reductions in both employment and GDP within the EU**.

Overall Policy Instruments Ranking

The simulation of individual and combined policy instruments is followed by a normalized Policy Ranking Matrix which compares their performance across different weightings for employment, welfare, economy, and carbon leakage indicators. Three variations on the weighting are considered: one where equal weighting (0.25) is applied to all indicators; one where leakage is weighted more heavily (0.4) with lower weighting for employment and welfare (0.2) and lowest for economy (0.1); and one where leakage is given the highest weighting (0.5) with lower weighting for employment and welfare (0.2) and lowest for economy (0.1).

The objective of the Policy Measure Ranking Matrixes are to provide a normalized, objective comparison between the quantitative performance of the different measures considered, where the three variations simulate an increasing scale in the priority to EU carbon leakage reduction. Table 4 summarizes key policy results as well as normalized policy ranking with equal weighting while policy ranking with the alternative weighting can be found in section 4.9 of the report.

Table 4: Scenario Results & Normalized Policy Ranking Matrix with Equal Weighting - All Trade & Tax Policy Measures (Individual & Combined)

	% Change GDP	% Change Employment	Change in Non-EU GHG (mt CO2, 2025-2050)	Normalized Ranking Matrix (Equal Weighting = 0.25)				
				Employment	Welfare	Economy	Leakage	Rank
COMBO - CBAM & All International Instruments (aii)	0.33%	0.22%	-8 708	16	16	16	16	1
COMBO - CBAM & aii without Reduction of Fossil Fuel Subsidies	0.32%	0.21%	-7 995	15	14	15	15	2
COMBO - CBAM & aii without Carbon Content-modulated Preferential Tariffs + Environmental Goods List	0.31%	0.20%	-7 460	14	15	14	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	0.29%	0.19%	-5 019	13	12	13	12	4
CBAM, With Recycling, No Retaliation	0.10%	0.07%	-4 819	12	9	12	11	5
CBAM, With Recycling, With Retaliation	0.09%	0.06%	-4 328	11	8	11	8	6
COMBO - Aii	0.04%	0.03%	-3 731	10	10	10	6	7
COMBO - Final Consumption Tax & aii	-0.01%	-0.10%	-5 290	5	11	6	13	8
Reduction of Industrial Subsidies	0.01%	0.00%	-1 738	8	7	8	5	9
Carbon Content-modulated Preferential Tariffs + Environmental Goods List	0.01%	0.00%	-1 117	9	5	9	4	10
CBAM on three sectors, No Recycling, No Retaliation	-0.07%	-0.09%	-4 499	6	4	5	9	11
CBAM, No Recycling, No Retaliation	-0.08%	-0.11%	-4 642	4	3	4	10	12
Reduction of Fossil Fuel Subsidies	0.00%	-0.01%	-660	7	6	7	1	13
Final Consumption Tax & Recycling	-0.12%	-0.26%	-979	2	13	2	2	14
CBAM, No Recycling, With Retaliation	-0.09%	-0.11%	-4 153	3	2	3	7	15
Final Consumption Tax	-0.15%	-0.27%	-1 077	1	1	1	3	16

Source: GEM-E3

The combination of the CBAM with all international trade disciplines (COMBO - CBAM & aii) is consistently the strongest performing policy in terms of reducing carbon leakage while remaining positive in terms of the impact on EU GDP and employment growth. This remains the case even as the weighting of GHG emissions reduction is increased. The second best-performing option overall consists of a combination similar to the COMBO – CBAM & aii, however without the inclusion of an agreement on the reduction of fossil fuel subsidies. **The difference between these two combination scenarios is narrow** – within 0.01% for employment and GDP indicators, while the reduction of non-EU GHG emissions is estimated to be 8% less when fossil fuel subsidies are not addressed.

The best-performing individual policy measure is the combination of the CBAM with recycling of revenues as Domestic Subsidies for low-carbon technology, assuming no retaliation on either measure by international trading partners. The CBAM scenarios with recycling – with and without retaliation also performa comparatively well as individual policy measures, 4th and 5th overall.

The best-performing policy measure outside of the CBAM variants considered is the Reduction of Industrial Subsidies, despite the construction of the scenario focusing on China. This performance is sector-agnostic.

The performance of individual measures differs across specific sectors of economic activity. **A key finding is that the CBAM measure is more beneficial for upstream sectors whereas the consumption tax performs better for downstream sectors**. The CBAM increases production costs further down the value chain through higher import costs, whereas it is quite effective on basic materials. The best performing options are presented in Table 5.

- For **Ferrous Metals**, all variants of the CBAM far exceed the performance of the other instruments considered, and level out any competitiveness losses. The combined policy scenario with CBAM is the best performing scenario for the sector (COMBO – CBAM & aii). For **Non-Ferrous Metals** the best-performing option is the Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenario, followed by combined policy scenario where a consumption tax is used to mitigate carbon leakage (COMBO – Final Consumption Tax & aii). The reason for this is that aluminium production in EU is largely dependent on imports of basic materials – 84% of bauxite and 25% of copper ore and concentrations are imported – and on secondary processed products. Hence the removal of tariffs on imports reduces production costs.
- For the **Chemicals** industry combining the elimination of fossil fuels, industrial subsidies and tariffs with the CBAM is the most efficient mix of policies (COMBO - CBAM & aii without Carbon Content-modulated Preferential Tariffs + Environmental Goods List). Individually, the CBAM and Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenarios present comparable results and benefits. The performance of these instruments is followed by the Removal of Fossil Fuel Subsidies.
- The impact of the different instruments examined is small, but positive on the economic performance of the **Paper Industry**. The industry benefits most in the modelling from adoption of a mix of policies where fossil fuel subsidies and non-EU industrial subsidies are reduced along with the implementation of Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenario and CBAM (COMBO – CBAM & aii).
- All instruments examined have significant positive effects on the sales of the **Non-Metallic Minerals** industry. The best performing

option for the non-metallic minerals industry is the is the combined policy scenario with CBAM. The CBAM alone scenario is quite beneficial for the industry, leading to up to a 5% increase in production during the 2025-2050 period. This industry is invariant to the choice of recycling, but sensitive to retaliation.

- The implementation of CBAM has a negative impact on the **Electrical Equipment industry**, as it further increases the cost of its intermediate inputs. The horizontal tax seems to be the most preferable option for the industry.
- A combined policy including reduction of fossil fuel and industrial subsidies together with Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenario and a Final Consumption Tax (COMBO – aii) is the best-performing option for the **Air Transport** sector. As far as unilateral instruments, the consumption tax is the most beneficial option for the sector as it increases both employment and production by around 5% between 2025-2050.

Table 5: Best-performing Policy Measures by Selected Economic Sectors

SECTOR	BEST PERFOMING POLICY
Ferrous Metals	COMBO - CBAM & aii
Non-Ferrous Metals	Tariffs + ENG's
Chemical	COMBO - CBAM & aii
Paper	COMBO - CBAM & aii
Non-Metallic Minerals	COMBO - CBAM & aii
Electrical Equipment	Industrial Subsidies
Transport Equipment	Fossil Fuel Subsidies
Computer, Electronic and Optical	Final Consumption Tax
Air Transport	COMBO - Final Consumption Tax & All

Source: GEM-E3

Further to the modelling performance of the different instruments, the study provides a qualitative assessment on the possible feasibility of implementing the different measures at the EU and international level.

Table 6: Abbreviated Feasibility Summary of Trade & Tax Related Policy Measures

	SUMMARY	OUTLOOK
Carbon Border Adjustment Mechanism	High degree of feasibility for a CBAM in the EU. Different variants exist depending on possible political obstacles – for example, as a tax-based measure, unanimity required between Member States, however CBAM could alternatively operate as an ETS extension or mirror with similar characteristics to the modelled results. Whether WTO sanctioned or not, retaliation is foreseen as a possibility and is included in the modelling.	Feasible depending on design (to comply with WTO rules) Relatively least controversial, however retaliation remains a risk
EU-wide Subsidies in Support of Low-carbon Technology	The implementation of this policy is dependent on several factors. First, to finance the subsidies, it requires the CBAM to be implemented. It then requires EU MS not only to agree to apply CBAM revenues towards subsidies for Low-carbon technologies, but do so on a national basis that is consistent with EU state aid rules as well as ensuring that they remain within the scope of permitted subsidies under the WTO ASCM.	Relatively less controversial; need to clarify funding and ensure compliance with EU state aid rules and WTO subsidy rules
EU-wide Horizontal Tax on Carbon Content	While the measure is effective in reducing carbon leakage in the EU, it is also one of the few policy instruments modelled that leads to negative outcomes in terms of socio-economic indicators. Although the measure is objective and directly linked to carbon content of final products, it would require MS to unanimously adopt despite the negative expected impact over the long-term on GDP and employment in the EU.	Relatively less controversial; consider socio-economic impacts
Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods List	Relative to the other instruments, the potential for consensus among the negotiating partners is fairly good – in part due to the relatively limited impact of the agreement. As observed through EGA negotiations in the past, interests in the principle of an agreement reached a good level, however negotiations and agreement on a final list proved to be the barrier to finalisation.	Potentially least controversial; requires acceptance from PTA partners
Plurilateral Agreement on the Reduction of Industrial Subsidies	EU has already expressed leadership on the issue along with Japan and the US, however achieving a revision of existing multilateral rules would require to reach an agreement with China and other significant users of industrial subsidies. The measure is not explicitly tied to environmental objectives and is therefore likely to be more difficult to advance in negotiations.	Relatively less controversial; requires agreement with China
Plurilateral Agreement on the Reduction of Fossil Fuel Subsidies	Net impact on global economy is marginally negative, with losses concentrated in energy producer countries. Given the scale and diversity of existing fossil fuel subsidies is it unlikely that an agreement would succeed in eliminating them, however some subsidies could be restructured. As expected to take place in the EU, fossil fuel subsidies will likely persist however moving to less carbon-intensive applications over time.	Relatively least controversial; restructure subsidies through G20 and WTO

Conclusions and Recommendations

The results suggest that a CBAM that includes recycling of revenues would be the single most effective policy for the EU to pursue, with the economic gains from this projected to increase significantly when complemented by a domestic subsidy programme funded by ETS revenues. The study finds that the manner in which these revenues are used is highly important, with results suggesting that this may serve as the difference between whether such policies are beneficial or detrimental to economic outcomes within the EU.

From a sectoral point of view, the optimal selection of policy measures vary. In terms of performance, the **CBAM is better suited to upstream sectors, whereas downstream sectors benefit more from the Final Consumption Tax Scenario. Sectors that are greatly dependent on imports of taxed basic materials benefit most under the Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenario**.

The study finds, however, that **the best approach for the EU would be to pursue multiple policies in order to maximise potential gains to employment and GDP and to minimise carbon leakage**. To this end, a **CBAM pursued in conjunction with international agreements** on subsidy reduction and preferential tariffs for environmental goods is **found to expand notably on the results of a CBAM**.

These results highlight that **while a CBAM can be effective, careful consideration should be given to its ultimate design** – with emphasis placed on **how the funds are used and on ensuring WTO compliance so as to limit retaliation from trading partners**, though the study finds that that the incidence of retaliation does not drastically reduce the effectiveness of the instrument. While international agreements with key partners are also likely to be effective, it remains important to consider that any gains derived from such approaches may be limited and restricted by the lack of buy-in from partners.

On a broader level, three out of the six trade and tax related policy measures considered have a crucial extra-EU dimension, where cooperation and action on the part of the EU's international partners will be needed. Given the challenges inherent to achieving a greater alignment between the EU's climate goals and those of its trading partners, one pathway to improving cooperation in this field could **focus on smaller-scale agreements as confidence-building measures towards more ambitious GHG emissions reductions**.

An EU strategy which prioritizes the conclusion of an EGA-type agreement, revitalizing the negotiating framework from previous rounds, would have good political prospects for success while laying the foundation for more intensive negotiations and agreement on additional disciplines, including carbon-content modulated tariff preferences, reduction of fossil fuel subsidies, and ultimately revised rules on industrial subsidies. Such an agreement would reaffirm the **willingness of the EU to work with partners on addressing trade-related climate externalities**.

Given the limited additional benefits observed from the modelling of the reduction of fossil fuels, both individually and as a combined instrument, this strategy could be further optimized by honing in on a combination of an EU CBAM along with international agreements on preferential tariffs for environmental goods and the reduction of industrial subsidies. Pursuing a mix that includes the reduction of fossil fuel subsidies would likely entail challenging negotiations, both internationally but also within the EU to reach a common negotiating mandate given the ubiquity but also diversity in these kinds of subsidies, without clear estimated gains for GDP, employment, or leakage reduction if successful in reaching such an agreement.

From the perspective of reducing carbon leakage, **an agreement on the reduction of industrial subsidies remains the best performing individual instrument outside of the unilateral CBAM**. Existing cooperation between the EU, US, and Japan is promising in this regard. At the same time, the study finds that the impact of industrial subsidies on climate in the case of China is significant. In the context of heightened domestic commitments on the part of China, as well as other countries implicitly targeted by the measure, part of the difficulty in reaching an agreement on reform of the ASCM or another avenue of industrial subsidies reduction could be overcome in reframing as an environmentally-oriented, resource efficiency measure.

2

Introduction

Key Summary
Introduction & Baseline Scenario

- The size and direction of carbon leakage depends on relative production costs of key competing countries and sectors.
- In the baseline scenario the key trade partners of EU until 2050 are the USA, India, Turkey, Russia, China, Canada and Japan.
- The largest categories of EU exported goods by value of transactions for the 2020-2050 period are cars, machinery, pharmaceuticals, chemicals and metals.
- Market services steadily increase their share in EU value added over the Baseline Scenario period.
- By 2050 China will become the largest economy, followed by EU and US.
- The carbon price, calculated by the GEM-E3 model, required to achieve the 40% and 80% EU GHG emission reduction in 2030 and 2050 respectively ranges from a low of 25€ ($33) in 2020 and peaks in 2050 at 176€ ($234) per tonne of CO_2.
- To achieve the NDCs of China, South Korea, and Mexico, a de facto carbon price of approximately 26€ ($34) per tonne of CO_2 is calculated by the GEM-E3 model. The US, Canada and India have much smaller carbon prices to reach their targets, ranging between 6€ ($8) and 11€ ($15) per tonne of CO_2.

The EU has been at the forefront of market-based approaches for reducing carbon emissions and addressing the challenges associated with climate change. Since 2005, the EU-wide Emissions Trading System (ETS) has served as the cornerstone of these efforts, with domestic regulatory and tax-based measures by EU Member States serving to supplement this tool for meeting the EU's commitments as set out in the 2015 Paris Agreement.

The issue of climate change has also received greater focus within the EU's external trade policy. Since 2006, for example, the EU has pursued a number of 'Second Generation' trade and investment agreements which seek to more effectively align economic objectives with those pursuant to climate change – most notably in chapters on Trade and Sustainable Development. This has led to the inclusion of provisions which, among factors, seek to promote trade and investment in 'green goods'; foster sharing of EU expertise with partner countries on climate change mitigation; encourage the ratification of multilateral environmental agreements and realisation of the commitments agreed to therein; and reduce incentives for offshoring production to locations with less stringent environmental standards.

Despite these efforts, concerns have been raised within the EU over whether more may be needed to ensure that partner countries are doing their fair share to limit the potential fallout from climate change and to ensure that EU operators are not being disproportionately penalised from the more stringent environmental regulations faced vis-à-vis competitors located abroad. In response, the recently appointed Commission has launched the European Green Deal and its 2030 Climate Target Plan, which includes a package of more ambitious initiatives designed to make the EU climate neutral by 2050[14].

Guided by 'green deal diplomacy', the European Green Deal aims to not only intensify efforts to encourage and support international partners to commit to more sustainable development, but signals the Commission's willingness to strategically leverage the EU's economic and political position towards the achievement of its climate goals. This is expected to include a suite of approaches designed to incentivise partner countries to adopt more stringent environmental regulations and align their efforts with those observed in the EU.

One the approaches being explored is a Carbon Border Adjustment Mechanism (CBAM), which would potentially apply a fee on imports that do not meet certain environmental criteria. Such a measure would potentially be designed to meet several objectives. Among these would likely be the goal of offsetting additional costs incurred by EU producers as a result of the more stringent environmental regulations applied domestically and narrowing gaps in EU competitiveness that emerge as a result. More broadly, however, a CBAM could be deployed as a means to encourage foreign governments to enact environmental measures on par with those in place in the EU and incentivise foreign firms to reduce their carbon footprints.

In the context of the Commission's initiatives under the European Green Deal, there is a need for stakeholders to assess the potential impact of trade-related measures such as a CBAM in order to ensure that the policies pursued most effectively balance environmental and economic objectives. This is the **rationale** for this study: to assess the economic, environmental and legal dimensions of various policy instruments that the EU may consider for meeting its climate objectives and commitments, preventing carbon leakage and enhancing EU competitiveness.

The main **objectives** are twofold. **Firstly, the study aims to provide an analytical framework for empirically assessing the interaction between international trade and climate change**. It does this by designing an objective methodology for quantifying the overall balance of carbon emissions due to international trade and investment and, by contrast, carbon emission avoidance due to the same trade and investment flows. The methodology used includes an analytical framework that allows for the measurement of potential competitiveness gaps between the EU as a production site and key trading partners based on carbon price divergence in the medium-to-long term. Under this first tier of the study, two scenarios are modelled:

14 European Commission (2019): The European Green Deal. Available at: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf
Domestically, the EC has committed to reducing carbon emission to at least 50% and towards 55% compared with 1990 levels by 2030 and climate neutrality by 2050, as well as an extension of the ETS to additional sectors [European Commission (2019): Communication from the Commission to the European Parliament, the European Council, the Council, The European Economic and Social Committee, and the Committee of the Regions – The European Green Deal (COM/2019/640 final). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN.] These measures will be complemented by domestic reduction targets for sectors outside the ETS. These domestic goals are however accompanied by the risk of increasing competitiveness gaps for European businesses. In the existing context, free allowances are issued through the ETS to domestic producers in energy-intensive sectors that are susceptible to competition from imported products originating in countries with lower environmental and climate standards. The European Green Deal includes a proposal for a more active form of accounting for this gap in climate standards, through the implementation of a border carbon adjustment applied to products imported to the EU; See also: European Commission (2020): 2030 Climate Target Plan. Available at: https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en.

Baseline Scenario: Existing NDC Commitments
• In-line with current targets, the EU reduces greenhouse gas (GHG) emissions by 40% in 2030 and 80% in 2050 compared to 1990 levels.
• Outside of the EU, third countries implement their Nationally Determined Contributions (NDCs) under the 2015 Paris Climate Agreement until 2050.

EU Carbon Neutrality Scenario
• Under this scenario, the EU takes a more ambitious approach to GHG emissions reductions based on targets of 55% and 90%, respectively, compared to 1990 levels.
• Non-EU countries implement their NDCs under the 2015 Paris Climate Agreement until 2050, which is the same as under the Baseline Scenario.

Secondly, this methodological framework is extended to include six potential policies that may be pursued by the EU to meet its climate goals and quantitatively estimates the associated environmental and economic impacts of each. The policy scenarios assessed include:

(1) an EU-wide CBAM on imports;

(2) EU-wide subsidisation in support of low-carbon technologies financed by CBAM revenues;

(3) an EU-wide final consumption tax on the carbon embodied in manufactured goods;

(4) a multilateral agreement that extends preferential tariffs to imports that meet certain environmental criteria and which eliminates tariffs on 'Environmental Goods';

(5) a multilateral agreement that broadens the scope of prohibited industrial subsidies under current international rules; and

(6) a multilateral agreement that broadens the scope of prohibited fossil fuel subsidies under current international rules.

This assessment is, in turn, complemented by a review of these policies' potential feasibility with respect to their compatibility with international law, in order to arrive at a determination of the relative costs and benefits of each policy with respect to the EU's environmental and economic objectives.

The study blends together the analysis of policy instruments that are already under consideration, such as the border carbon adjustment proposed by the European Commission – for which an impact assessment and public consultation are ongoing at the time of publication of the present report – as well as introducing novel instruments and international agreements that may complement the EU's toolkit in addressing GHG emissions emanating from production sites in third countries[15].

As this study has been commissioned by the *Association française des entreprises privées* (AFEP), it is principally aimed at providing its members with an objective understanding of the relative costs and benefits associated with these various policy tools. While it therefore places greater emphasis on the French economy (particularly the sectors represented by AFEP), it is intended to be of relevance to a wider audience of stakeholders across Europe – including government officials, academics and firms operating in other Member States.

2.1 Baseline Scenario: Current NDC Commitments[16]

Having met the 2020 target for GHG emissions, with an overall reduction greater than 20% compared with 1990 levels, the EU has enacted legislation to achieve a further 40% reduction in GHG emissions by 2030. Under the 2030 Climate and Energy Framework, this 40% target is implemented through the EU Emissions Trading System (ETS), the Effort Sharing Regulation combining with Member States' (MS) targets, and the Land Use, Land Use Change and Forestry Regulation (LULUCF), as well as supplemental legislation including the Energy Performance of Buildings

15 European Commission (2020): EU Green Deal (carbon border adjustment mechanism). Available at: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12228-Carbon-Border-Adjustment-Mechanism.
16 Also referred to as Scenario (A) in technical annexes relating to the modelling.

Directive (EPBD), Renewable Energy Directive, Energy Efficiency Directive (EED), among others[17]. Under the Baseline Scenario, the EU will then continue reducing GHG emissions at a rate of 114 megatonne per year between 2030 and 2050 to achieve an 80% reduction overall.

2.1.1 Baseline Scenario Modelling Approach

For the purposes of this study, the Baseline Scenario provides a point of reference for the assessment of greater emissions reductions efforts under the so-called EU Carbon Neutrality Scenario. The Baseline Scenario represents the current trajectory of demographic and economic growth, applying currently established climate ambition in the form of existing NDCs and EU legislation.

Table 7 reflects the trajectory of GHG emissions reductions under the Baseline Scenario. From columns left to right, the table indicates aggregate EU GHG emissions falling under ETS and non-ETS sectors, followed by the respective percentage changes from 2005 and 1990.

Emissions data are aggregated at the EU28 level, as the EU's 2030 and 2050 targets have been designed while the UK was still a part of the EU. The Baseline Scenario assumes that the United Kingdom's (UK) climate and energy policies remain on the same trajectory as the EU's, targeting a 40% reduction by 2030 and 80% reduction by 2050 and, for modelling purposes, that it therefore participates in the EU ETS system. At the time of publication, the UK has not defined alternative targets and negotiations to link a UK-wide ETS with the EU remain ongoing.

Table 7: EU GHG emission reduction targets in Baseline Scenario

	GHG Emissions (megatonne CO_2 equiv.)			% change from 2005			from 1990
	ETS	**Non-ETS**	**EU28**	**ETS**	**Non-ETS**	**EU28**	**EU28**
1990			5 693				
2005	2 502	2 894	5 396				
2015	1 913	2 585	4 498				
2020	1 660	2 477	4 136	-34%	-14%	-23%	-27%
2030	1 426	2 026	3 452	-43%	-30%	-36%	-39%
2050			1 138			-79%	-80%

17 European Commission (2020): 2030 Climate & Energy Framework. Available at: https://ec.europa.eu/clima/policies/ strategies/2030_en

The Baseline Scenario of existing NDC commitments is therefore premised on existing legislation in the EU covering the period until 2030, and the projected trend in emissions reductions assuming the 40% target is reached to continue with a further 40% reduction compared to 1990 levels between 2030 and 2050 – 80% overall. Non-EU countries in this scenario implement GHG emissions reductions for 2030 in-line with their NDCs[18]. After 2030, the Baseline Scenario does not presume any additional efforts to reduce GHG emissions by non-EU countries. In modelling terms, this means that the carbon prices resulting from NDC policies in 2030 are kept constant until 2050.

Table 8 outlines non-EU countries' NDCs as applied in the Baseline Scenario. In some cases, emerging economies such as Indonesia, Mexico, and Argentina have outlined conditional targets which would further reduce GHG emissions contingent on international support. NDCs vary in their timeline and effect on emissions, therefore these have been normalized to 2030 for the purpose of a consistent comparison in the modelling.

Table 8: Non-EU GHG Emissions Reductions NDCs Normalised to 2030

	GHG Emissions Reduction Target		% change from 2005
	Unconditional	**Conditional**	
United States	-27% from 2005		-28%
Canada	-30% from 2005		-30%
Brazil	-43% from 2005		-19%
China	-60% from carbon intensity of 2005		59%
India	-30% from carbon intensity of 2005		108%
South Korea	37% below Business as Usual (BAU) by 2030		-7%
Indonesia	29% below BAU by 2030	Additional 12%	179%
Mexico	25% below BAU by 2030 (22% of GHG and a reduction of 51% of Black Carbon)	Additional 15% is subject to a global agreement	8%
Argentina	+32% from 2010	+1% from 2010	6%
Turkey	21% below BAU levels by 2030		105%
Russian Federation	25-30% below 1990 levels by 2030		34%
South Africa	Peak GHG emissions in 2025 and plateau for a decade	15%	

18 National NDCs differ by country, both in terms of ambition and implementation, with different sectoral targets, mixes of renewable energy sources, energy efficiency options, and other considerations. In the model, an ultimate GHG emission reduction target has been imposed at a national level, defined by a uniform carbon price.

In addition to these NDCs, which form the basis of the modelling of non-EU countries emissions reduction trajectories, several partners have announced plans to further reduce their emissions beyond what has been submitted to the United Nations Framework Convention on Climate Change (UNFCCC)[19]. A brief summary of additional aspirations which have been communicated by non-EU countries, but not yet submitted as NDCs and which do not influence the modelling are outlined in Table 9.

China's recent announcement to achieve carbon neutrality by 2060 partiuclarly affects the decarbonization process of the EU energy system in the long-term, with these effects manifested in several ways. Fully decarbonizing the Chinese energy system entails the electrification of transport and heating and cooling technologies, together with the introduction of RES and new fuels that can act both as zero-carbon energy carriers and as storage (e.g. hydrogen). This transformation process is expected to require accompanying domestic measures that discourage the adoption of carbon intensive processes (carbon pricing, removal of subsidies on fossil fuels etc.).

This will lead to a reduction of the capital costs for access to clean energy technologies through acceleration of the performance of R&D and economies of scale. At the same time carbon pricing and other measures that are used to decarbonize the energy system (RES and energy efficiency targets) are expected to increase production costs in some sectors and, in particular, in energy- and carbon- intensive sectors. The adoption of ambitious climate and energy targets by China disproportionately facilitates international efforts to reduce GHG emissions, as the pace to reduce costs of clean energy technologies will be accelerated, but also will level out the playing field among energy and carbon intensive industries. This study estimates that around 10% of total carbon leakage is due to industry relocation to the Chinese economy and regards mostly the non-metallic minerals sector, followed by metals and chemicals.

Assuming that China adopts the comparable environmental and carbon-intensity standards needed to achieve neutrality by 2060, expected leakage could decrease by 170 mt of CO2 than would otherwise be the case between the period 2025-2050. In aggregate terms this means that the leakage rate will be improved by 1 percentage point (from 14% to 13%) over the 2025-2050 period.

Table 9: Non-NDC GHG Emissions Reduction Targets in Non-EU Countries

	Target
China	Peak GHG emissions before **2030** and carbon neutrality by **2060**
Canada	Carbon neutrality by **2050** (no 2030 target in draft legislation)
United States	Currently no central-level emissions reduction target, however 23 States and the District of Columbia have enacted targets for emissions reductions ranging from 80% to full neutrality by **2050**. Incoming US administration has communicated a Federal carbon neutrality target by **2050**
Japan	Carbon neutrality by **2050**
United Kingdom	Carbon neutrality by **2050**

19 UNFCCC (2020): NDC Registry (Interim). Available at: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx

For each country included in the model[20], the GHG emissions reduction target is achieved endogenously. In the modelling, GHG emissions reductions as outlined in the countries' NDCs are achieved through a de facto carbon market in each jurisdiction. This allows the Baseline Scenario to simulate the efficient allocation of scarce capital to RES, EE, and other low-carbon improvements necessary to meet the NDC targets, and means that a constraint is introduced whereby the supply of available GHG emissions allowances should not be greater than the number of allowances demanded in each market. To achieve the balance, a price for carbon is calculated that enables the appropriate fuel substitutions, process and EE improvements to unfold. This carbon price is applied to all economic sectors.

Under this Baseline Scenario, public revenues from the auctioning of carbon emissions allowances are retained by the government to improve its fiscal position. In modelling terms, this reduces the base interest rate at which countries lend and borrow.

In the EU, an established market for carbon emissions already exists. Under the Baseline Scenario, the current rules of Phase IV of the EU ETS were applied for EU ETS Allowances (EUA). For the period after 2030, it has been assumed that auctioning of EUA is phased in, reaching full auctioning of allowances across sectors in 2040. The auctioning rates used are provided in Table 10.

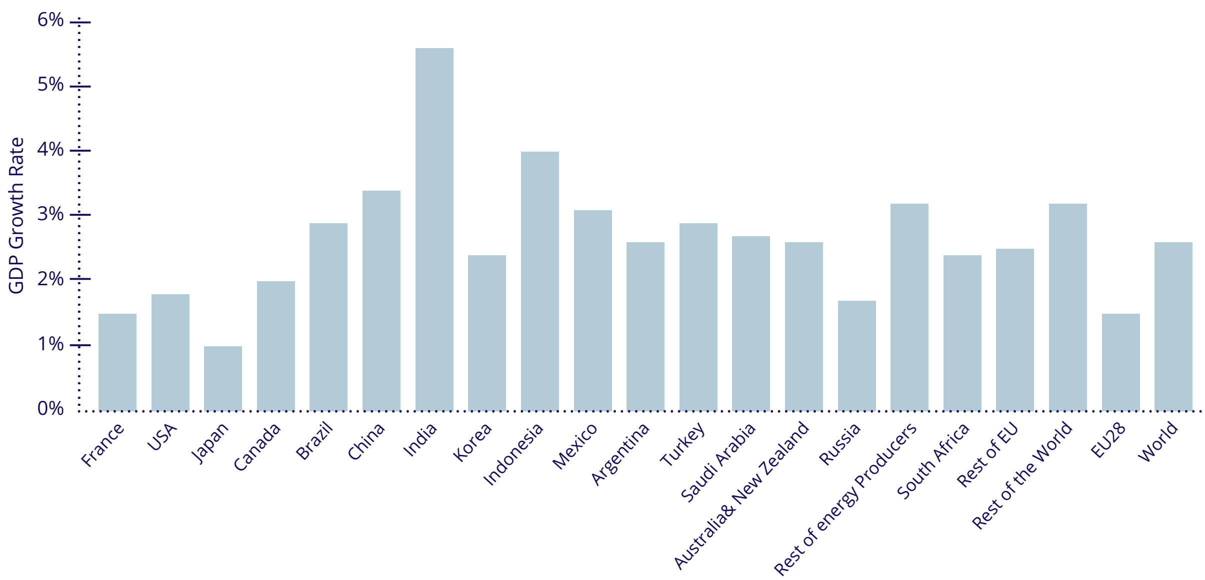
Table 10: Share of auctioning in EU-ETS

Sector	2020	2030	2050
Refineries	0%	0%	100%
Power Supply	100%	100%	100%
Ferrous Metals	0%	0%	100%
Non-Ferrous Metals	0%	0%	100%
Chemicals	0%	0%	100%
Paper	0%	0%	100%
Non-Metallic Minerals	0%	0%	100%
Air Transport	15%	15%	100%

The Baseline Scenario is the reference to which the EU Carbon Neutrality Scenario[21] is compared, and is based on current trends and socio-economic trajectory. The modelling follows the socio-economic projections of the European Commission's 2018 Ageing Report for the EU, with International Monetary Fund (IMF) and International Labour Organisation (ILO) projections for non-EU countries[22]. These outlooks do not take into account the current developments relating to the Covid-19 pandemic, which will affect short and medium-term economic growth. Notwithstanding, the Baseline Scenario assumes that the global economy grows 2.5% annually until 2050, compared to 1.5% for the EU28.

__20__ Countries and regional agglomerations included: United States of America (USA), Japan, Canada, Brazil, China, India, South Korea, Indonesia, Mexico, Argentina, Turkey, Saudi Arabia, Oceania, Russian Federation, Rest of energy producing countries, South Africa, Rest of Europe, Rest of the World
__21__ Also referred to as Scenario (A+) in technical annexes relating to the modelling.
__22__ European Commission (2018): The 2018 Ageing Report: Economic and Budgetary Projections for the EU Member States (2016-2070). Available at: https://ec.europa.eu/info/publications/economy-finance/2018-ageing-report-economic-and-budgetary-projections-eu-member-states-2016-2070_en

Figure 1: GDP average annual growth rate by country or region (2020-2050)

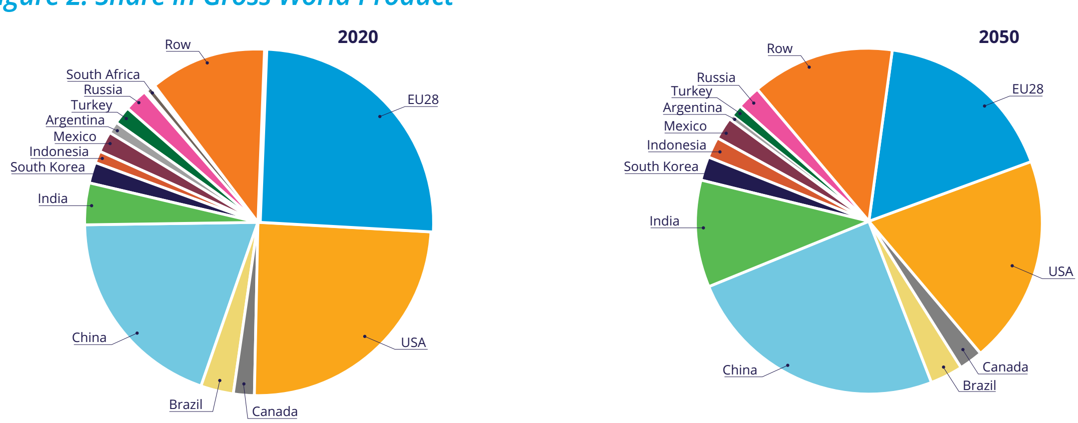


A significant factor affecting the EU28 economic growth is its ageing population. It is expected that in the long-term, the share of the EU's population above 65 years of age will be 50% of the population between 15-65 – this ratio is currently 20%.

Among international economies, it is projected that China and India will increase their share of global income while China will become the largest economy in the world by 2050, followed by the EU28 and USA. The pattern of growth for each country in the world is different, however the basic trend used in the simulation is that countries adopt a sustainable growth path where excessive surplus or deficits are reduced. Hence economies that are at the early stage of their development increase saving rates, reduce consumption and increase investment and improve their trade balance.

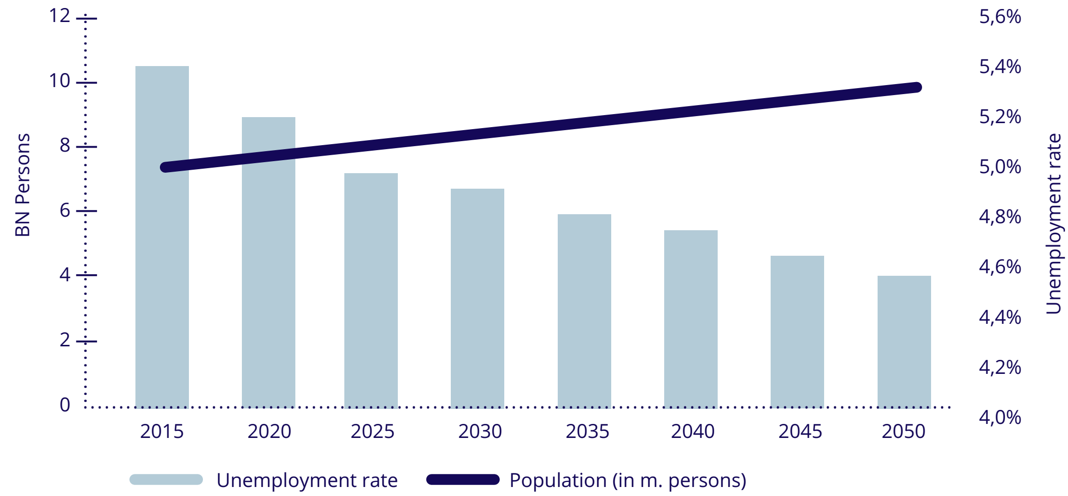
In terms of population, the global population is estimated to reach 9.7 billion by 2050, growing at an average annual growth rate of 1.1% over the period 2020-2050[23]. Over the same period, the world unemployment rate is assumed to be reduced to 4.6% converging toward the natural rate of unemployment.

Figure 2: Share in Gross World Product



23 United Nations (2019): 2019 Revision of World Population Prospects. Available at: https://population.un.org/wpp/.

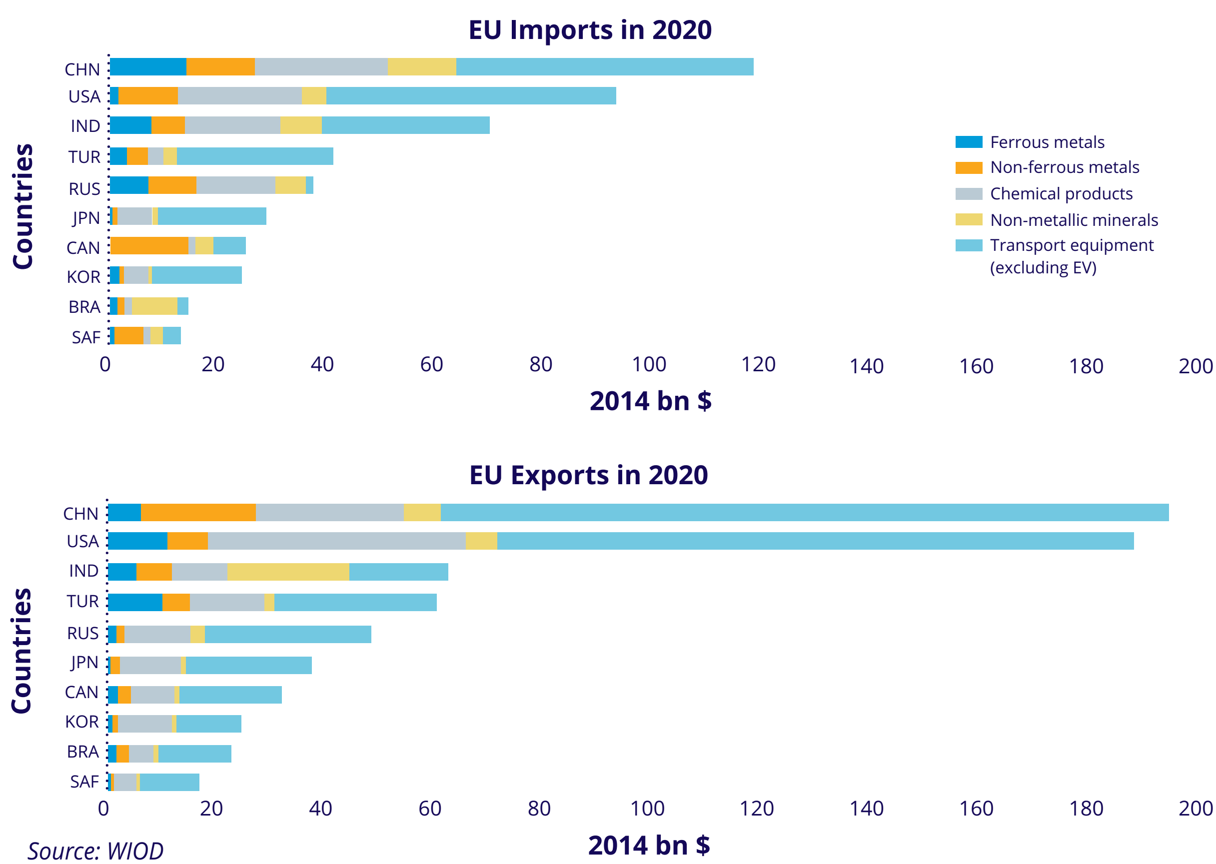
Figure 3: World Population and Unemployment Rate



Source: GEM-E3

Apart from demographic trends, the modelling assumptions under the Baseline Scenario are derived from up-to-date data for the EU's economic performance, as well as key characteristics of the French economy in particular. The principal breakdown of extra-EU trade flows is summarised in Figure 4.

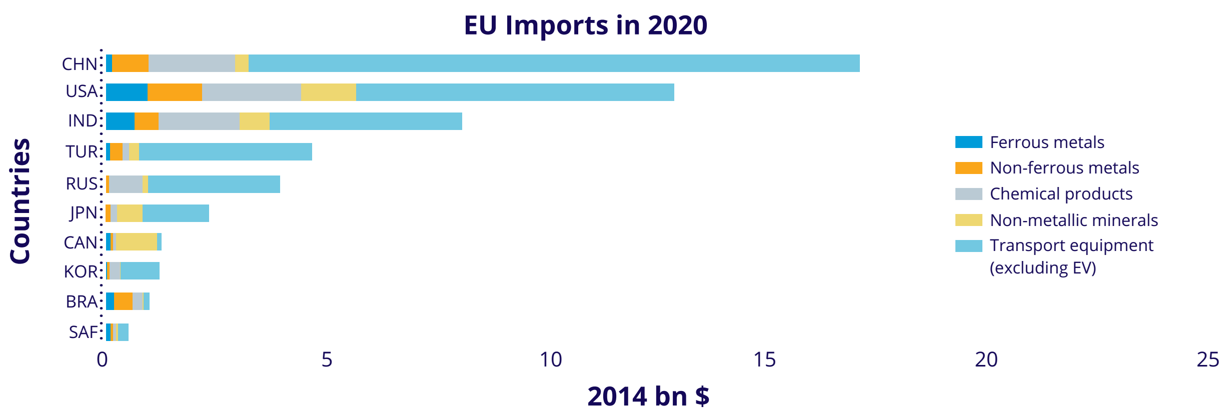
Figure 4: EU Imports & Exports, 2020 - Sector and Main Trading Partners

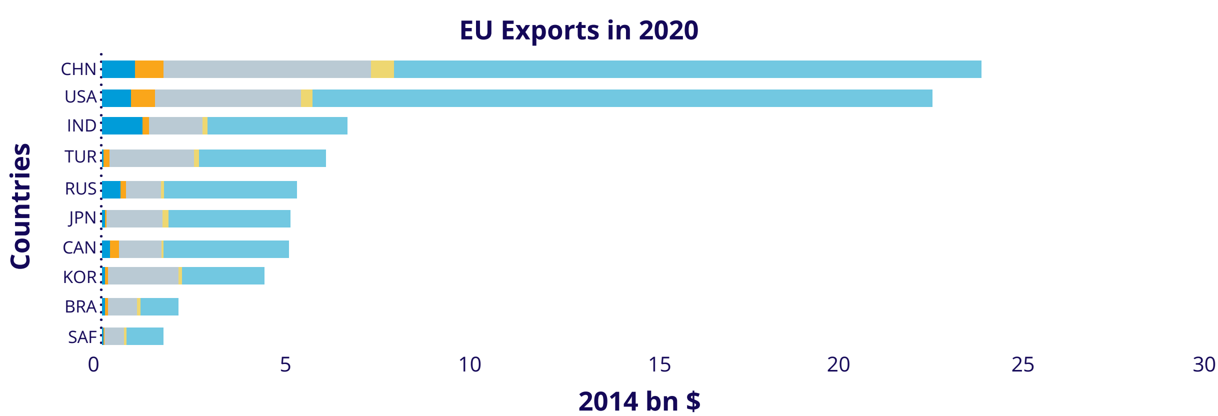


Source: WIOD

France's main trading partners outside of the EU are China and the USA, followed by India, Turkey and Japan. Among the sectors analysed in this study, the greatest amount of trade occurs in transport equipment, followed by chemical products and metals. Key trade figures for the French economy are detailed in Figure 5.

Figure 5: France's trade with non-EU countries





Source: WIOD

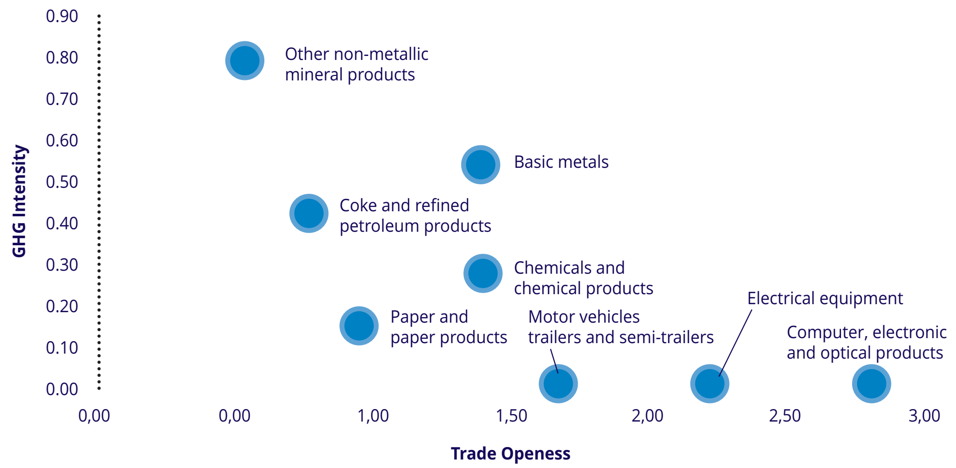
Trade partners with good access to the EU market and a less restrictive climate policies can be considered the main economies toward which production could be relocated from the EU. In the US, 13 states have introduced a price on carbon through a regional cap and trade systems, however no such scheme exists at the national level. The same applies to China[24]. In India and Russia, no effective carbon pricing system applies.

EU competitiveness strongly depends on production costs in the EU versus competing non- EU markets. In some sectors, production costs are significantly lower in non-EU countries. For example, the cost advantage of steel production in Russia compared to production in the EU can be on the order of up to 30% less[25]. The effect of the carbon price, if not mitigated by counteracting measures, further increases the difference in production costs and reduces the competitiveness of European industries in international markets.

Currently safeguarding the competitiveness of industries covered by the EU ETS, producers in sectors that are exposed to a significant risk of carbon leakage receive a higher share of free allowances compared to other industrial installations. This system has been in place since the initiation of the EU ETS and will continue in Phase IV of the EU ETS (2021-2030)[26].

For this purpose, with the agreement of Member States, the European Commission compiles a list of sectors and sub-sectors considered to be at significant risk of carbon leakage. For Phase IV, a new list was published in 2019. Highly exposed sectors are placed on the carbon leakage list and will receive 100% free allocation of allowances. For less-exposed sectors, free allocation will amount to 30% up to 2026 and will be phased out by 2030. The level of carbon leakage exposure of sectors is assessed on the basis of an indicator reflecting trade openness and emissions intensity. This is further illustrated in Figure 6.

Figure 6: Exposure to carbon leakage by sector as a function of trade openness and GHG intensity



* Trade Openness is calculated as: $\frac{\text{(Imports+Exports)}}{\text{GDP}}$. GHG Intensity is calculated as: tn CO2 / 1000's $.

24 For example, see New York Times (2019): These Countries have a Price on Carbon. Are they Working? Available at: https://www.nytimes.com/interactive/2019/04/02/climate/pricing-carbon-emissions.html?mtrref=www.google.com&gwh=5B78468486D2ED13953C562F3A374212&gwt=pay&assetType=PAYWALL

25 European Commission, Joint Research Centre (2016), Production Costs from Energy-Intensive Industries in the EU and Third Countries. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC100101/ldna27729enn.pdf

26 European Commission, Climate Action: Emissions Trading System (EU ETS) Revision for phase 4 (2021-2030). Available at: https://ec.europa.eu/clima/policies/ets/revision_en

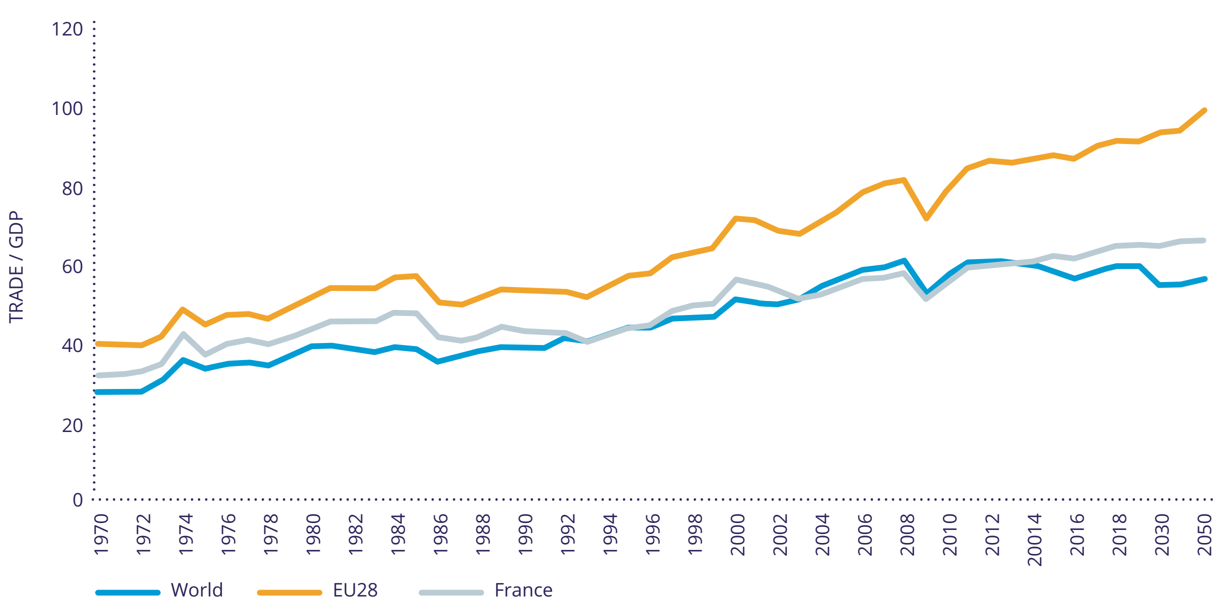
27 European Commission, Climate Action: Emissions Trading System (EU ETS) Carbon Leakage. Available at: https://ec.europa.eu/clima/policies/ets/allowances/leakage_en

Findings from recent literature on carbon leakage confirm that the risk of relocation and subsequent increase of emissions outside the EU is highest in the steel, cement and aluminum industries[28]. The volume of trade in the main sectors considered in this study and the main trade partners of France and the EU are presented in the following figures.

The price of EUAs has increased to approximately 25€ per tonne of CO_2 in 2020 from 5€ per tonne in 2017. The increase can be attributed, amongst other factors, to the recent reforms of the EU ETS – in particular the launch of the Market Stability Reserve in January 2019 – leading to a strengthened carbon price signal. As a result of higher production costs, the risk of carbon leakage in energy-intensive industries exposed to trade (EITE) has increased. According to the official lists, sectors viewed as vulnerable to carbon leakage include metals, chemical products, cement and paper[29].

At a global level, the world economy is expected to become more interconnected over the coming decades as the trade-to-Gross Domestic Product (GDP) ratio increases steadily, with the assistance of gradual tariff reductions, diminished transportation costs and digitalisation of the economy.

Figure 7: Trade openness



Source: World Bank (1970 – 2019), GEM-E3 (2020 – 2050).

28 C. Böhringer, E.J. Balistreri, T.F. Rutherford, "The role of border carbon adjustment in unilateral climate policy: overview of an Energy Modeling Forum study (EMF 29)", Energy Econ., 34 (Supplement 2) (Dec. 2012), pp. S97-S110

29 See: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1602245149753&uri=CELEX:32012D0498; Phase III (2015-2019): https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32014D0746; and Phase IV (2021 – 2030): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2019:120:FULL

Economic activity and GHG emissions are expected to become decoupled throughout the projection period. Therefore, under the Baseline Scenario, GHG intensity is reduced in all countries, with GDP growth outpacing GHG emissions as a result of improving EE, increasing RES deployment, fuel switching and stricter environmental regulations. Full decoupling of GHG emissions and economic growth is evident only in the EU due to its ambitious actions towards the mitigation of climate change.

Figure 8: GHG Emissions and Economic Growth

Source: GEM-E3

In the EU28, GHG emissions are policy-driven following the Baseline Scenario targets of achieving a 40% reduction in GHG emissions by 2030 and an 80% reduction by 2050, compared to 1990 levels. The carbon price required to achieve these targets ranges from a low of 33€ in 2020 and peaks in 2050 to 234€ per tonne of CO_2, reflecting the reduction of abatement possibilities – mainly in sectors where easy and low-cost opportunities to reduce emissions are expected to be difficult to attain, such as freight and transportation.

Further to the NDC emissions reductions targets summarised in Table 7 and Table 8, the national carbon prices required to achieve these respective targets are presented in Table 11. Countries that are not reported in the table have a carbon price of zero, indicating that the GHG emission reduction constraint in their NDCs are not binding[30]. The level of the carbon price demonstrates the “effort” required by the energy system to adjust and meet the respective emission reduction target – the greater the distance, the higher the carbon price. National carbon prices for the EU and trading partner countries are calculated endogenously by the model under simulation of the Baseline Scenario.

***30** The constraint is not restrictive in the sense that the solution already goes beyond the constraint.*

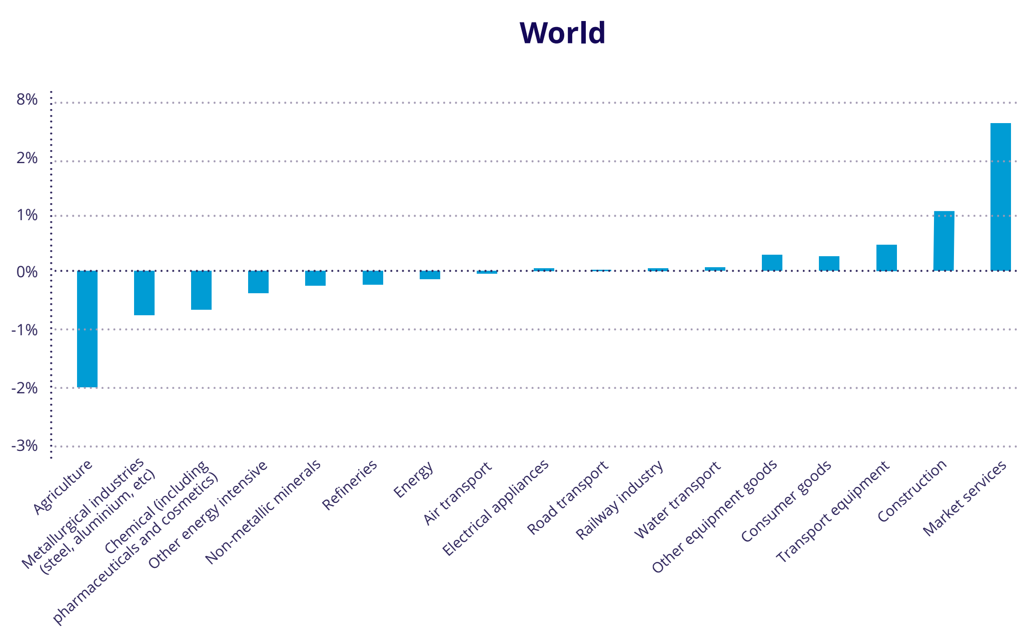
Table 11: Estimated carbon price per tonne of CO2, (2010 prices - €)

	2020	2030	2040	2050	Target % change from 2005
EU28	33	39	213	234	
United States	0	15	15	15	-28%
Canada	0	43	43	43	-30%
Brazil	0	38	38	38	-19%
China	0	44	44	44	59%
India	0	8	8	8	108%
South Korea	0	38	38	38	-7%
Indonesia	0	19	19	19	179%
Mexico	0	37	37	37	8%

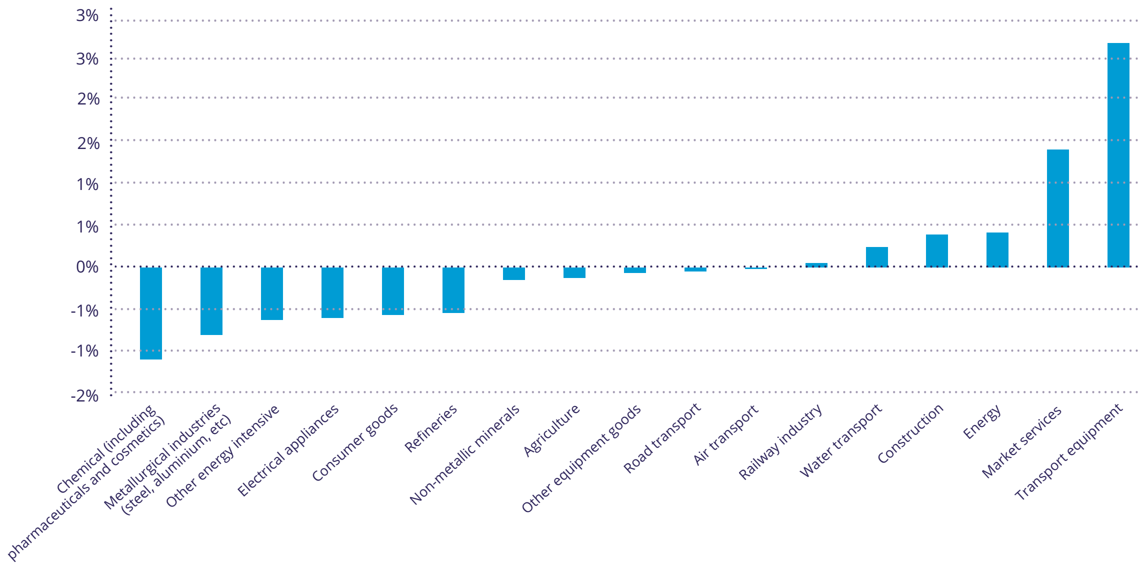
Source: GEM-E3

In terms of sectoral production, the model predicts that the world economy will become more service oriented and go through a process of greater dematerialisation, meaning less use of primary raw materials with increased resource and energy efficiency. Services will dominate global value added at more than 60% of the total, whereas the primary sector continues to see its share reduced.

Figure 9: Estimated change in sectoral contribution to total production in 2050 (sum across sectors is zero)



France



Source: GEM-E3

3

EU Carbon Neutrality Scenario

Key Summary

EU Carbon Neutrality Scenario[31]

- The carbon price that is required for the EU to achieve the 55% and 90% targets are 56€ ($74) and 444€ ($590), respectively. Under the EU Carbon Neutrality Scenario, the estimated carbon price generated by the model nearly doubles in almost all years when compared to the Baseline Scenario.
- In the EU Carbon Neutrality Scenario, the driving factor for carbon leakage is the change in production costs of carbon intensive technologies through higher carbon prices.
- The carbon leakage over the period 2025-2050 is estimated to be 14%, reaching 23% in 2050.
- The countries where leakage would take place are Russia, USA, China, India, Turkey and Northern African countries
- The sectors that present the highest leakage risk are metals, chemical, cement and air transport.

Further to the ambition of achieving a 40% reduction in GHG emissions by 2030 and 80% by 2050 as outlined under the 2030 Climate and Energy Framework, the European Commission proposed a new plan to increase this target to 55% by 2030 during the 2020 State of the Union address[32]. The long-term objective of this plan is to achieve climate neutrality in the EU by 2050. The Impact Assessment accompanying this proposal was published in September 2020, and considers a range of measures to reach the target. The European Commission is expected to formally set out the legislative proposals for enacting the target of 55% GHG emissions reductions by 2030 no later than June 2021[33].

This developing proposal forms the basis of the Study's EU Carbon Neutrality Scenario, matching the 55% reduction in GHG emissions by 2030 as targeted by the European Commission's recent proposal and anticipating an eventual 90% reduction in GHG emissions by 2050 through transformation of the energy system, net zero emission.

3.1 EU Carbon Neutrality Scenario Modelling Approach

In this EU Carbon Neutrality Scenario, the same assumptions apply as in the Baseline Scenario regarding the GHG targets for non-EU countries and the way their allowances are functionally allocated. The sole difference in this scenario are the EU targets, which are aligned with those proposed under the European Green Deal and recent Commission proposal[34]. The EU reduces its GHG emissions by 55% by 2030 and 90% by 2050 as compared to 1990 levels, net zero emission. As the EU Green Deal does not separately set a target for ETS and non-ETS, an EU-wide uniform carbon price has been used in the model, as summarised in Table 12.

31 Also referred to as Scenario A+ for the purposes of the modelling.
32 European Commission (2020): State of the Union: Commission raises climate ambition and proposes 55% cut in emissions by 2030. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1599.
33 European Commission (2020): Impact Assessment [...] Stepping up Europe's 2030 climate ambition / Investing in a climate-neutral future for the benefit of our people. Available at: https://ec.europa.eu/clima/sites/clima/files/eu-climate-action/docs/impact_en.pdf.
34 European Commission (2020): European Green Deal. Available at: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

Table 12: EU GHG emission reduction targets, EU Carbon Neutrality Scenario

	GHG Emissions (megatonne CO_2 equiv.)	% Change from 2005	Difference from Baseline Scenario (megatonne CO_2 equiv.)	% Difference from Baseline Scenario
2030	2 562	-53%	-890	-26%
2050	569	-89%	-569	-50%

3.2 EU Carbon Neutrality Scenario Results

The GHG emission reductions in the EU Carbon Neutrality Scenario are driven by the increase in the EU's carbon price in order to achieve the ambitious European Green Deal targets. Under the EU Carbon Neutrality Scenario, the estimated carbon price generated by the model nearly doubles in 2030 and 2040 when compared to the Baseline Scenario, tapering to an increase of 40% by 2050 indicating the increasing marginal abatement effort and difficulty in fully decarbonising the EU energy system – especially in hard-to-abate sectors with limited access to technological mitigation options.

Table 13: EU Carbon Neutrality Scenario carbon price per tonne of CO2, (2014 prices - $)

	2020	2030	2040	2050
EU Carbon Neutrality Scenario ($ per tonne of CO_2)	33	74	380	590
Difference from Baseline Scenario ($ per tonne of CO_2)	-	35	167	356
% change between EU Carbon Neutrality & Baseline Scenarios	-	53%	56%	40%

Source: GEM-E3

The increased abatement efforts required by the EU28 to meet these more ambitious targets has three main impacts:

(i) increases production costs for carbon intensive processes;

(ii) reduces production costs for clean energy technologies; and

(iii) increases the cost of capital (throughout the economy) due to greater demand for financing to meet the large investments required to transition energy systems[35].

As non-EU countries are not assumed to increase their ambition to reduce GHG emissions within this scenario, the market demand for clean energy technologies outside the EU remains relatively small, making the potential export benefits from a more competitive EU position in this sector limited overall. In the EU Carbon Neutrality Scenario, the driving factor for carbon leakage is the change in production costs of carbon intensive technologies through higher carbon prices as referenced in Table 13.

35 To simulate this within the model, a strict crowding out closure has been adopted where investments are constrained by available savings. Hence, any additional investment plan needs to be financed by reallocating existing financial resources.

With the EU acting largely alone in terms of GHG emissions reductions under this scenario, GHG emissions outside the EU increase as a result of domestically produced goods being substituted by imported goods. The cumulative (2025-2050) carbon leakage (covering all sectors of the economy) is estimated to be around 25% when full cost-pass-through (CPT) rates are used[36]. In 2030, the carbon leakage rate is low as the carbon price differential from the Baseline Scenario is relatively small, whereas the carbon prices in Baseline Scenario already imply some leakage[37].

Measuring Carbon Leakage

- Asymmetrical GHG mitigation efforts can lead to significant carbon price differences among countries and hence to carbon leakage. **Carbon leakage in this study is measured as the increase of GHG emissions in non-EU countries as a result of EU GHG mitigation action**. The leakage is calculated both in terms of absolute GHG emissions and as **a ratio of the increases in non-EU GHG emissions resulting from abatements of GHG emissions in the EU.**
- **Carbon leakage in this study is captured when two scenarios of different EU GHG emission reduction efforts are compared** - here, the **Baseline Scenario and EU Carbon Neutrality Scenario**. Subsequently, **leakage induced by the trade- and tax- related policy measures is measured against the EU Carbon Neutrality Scenario**.
- The study captures the leakage through the **industrial channel** and not through the energy channel. In the Baseline Scenario, asymmetrical policies lead to carbon leakage however this is not measured within the scope of the study as a **reference counterfactual scenario is needed** (for example, a BAU scenario where the EU would undertake lower GHG mitigation action than the Baseline).

Table 14: Carbon leakage under EU Carbon Neutrality Scenario, megatonne CO_2 equivalent

	EU28 GHG Emissions in Carbon Neutrality Scenario	EU28 GHG Emissions in Baseline Scenario	EU28 GHG Emissions Reduction Target	Non-EU GHG Emissions (absolute change from Baseline Scenario)	Carbon Leakage rate
2030	2 562	3 452	890	81	9%
2050	569	1 138	569	130	23%

** Full cost pass through rates have been assumed*

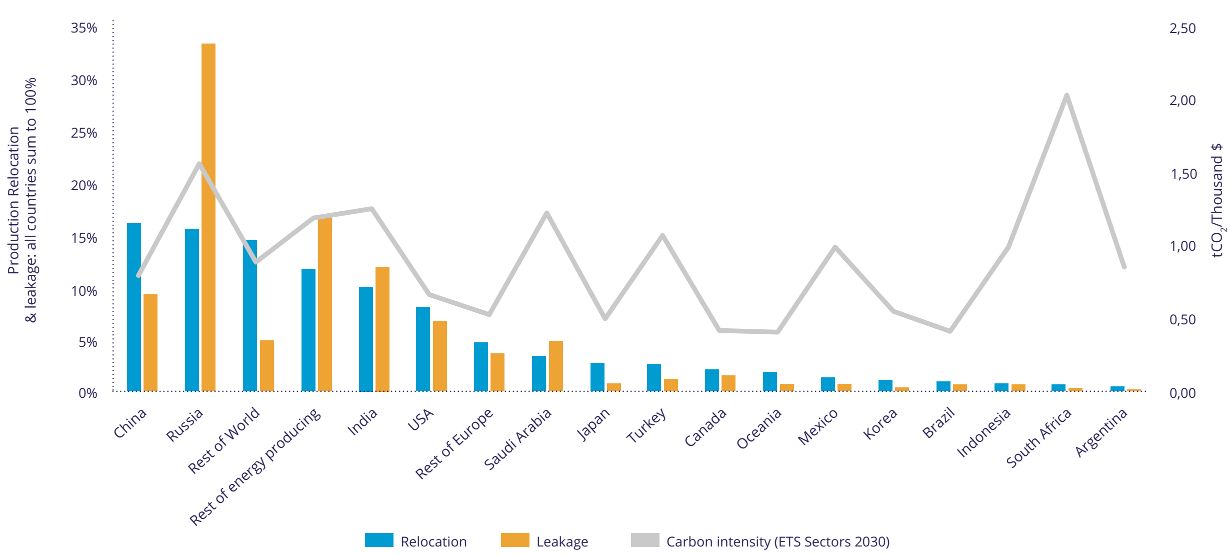
36 The CPT rate is the extent to which additional costs induced by the EU ETS (or another environmental policy) can be passed through to the final consumer. It is defined as the increase in the final price of the product divided by the additional carbon costs in production. The CPT rate can range between 0% and 100%.
37 The leakage in Scenario A could have been captured if it was compared with a scenario where no or lower carbon prices were applied.

3.2.1 Geographical distribution

The distribution of estimated leakage arising from the EU Carbon Neutrality Scenario by trading partner is presented in Figure 10, in which the 17 non-EU countries where carbon leakage occurs are ranked – 1 (red) indicates the highest degree of carbon leakage while 17 (green) is the lowest. The leakage rates are estimated to be highest to Russia, the US, India, China and Turkey. Together, the leakage as a result of displaced EU production to these countries accounts for more than 60% of the total estimated leakage. Low transportation costs to the EU market favour Russia and Turkey, while China and India have sufficient production capacities at low cost and relatively high energy and carbon intensities that induce a higher input of GHG emissions – and hence carbon leakage – under the EU Carbon Neutrality Scenario.

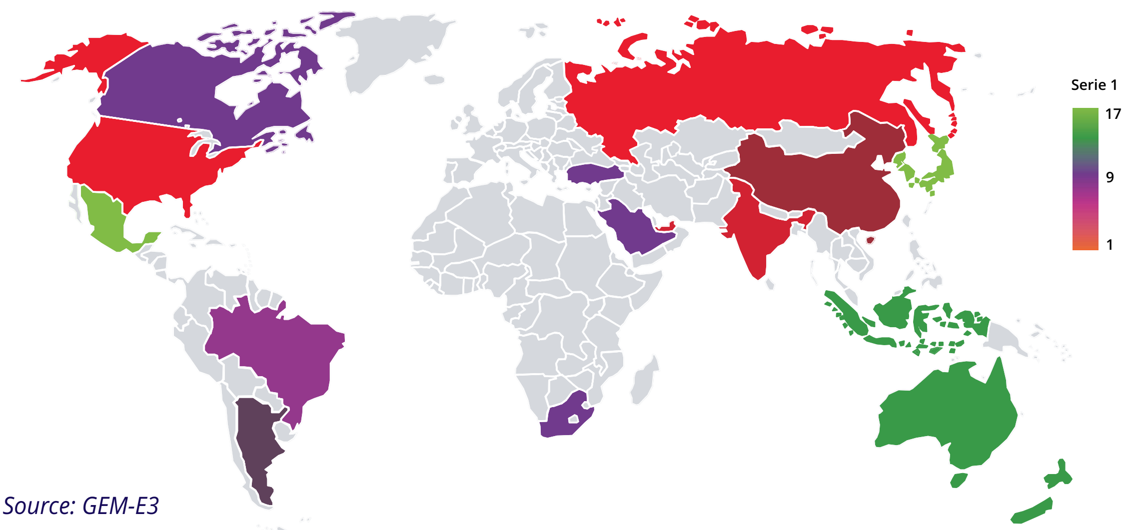
It should be noted that the relocation of EU production to the different countries is not proportional to the changes in GHG emissions (leakage rates) as each country is characterised by different GHG intensities. For example, one tonne of steel produced in the USA emits lower GHG emissions than in India.

Figure 10: Relocation-Leakage and Carbon Intensity (Cumulative 2025-2050)



Source: GEM-E3

Figure 11: Distribution of carbon leakage from the EU with selected trading partners, 2025-2050 (Max. = 1)

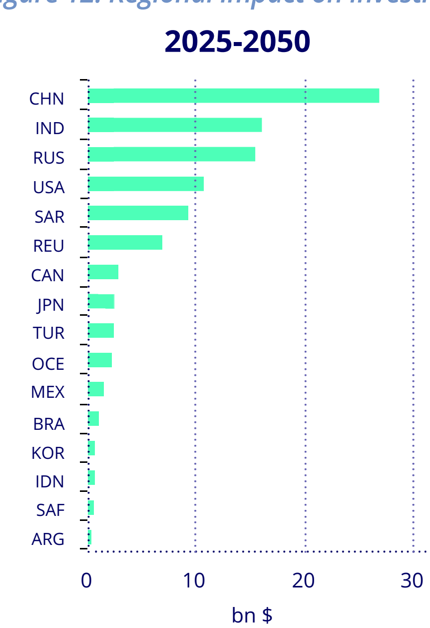


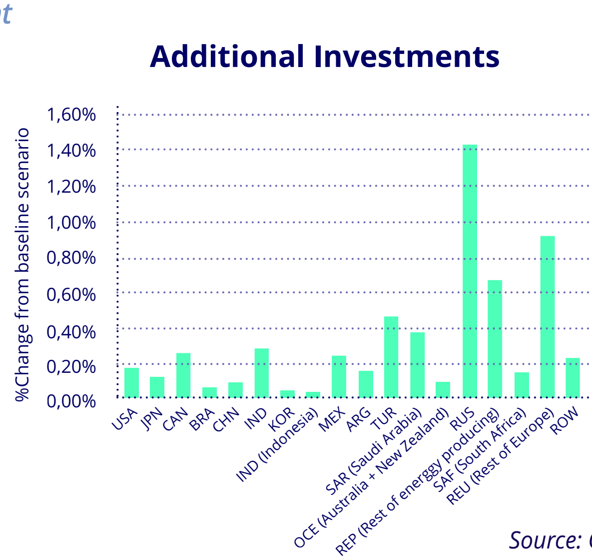
Source: GEM-E3

As the higher carbon price in the EU Carbon Neutrality Scenario leads to more production in non-EU countries, investments to increase production capacity in third countries are needed. The scale of investments by country is affected both by the flows of carbon leakage, the flows of production relation but also by the capital intensity of the production[38]. In this way, the modelling of investment decisions linked to carbon leakage is based on purely price considerations – relative production costs and transportation costs – and does not factor in other investment decision drivers such as regulatory conditions, political stability, or ease of doing business. The highest increase in investments takes place in Russia, where a significant part of carbon leakage also takes place.

38 One tonne of CO2 leakage of pharmaceuticals and one of metals do not require the same investment, for example. Metals production is more capital intensive.

Figure 12: Regional impact on Investment



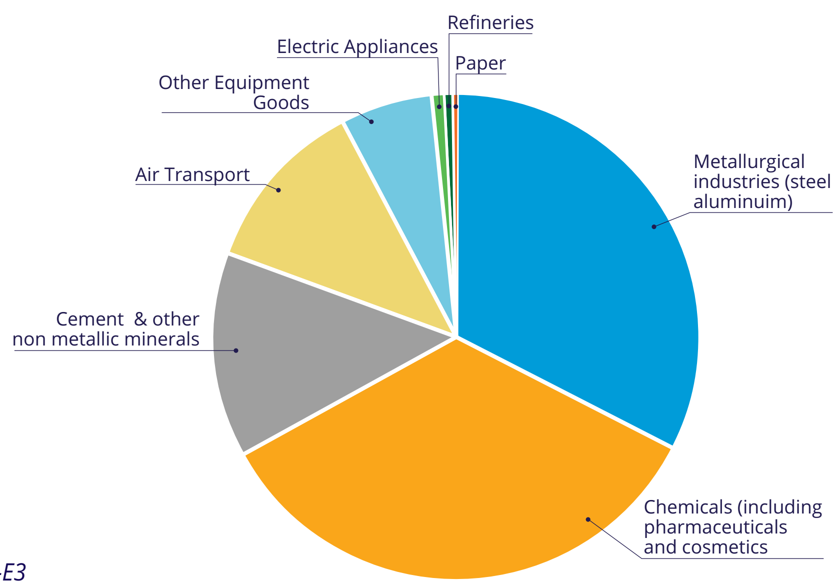


Source: GEM-E3

3.2.2 Sectoral distribution

The sectoral distribution of the carbon leakage is presented in the Figure 13. As expected (according to the GHG intensity and openness to trade ratios), the sectors that are most vulnerable to carbon leakage are metals, chemicals, cement and air transportation. It should be noted that the importance of sectoral leakage changes over time as the energy system gradually becomes decarbonised. For Refineries, the GHG emissions that increase in certain countries are cancelled out by emission reductions in other non-EU countries as the electrification of the EU energy system and the reduction of oil use in transport and heating purposes reduces the aggregate demand for oil.

Figure 13: Sectoral distribution of the carbon leakage (2025-2050)

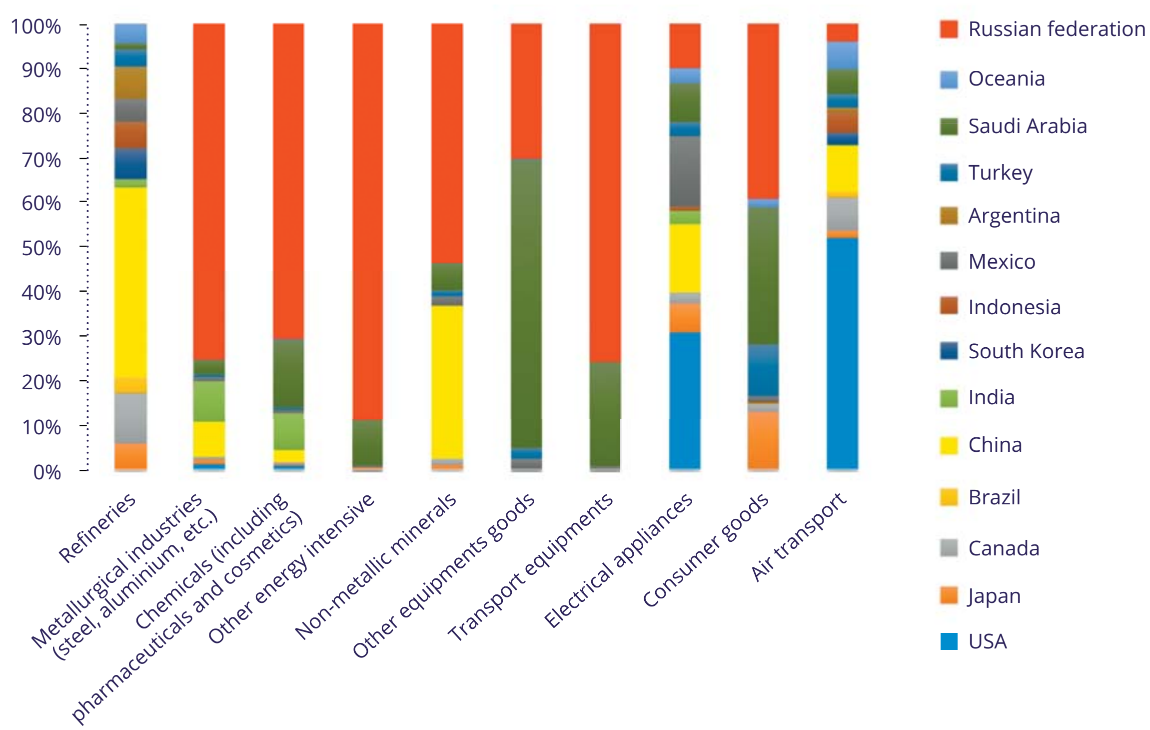


Source: GEM-E3

** The figure presents the share of each industry in total carbon leakage.*

The sectoral distribution of the estimated carbon leakage is quite different across countries. Russia is projected to be the host for industries related to metals, chemicals and equipment manufacturing, while the USA captures a significant share of air transportation. Cement production increases mainly in China, India and some Northern African Countries, which constitute a major part of the Rest of World (RoW) region within the model's reporting.

Figure 13: Sectoral distribution of the carbon leakage (2025-2050) in percentage of emissions



Source: GEM-E3

4

Trade & Tax Related Policy Measures

Key Summary
Individual policy measures

- Six primary policy instruments and international trade disciplines have been simulated in order to evaluate their performance on GHG emissions, GDP, employment and trade. The instruments have been evaluated individually, but also in the form of four different combinations that could plausibly be pursued.
- Recycling revenues from the tax-based scenarios – notably the CBAM and Final Consumption Tax – are significant in determining the impact of instruments on economic activity and employment. As these measures rely on public reinvestment in energy efficiency (60%) and clean energy technologies (40%), the efficacy of R&D is important to these results.
- The single instrument for which the model demonstrates the best performance in terms of reducing non–EU GHG emissions and increasing GDP and employment is the CBAM plus domestic subsidies program, with full recycling of CBAM revenues and half of ETS revenues to energy efficiency and R&D in clean energy technologies. Non-EU emissions are reduced by 5,019 megatonnes of CO2 compared with the EU Carbon Neutrality Scenario, while EU employment and GDP improve by 0.19% and 0.29%, respectively.
- In scenarios where retaliation by non-EU countries is applied, minor impacts on EU GDP and employment are observed.
- The simulation of a Final Consumption Tax without recycling results in an improvement of the EU's trade balance, but displays limited potential for reducing carbon leakage. This is due to the fact that households as end-consumers are less responsive to price changes than industries as producers.
- The scenario in which Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods are imposed is not as effective for the reduction of carbon leakage as other instruments, since existing tariff rates are assigned irrespective of a product's environmental characteristics or climate criteria.
- Where a reduction of industrial subsidies in China is hypothesized, the modelling predicts a greater reduction in China's GHG emissions than in the scale of carbon leakage from the EU. EU GDP increases as exports from EU become more competitive, both in China as well as on the global market.
- In the Reduction of Fossil Fuels scenario, that model predicts that EU industries benefit from the scaling back of subsidies as their competitiveness increases. Fossil fuel subsidies mainly concern final consumption and few subsidies are relevant for industrial purposes.

Combined measures

- Plausible combinations (COMBO scenarios) of the policy measures have been examined for their impacts on non-EU GHG emissions, production and employment.
- The best-performing combination projected by the model is the COMBO - CBAM & aii scenario where, in the context of a global concerted action fossil fuel subsidies are removed, tariffs on low carbon content goods are removed and industrial subsidies on energy intensives industries are reduced while the EU implements a CBAM.
- In the COMBO - CBAM & aii scenario,the model predicts non-GHG emission reductions to exceed EU reductions achieved under the EU Carbon Neutrality Scenario. The cumulative reductions over the 2025-2050 period are estimated to reach almost 7 gigatonnes of GHGs.
- Applying a variant of the COMBO – CBAM & aii that does not include an international agreement on the reduction of fossil fuel subsidies (COMBO – CBAM & aii minus Reduction of Fossil Fuel Subsidies) is the second best performing option overall. The difference in performance between the two scenarios modelled is very narrow – within 0.01% for GDP and employment, while the reduction of non-EU GHG emissions is lessened by 8% - suggesting that the impact of securing an agreement on the reduction of fossil fuel subsidies may be limited.
- The inclusion of anti-leakage measures in the combined scenarios appears significant in increasing their emissions reductions performance.

In both the Baseline and EU Carbon Neutrality Scenarios, the EU's emissions reductions targets are greater than all major third countries with which it trades. This gap in the EU's ambition and that of its trading partners inherently creates an imbalance in the distribution of production costs. In the absence of complementary measures, higher EU GHG emissions reductions targets and the associated carbon price may leave EU industries at a competitive disadvantage compared with third countries whose production costs are not elevated by the cost of significant energy systems transformation.

This study considers a series of measures that are conceptualised to balance or offset carbon leakage and lost competitiveness for EU firms as a result of higher EU GHG emissions reductions targets. At the outset of the study, a wide range of different unilateral and plurilateral instruments were considered for their potential to deter lost competitiveness and carbon leakage, as well as their political feasibility within the EU and expected compatibility with international trade rules. A shortlist of up to nine possible instruments was compiled, culminating in a final selection of the six that are presented below. The full list of policy measures considered but not included in the final study, including a variant of CBAM, can be found in the Annex.

For the purpose of identifying policy measures that have the potential to safeguard both the EU's climate and economic objectives, the following series of instruments detailed in Sections 4.1 through 4.6 have been modelled. Across the different options examined, two features are universally applied:

(i) use of a carbon price determined by taking the difference between the prices calculated in the Baseline and EU Carbon Neutrality Scenarios; and

(ii) functional implementation of the measure beginning in 2025.

Further characteristics in the design of each policy scenario as applied to the modelling are detailed in the subsequent sections.

4.1 Carbon Border Adjustment Mechanism (CBAM)

Key Summary – CBAM Policy Scenario

- The CBAM applies to EU imported goods that fall under ETS. The tax applied is set to be equivalent tothe ETS carbon price.
- Implementation of this measure is effective in balancing out changes in competitiveness and eliminating carbon leakage.
- The CBAM revenues over the 2025-2050 period are estimated to be 689€ billion ($915 billion).
- Under optimal conditions with revenue recycling and no retaliation, the model projects a reduction of carbon leakage by nearly 4,819 mega-tonnes of CO2 compared with the EU Carbon Neutrality Scenario, while EU employment and GDP improve by 0.07% and 0.10%, respectively.
- The model identifies the inclusion of recycling of CBAM revenues is critical effect on the positive impact of the instrument. Implementation of a CBAM without recycling has small negative effects on GDP, whereas the use of CBAM revenues to promote R&D in clean energy technologies and energy efficiency brings benefits to the economy.
- The modelling indicates that retaliation to the CBAM results in relatively limited impacts on GDP and employment, particularly as the EU is already energy-efficient and characterized by low carbon intensities.

The main principles of a CBAM are relatively well-defined and already form part of the current debate surrounding the European Green Deal. The European Commission includes a potential CBAM as one of the measures under consideration for reaching greater GHG emissions reductions by 2030 and 2050[39].

Fundamentally, enacting a CBAM in the EU can be used to counteract price differences between markets where carbon emissions are not accounted for equally in production costs. Under a CBAM, products imported into the EU from markets where carbon emissions during production are not priced or are undervalued compared to the EU would not be able to undercut domestic producers due to the instrument's levelling out of carbon costs. With the right design, such a measure would prevent carbon leakage, incentivise foreign producers to shift toward lower emission technologies and methods, and exert pressure on trade partners to strengthen their policies for addressing climate change and enforce international commitments.

In this modelling scenario, the CBAM is aligned with the EU ETS carbon pricing, entailing a similar coverage of products and the requirement for importers to pay a tax at import that is the functional equivalent of the value of EUAs that would be needed to bridge between the product's de facto carbon intensity in the country of origin and price under the ETS. This instrument targets the carbon content of imported goods that fall under the EU ETS sectoral classification.

Although the CBAM is determined based on the difference between EU ETS benchmarks and the carbon profiles of products originating in trading partner countries, the scenario is simulated as a purely financial instrument and does not entail any direct participation in the EU ETS or a mirrored system by importers. The model treats

39 European Commission (2019): EU Green Deal (carbon border adjustment mechanism). Available at: https://ec.europa.eu/info/ law/better-regulation/have-your-say/initiatives/12228-Carbon-Border-Adjustment-Mechanism.

the instrument as a simple tax to be paid by economic operators at the port of entry, rather than purchasing and exchanging a form of EU ETS allowances. On a functional level, the core features of the CBAM remain unchanged regardless of whether it is applied as a border tax or requires EUAs or equivalents to be purchased. This presumes stability in the EU's carbon price, even if a allowance-based system is enacted: for example, with importers purchasing virtual EUAs whereby the purpose of the ETS for these actors is to function as a price signal reflecting the cost of carbon in the EU. Further details on the rationale for consideration and selection of the tax-based CBAM relative to an EU ETS mirroring or comparable system are in Annex.

Revenues generated through the CBAM are then recycled back into the economy in the following way: (i) 60% of the revenues are used to promote energy efficiency projects; and (ii) 40% are used to support R&D in renewable energy and battery technologies. The split between these two recycling streams has been imposed on an arbitrary basis not linked to a calculation of optimal allocations. This measure has been simulated in three stages:

a/ Imposition of the CBAM, with costs assumed to fully pass on to the consumers.

b/ Recycling of CBAM revenues.

c/ The CBAM scenario plus symmetrical retaliation by non-EU countries to the border tax. Costs are assumed to fully pass on to the consumers.

Calculation of Carbon Intensity:

$$CI_{s,c,t} = \frac{EM_{s,c,t}}{PROD_{s,c,t}}$$

Where:

CI: Is the Carbon intensity by sector(s), country(c) and year(t).

EM: The Scope 1 emissions at year t from sector s and country c.

PROD: The value of the production at year t for sector s and country c.

Calculation of CBAM:

$$CBAM_{s,eu,noneu,t} = IMP_{s,eu,noneu,t}\ CI_{s,noneu,t}\ DCP_{s,eu,t}$$

Where:

CBAM: CBAM revenues of the EU countries (eu) at year t from non-EU countries (noneu) and sector s.

IMP: Value of EU imports for sector s at year t from non-EU countries.

CI: Carbon intensity of non-EU countries for sector s, at year t.

DCP: The EU carbon price difference between EU carbon neutrality scenario and baseline scenario.

Further details regarding the technical implementation of the CBAM scenario are provided in Annex.

Results from CBAM Scenario

Table 15: Estimated impact of CBAM variations on GDP, Unemployment and Cumulative non-EU GHG Emissions, 2025-2050 (in comparison to results from the EU Carbon Neutrality Scenario

	No recycling, No retaliation	With recycling, With retaliation	With recycling No retaliation	No Recycling, With Retaliation	3 sectors, No recycling, No retaliation
GDP	-0.08%	0.09%	0.10%	-0.09%	-0.07%
EU Exports	-1.53%	-1.81%	-1.60%	-1.75%	-1.45%
EU Imports	-1.85%	-2.02%	-1.81%	-2.06%	-1.73%
Employment rate	-0.11%	0.06%	0.07%	-0.11%	-0.09%
Change in non-EU GHG (Mt, 2025-2050)	-4 642	-4 328	-4 819	-4 153	-4 499

Source: GEM-E3

Compared with all instruments modelled, **the CBAM is the most effective standalone measure in terms of mitigating EU carbon leakage**. The CBAM is a focused instrument that captures both the regional differences in carbon intensities and the cost increases induced by the ETS carbon price. In its base design this instrument aims to balance the competition that EU industries face within the EU internal market, but it is not designed to support their competitiveness in international markets (exported goods do not receive any compensation for their higher production cost as a direct intervention would be non-WTO compliant).

One of the better-performing variants of the **CBAM scenario includes a recycling of the CBAM revenues towards the accelerated deployment of clean energy technologies and energy efficiency measures.** This recycling aims to reduce costs of RES, batteries and energy efficiency projects so as to moderate the GHG abatement costs borne by the industries.

In variants where retaliation to the CBAM from non-EU countries is modelled, effectively meaning that non-EU countries apply the EU ETS carbon price on EU exports, **adverse effects on EU production are small** as the EU industries are already quite efficient in producing goods with low energy and carbon contents and any retaliatory carbon pricing has very limited impacts on their production costs and hence on their selling prices.

The modelling finds that **the manner in which CBAM revenues are recycled greatly affects the performance of the measure on the economic and employment indicators**. When there is **no recycling of revenues, the CBAM results in a slightly negative impact on GDP as it increases costs incurred in production and consumption.** The negative impact on activity is found both in EU and non-EU countries as the imposition of the tax increases frictions in the economy. Additional taxes imposed on imports further increase production costs of EU-based industries and reduce real disposable income for households.

The recycling of the CBAM towards research and development and energy efficiency improvements increase the economy's productivity and lower production costs and energy expenditures. It should be noted however that **the benefits from increasing research and development expenditure[40] are uncertain** and the specific results should be treated with caution.

The CBAM measure is found to be a beneficial measure for the net trade balance[41] of the EU even when retaliation measures are taken by non-EU countries. The comparatively low-carbon intensity of EU products leaves little room for significant cost increases in its exported goods once the retaliation tax measure is applied. Therefore it should be noted that **the CBAM is an instrument that is resilient to potential counteracting measures by non-EU competitors.**

4.2 EU-wide Subsidies in Support of Low-carbon Technologies

Key Summary – EU-wide Subsidies in Support of Low-carbon Technologies Scenario

- The ETS revenues recycled back to the economy over the 2025 -2050 period are 281€ billion ($373 billion).
- The effectiveness of the ETS recycling through the increase of domestic subsidies on R&D greatly depend on the success and performance of R&D.

This policy measure assumes a scenario in which an EU CBAM with recycling is enacted in the framework of an EU carbon price driven by the Neutrality Scenario. In this context, the recycling of EU ETS revenues to support domestic energy efficiency programs and clean energy research is added to recycling of CBAM revenues and simulated from 2025 to 2050.

Both the CBAM and domestic subsidies are targeted to address potential disadvantages to EU producers as a result of being subject to more stringent environmental regulations, either in the form of greater competition with imports or otherwise to deter relocation to less stringent locales. While the CBAM attempts to equate the carbon cost of imported goods with those produced in the EU, the EU-wide domestic subsidies policy seeks to lower the impact on EU production costs due to energy transition. Traditionally, subsidies are applied to vulnerable sectors such as agriculture, or to low-income households and are rarely used to artificially reduce costs and increase competitiveness. However, in order to offset significant investments and increased production costs required for a unilateral EU decrease in GHG emissions, targeted subsidies may be warranted.

Within the model, the granting of these subsidies is neutral to the public budget: 50% of the ETS revenues are recycled back into the economy so as to subsidise low-carbon technologies. These subsidies are then assumed to be used in the following way: (i) 60% of the revenues are used to subsidise energy efficiency technologies; and (ii) 40% are used to subsidise R&D in renewable energy and battery technologies. As the revenues are derived from the EU carbon price, the efficacy of this instrument is contingent on the model's ability to project these carbon prices.

The targeting of this recycling to public programs to support energy efficiency technologies and facilitate R&D in clean energy technology is specifically intended to comply with permissible subsidies under the WTO discipline, avoiding direct firm-level transfers.

40 *The performance of R&D is based on learning by research rates for specific technologies found in the respective scholarly literature. It is assumed that under baseline conditions these R&D expenditures have not been performed (although profitable) as the "enabling condition" were not sufficient. The high carbon price signal is adequate to formulate the necessary enabling conditions.*
41 *Trade balance improves by lower imports but also lower exports. Exports further decrease as taxation on imports of intermediate goods increase overall production costs. The net-effect on balance of trade is positive as the reduction in exports is smaller than reduction in imports.*

Results from EU-wide Subsidies in Support of Low-carbon Technologies Scenario

Table 16: Estimated impact of the EU-wide subsidies policy together with CBAM on GDP, Unemployment & Cumulative Change in non-EU GHG Emissions, 2025-2050 (in comparison to results from the EU Carbon Neutrality Scenario)

	EU-wide subsidies in support of low-carbon technologies & CBAM (with recycling, no retaliation)	CBAM only (with recycling, no retaliation)
GDP	0.29%	0.10%
Employment rate	0.18%	0.07%
Change in non-EU GHG (Mt, 2025-2050)	- 5 019	- 4 819
Revenues Recycled into EU economy ($ billion)	1 288	915

Source: GEM-E3

The effect of domestic subsidies is small as it is essentially a redistribution of resources and is mainly driven by their impact on reducing the EU-ETS carbon price which indirectly moderates the impact on production costs. In this scenario, the EU-ETS carbon price is reduced as compared to the EU Carbon Neutrality scenario, due to the lower cost over time of accessing carbon-efficient technologies for production. This measure is effective both in supporting the industrial competitiveness in domestic and international markets.

Domestic subsidies have a mixed effect on GDP. At the global level, the performance is low as the initial allocation of resources was optimum (in the Baseline Scenario, the ETS revenues are kept in the public budget and reduce the international interest rate). For the EU, the use of resources to further support clean energy technologies is preferable to the reduction of the world base interest rate because clean energy industries have sufficiently developed already in the Baseline Scenario where ambitious GHG emission reduction targets are already in place.

The domestic subsidies have a neutral impact on EU trade balance.

4.3 EU-wide Final Consumption Tax on Carbon Content

Key Summary – Final consumption Tax on Carbon Content Scenario

- The final consumption tax is effective in reducing leakage both by capturing competitiveness losses in domestic (tax on final consumption) and international markets (free allowances).
- The final consumption tax reduces both economic activity and welfare through reduced disposable income for households (higher consumer prices reduces real disposable income).
- The base of the tax is larger than the CBAM. Total revenues for the 2025-2050 period are 2 371€ billion ($3 150 billion).

The design of the final consumption tax scenario is such that it captures changes in competitiveness both within the EU domestic market and in international markets. In this scenario an end-user consumption tax is imposed on all consumption products regardless of origin (i.e., on both domestic and imported goods). The tax is imposed only on final demand categories (households and formation of capital goods). Taxing only final consumption is made so as to avoid incremental and indirect costs through the supply chain. The full carbon footprint of final consumption products is approximated using the Loentief carbon multipliers[42].

The level of the tax[43] is calculated using the ETS carbon pricing[44], and the GHG intensity (carbon content) of the products directed to the household consumption and gross fixed capital formation.

In order to avoid double carbon taxation of EU products (both within ETS and at the final consumption stage) it is assumed that ETS allowances are distributed for free. The model mechanism to simulate the free allocation is to tax the carbon emissions of ETS (so that they perform the necessary emission reductions in a cost optimal way) and then return the tax revenues back to the industry (i.e. increase the capital income of the firm).

Calculation of Carbon Intensity:

$$CI\_H_{s,c,t} = (I-A)^{-1}_{s,b,c} \cdot \frac{EM_{b,c,t}}{PROD_{b,c,t}}$$

Where:

$(I-A)^{-1}_{s,b,c}$**:** Is the inverse Leontief Multiplier.

EM: The Scope 1 emissions at year t from sector s and country c.

PROD: The value of the production at year t for sector s and country c.scenario.

$(I-A)^{-1}_{s,b,c} \cdot EM$**:** Is the Carbon footprint in Sector s for Country c.

Calculation of Total final consumption Tax:

$$FC\_TAX_{s,eu,t} = DCP_{s,eu,t} \cdot (CI\_H_{s,eu,t} \cdot DOM\_SHR_{s,eu,t} + \sum_{noneu} CI\_H_{s,noneu,t} \cdot IMP\_SHR_{s,eu,t} \cdot Cons_{e,eu,t}$$

Where:

CI_H: Carbon intensity of EU countries and non-EU countries for sector s, at year t.

DCP: The EU carbon price difference between EU carbon neutrality scenario and baseline scenario.

DOM_SHR: Domestic share of the final composite good.

IMP_SHR: Imported share of the final composite good.

Cons: The value of the final consumption.

Further details regarding the technical implementation and rates applied for the Final Consumption Tax scenario are detailed in Annex.

42 The carbon multipliers refer to total emissions associated with the production of a product (direct and indirect) and are derived suing the carbon intensity and economic Input output tables.

43 The exact tax rates applied within the model are presented in Annex.

44 Its difference between the Baseline and EU Carbon Neutrality Scenarios.

Results from Final consumption Tax on Carbon Content Scenario

The final consumption tax is effective in reducing the carbon leakage. In the case of its implementation, non-EU emissions are estimated to be 1,077 mega-tonnes of CO_2 lower over the 2025-2050 period compared to the EU Carbon Neutrality Scenario.

It should be noted that the final consumption tax is applied to a much wider tax base than the CBAM (all products in private consumption and gross fixed capital formation), hence it is not easily comparable. This instrument is able by design to balance out EU products' competitiveness loss both in domestic and international markets. Competition in the internal market is supported by applying a uniform tax across the different products according to their carbon intensities (in this respect EC products are privileged as they are characterized by low GHG emission intensities relative to non-EU ones). Competition in the international market is supported by providing EUAs for free in the domestic market hence reducing the impact of GHG mitigation on production costs. It should be noted that the final consumption tax does not capture the impact on trade of intermediate goods / value chains as only final consumption goods are captured.

The final consumption tax reduces both economic activity and welfare through reduced disposable income for households (higher consumer prices reduces real disposable income).

4.4 Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods List[45]

Key Summary – Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods List Scenario

- The modelling of Carbon-content Modulated Tariffs & Zero Duties on Environmental Goods indicates a reduction of carbon leakage by 1,116 mega-tonnes over the 2025-2050 period.
- Existing tariff rates are not intended to offset negative climate externalities associated with the covered products. As such, the scope for this instrument to achieve environmental aims is limited compared to others considered by the study.
- Small but positive effects projected by the model on EU GDP, employment and trade as it increases efficiency of resource allocation.

This policy tool presumes the signing of a global agreement that provides preferential tariffs on trade of goods between participating countries provided those goods limit the content of carbon embodied in its production. It further assumes that tariffs are eliminated on all trade in "environmental goods" (EGs) between signatory countries.

Calculating tariffs according to their carbon content or footprint and climate change mitigation has the following effects:

(i) levels the playing field between domestic and imported products with respect to carbon costs;

(ii) incentivises adoption of greener production processes and technologies; and

(iii) promotes the positive trade and use of environmental goods, whereby the plurilateral nature of the instrument also reduces the threat of retaliation encountered with other instruments such as the CBAM.

Preferential tariffs are applied to imported goods that are below a specific carbon content threshold as well as to all goods that are classified as environmental goods (EGs). The difference from the CBAM scenario is that the level of the tariff is unconnected to the leakage potential (it does not take into account the regional and sectoral specifics) and it is based on existing tariffs[46].

45 The instrument is referred to interchangeably by the shorthand "Tariffs + ENG's" in certain graphics and modelling notes.
46 The bilateral duty rates used have been extracted from the GTAP database.

At the same time, tariffs will also be adjusted on the APEC list[47] of environmental goods so that they are afforded duty-free access in trade between all partners subject to the agreement. Functionally, all members of this Environmental Goods Agreement-type agreement would extend duty free access for the covered products, and the initiative would be considered to reach a critical mass threshold where the benefits would apply to trade that does not involve the EU (e.g. between China and the United States)[48].

Results from Carbon-content Modulated Tariffs Reduction & Environmental Goods List Scenario

Eliminating the tariffs on environmental goods or goods that are characterized by low carbon intensities reduces carbon leakage by 1,116 mega-tonnes over the 2025-2050 period, however to a lesser extent than the CBAM and horizontal taxes.

The performance of this instrument in reducing carbon leakage depends on:

i) The non-targeted application of tariffs as regards to the carbon content of goods. Tariff rates are typically not assigned based on climate or environmental criteria, therefore for products with a good climate profile and high tariffs there is substantial 'overhang' for this instrument to address, thereby increasing the attractiveness of these goods through preferential duty rates.

ii) The degree of globalisation (trade agreements and regional trade areas). Common trade markets are characterised by low or non-existing tariff rates, however carbon leakage among the countries that participate in the common market may take place. This instrument is only effective to the extent that there are pre-existing tariffs to reduce.

iii) The plurilateral nature of this measure (i.e. tariffs are removed plurilaterally at a global scale), which means that the EU unilateral action (as compared to the Baseline Scenario it is the only region that increase its GHG abatement effort) is not taken into account when tariffs are removed.

The removal/reduction of tariffs increases the efficiency of trade both at world and EU level hence improving GDP. Higher economic activity in the EU is accompanied by higher demand for labor leading to increasing employment. It should be noted that although the impacts are positive the scale is small.

EU balance of trade is improved when removing tariffs. This is due to the unbalanced allocation of tariffs between EU imported goods and EU exported goods. EU exports receive higher duty rates at their destination than the rates EU imposed by the EU on its imports.

4.5 Plurilateral Agreement on the Reduction of Industrial Subsidies

Key Summary – Reduction of Industrial Subsidies Scenario

- The reduction of the industrial subsidies in China reduces the GHG emissions in China at a scale larger than the carbon leakage that is directed to China.
- World emissions are reduced by almost 1,800 mega-tonnes of CO_2 both as a result of reducing carbon leakage but also due to relocation of industries from China to other countries with lower carbon intensities.
- EU GDP increases as exports of EU (into China but also to other markets where EU products compete with Chinese products) become more competitive.

Based on the January 2020 trilateral statement from the EU, US and Japan, it is envisaged that this policy would seek to expand the scope of prohibited subsidies under the WTO (in terms of Article 3.1 of the Agreement on Subsidies and Countervailing Measures [ASCM]), strengthen reporting requirements on subsidies by members (Art. 25) and reverse the burden of proof[49]. In particular, the policy would – as noted in the statement – seek to identify the following types of subsidies as unconditionally prohibited: (i) unlimited guarantees, (ii) subsidies to an insolvent or ailing enterprise in the absence of a credible restructuring plan; (iii) subsidies to enterprises unable to obtain long-term financing or investment from independent commercial sources operating in sectors or industries in overcapacity; and (iv) certain direct forgiveness of debt.

In parallel, further work addressing industrial subsidies in key sectors has been channelled through the Organisation for Economic Co-operation and Development (OECD). Notably, the OECD has produced regular reporting on global steel capacity and market developments while delivering recommendations to other fora addressing the topic, such as the G20 Global Forum on Steel Excess Capacity Ministerial Meeting[50]. Similarly in the aluminium sector, also characterised by a high degree of intervention by governments, the OECD has produced Trade Policy Papers on measuring distortions in international markets throughout the value chain[51].

Both the trilateral statement on revision of the ASCM and recent research publications indicate that the policy is particularly targeted towards the practices of one country, China. In focus are the ease of access to credit through local and central governments in China, prevalence of large state-owned enterprises, and direction of the country's industrial policy which emphasises domestic manufacturing[52]. This combination of characteristics specific to the Chinese economy, relative to other EU trading partners, leads to distortions in production that are specific to China.

Due to the prevalence of subsidies in China that are likely to be targeted under a revised ASCM and the global impact and scale of Chinese production, the modelling of this scenario has been designed to simulate the reduction of industrial subsidies in China. In order to estimate the level of industrial subsidies applied, a systematic review of the academic literature has been performed. Over 15 studies and reports were identified and reviewed.

Based on available data and subsidy rates derived from literature - and given that that the 2020 Trilateral Statement is widely believed to be principally directed at China - this scenario has removed industrial subsidies[53] provided to Chinese ETS sectors at the rates quantified in Table 17[54]. It is assumed that the additional revenues to the Chinese government freed up by the subsidies not spent are used to improve the its fiscal position, not recycled.

47 See: https://www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexC.aspx

48 The list of 54 products is specified at the HS-6 customs code classification – in many cases these are specialized parts that form part of more commonly recognized environmental goods, e.g. constituent machinery and parts that are assembled after import as wind turbines. The 54 products need to be mapped to the sectoral aggregations that are applied in the model. Then, bilateral trade data among all flagged countries will need to be gathered for each of these products so that their share of trade can be calculated.

49 European Commission, Japanese Ministry of Economy, United States Trade Representative (2020): Joint Statement of the Trilateral Meeting of the Trade Ministers of Japan, the United States and the European Union. Available at: https://trade.ec.europa.eu/doclib/docs/2020/january/tradoc_158567.pdf.

50 OECD (2020): Steelmaking Capacity. Available at: http://www.oecd.org/sti/ind/steelcapacity.htm.

51 OECD (2019): Measuring distortions in international markets: the aluminum value chain. Available at : https://www.oecd-ilibrary.org/trade/measuring-distortions-in-international-markets-the-aluminium-value-chain_c82911ab-en.

52 Wiley Rein (2017): Follow the Money: The State Financial Sector & the Aluminum & Steel Overcapacity Crisis. Available at: https://www.oecd.org/industry/ind/Item_6_2_Alan-Price.pdf.

53 hese have been modeled as direct output price reductions

54 Industrial subsidies in China and other markets are inherently obfuscated. While the ASCM Trilateral Statement which underpins the rationale for this scenario does not indicate a likely elimination of industrial subsidies, targeting elimination of subsidies at the rates quantified under this scenario may inherently capture further subsidies which are unreported and unaccounted for in the literature.

Table 17: Reduction in subsidy rates (absolute percentage difference)

Sector	Subsidy rate (%)
Power Supply	-2.77%
Refineries	-1.50%
Chemical Products	-1.50%
Coal	-1.97%
Air Transport	-1.20%
Ferrous Metals	-0.37%
Non-Ferrous Metals	-1.58%

Results from Reduction of Industrial Subsidies Scenario

The reduction of industrial subsidies scenario applies to only China and is disconnected from the scale of EU leakage to China – i.e. the removal of subsidies is not such that the changes in production costs is restored to prior the imposition of the EU-ETS carbon price levels.

The removal of subsidies reduces emissions in China at much larger scale than the initial leakage to China. Competing sectors in other countries benefit and further increase their emissions. Hence, if only the net effect is calculated (only the GHG emission reductions) the performance of the instrument is still considerable (mainly through emission reductions on China). This measure reduces leakage towards China in all sectors but mostly those related to Chemicals and Non-Ferrous metals.

The removal of industrial subsidies in China has a beneficial impact on EU GDP as the EU industries benefit from the rationalisation of international competitiveness. At the world level the net impact on GDP is negative. Key competing countries of China such as USA and Japan increase their GDP but countries such as Russia, Energy producers and Mexico lose GDP.

4.6 Plurilateral Agreement on the Reduction of Fossil Fuel Subsidies

Key Summary – Reduction of Fossil Fuel Subsidies Scenario

- The reduction of the fossil fuel subsidies reduces carbon leakage by 660 mega-tonnes of CO_2.
- Reduction of subsidies across fossil fuels may lead to adverse effects (reducing subsidies in oil and gas may increase the use of solids).
- EU industries benefit from the global reduction of fossil fuels as their competitiveness increases. Fossil fuel subsidies mainly concern consumption and few subsidies are relevant for industrial purposes.

As with industrial subsidies, this scenario assumes the implementation of a plurilateral agreement that would broaden restrictions on the use of fossil fuel subsidies across all countries. Government subsidies to offset costs of fossil fuel consumption or production remain pervasive and have a pronounced direct effect on global carbon emissions. International rules limiting their use could reduce carbon emissions and promote investment in clean energy and in energy efficiency.

In practice, the model assumes the full elimination of fossil fuel subsidies on production globally. A fiscal accounting of subsidies is adopted (i.e., not the price differential between actual and effective price–opportunity cost). It should be noted that while no direct data were available on fossil fuel subsidies (by industry, fuel and country), the study has been able to compile figures using aggregate data found in IEA[55], OECD[56] and IMF[57] databases. The estimates of the overall level of fossil fuel subsidisation, however, exhibit notable variation depending on the source; for example, the IEA tallies approximately $400 billion in global fossil fuel subsidies while the IMF's estimate stands at $4.7 trillion. The modelling of an agreement on the reduction of fossil fuel subsidies has largely been based on the IEA dataset in this study.

Results from Reduction of Fossil Fuel Subsidies Scenario

The elimination of fossil fuel subsidies internationally reduces the dependence on fossil fuels as it makes other energy forms more competitive. The scenario results are greatly dependent on the scale of fossil fuel subsidies, but also on the distribution among fuels – coal, oil, and gas. For this reason, two scenarios have been simulated: one with full phase out of subsidies to all three fossil fuel types, and one with elimination of oil and gas subsidies, while only partially removing coal subsidies. The reasoning for the second variant is that when subsidies in oil and gas are removed, there is a substitution towards the cheaper fossil fuel option which essentially leads to an increase in emissions. As fossil fuel subsidies on production are quite low in the EU (especially in the conditions prevailing in the Baseline Scenario that assume GHG emission reduction by 80% in 2050) whereas sizeable amounts are applicable in non-EU countries and especially in energy producers, the performance of this option in mitigating carbon leakage is higher in the early years of implementation (where these rates are still applicable and associated fuel consumption sizeable) but diminishes over time.

Caution should be given on the effect of subsidy removal to the relative price change among fossil fuels. **A full phase out of subsidies to fossil fuel types may in some cases lead to adverse effects**. This is true in some countries where subsidies are higher in oil and gas and much lower in coal their removal essentially favours coal (as the change in relative prices indicates that coal becomes cheaper relative to oil and gas). To the extent that fuel substitution is possible this will trigger an opposite result (increase in emissions) as the economy substitutes gas/oil with coal. However, this effect is not dominant.

The removal of fossil fuel subsidies is found to be beneficial for the EU as it improves its overall competitiveness on industries that are carbon intensive. The overall impact at a world level is marginally negative as the negative impact on countries and sectors producing fossil fuels dominates the gains in countries that tax removal improves overall economic efficiency.

The removal of fossil fuel subsidies has a negligible impact on EU trade balance and globally (marginally negative).

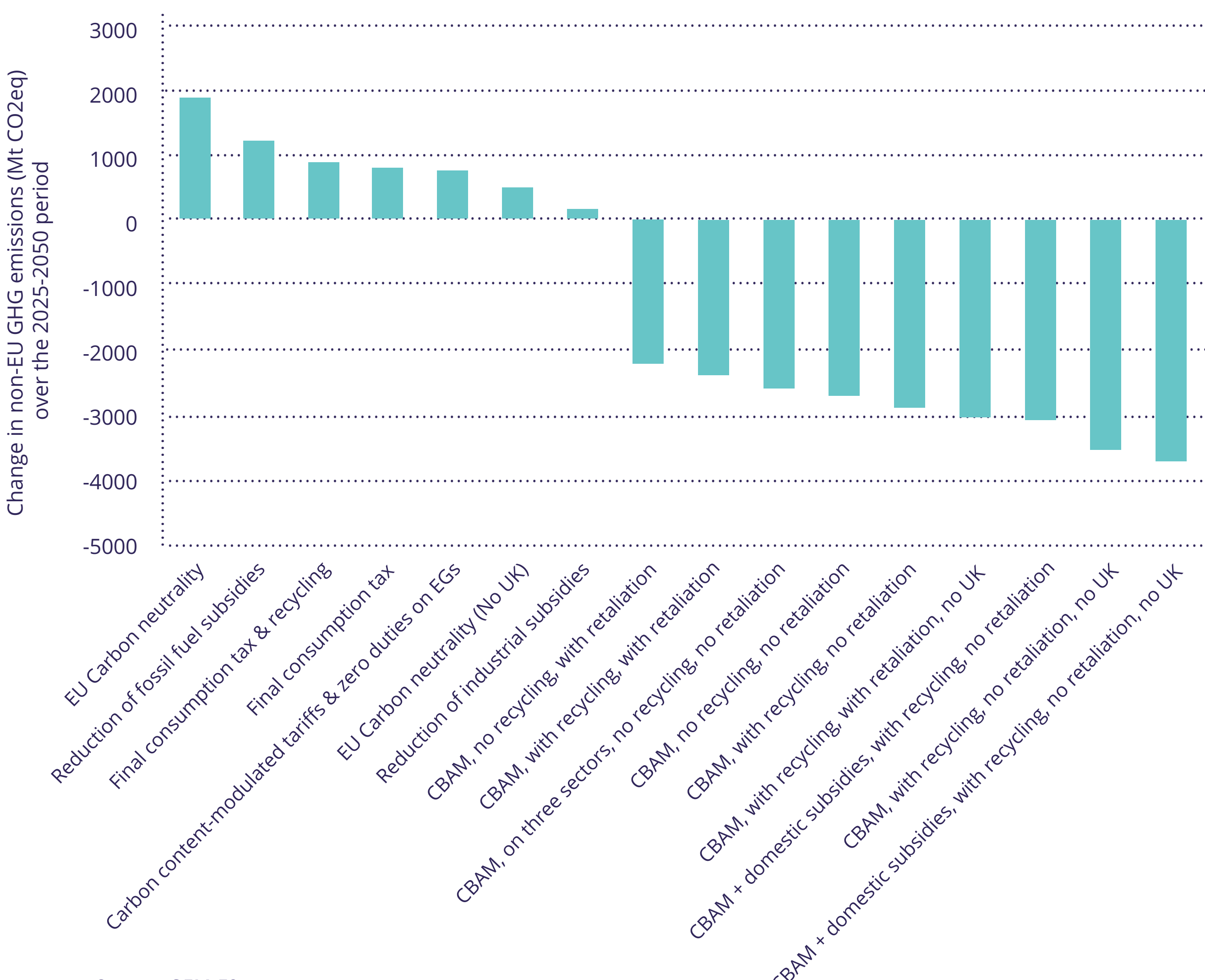
__55__ IEA (2019): Energy Subsidies, Tracking the Impact of Fossil-fuel Subsidies. Available at: https://www.iea.org/topics/energy-subsidies.
__56__ OECD (2020): Fossil Fuel Support – DEU. Available at: https://stats.oecd.org/Index.aspx?DataSetCode=FFS_DEU.
__57__ IMF (2019): Global Fossil Fuel Subsidies Remain Large: An Update based on Country-Level Estimates. Available at: https://www.imf.org/en/Publications/WP/Issues/2019/05/02/Global-Fossil-Fuel-Subsidies-Remain-Large-An-Update-Based-on-Country-Level-Estimates-46509.

4.7 Trade & Tax Related Policy Measures Comparative Results

The performance of the different policy options in reducing carbon leakage is presented in Figure 15. Not all policy options are directly comparable as they have different sectoral and regional coverage, while they do not involve comparable fiscal interventions.

It should be noted that the increase of non-EU emissions under the different scenarios examined may not be directly linked to an increase of activity in non-EU ETS competing sectors but beyond these sectors. In the analysis below, this distinction is made when required.

Figure 15: Absolute Change in Non-EU GHG Emissions relative to Baseline Scenario – cumulative over 2020-2050



Source: GEM-E3

** Performance is measured as (Non-EU Emissions in Policy Scenario – Non-EU Emissions in the EU Carbon Neutrality Scenario) / Carbon Leakage in CO_2 eq.).*

By design, each option has different implications for sectoral performance and industrial leakage. Figure 16 presents the performance of each option in reducing the leakage in the different options. The bars show how much of the leakage reduction is due to the change in emissions in a specific sector, with all sectors adding to 100%.

- **The Carbon Content-modulated Tariffs and Zero Duties on Environmental Goods scenario is not directly linked with the EU's carbon price opposed to the CBAM scenario**. Carbon pricing is one of the main drivers of leakage, so taking this into account is essential for the reduction of carbon leakage.
- **The CBAM Scenario has a significant impact in reduction of carbon leakage**. This can be explained by the high difference in carbon intensities, as well as emissions reduction ambitions, between the EU and trading partner countries. The EU28 has the lowest carbon intensities in ETS sectors, while the main trade partners of EU28 have the highest (Russia, China, India).
- **The scenario simulating a removal of industrial subsidies, with a focus on China, is the second-best standalone option of reducing leakage after the CBAM and CBAM plus domestic subsidies variant**. The GHG emissions from power generation technologies and chemical products are significantly reduced. However, in China the chemical sector leads to high leakage mostly into India and Russia where both countries have higher carbon intensity in chemical products. The total carbon leakage from China to other non-EU countries is almost 30%. Furthermore, the scenario models a full elimination of industrial subsidies in China at the rates specified, while in practice the political pathway for securing such an agreement with China is tenuous.
- **Removing fossil fuel subsidies in countries included in the plurilateral agreement has small impact in reducing carbon leakage**. The higher amounts of fossil fuel subsidies eliminated are in India and Rest of the world region where the reduction in the GHG emissions are produced in other non-EU countries such as Russia, China and the rest of the energy producing region.
- **Metals and Chemicals have the highest sectoral performance in the CBAM scenario because of the higher carbon intensity and share of EU imports in ETS sectors related to the other sectors of the EU ETS**. Combined they cover almost 60% of the EU imports on ETS sectors.
- **The highest reduction of GHG emissions in the industrial subsidy scenario derives from the power generation technologies (coal fired) in China**.

In-terms of macro-level indicators – employment, trade balance[58], and GDP – the following results are observed from individual simulation of each policy instrument. Figure 18, Figure 19 and Figure 20 show the cumulative effects of each instrument within the simulation during the 2025-2050 time period.

The impact on employment differs by policy instrument and depends on its impact on economic performance and the labour intensity of the sectors that are mostly affected. The removal of tariffs improves economic performance and employment, whereas the elimination of fossil fuel subsidies and the reduction of production in some labour-intensive industries like coal mines tend to reduce employment.

58 Net effect on EU trade balance, whereas at the world level this is represented as the total volume of trade, sum of imports and exports.

Figure 16: Sectoral Performance of Individual Trade- and Tax- Measures – CBAM Variants

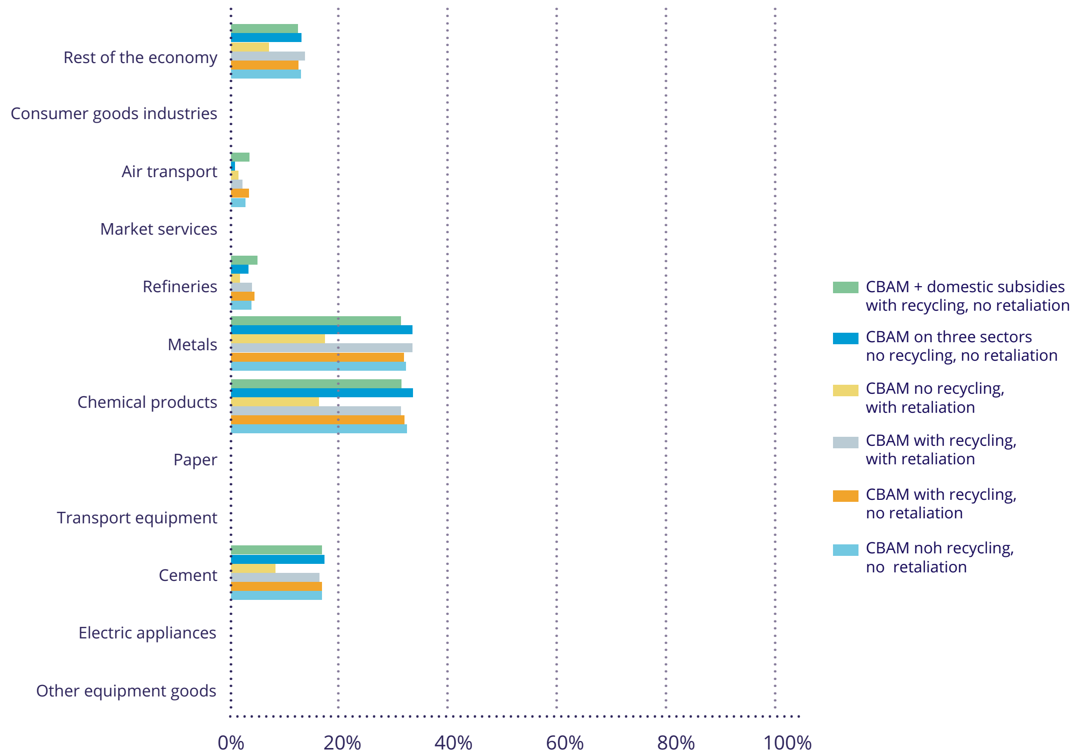


Figure 17: Sectoral Performance of Individual Trade- and Tax- Measures

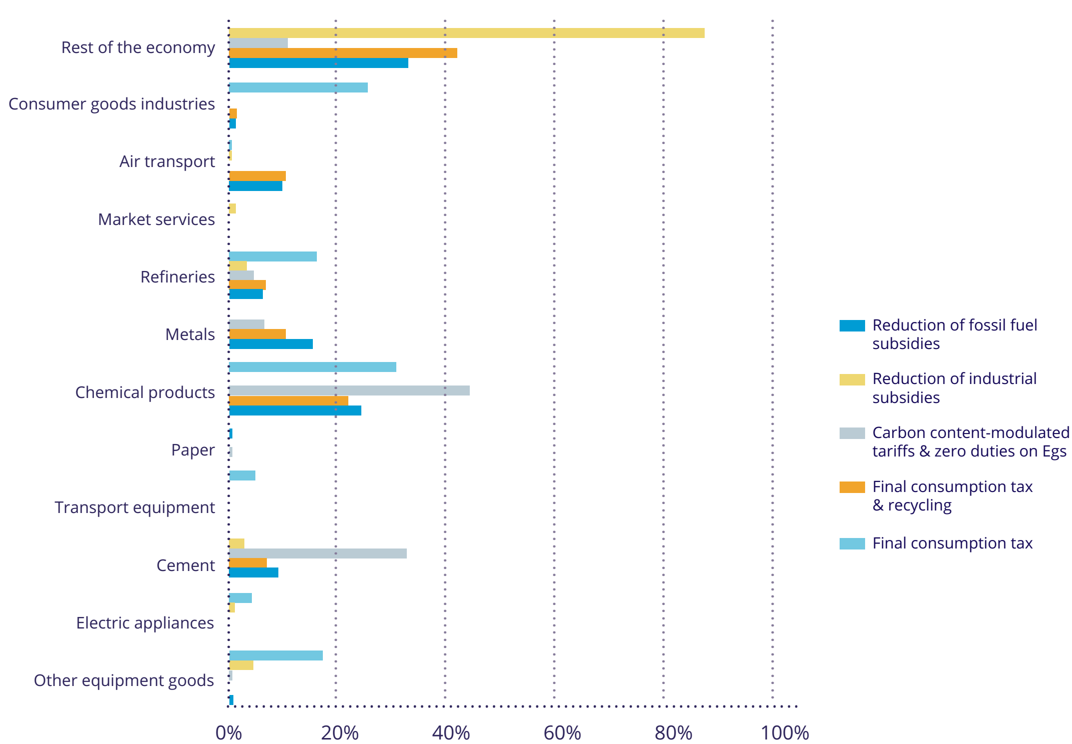
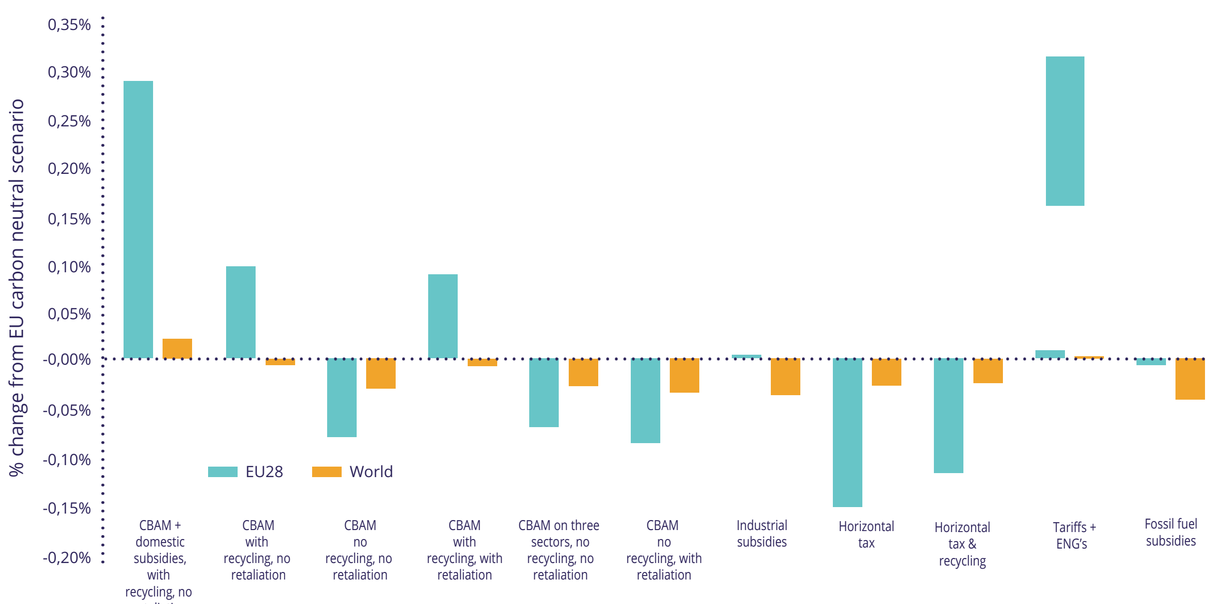


Figure 18: Performance of Individual Measures on Non-EU GHG Emissions.

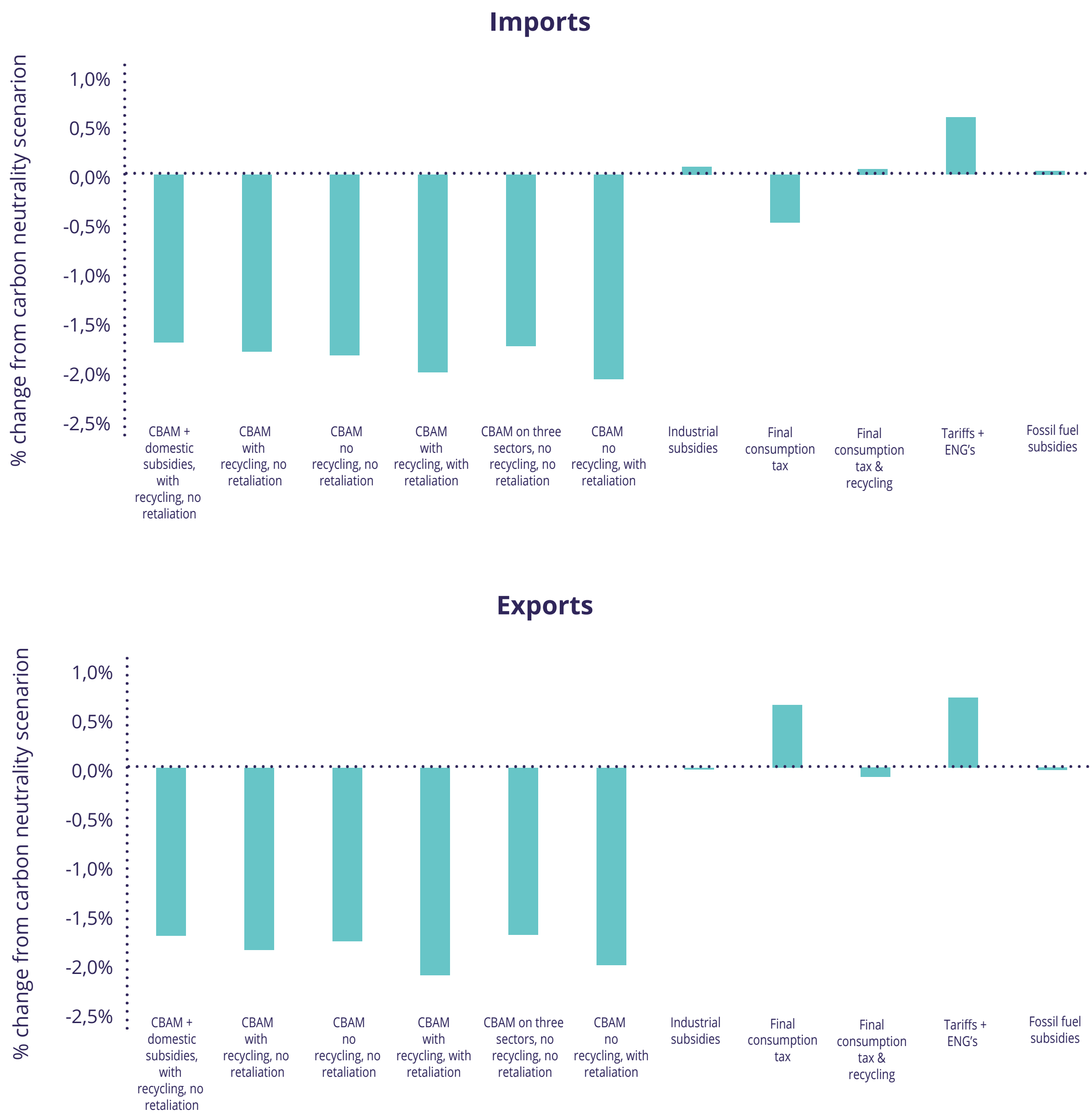
Source: GEM-E3

Figure 19: Performance of Individual Measures on GDP



Source: GEM-E3

Figure 20: Performance of policy measures on EU Imports & Exports



Source: GEM-E3

4.8 Policy Measure Combinations

Key Summary – Combined Scenarios

- Plausible combinations (COMBO scenarios) of the policy measures have been examined for their impacts on non-EU GHG emissions, production and employment.
- The best-performing combination projected by the model is the COMBO - CBAM & aii scenario where, in the context of a global concerted action fossil fuel subsidies are removed, tariffs on low carbon content goods are removed and industrial subsidies on energy intensives industries are reduced while the EU implements a CBAM.
- In the COMBO - CBAM & aii scenario, the model predicts non-GHG emission reductions to exceed EU reductions achieved under the EU Carbon Neutrality Scenario. The cumulative reductions over the 2025-2050 period are estimated to reach almost 7 gigatonnes of GHGs.
- The inclusion of anti-leakage measures in the combined scenarios appears significant in increasing their emissions reductions performance.

The EU's approach to meeting its GHG emissions reduction targets while safeguarding domestic production will rely on a combination of policy measures, both domestically as well as in concert with the EU's international partners. Building on the results from simulation of the individual instruments, the subsequent sections present a series of possible policy combinations that the EU might apply towards mitigating GHG emissions and carbon leakage.

All international trade disciplines (COMBO – all)

In this combined scenario it assumed that there is a global concerted action in reducing GHG emissions. This action is not driven by specific GHG emission reduction targets but rather with alignment of taxes with environmental concerns. To this end fossil fuel subsidies are removed, tariffs on low carbon content goods are removed and industrial subsidies on energy intensives industries are reduced. There is no specific anti-leakage measure considered in this scenario.

All international trade disciplines plus CBAM (COMBO - CBAM & all)

This scenario considers all options under the first combination, plus the addition of the CBAM by the EU as an anti-leakage measure

All international trade disciplines apart from reduction of fossil fuel subsidies plus CBAM (COMBO - CBAM & aii minus Reduction of Fossil Fuel Subsidies)

This scenario consists in an alternative mix of CBAM and international trade disciplines, combining CBAM with international agreements on preferential tariffs based on carbon content and for environmental goods and reduction of industrial subsidies but excluding the reduction of fossil fuel subsidies. This presumes that, at the international and WTO level, the ASCM reform and a possible relaunch of the plurilateral agreement on green goods could raise more support than the reduction on fossil fuel subsidies.

All international trade disciplines plus CBAM without Preferential Tariffs on Environmental Goods (COMBO – CBAM & aii without Carbon Content-modulated Preferential Tariffs + Environmental Goods List)

The fourth combination mixes CBAM with international agreements on reduction of industrial subsidies and the reduction of fossil fuel subsidies excluding this time the plurilateral agreement preferential tariffs based on carbon content and for environmental goods. This factors in a more realistic assessment that negotiation of such an agreement would be at odds with the EU's implementation of a CBAM. The performance of the combination remains strong and is a slight second to the previous mix across all indicators – the impact of removing the tariff preferences and environmental goods list is marginal.

All international trade disciplines plus Final Consumption Tax (COMBO – Final Consumption Tax & all)

Finally a fifth combination is considered which includes all international trade disciplines and the EU horizontal carbon tax as an anti-leakage measure. This combination improves on the performance of the first by reducing leakage by around 1,560 mega-tonnes of CO_2 over 25 years, however the impact on employment and GDP are both slightly negative.

As expected the combined effect on the different measures on leakage and economic activity is larger than the individual measures, however decreasing returns are presented in all combinations. For this reason the gains that result are not a linear addition of the individual scenarios. As early emissions reductions are achieved, further marginal reductions become more difficult to attain, therefore instruments when combined together will not have the same effects as when conducted individually. The figures below present the results on leakage, GDP and employment of the different combinations of measures.

The best performing combined policy scenario is the COMBO - CBAM & all scenario where, in the context of a global concerted action, fossil fuel subsidies are removed, tariffs on low carbon content goods are removed and industrial subsidies on energy intensives industries are reduced whereas the EU adopts a CBAM policy. In the COMBO - CBAM & all scenario the non -GHG emission reductions surpass by large the EU reductions achieved under its carbon neutrality scenario. The cumulative reductions over the 2025-2050 period reach almost 7 Gt GHG.

The socioeconomic implications of the combined scenarios that include CBAM as an anti-leakage measure are positive. In particular the average increase over the 2025-2050 period is 0.25 and 0.3%in employment and GDP, respectively, when compared to the EU Carbon Neutrality Scenario. From a sectoral point of view the performance of the scenarios is diversified and distributed across the different economic activities. This result is consistent with the design of the combined scenarios which includes policy options that perform in a complementary way.

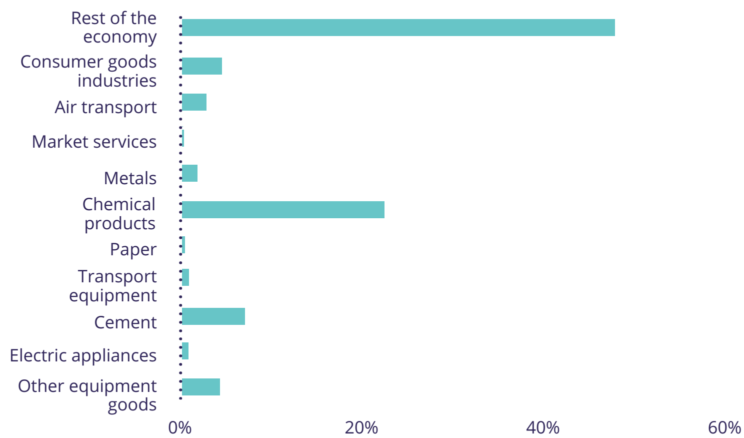
Table 18: Performance of Trade & Tax Policy Measures on Non-EU GHG Emissions, 2025-2050

	Cumulative (2025-2050) GHG Emissions Absolut Change (mt CO_2)		Cumulative (2025-2050) GHG Emissions % Change	
	From Baseline Scenari	From EU Carbon Neutrality Scenario	From Baseline Scenario	From EU Carbon Neutrality Scenario
EU Carbon Neutrality	1 911	0	0.15%	
COMBO - CBAM & all	-6 798	-8 708	-0.54%	-0.69%
COMBO - CBAM & all without Fossil fuel Subsidies	-6 085	-7 995	-0.48%	-0.63%
COMBO - CBAM & all without tariffs	-5 549	-7 460	-0.44%	-0.59%
COMBO - Final Consumption Tax & All	-3 379	-5 290	-0.27%	-0.42%
CBAM + Domestic Subsidies, With Recycling, No Retaliation	-3 108	-5 019	-0.25%	-0.40%
CBAM, With Recycling, No Retaliation	-2 909	-4 819	-0.23%	-0.38%
CBAM, No Recycling, No Retaliation	-2732	-4 642	-0.22%	-0.37%
CBAM on three sectors, No Recycling, No Retaliation	-2 588	-4 499	-0.20%	-0.35%
CBAM, With Recycling, With Retaliation	-2 418	-4 328	-0.19%	-0.34%
CBAM, No Recycling, With Retaliation	-2 242	-4 153	-0.18%	-0.33%
COMBO - All	-1 821	-3 731	-0.14%	-0.29%
Industrial Subsidies	172	-1 738	0.01%	-0.14%
Tariffs + ENG's	794	-1 117	0.06%	-0.09%
Final Consumption Tax	833	-1 077	0.07%	-0.08%
Final Consumption Tax & Recycling	932	-979	0.07%	-0.08%
Fossil Fuel Subsidies	1 250	-660	0.10%	-0.05%

Figure 21: Performance of Combined Policy Measures on Leakage, GDP and Employment

Figure 22: Sectoral performance of Policy Combinations

COMBO - Final consumption tax & all



	Carbon Border Adjustment Scenarios (CBAM)							External Instruments					Combined Policies			
	No Recycling, No Retaliation	No Recycling, With Retaliation	With Recycling, No Retaliation	With Recycling, With Retaliation	three sectors, No Recycling, No Retaliation	CBAM + Domestic Subsidies, With Recycling, No Retaliation	Final Consumption Tax	Final Consumption Tax & Recycling	Tariffs + ENG's	Fossil Fuel Subsidies	Industrial Subsidies	COMBO - CBAM & aii	COMBO - aii	COMBO - CBAM & aii without Fossil Fuel Subsidies	COMBO - CBAM & aii without tariffs	COMBO - Final Consumption Tax & aii
Change in GDP	-0.08%	-0.09%	0.10%	0.09%	-0.07%	0.29%	-0.15%	-0.12%	0.01%	0.00%	0.01%	0.33%	0.04%	0.32%	0.31%	-0.01%
Change in employment rate	-0.11%	-0.11%	0.07%	0.06%	-0.09%	0.19%	-0.27%	-0.26%	0.00%	-0.01%	0.00%	0.22%	0.03%	0.21%	0.20%	-0.10%
Change in Non-EU GHG (mt CO_2, 2025-2050)	-4 642	-4 153	-4 819	-4 328	-4 499	-5 019	-1 077	-979	-1 117	-660	-1 738	-8 708	-3 731	-7 995	-7 460	-5 290

4.9 Policy Measure Ranking Matrix

The evaluation of the performance of the policy options is not straightforward as they perform differently across different indicators. The figures below show which options are better placed in terms of their performance on two main criteria, emisisons leakage reduction and impact on GDP. Figure 23 presents the performance of indicators on reducing leakage and increasing economic activity. In the top right quadrant lay the best performing options in both indicators. For example, the option of removing industrial subsidies in China is beneficial for the EU both in terms of economic activity and reducing carbon leakage. The removal of fossil fuel subsidies is found to perform low both on economic activity and leakage.

In order to take into account the performance of instruments over a series of indicators a combination indicator with arbitrary[59] weights show in Table 19 has been constructed in order to rank the policy instruments through a multi-criteria approach. These weightings are allocated to reflect the following prioritization of criteria: (1) Equal Weighting; (2) Moderate Leakage Reduction; and (3) High Leakage Reduction.

Figure 23: Performance of Policy Measures on Leakage and Economy

59 Should be mentioned that this classification is subject to the subjective weighting across indicators.

Normalized Performance Matrix – All Trade & Tax Policy Measures

Weighting Distribution (1) : Equal Weighting					
Indicator	Employment	Welfare	Economy	Leakage	Rank
Equal weights =	0.25	0.25	0.25	0.25	
COMBO - CBAM & aii	16	16	16	16	1
COMBO - CBAM & aii without fossil fuel subsidies	15	14	15	15	2
COMBO - CBAM & aii without tariffs	14	15	14	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	13	12	13	12	4
CBAM, With Recycling, No Retaliation	12	9	12	11	5
CBAM, With Recycling, With Retaliation	11	8	11	8	6
COMBO - Aii	10	10	10	6	7
COMBO - Final Consumption & Aii	5	11	6	13	8
Industrial Subsidies	8	7	8	5	9
Tariffs + ENG's	9	5	9	4	10
CBAM on three sectors, No Recycling, No Retaliation	6	4	5	9	11
CBAM, No Recycling, No Retaliation	4	3	4	10	12
Fossil Fuel Subsidies	7	6	7	1	13
Final Consumption & Recycling	2	13	2	2	14
CBAM, No Recycling, With Retaliation	3	2	3	7	15
Final Consumption	1	1	1	3	16

Weighting Distribution (2) : Moderate Leakage Reduction					
Indicator	Employment	Welfare	Economy	Leakage	Rank
Weights =	0.2	0.2	0.2	0.4	
COMBO - CBAM & aii	16	16	16	16	1
COMBO - CBAM & aii without fossil fuel subsidies	15	14	15	15	2
COMBO - CBAM & aii without tariffs	14	15	14	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	13	12	13	12	4
CBAM, With Recycling, No Retaliation	12	9	12	11	5
COMBO - Final Consumption & Aii	5	11	6	13	6
CBAM, With Recycling, With Retaliation	11	8	11	8	7
COMBO - Aii	10	10	10	6	8
CBAM on three sectors, No Recycling, No Retaliation	6	4	5	9	9
Industrial Subsidies	8	7	8	5	9
CBAM, No Recycling, No Retaliation	4	3	4	10	11
Tariffs + ENG's	9	5	9	4	12
Fossil Fuel Subsidies	7	6	7	1	13
CBAM, No Recycling, With Retaliation	3	2	3	7	14
Final Consumption & Recycling	2	13	2	2	15
Final Consumption	1	1	1	3	16

Weighting Distribution (3) : High Leakage Reduction					
Indicator	Employment	Welfare	Economy	Leakage	Rank
Weights =	0.2	0.2	0.1	0.5	
COMBO - CBAM & aii	16	16	16	16	1
COMBO - CBAM & aii without fossil fuel subsidies	15	14	15	15	2
COMBO - CBAM & aii without tariffs	14	15	14	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	13	12	13	12	4
CBAM, With Recycling, No Retaliation	12	9	12	11	5
COMBO - Final Consumption & Aii	5	11	6	13	6
CBAM, With Recycling, With Retaliation	11	8	11	8	7
COMBO - Aii	10	10	10	6	8
CBAM on three sectors, No Recycling, No Retaliation	6	4	5	9	9
CBAM, No Recycling, No Retaliation	4	3	4	10	10
Industrial Subsidies	8	7	8	5	11
Tariffs + ENG's	9	5	9	4	12
CBAM, No Recycling, With Retaliation	3	2	3	7	13
Final Consumption & Recycling	2	13	2	2	14
Fossil Fuel Subsidies	7	6	7	1	15
Final Consumption	1	1	1	3	16

Notably, as the weighting for leakage performance increases, some key adjustments to the ranking are observed. CBAM variants which include unfavorable combinations of recycling and retaliation move up in the rankings as the weighting for climate and carbon leakage considerations is increased. Conversely, measures such as the Carbon Content-modulated preferential tariffs & Zero Duties on Environmental Goods, and Reduction of Fossil Fuels fare poorly as this weighting is increased. Ranking of the policy combinations remains consistent even as weighting for carbon leakage is increased and weighting of economic performance is decreased.

While the Matrix does not include a measure for the expected political feasibility and compatibility with international trade rules for each policy instrument, these considerations are factored into the assessment through qualitative analysis.

4.9.1 Qualitative Assessment of Instruments' EU and International Feasibility

4.9.1.1 Carbon Border Adjustment Mechanism

Feasibility at EU and international level. On the EU level, French President Emmanuel Macron has championed a CBAM, while Germany and business groups were initially reluctant to back a CBAM, fearing it could trigger a trade war. EU industry associations such as BusinessEurope have since warmed to at least looking into the idea, spurred by China's continued exports of dumped steel to Europe and announcements that the US will withdraw from the Paris Agreement[60]. The European Green Deal will boost the momentum for a CBAM. The EU is currently conducting a feasibility study that was supposed to be ready by early 2021 and plans to present a proposal by 2021. As CBAMs are seen by the EU as a last resort, decisions on a CBAM are proba-

60 EurActiv (2019): BusinessEurope Warms to Macron's EU Carbon Tariff Idea. Availalabe at: https://www.euractiv.com/section/emissions-trading-scheme/news/businesseurope-warms-to-macrons-eu-carbon-tariff-idea/.

bly linked to the commitment by other countries to the Paris Agreement. More clarity on that commitment was expected to come out of COP26 in Glasgow in November, but with that event being postponed it would make sense that the decision-making process on CBAMs is also delayed.

Little clarity exists regarding the compatibility of CBAMs with WTO obligations. On the one hand, it is because they have never been tested in a WTO dispute. On the other hand, it is due to the special nature of the measures, which belong to the category of non-product related process and production methods (npr-PPMs) which cannot be traced in the final product. CBAMs are measures with an extraterritorial reach, as they interfere with other countries' jurisdiction to regulate environmental matters and the use of technologies. While the use of npr-PPMs remains a politically sensitive issue, a more tolerable approach to npr-PPMs is emerging in the judicial field. It seems that WTO case law is moving towards the position that admits that npr-PPMs are not illegal so long as they apply on a non-discriminatory basis[61]. In case if they are found to discriminate against imports, they may still be justified under the exceptions provided in GATT Article XX for measures taken with moral, health, environmental and other public policy objectives[62].

Retaliations. US lawmakers in particular are concerned about the introduction of CBAMs by the EU. Unless there is some traction, especially with China and some other major EU trading partners, it would be hard to pull off CBAMs by the EU itself. The outcome of the US elections in November 2019 will also play a big role in the US' reaction. A Democratic administration would open up ways to a transatlantic CBAM. Biden's campaign climate plan commits to a US CBAM. Likewise, China opposes a CBAM as an act of unilateralism and protectionism.

4.9.1.2 EU Domestic Subsidies in Support of Low-carbon Technologies

Feasibility at EU and international level. The types of subsidies envisaged under this scenario are directed towards the EU's energy system, namely in the form of reducing the cost of research and development in energy efficiency technologies. This leads to an accelerated pace of decarbonisation in the EU's energy system, leading to lower GHG emissions from domestic production.

Distribution of subsidies within the EU falls under the competence of the Member States, however they must comply with EU-wide state aid and competition rules. Specifically under this scenario, EU Member States would not only need to agree to implement a CBAM – in order to finance the domestic subsidies – but they need to agree to allocate those revenues nationally to research and development subsidies and energy efficiency improvements.

The challenge for such a policy in the EU would more likely lie in the details rather than the spirit. While Member States would likely agree in principle to fund domestic research and development and other public subsidies for energy efficiency, they may not all agree to the specific allocation of CBAM revenues and priorities are likely to change during the period between 2025 and 2050 – particularly as additional marginal improvements become more costly as time goes on.

While the subsidies as conceived in the model are not in breach of WTO rules, their cross-cut-

61 K Holzer (2014) Carbon-related border adjustment and WTO law, at 96-98. See also N Bernasconi -Osterwalder et al. (2006) Environment and Trade: A Guide to WTO Jurisprudence (London: Earthscan) at 205-218.
62 World Trade Institute (2016): WTO Law Issues of Emissions Trading. Available at: https://www.wti.org/media/filer_public/6e/88/6e884b29-f5e2-4a25-85a6-a6edb5c25ed9/working_paper_short_version.pdf.

ting nature, potential variation across Member States, and inevitable involvement in indirectly shaping key export sectors means that the possibility that such subsidies may be caught up in other WTO disputes cannot be excluded.

Further detail on the compatibility of green subsidies with WTO rules can be found in Annex.

4.9.1.3 EU-wide Final Consumption Tax on Carbon Content

Feasibility at EU and international level. The EU has considered the prospect of an economy-wide carbon tax before. During the 1990s, an EU-wide carbon tax was proposed but ultimately failed to be approved. Instead, a patchwork has emerged with some Member States taxing domestic carbon alongside the EU ETS arrangement.

As passage of EU-wide legislation on a horizontal carbon tax would require unanimity among Member States, the threshold for successfully implementing the policy is high. In the past, opposition to an EU-wide carbon tax was attributed in large-part to reticence by the UK. At the same time, the urgency of addressing climate change was less widely acknowledged in early 1990s, when the EU carbon tax was previously proposed. While the barrier remains high there are likely better prospects for passage of such an initiative in the current political landscape.

An EU-wide carbon tax would introduce additional pressure on the EU's long term socioeconomic development. In particular, a carbon tax would have a regressive effect on lower income citizens. The formulation of a successful proposal on this would need to address these concerns in order to have a reasonable prospect of success.

4.9.1.4 Carbon Content-modulated Tariff Erosion and Environmental Goods List

Feasibility at EU and international level. The EU has always been a strong supporter of negotiations on environmental goods and services (EGS) and an Environmental Goods Agreement (EGA). It is also in favour of a wide-ranging agreement that covers environmental goods as well as services[63]. Regarding the compatibility with WTO rules, a plurilateral EGA agreement would need to be implemented on a most-favored nation (MFN) basis. This means that the benefits would extend to all WTO members. In order to avoid free riders, a critical mass would be needed in terms of countries that commit to the agreement (covering 80-90% of trade in EGS).

Cooperation: The challenge for an EGA is to engage developing countries. Developed countries already have low tariffs on EGS. In addition, a wide-reaching EGA is necessary that covers not just tariffs but also non-tariff barriers (NTBs) and services.

If in addition to liberalization of EGS there would be a calculation of tariffs according to carbon footprint with a system of preferential tariffs on goods that do not exceed a certain carbon footprint, then this would be a barrier to developing country participation as those countries have less capacity to comply with such an agreement. Also, such a system could be seen as unworkable (e.g. for customs reasons) and as protectionism against developing countries in particular as they usually export goods with a higher carbon footprint. Even for the EU it would be challenging to set a threshold according to EU ETS benchmarks (which would be calculated to reflect the best available technology in terms of lowest carbon intensity across countries – which

__63__ European Commission (2015): The Environmental Goods Agreement (EGA): Liberalising Trade in Environmental Goods and Services. Available at: http://trade.ec.europa.eu/doclib/press/index.cfm?id=1116.

is a moving target and unpredictable). This would only be workable for a limited set of products.

4.9.1.5 Agreement on Industrial Subsidies

Feasibility at EU and international level. In the EU, the question now is how much progress we can make on subsidies any time soon. The COVID-19 stimulus and bailout packages are a subsidy fest and all countries are 'guilty' of breaking EU and WTO rules at the moment because we are in an economic emergency situation. The pandemic would lead to under-production and demand in the short to medium term, which countries will try to address through subsidies. In the longer term, budget cuts will require a re-thinking of industrial subsidies.

Cooperation: As indicated above, based on the January 2020 trilateral statement from the EU, US and Japan[64], it is envisaged that this policy would seek to expand the scope of prohibited subsidies under the WTO (in terms of Article 3.1 of the ASCM), strengthen reporting requirements on subsidies by members (Art. 25) and reverse the burden of proof. In particular, the policy would seek to identify the following types of subsidies as unconditionally prohibited: (i) unlimited guarantees, (ii) subsidies to an insolvent or ailing enterprise in the absence of a credible restructuring plan; (iii) subsidies to enterprises unable to obtain long-term financing or investment from independent commercial sources operating in sectors or industries in overcapacity; and (iv) certain direct forgiveness of debt. In the post-COVID-19 world, it will be particularly difficult to address these types of subsidies.

The trilateral format (EU, US, Japan) is promising. Eventually the success of this approach will depend on engagement with China (especially in terms of transparency regarding subsidies). Before taking the proposals to the multilateral level with all WTO members, the EU, US, and Japan were planning to discuss the joint statement with around 10 or 15 countries that have expressed their interest over the past two years and with China.

4.9.1.6 Agreement on Fossil Fuel Subsidies

Feasibility at EU and international level. Both the European Green Deal plus the pandemic and its pressure on public finances may increase the momentum for fossil fuel subsidy reform. Poland has the highest fossil fuel subsidies (mainly for coal) in the EU. However, coal production in Poland has been declining for decades.

Cooperation: According to the IMF, globally, fossil fuel subsidies were $5.2 trillion (6.5 percent of GDP) in 2017. The largest subsidizers in 2015 were China ($1.4 trillion), United States ($649 billion), Russia ($551 billion), European Union ($289 billion), and India ($209 billion). Most of these subsidies are taxes foregone. The amounts of direct subsidies are more in the range of $400 billion. Efficient fossil fuel pricing (in 2015) would have lowered global carbon emissions by 28 percent and fossil fuel air pollution deaths by 46 percent, and increased government revenue by 3.8 percent of GDP. With the G20 being active again as a result of COVID-19, there would be the opportunity to bring up fossil fuel subsidies there again soon as several commitments on removal of those subsidies have been made in the G20 over the past few years.

64 European Commission, Japanese Ministry of Economy, United States Trade Representative (2020): Joint Statement of the Trilateral Meeting of the Trade Ministers of Japan, the United States and the European Union. Available at: https://trade.ec.europa.eu/doclib/docs/2020/january/tradoc_158567.pdf.

65 In the Friends group are Costa Rica, Denmark, Ethiopia, Finland, New Zealand, Norway, Sweden, Switzerland and Uruguay. More info at http://fffsr.org/.

A group of WTO members called 'Friends of Fossil Fuel Subsidy Reform'[65] have been pushing for starting negotiations in the WTO on eliminating fossil fuels subsidies for a decade now.

Subsidy disciplines in the WTO

The WTO has a system of disciplines for agricultural subsidies, upon which a regime for reduction of fossil fuel subsides could easily be modelled. In addition, the WTO is currently in the process of finalizing negotiations on the reduction of harmful fisheries subsidies, which also provide a model for negotiation and eventual agreement on a mechanism to reduce fossil fuel subsidies.

The WTO already has a set of rules for disciplining subsidies generally, including the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement). However, this agreement was designed to address subsidies based on their trade-distorting effects, and is not well suited to fossil fuel subsidies, which may be environmentally (and health-wise) harmful even when they do not cause injury to another member's domestic industry – a required condition for subsidies to be deemed actionable and thus subject to challenge.

Furthermore, fossil fuel subsidies may not be sufficiently specifically targeted at a particular industry, or group of industries, to meet the requirement for "specificity" that is a prerequisite for action against them (also see the section below on domestic subsidies for low-carbon technologies). Perhaps most importantly, the very definition of "subsidy" in the WTO excludes failure to charge firms for the "social costs of carbon" – which arise from the adverse environmental and health effects of carbon and other harmful emissions.

Table 20: Qualitative Feasibility Matrix of Policy Instruments

	Political & Legal Feasibility – EU	Political & Legal Feasibility – Int'l	Technical Sensitivity	Summary	Outlook
Carbon Border Adjustment Mechanism	• Political momentum due to the European Green Deal • Hesitation among some member states fearing initiation of a trade war • Analysis of possible configurations which would either consist of a financial (tax-based) instrument or otherwise a requirement for the purchasing of EU ETS allowances by importers	• WTO compatibility remains unclear as (i) the measure has never been subject to a WTO dispute and (ii) special nature of the tool • Indication that tool might be compatible as long as npr-PPMs are applied on a non-discriminatory basis	• Protection of domestic market according to carbon content • Effects from ETS revenues recycling • Global coverage • No protection in international	High degree of feasibility for a CBAM in the EU. Different variants exist depending on possible political obstacles – for example, as a tax-based measure, unanimity required between Member States, however CBAM could alternatively operate as an ETS extension or mirror with similar characteristics to the modelled results. Whether WTO sanctioned or not, retaliation is foreseen as a possibility and is included in the modelling.	Feasible depending on design (to comply with WTO rules) Relatively least controversial, however retaliation remains a risk
EU-wide Subsidies in Support of Low-carbon Technology	• Political momentum, particularly in the context of large-scale government interventions due to Covid-19 pandemic, to subsidise investments in low-carbon technologies • Revenues are raised through EU CBAM and EU ETS, with the assumption that EU MS then distribute subsidies through national programs that are compatible.	• Legal basis: WTO Agreement on Subsidies and Countervailing Measures (SCM) •A legal space for certain kinds of subsidies exists, particularly those oriented towards public R&D spending and renewable energy procurement. This corresponds with the allocation of the subsidies in the model, however, does not preclude that the subsidies would not be challenged. The measure is however not targeted to any specific producer or sector and would likely withstand such challenges.	• Reduce production costs in the EU indirectly through recycling of CBAM and ETS revenues towards research and development in energy system transition • Impact on both domestic and international markets	The implementation of this policy is dependent on several factors. First, to finance the subsidies, it requires the CBAM to be implemented. It then requires EU MS not only to agree to apply CBAM revenues towards subsidies for Low-carbon technologies, but do so on a national basis that is consistent with EU state aid rules as well as ensuring that they remain within the scope of permitted subsidies under the WTO ASCM.	Relatively less controversial; need to clarify funding and ensure compliance with EU state aid rules and WTO subsidy rules
EU-wide Horizontal Tax on Carbon Content	• Tax-based instrument to require unanimity between EU Member States for adoption • Final consumption charge with redistribution of revenues to house-holds and firms for low-carbon energy uptake	• Domestic tax applied equally to EU-produced as well as non-originating goods, however requires to determine the carbon content of non-originating goods	• Split of domestic and imported final goods consumed by EU house-holds, where carbon content is applied to goods based on EU ETS and tax paid to national governments	While the measure is effective in reducing carbon leakage in the EU, it is also one of the few policy instruments modelled that leads to negative outcomes in terms of socio-economic indicators. Although the measure is objective and directly linked to carbon content of final products, it would require MS to unanimously adopt despite the negative expected impact over the long-term on GDP and employment in the EU.	Relatively less controversial; consider socio-economic impacts

	Political & Legal Feasibility – EU	Political & Legal Feasibility – Int'l	Technical Sensitivity	Summary	Outlook
Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods List	• Question is more about acceptability by FTA partners if future FTAs negotiated with third countries are to include this measure • Potential for limited sectoral opposition for sectors that rely on tariffs for production in the EU	• Acceptance depends on bargaining power of the trading partners • Legal reference: WTO Agreement on Rules of Origin • PTAs give a lot of leeway to negotiating partners of what to include	• Protection of domestic market according to existing tariff rates • Fiscal effect incompa-rable to ETS revenues • Regional coverage	Relative to the other instruments, the potential for consensus among the negotiating partners is fairly good – in part due to the relatively limited impact of the agreement. As observed through EGA negotiations in the past, interests in the principle of an agreement reached a good level, however negotiations and agreement on a final list proved to be the barrier to finalisation.	Potentially least controversial; requires acceptance from PTA partners
Plurilateral Agreement on the Reduction of Industrial Subsidies	• Currently high momentum for subsidies for economic stimuli however questionable in the long-run	• Trilateral statement (EU, US, Japan) indicates an expansion of the scope of prohibited subsidies • Success depends on engagement with China, but also on coalition with other like-minded countries	• Limited countries under investigation • Recycling effects	EU has already expressed leadership on the issue along with Japan and the US, however achieving a revision of existing multi-lateral rules would require to reach an agreement with China and other significant users of industrial subsidies. The measure is not explicitly tied to environmental objectives and is therefore likely to be more difficult to advance in negotiations.	Relatively less controversial; requires agreement with China
Plurilateral Agreement on the Reduction of Fossil Fuel Subsidies	• High political momentum for green transition due to economic slow-down and the European Green Deal • Fossil fuel subsidies likely to remain in EU in the medium-term, albeit in more moderate forms	• G20 committed to remove Fossil Fuel subsidies in the past, economic slow-down offers political momentum • Could be integrated within current WTO regulations		Net impact on global economy is marginally negative, with losses concentrated in energy producer countries. Given the scale and diversity of existing fossil fuel subsidies is it unlikely that an agreement would succeed in eliminating them, however some subsidies could be restructured. As expected to take place in the EU, fossil fuel subsidies will likely persist however moving to less carbon-intensive applications over time.	Relatively least controversial; restructure subsidies through G20 and WTO

5

Conclusions and Recommendations

Conclusions and Recommendations

Quantifying the interactions of the multiple economic agents across different countries, sectors and points in time is a highly complex undertaking that endeavors to account for different production structures, consumer behaviors, value chains, trade dependencies, technology dynamics, climate and energy policies, and agents' responses. In this study, a large-scale, multi-region, multi-sector, dynamic computable general equilibrium model – the GEM-E3 – has been used to calculate what would be the carbon leakage in a scenario where the EU undertakes unilateral action to drastically reduce its EU GHG emissions, while non-EU countries stick to their 2030 NDCs and do not further increase their abatement efforts thereafter. Six unique trade- and tax-related policy measures, and five policy combinations are further evaluated for their estimated impact on trade, economy, employment, and carbon leakage.

When the EU achieves 55% and 90% GHG emissions reduction in 2030 and 2050, respectively, the **cumulative additional** carbon leakage between **2025 and 2050 compared with carbon leakage resulting from the baseline scenario is estimated to be 14% carbon leakage between 2020 and 2050 is estimated to be 14%**. In the model the GHG emission reduction targets are achieved through carbon pricing. **The EU carbon prices required to achieve these targets are €56 ($74) and €444 ($590) per tonne of CO_2**. These prices increase the production costs of energy and carbon intensive industries in the EU with direct impact on their competitiveness.

All measures evaluated in this study achieved a reduction in carbon leakage and in many cases achieved GHG emissions reductions in non–EU countries greater than the initial carbon leakage. Each measure performs differently both in terms of reducing non-EU GHG emissions, but also on the EU economic growth and employment.

The results suggest that a CBAM that includes recycling of revenues would be the single most effective policy for the EU to pursue, with the economic gains from this projected to increase significantly when complemented by a domestic subsidy programme funded by ETS revenues. The study finds that the manner in which these revenues are used is highly important, with results suggesting that this may serve as the difference between whether such policies are beneficial or detrimental to economic outcomes within the EU.

From a sectoral point of view, the optimal selection of policy measures vary. In terms of performance, the **CBAM is better suited to upstream sectors, whereas downstream sectors benefit more from the Final Consumption Tax Scenario. Sectors that are greatly dependent on imports of taxed basic materials benefit most under the Carbon Content-modulated Tariffs & Zero Duties on Environmental Goods scenario**.

Ranking of policy instruments applied to the sectoral level yields revealing patterns in this regard:

- Despite low performance in overall rankings, the **Final Consumption Tax** and policy combinations including it perform among the leading options for a number of specific sectors, including Refineries, Electronics, Air Transport, and Consumer Goods.
- Likewise, despite poor performance in overall rankings the **Reduction of Fossil Fuel Subsidies** is nonetheless a leading candidate in terms of impact across production, employment, and carbon leakage indicators for the Consumer Goods, Market Services, Electronics, Transport Equipment, Electrical Equipment, and Other Equipment categories.
- The **CBAM** and policy combinations wherein the CBAM is the primary anti-leakage measure is a leading performer across main indiactors for the Refineries, Ferrous Metals, Chemicals, Paper, Minerals, and Air Transport sectors.

The study finds, however, that **the best approach for the EU would be to pursue multiple policies in order to maximise potential gains to employment and GDP and to minimise carbon leakage**. To this end, a CBAM pursued in conjunction with international agreements (particularly plurilateral agreements that reduce industrial and fossil fuel subsidies) is **found to expand notably on the results of a CBAM**. Though the Reduction of Fossil Fuel subsidies is projected to lead to significant gains for some EU sectors, the modelling finds that even a combination of an EU CBAM with international agreements on preferential tariffs and a reduction of industrial subsidies is one of the most optimal mixes across-the-board.

These results highlight that while a CBAM can be effective, careful consideration should be given to its ultimate design – with emphasis placed on how the funds are used and on ensuring WTO compliance through non-discrimination so as to limit retaliation from trading partners, though the study finds that that the incidence of retaliation does not drastically reduce the effectiveness of the instrument. The political considerations in constructing a CBAM and agreeing to reallocation of derived revenues are not insignificant, as different variations require varying levels of agreement and commitment between EU Member States. While international agreements with key partners are also likely to be effective, it remains important to consider that any gains derived from such approaches may be limited and restricted by the lack of buy-in from partners.

On a broader level, three out of the six trade and tax related policy measures considered have a crucial extra-EU dimension, where cooperation and action on the part of the EU's international partners will be needed. Given the challenges inherent to achieving a greater alignment between the EU's climate goals and those of its trading partners, one pathway to improving cooperation in this field could **focus on smaller-scale agreements as confidence-building measures towards more ambitious GHG emissions reductions**.

An EU strategy which prioritizes the conclusion of an EGA-type agreement, revitalizing the negotiating framework from previous rounds, would have good political prospects for success while laying the foundation for more intensive negotiations and agreement on additional disciplines, including carbon-content modulated tariff preferences, reduction of fossil fuel subsidies, and ultimately revised rules on industrial subsidies. Such an agreement would reaffirm the **willingness of the EU to work with partners on addressing trade-related climate externalities. Given the limited additional benefits**

observed from the modelling of the reduction of fossil fuels, both individually and as a combined instrument, this strategy could be further optimized by honing in on a combination of an EU CBAM along with international agreements on preferential tariffs for environmental goods and the reduction of industrial subsidies. Pursuing a mix that includes the reduction of fossil fuel subsidies would likely entail challenging negotiations, both internationally but also within the EU to reach a common negotiating mandate given the ubiquity but also diversity in these kinds of subsidies, without clear estimated gains for GDP, employment, or leakage reduction if successful in reaching such an agreement.

From the perspective of reducing carbon leakage, **an agreement on the reduction of industrial subsidies remains the best performing individual instrument outside of the unilateral CBAM**. Existing cooperation between the EU, US, and Japan is promising in this regard. At the same time, the study finds that the impact of industrial subsidies on climate in the case of China is significant. In the context of heightened domestic commitments on the part of China, as well as other countries implicitly targeted by the measure, part of the difficulty in reaching an agreement on reform of the ASCM or another avenue of industrial subsidies reduction could be overcome in reframing as an environmentally-oriented, resource efficiency measure.

The EU is poised to lead international efforts to address climate externalities linked to trade, with continued momentum depending crucially on intra-EU cooperation and the ability to convinence international partners to align their emissions mitigations, or be compelled to do so through innovative new trade and tax related measures.

6

Annexes

Contents

1. Technical Fiches by Sector

Key Summary - Ferrous Metals

- In terms of production and employment the best performing option for the Ferrous Metals industry is the reduction of fossil fuel and industrial subsidies in China together with reduction on tariffs and application of a CBAM.
- All variants of the CBAM instrument are the best performing options by far for the sector as they completely level out any competitiveness loss of the sector.
- The impact of CBAM on the costs of intermediate inputs in producing metals is small hence there are no significant indirect cost increases.
- The performance of the different CBAM variants is comparable with the best option being the CBAM with full recycling of ETS and CBAM revenues.
- The imposition of the consumption tax has small but positive implications on metals (very small impact on leakage though as the private consumption elasticities are much lower than the firm's elasticities).
- Removal of fossil fuel subsidies benefit the sector as EU subsidies on production are already low in the baseline whereas the non -EU are higher hence the change in comparative costs is in the favour of EU.

Policy Ranking Matrix – Ferrous Metals

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
COMBO - CBAM & all	15	11	15	1
CBAM + Domestic Subsidies, With Recycling, No Retaliation	13	15	13	2
CBAM, With Recycling, No Retaliation	12	14	12	3
COMBO - CBAM & all without tariffs	14	8	14	4
CBAM on three sectors, No Recycling, No Retaliation	11	13	11	5
CBAM, No Recycling, No Retaliation	10	12	10	6
CBAM, With Recycling, With Retaliation	9	10	9	7
CBAM, No Recycling, With Retaliation	8	9	8	8
COMBO - Final Consumption Tax & All	7	6	7	9
Final Consumption Tax	5	7	5	10
COMBO - All	6	2	6	11
Final Consumption Tax & Recycling	4	5	4	12
Tariffs + ENG's	3	4	3	13
Fossil Fuel Subsidies	2	3	2	14
Industrial Subsidies	1	1	1	15

Ferrous Metals (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No	Instrument		Production	Emissions	Employment
1	CBAM				
1.1		*No Recycling, No Retaliation*	11.00%	-1.68%	11.04%
1.2		*With Recycling, No Retaliation*	11.19%	-1.71%	11.16%
1.3		*With Recycling, With Retaliation*	10.33%	-1.61%	10.27%
1.4		*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	11.08%	-1.70%	11.11%
1.5		*No Recycling, With Retaliation*	10.13%	-1.59%	10.14%
1.6		*ETS Recycling, CBAM Recycling, No Retaliation*	11.46%	-1.75%	11.38%
2	Industrial Subsidies		0.18%	0.19%	0.17%
3	Final Consumption Tax				
3.1		*No Recycling*	1.91%	-0.17%	1.41%
3.2		*Recycling*	1.40%	-0.12%	0.92%
4	Tariffs + ENG's		1.01%	-0.07%	0.84%
5	Fossil Fuel Subsidies		0.57%	-0.01%	0.56%

Ferrous Metals (EU27+UK)		(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.51%	2.88%	13.22%	22.44%
1.2	*With Recycling, No Retaliation*	0.54%	2.97%	13.44%	22.70%
1.3	*With Recycling, With Retaliation*	0.41%	2.39%	12.26%	21.84%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.52%	2.90%	13.30%	22.61%
1.5	*No Recycling, With Retaliation*	0.38%	2.29%	12.02%	21.57%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.60%	3.09%	13.81%	23.16%
2	Industrial Subsidies	0.10%	0.13%	0.19%	0.25%
3	Final Consumption Tax				
3.1	*No Recycling*	0.64%	2.10%	2.76%	-0.79%
3.2	*Recycling*	0.62%	1.95%	2.19%	-1.81%
4	Tariffs + ENG's	0.67%	1.02%	0.93%	1.13%
5	Fossil Fuel Subsidies	0.32%	0.38%	0.59%	0.93%

Ferrous Metals (EU27+UK)		(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.13%	-0.63%	-2.08%	-2.81%
1.2	*With Recycling, No Retaliation*	-0.13%	-0.64%	-2.11%	-2.85%
1.3	*With Recycling, With Retaliation*	-0.12%	-0.58%	-1.99%	-2.75%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.13%	-0.63%	-2.10%	-2.84%
1.5	*No Recycling, With Retaliation*	-0.11%	-0.56%	-1.96%	-2.70%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.14%	-0.65%	-2.16%	-2.93%
2	Industrial Subsidies	0.17%	0.14%	0.19%	0.23%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.06%	-0.17%	-0.24%	0.02%
3.2	*Recycling*	-0.06%	-0.15%	-0.18%	0.13%
4	Tariffs + ENG's	-0.22%	-0.08%	-0.05%	-0.04%
5	Fossil Fuel Subsidies	-0.43%	-0.33%	-0.01%	0.56%

Ferrous Metals (EU27+UK)		(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.55%	3.06%	13.96%	23.73%
1.2	*With Recycling, No Retaliation*	0.56%	3.12%	14.10%	23.83%
1.3	*With Recycling, With Retaliation*	0.42%	2.49%	12.87%	22.93%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.55%	3.08%	14.05%	23.90%
1.5	*No Recycling, With Retaliation*	0.40%	2.42%	12.71%	22.80%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.61%	3.24%	14.43%	24.20%
2	Industrial Subsidies	0.10%	0.13%	0.19%	0.25%
3	Final Consumption Tax				
3.1	*No Recycling*	0.58%	1.98%	2.02%	-1.69%
3.2	*Recycling*	0.55%	1.82%	1.43%	-2.70%
4	Tariffs + ENG's	0.47%	0.80%	0.81%	1.01%
5	Fossil Fuel Subsidies	0.31%	0.38%	0.59%	0.94%

Key Summary – Non-Ferrous Metals

- The best performing option is the removal of tariffs followed by combined policy scenario where consumption tax is used as an instrument to reduce carbon leakage. A key reason for this ranking is that aluminium production in the EU is largely dependent on imports of basic materials (84% of bauxite and 25% copper ore and concentrations are imported) and on secondary processed products. Hence the removal of the tariffs on imports reduce production costs and facilitate the EU production.
- The Final Consumption Tax scenario, both individually as well as a combined instrument with international trade agreements, suggests small but positive effects on production and employment, while contributing to emissions leakage reduction. Inclusion of recycling in the Final Consumption Tax variant however reverses the positive impact on employment and leads to a minor reduction in comparison with the Carbon Neutrality Scenario.
- The CBAM measure has a negative impact on the sector as it increases indirectly the production costs of the sector. However, the inclusion of international agreements on the reduction of fossil fuel subsidies, industrial subsidies, and preferential tariffs for environmental goods are effective in mitigating the negative impact of the CBAM, as this combination performs fifth overall – largely buoyed by the performance of the Carbon Content-modulated Preferential Tariffs & Zero Duties on Environmental Goods scenario.

Policy Ranking Matrix – Non-Ferrous Metals

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
Tariffs + ENG's	13	15	12	1
COMBO - Final Consumption Tax & All	15	5	15	2
Final Consumption Tax	10	14	9	3
COMBO - All	14	2	14	4
COMBO - CBAM & all	12	4	13	5
Final Consumption Tax & Recycling	9	12	7	6
Industrial Subsidies	11	3	11	7
CBAM on three sectors, No Recycling, No Retaliation	6	9	6	8
Fossil Fuel Subsidies	7	6	8	8
COMBO - CBAM & all without tariffs	8	1	10	10
CBAM, No Recycling, No Retaliation	5	8	5	11
CBAM + Domestic Subsidies, With Recycling, No Retaliation	2	13	2	12
CBAM, With Recycling, No Retaliation	3	11	3	13
CBAM, No Recycling, With Retaliation	4	7	4	14
CBAM, With Recycling, With Retaliation	1	10	1	15

Non-ferrous Metals (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No		Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-1.60%	0.14%	-0.67%
	1.2	*With Recycling, No Retaliation*	-1.90%	0.05%	-1.04%
	1.3	*With Recycling, With Retaliation*	-2.11%	0.12%	-1.24%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-1.52%	0.13%	-0.58%
	1.5	*No Recycling, With Retaliation*	-1.82%	0.22%	-0.88%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-1.99%	-0.07%	-1.17%
2		Industrial Subsidies	2.06%	0.63%	2.07%
3		Final Consumption Tax			
	3.1	*No Recycling*	1.17%	-0.15%	0.69%
	3.2	*Recycling*	0.38%	-0.02%	-0.09%
4		Tariffs + ENG's	3.79%	-0.24%	3.59%
5		Fossil Fuel Subsidies	0.05%	0.27%	0.10%

	Non-ferrous Metals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.09%	-0.54%	-2.14%	-2.83%
1.2	*With Recycling, No Retaliation*	-0.20%	-0.72%	-2.48%	-3.36%
1.3	*With Recycling, With Retaliation*	-0.22%	-0.78%	-2.75%	-3.78%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.09%	-0.52%	-2.04%	-2.64%
1.5	*No Recycling, With Retaliation*	-0.11%	-0.61%	-2.42%	-3.27%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.20%	-0.71%	-2.53%	-3.51%
2	Industrial Subsidies	1.84%	1.97%	2.13%	2.10%
3	Final Consumption Tax				
3.1	*No Recycling*	0.82%	1.10%	1.32%	0.11%
3.2	*Recycling*	0.77%	0.85%	0.42%	-1.49%
4	Tariffs + ENG's	2.96%	3.39%	4.23%	5.40%
5	Fossil Fuel Subsidies	0.03%	0.05%	0.06%	0.03%

	Non-ferrous Metals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.01%	0.05%	0.18%	0.21%
1.2	*With Recycling, No Retaliation*	-0.03%	0.00%	0.09%	0.03%
1.3	*With Recycling, With Retaliation*	-0.03%	0.00%	0.14%	0.24%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.01%	0.05%	0.17%	0.18%
1.5	*No Recycling, With Retaliation*	0.01%	0.05%	0.23%	0.41%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.03%	-0.01%	-0.04%	-0.21%
2	Industrial Subsidies	0.18%	0.40%	0.69%	0.87%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.08%	0.00%	-0.14%	-0.24%
3.2	*Recycling*	-0.07%	0.05%	0.00%	-0.02%
4	Tariffs + ENG's	-0.26%	-0.28%	-0.28%	-0.27%
5	Fossil Fuel Subsidies	-0.43%	-0.30%	0.24%	1.11%

	Non-ferrous Metals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.05%	-0.30%	-1.08%	-0.89%
1.2	*With Recycling, No Retaliation*	-0.20%	-0.53%	-1.51%	-1.59%
1.3	*With Recycling, With Retaliation*	-0.22%	-0.60%	-1.80%	-2.00%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.05%	-0.28%	-0.98%	-0.68%
1.5	*No Recycling, With Retaliation*	-0.07%	-0.38%	-1.39%	-1.32%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.22%	-0.52%	-1.60%	-1.86%
2	Industrial Subsidies	1.86%	1.99%	2.15%	2.12%
3	Final Consumption Tax				
3.1	*No Recycling*	0.93%	0.83%	0.62%	-0.64%
3.2	*Recycling*	0.88%	0.56%	-0.33%	-2.28%
4	Tariffs + ENG's	2.79%	3.21%	4.04%	5.35%
5	Fossil Fuel Subsidies	0.06%	0.09%	0.11%	0.11%

Key Summary - Chemical

- The three combined policy scenarios that include a carbon leakage mitigation measure (e.g. Final Consumption Tax or CBAM) provide the best prospects in terms of production, leakage reduction and employment. The combination of all international instruments without a carbon leakage mitigation measure does not perform as well, reaffirming the relative vulnerability to leakage of the sector.
- Combining the elimination of fossil fuels, industrial subsidies and tariffs with the CBAM is the most efficient mix of policies for the sector (1st ranking across all indicators examined)
- The CBAM and tariffs removal instruments present comparable results and benefits for the Chemicals sector followed by the removal of fossil fuel subsidies.
- The best performing individual measure both in terms of production and employment is the CBAM with domestic subsidies plus revenues recycling and no retaliation.
- The benefits to the sector increase over time following the escalating taxation on competitive imported goods.
- The Consumption tax is beneficial for the sector but is not as beneficial as the other instruments examined apart from the removal of industrial subsidies in China.

Policy Ranking Matrix – Chemicals

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
COMBO - CBAM & all	15	15	15	1
COMBO - CBAM & all without tariffs	13	14	13	2
COMBO - Final Consumption Tax & All	14	7	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	11	13	10	4
CBAM on three sectors, No Recycling, No Retaliation	9	11	11	5
CBAM, With Recycling, No Retaliation	10	12	8	6
COMBO - All	12	6	12	6
CBAM, No Recycling, No Retaliation	8	10	9	8
CBAM, With Recycling, With Retaliation	7	9	6	9
CBAM, No Recycling, With Retaliation	6	8	7	10
Tariffs + ENG's	5	5	5	11
Fossil Fuel Subsidies	4	4	4	12
Final Consumption Tax	3	3	3	13
Final Consumption Tax & Recycling	2	2	2	14
Industrial Subsidies	1	1	1	15

Chemical (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
	No	Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	8.64%	-2.63%	8.39%
	1.2	*With Recycling, No Retaliation*	8.75%	-2.68%	8.31%
	1.3	*With Recycling, With Retaliation*	7.55%	-2.38%	7.11%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	8.74%	-2.65%	8.47%
	1.5	*No Recycling, With Retaliation*	7.43%	-2.33%	7.19%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	9.05%	-2.76%	8.44%
2		Industrial Subsidies	1.03%	0.20%	0.99%
3		Final Consumption Tax			
	3.1	*No Recycling*	2.43%	-0.46%	1.93%
	3.2	*Recycling*	2.05%	-0.39%	1.59%
4		Tariffs + ENG's	6.01%	-0.90%	5.89%
5		Fossil Fuel Subsidies	4.19%	-0.48%	3.98%

	Chemical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Domestic Production	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.37%	2.25%	10.05%	18.08%
1.2	*With Recycling, No Retaliation*	0.56%	2.50%	10.19%	17.76%
1.3	*With Recycling, With Retaliation*	0.42%	1.81%	8.56%	16.23%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.39%	2.29%	10.20%	18.25%
1.5	*No Recycling, With Retaliation*	0.23%	1.56%	8.42%	16.53%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.92%	3.01%	10.53%	17.69%
2	Industrial Subsidies	0.97%	1.00%	1.05%	1.03%
3	Final Consumption Tax				
3.1	*No Recycling*	0.65%	3.05%	3.15%	0.19%
3.2	*Recycling*	0.63%	2.94%	2.72%	-0.62%
4	Tariffs + ENG's	4.28%	4.83%	6.04%	8.26%
5	Fossil Fuel Subsidies	2.55%	2.95%	4.36%	6.44%

	Chemical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	GHG Emissions	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.24%	-1.20%	-3.17%	-3.85%
1.2	*With Recycling, No Retaliation*	-0.28%	-1.25%	-3.23%	-3.90%
1.3	*With Recycling, With Retaliation*	-0.25%	-1.10%	-2.88%	-3.47%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.25%	-1.21%	-3.20%	-3.89%
1.5	*No Recycling, With Retaliation*	-0.21%	-1.04%	-2.83%	-3.43%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.36%	-1.35%	-3.31%	-3.97%
2	Industrial Subsidies	-0.01%	0.09%	0.22%	0.32%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.14%	-0.55%	-0.53%	-0.22%
3.2	*Recycling*	-0.14%	-0.53%	-0.46%	-0.09%
4	Tariffs + ENG's	-0.88%	-0.84%	-0.84%	-1.06%
5	Fossil Fuel Subsidies	-0.62%	-0.60%	-0.48%	-0.31%

	Chemical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Employment	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.40%	2.37%	10.49%	18.75%
1.2	*With Recycling, No Retaliation*	0.50%	2.47%	10.38%	18.12%
1.3	*With Recycling, With Retaliation*	0.33%	1.72%	8.69%	16.56%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.41%	2.40%	10.60%	18.89%
1.5	*No Recycling, With Retaliation*	0.23%	1.63%	8.80%	17.16%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.77%	2.84%	10.52%	17.81%
2	Industrial Subsidies	0.93%	0.96%	1.02%	0.99%
3	Final Consumption Tax				
3.1	*No Recycling*	0.62%	2.93%	2.24%	-0.49%
3.2	*Recycling*	0.60%	2.82%	1.83%	-1.23%
4	Tariffs + ENG's	4.27%	4.83%	6.10%	8.19%
5	Fossil Fuel Subsidies	2.48%	2.87%	4.25%	6.30%

Key Summary - Paper

- The paper industry benefits most by an adoption of a mix of policies where fossil fuel subsidies, non – EU industrial subsidies, elimination of tariffs and CBAM are used. The best-performing instruments comprising this mix are the elimination of tariffs, followed several rankings behind by the reduction of fossil fuel subsidies and finally industrial subsidies.
- The impact of the different instruments examined is small but positive on the economic performance of the paper industry.
- The most beneficial single option is the Carbon Content-modulated Preferential Tariffs and Zero Duties for Environmental Goods.
- The option of CBAM without recycling and without retaliation from competing industries ranks as the second-best option for the industry.
- Over the 2025-2050 period production and employment may marginally increase by 0.7%.

Policy Ranking Matrix – Paper

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
COMBO - CBAM & all	15	15	15	1
COMBO - All	14	14	14	2
CBAM, No Recycling, No Retaliation	12	12	12	3
Tariffs + ENG's	13	10	13	3
CBAM, No Recycling, With Retaliation	11	7	11	5
COMBO - Final Consumption Tax & All	10	11	8	5
CBAM, With Recycling, No Retaliation	9	8	10	7
COMBO - CBAM & all without tariffs	7	13	7	7
CBAM, With Recycling, With Retaliation	8	5	9	9
Fossil Fuel Subsidies	5	9	5	10
CBAM + Domestic Subsidies, With Recycling, No Retaliation	6	6	6	11
Industrial Subsidies	4	2	4	12
Final Consumption Tax	3	4	2	13
Final Consumption Tax & Recycling	2	3	1	14
CBAM on three sectors, No Recycling, No Retaliation	1	1	3	15

Paper (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No		Instrument	Production	Emissions	Employment
1	CBAM				
	1.1	*No Recycling, No Retaliation*	0.63%	-0.21%	0.64%
	1.2	*With Recycling, No Retaliation*	0.35%	-0.17%	0.28%
	1.3	*With Recycling, With Retaliation*	0.34%	-0.11%	0.27%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.36%	0.22%	-0.27%
	1.5	*No Recycling, With Retaliation*	0.62%	-0.15%	0.63%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.18%	-0.15%	0.06%
2	Industrial Subsidies		-0.02%	0.12%	-0.02%
3	Final Consumption Tax				
	3.1	*No Recycling*	-0.22%	0.02%	-0.64%
	3.2	*Recycling*	-0.35%	0.07%	-0.74%
4	Tariffs + ENG's		0.66%	-0.17%	0.73%
5	Fossil Fuel Subsidies		0.02%	-0.17%	0.02%

	Paper (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.01%	0.07%	0.55%	1.62%
1.2	*With Recycling, No Retaliation*	-0.07%	-0.08%	0.24%	1.14%
1.3	*With Recycling, With Retaliation*	-0.07%	-0.09%	0.22%	1.15%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.02%	-0.09%	-0.39%	-0.75%
1.5	*No Recycling, With Retaliation*	0.01%	0.06%	0.53%	1.63%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.08%	-0.11%	0.04%	0.83%
2	Industrial Subsidies	-0.03%	-0.03%	-0.01%	0.00%
3	Final Consumption Tax				
3.1	*No Recycling*	0.11%	0.18%	-0.25%	-0.58%
3.2	*Recycling*	0.10%	0.15%	-0.39%	-0.85%
4	Tariffs + ENG's	0.57%	0.51%	0.67%	1.10%
5	Fossil Fuel Subsidies	0.03%	0.03%	0.02%	0.00%

	Paper (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.00%	-0.02%	-0.17%	-0.49%
1.2	*With Recycling, No Retaliation*	0.02%	0.02%	-0.11%	-0.45%
1.3	*With Recycling, With Retaliation*	0.02%	0.02%	-0.07%	-0.31%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.01%	0.07%	0.25%	0.39%
1.5	*No Recycling, With Retaliation*	0.00%	-0.02%	-0.13%	-0.35%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.02%	0.03%	-0.09%	-0.45%
2	Industrial Subsidies	0.15%	0.12%	0.12%	0.11%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.01%	0.05%	0.05%	-0.09%
3.2	*Recycling*	-0.01%	0.07%	0.11%	0.01%
4	Tariffs + ENG's	-0.19%	-0.16%	-0.18%	-0.24%
5	Fossil Fuel Subsidies	-0.75%	-0.64%	-0.16%	0.46%

	Paper (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.02%	0.10%	0.63%	1.73%
1.2	*With Recycling, No Retaliation*	-0.09%	-0.10%	0.21%	1.07%
1.3	*With Recycling, With Retaliation*	-0.10%	-0.12%	0.19%	1.08%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.01%	-0.07%	-0.31%	-0.63%
1.5	*No Recycling, With Retaliation*	0.01%	0.08%	0.61%	1.74%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.11%	-0.14%	-0.04%	0.64%
2	Industrial Subsidies	-0.03%	-0.03%	-0.02%	0.00%
3	Final Consumption Tax				
3.1	*No Recycling*	0.08%	0.06%	-0.81%	-1.41%
3.2	*Recycling*	0.08%	0.03%	-0.93%	-1.61%
4	Tariffs + ENG's	0.66%	0.59%	0.79%	1.17%
5	Fossil Fuel Subsidies	0.03%	0.03%	0.02%	0.01%

Key Summary – Non-Metallic Minerals

- All instruments examined have significant positive effects on the sales of the non-metallic minerals industry.
- The best performing option is the combined policy scenario with CBAM and all international instruments.
- The performance of this first-tier combination is driven in large part by the CBAM, which performs well even when it is used as a stand-alone instrument. It can lead to production increase over 5% by the 2025-2050 period. This industry is invariant to the choice of recycling but sensitive to retaliation action.
- After the CBAM variants it is the removal of tariffs that impacts positively the economic performance and employment of the industry.
- The positive effects on production and employment escalate over time peaking in 2050 where sales and employment in the sector may increase by ~11%.

Policy Ranking Matrix – Minerals

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
COMBO - CBAM & all	15	15	15	1
CBAM on three sectors, No Recycling, No Retaliation	13	12	13	2
COMBO - CBAM & all without tariffs	14	8	14	3
CBAM, No Recycling, No Retaliation	11	11	12	4
CBAM + Domestic Subsidies, With Recycling, No Retaliation	10	14	10	4
CBAM, With Recycling, No Retaliation	9	13	11	6
CBAM, No Recycling, With Retaliation	8	9	9	7
CBAM, With Recycling, With Retaliation	7	10	8	8
COMBO - Final Consumption Tax & All	12	6	7	8
Tariffs + ENG's	5	7	5	10
COMBO - All	6	5	6	10
Final Consumption Tax	4	4	4	12
Final Consumption Tax & Recycling	3	3	3	13
Fossil Fuel Subsidies	2	1	2	14
Industrial Subsidies	1	2	1	15

Non-Metallic Minerals (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
	No	Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	5.43%	-0.71%	5.62%
	1.2	*With Recycling, No Retaliation*	5.41%	-0.73%	5.55%
	1.3	*With Recycling, With Retaliation*	4.78%	-0.65%	4.85%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	5.47%	-0.72%	5.66%
	1.5	*No Recycling, With Retaliation*	4.80%	-0.63%	4.92%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	5.43%	-0.76%	5.53%
2		Industrial Subsidies	0.10%	-0.06%	0.10%
3		Final Consumption Tax			
	3.1	*No Recycling*	1.07%	-0.09%	0.89%
	3.2	*Recycling*	0.88%	-0.07%	0.75%
4		Tariffs + ENG's	2.64%	-0.35%	1.52%
5		Fossil Fuel Subsidies	0.74%	0.21%	0.62%

	Non-Metallic Minerals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.22%	1.22%	5.86%	11.03%
1.2	*With Recycling, No Retaliation*	0.18%	1.19%	5.87%	10.93%
1.3	*With Recycling, With Retaliation*	0.10%	0.84%	5.06%	10.23%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.22%	1.24%	5.90%	11.10%
1.5	*No Recycling, With Retaliation*	0.14%	0.87%	5.04%	10.32%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.22%	1.26%	5.89%	10.83%
2	Industrial Subsidies	0.08%	0.09%	0.10%	0.11%
3	Final Consumption Tax				
3.1	*No Recycling*	0.26%	1.22%	1.57%	-0.70%
3.2	*Recycling*	0.25%	1.16%	1.37%	-1.06%
4	Tariffs + ENG's	2.19%	2.33%	2.63%	3.30%
5	Fossil Fuel Subsidies	0.50%	0.56%	0.75%	1.05%

	Non-Metallic Minerals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.05%	-0.23%	-0.83%	-1.27%
1.2	*With Recycling, No Retaliation*	-0.06%	-0.24%	-0.85%	-1.30%
1.3	*With Recycling, With Retaliation*	-0.05%	-0.20%	-0.75%	-1.18%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.05%	-0.23%	-0.83%	-1.28%
1.5	*No Recycling, With Retaliation*	-0.04%	-0.19%	-0.73%	-1.15%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.06%	-0.25%	-0.88%	-1.36%
2	Industrial Subsidies	-0.04%	-0.07%	-0.05%	-0.05%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.02%	-0.07%	-0.12%	0.00%
3.2	*Recycling*	-0.02%	-0.06%	-0.09%	0.05%
4	Tariffs + ENG's	-0.38%	-0.35%	-0.34%	-0.38%
5	Fossil Fuel Subsidies	-0.39%	-0.27%	0.19%	1.09%

	Non-Metallic Minerals (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.24%	1.34%	6.41%	12.07%
1.2	*With Recycling, No Retaliation*	0.18%	1.28%	6.36%	11.85%
1.3	*With Recycling, With Retaliation*	0.09%	0.85%	5.43%	11.05%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.24%	1.35%	6.45%	12.15%
1.5	*No Recycling, With Retaliation*	0.15%	0.91%	5.47%	11.26%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.21%	1.33%	6.33%	11.66%
2	Industrial Subsidies	0.09%	0.09%	0.10%	0.11%
3	Final Consumption Tax				
3.1	*No Recycling*	0.30%	1.35%	1.37%	-1.40%
3.2	*Recycling*	0.29%	1.30%	1.20%	-1.69%
4	Tariffs + ENG's	1.25%	1.32%	1.49%	2.12%
5	Fossil Fuel Subsidies	0.42%	0.47%	0.64%	0.92%

Key Summary - Electrical Equipment

- The removal of industrial subsidies in competing regions is the most beneficial instrument for the sector, out-performing even combined policy mixes. All other instruments apart from the removal of industrial subsidies are projected to have a negative impact on production.
- The implementation of CBAM has a negative impact on the Electrical Equipment industry as it further increases the cost of its intermediate inputs.
- The horizontal tax seems to be the most preferred option for the industry. In the early years of the implementation of the consumption tax, its impact is negative both on production and employment however with the escalation of the consumption tax the impact on the industry becomes positive. This indicates that there is a tipping point after which private consumers perform sufficient substitution between domestically produced and imported products.

Policy Matrix Ranking – Electrical Equipment

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
Industrial Subsidies	15	12	15	1
Fossil Fuel Subsidies	13	13	14	2
COMBO - All	12	15	13	2
Final Consumption Tax	14	9	12	4
COMBO - Final Consumption Tax & All	11	14	10	5
Tariffs + ENG's	10	7	11	6
Final Consumption Tax & Recycling	9	8	9	7
CBAM, No Recycling, With Retaliation	8	6	8	8
CBAM on three sectors, No Recycling, No Retaliation	7	5	7	9
COMBO - CBAM & all without tariffs	3	11	4	10
CBAM, No Recycling, No Retaliation	6	4	6	11
CBAM, With Recycling, With Retaliation	5	3	5	12
COMBO - CBAM & all	1	10	1	13
CBAM, With Recycling, No Retaliation	4	2	3	14
CBAM + Domestic Subsidies, With Recycling, No Retaliation	2	1	2	15

Electrical equipment (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
	No	Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-1.91%	0.28%	-1.88%
	1.2	*With Recycling, No Retaliation*	-2.53%	0.34%	-2.47%
	1.3	*With Recycling, With Retaliation*	-2.34%	0.31%	-2.28%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-1.84%	0.27%	-1.82%
	1.5	*No Recycling, With Retaliation*	-1.71%	0.24%	-1.69%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-2.91%	0.37%	-2.79%
2		Industrial Subsidies	0.40%	-0.23%	0.40%
3		Final Consumption Tax			
	3.1	*No Recycling*	-0.01%	0.01%	-0.41%
	3.2	*Recycling*	-0.67%	0.09%	-1.04%
4		Tariffs + ENG's	-0.61%	0.14%	-0.54%
5		Fossil Fuel Subsidies	-0.04%	-0.35%	-0.04%

	Electrical equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.09%	-0.51%	-2.24%	-3.99%
1.2	*With Recycling, No Retaliation*	-0.36%	-0.90%	-2.95%	-4.96%
1.3	*With Recycling, With Retaliation*	-0.33%	-0.78%	-2.69%	-4.71%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.09%	-0.50%	-2.17%	-3.84%
1.5	*No Recycling, With Retaliation*	-0.06%	-0.39%	-1.98%	-3.74%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.44%	-1.02%	-3.34%	-5.57%
2	Industrial Subsidies	0.33%	0.36%	0.41%	0.46%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.08%	-0.49%	0.12%	0.24%
3.2	*Recycling*	-0.11%	-0.68%	-0.61%	-1.12%
4	Tariffs + ENG's	-0.58%	-0.59%	-0.60%	-0.76%
5	Fossil Fuel Subsidies	-0.03%	-0.03%	-0.04%	-0.08%

	Electrical equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.02%	0.09%	0.31%	0.44%
1.2	*With Recycling, No Retaliation*	0.06%	0.15%	0.38%	0.52%
1.3	*With Recycling, With Retaliation*	0.05%	0.12%	0.34%	0.48%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.02%	0.10%	0.31%	0.44%
1.5	*No Recycling, With Retaliation*	0.01%	0.07%	0.26%	0.40%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.08%	0.17%	0.41%	0.52%
2	Industrial Subsidies	-0.23%	-0.23%	-0.23%	-0.22%
3	Final Consumption Tax				
3.1	*No Recycling*	0.03%	0.15%	0.00%	-0.07%
3.2	*Recycling*	0.04%	0.18%	0.08%	0.05%
4	Tariffs + ENG's	0.19%	0.15%	0.13%	0.15%
5	Fossil Fuel Subsidies	-0.24%	-0.26%	-0.35%	-0.50%

	Electrical equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.09%	-0.54%	-2.37%	-4.22%
1.2	*With Recycling, No Retaliation*	-0.36%	-0.92%	-3.07%	-5.20%
1.3	*With Recycling, With Retaliation*	-0.33%	-0.79%	-2.81%	-4.95%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.09%	-0.53%	-2.30%	-4.06%
1.5	*No Recycling, With Retaliation*	-0.06%	-0.41%	-2.11%	-3.97%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.44%	-1.01%	-3.42%	-5.75%
2	Industrial Subsidies	0.33%	0.36%	0.41%	0.46%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.08%	-0.62%	-0.32%	-0.61%
3.2	*Recycling*	-0.13%	-0.84%	-1.09%	-1.96%
4	Tariffs + ENG's	-0.50%	-0.52%	-0.55%	-0.71%
5	Fossil Fuel Subsidies	-0.03%	-0.03%	-0.04%	-0.10%

Key Summary – Transport Equipment

- All instruments have a negative impact on the Transport Equipment industry apart from the final consumption tax, without recycling, which is neutral for the performance of the sector.
- CBAM increases indirectly the production costs of the industry (more expensive imports of raw materials and semi-finished products).
- Recycling of the tax revenues is not beneficial for the sector as consumption is mainly directed to imported goods.
- Best performance in carbon leakage reduction is achieved through the scenario which considers a reduction in fossil fuel subsidies.

Policy Ranking Matrix – Transport Equipment

Weighting Distribution : Equal Weighting				
Indicator	**Prodcution**	**Leakage**	**Employment**	**Rank**
Weights	**0.33**	**0.33**	**0.33**	
Fossil Fuel Subsidies	13	15	14	1
Final Consumption Tax	15	10	13	2
Industrial Subsidies	14	8	15	3
COMBO - All	10	14	11	4
Final Consumption Tax & Recycling	12	9	10	5
Tariffs + ENG's	11	7	12	6
COMBO - Final Consumption Tax & All	9	13	8	6
CBAM, No Recycling, With Retaliation	8	4	9	8
CBAM on three sectors, No Recycling, No Retaliation	7	6	7	9
CBAM, No Recycling, No Retaliation	6	5	6	10
COMBO - CBAM & all without tariffs	2	12	2	11
COMBO - CBAM & all	1	11	1	12
CBAM, With Recycling, No Retaliation	4	3	4	13
CBAM, With Recycling, With Retaliation	5	1	5	13
CBAM + Domestic Subsidies, With Recycling, No Retaliation	3	2	3	15

Transport Equipment (EU27+UK)			**(2025-2050) (% change from carbon neutrality scenario)**		
	No	**Instrument**	**Production**	**Emissions**	**Employment**
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-1.41%	0.39%	-1.31%
	1.2	*With Recycling, No Retaliation*	-2.33%	0.44%	-2.27%
	1.3	*With Recycling, With Retaliation*	-2.20%	0.46%	-2.14%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-1.35%	0.38%	-1.25%
	1.5	*No Recycling, With Retaliation*	-1.27%	0.41%	-1.18%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-2.92%	0.45%	-2.83%
2		Industrial Subsidies	-0.14%	0.05%	-0.13%
3		Final Consumption Tax			
	3.1	*No Recycling*	0.01%	-0.02%	-0.38%
	3.2	*Recycling*	-0.43%	0.05%	-0.79%
4		Tariffs + ENG's	-0.48%	0.17%	-0.42%
5		Fossil Fuel Subsidies	-0.18%	-1.88%	-0.17%

	Transport Equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Domestic Production	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.07%	-0.38%	-1.59%	-2.73%
1.2	*With Recycling, No Retaliation*	-0.48%	-1.06%	-2.61%	-3.93%
1.3	*With Recycling, With Retaliation*	-0.46%	-0.97%	-2.43%	-3.76%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.06%	-0.37%	-1.52%	-2.61%
1.5	*No Recycling, With Retaliation*	-0.05%	-0.29%	-1.41%	-2.56%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.57%	-1.25%	-3.30%	-4.77%
2	Industrial Subsidies	-0.12%	-0.13%	-0.14%	-0.14%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.06%	-0.07%	0.16%	-0.07%
3.2	*Recycling*	-0.08%	-0.18%	-0.30%	-0.97%
4	Tariffs + ENG's	-0.44%	-0.47%	-0.47%	-0.57%
5	Fossil Fuel Subsidies	-0.11%	-0.13%	-0.18%	-0.27%

	Transport Equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	GHG Emissions	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.02%	0.12%	0.43%	0.66%
1.2	*With Recycling, No Retaliation*	0.08%	0.18%	0.48%	0.70%
1.3	*With Recycling, With Retaliation*	0.08%	0.16%	0.49%	0.80%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.02%	0.12%	0.43%	0.65%
1.5	*No Recycling, With Retaliation*	0.02%	0.10%	0.44%	0.76%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.10%	0.20%	0.51%	0.67%
2	Industrial Subsidies	0.12%	0.06%	0.04%	0.06%
3	Final Consumption Tax				
3.1	*No Recycling*	0.01%	0.05%	-0.04%	-0.07%
3.2	*Recycling*	0.01%	0.07%	0.02%	0.05%
4	Tariffs + ENG's	0.16%	0.16%	0.17%	0.21%
5	Fossil Fuel Subsidies	-1.47%	-1.59%	-1.84%	-2.40%

	Transport Equipment (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Employment	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.07%	-0.38%	-1.58%	-2.72%
1.2	*With Recycling, No Retaliation*	-0.50%	-1.09%	-2.67%	-4.01%
1.3	*With Recycling, With Retaliation*	-0.48%	-1.00%	-2.50%	-3.85%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.06%	-0.36%	-1.51%	-2.59%
1.5	*No Recycling, With Retaliation*	-0.05%	-0.29%	-1.41%	-2.56%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.59%	-1.27%	-3.38%	-4.89%
2	Industrial Subsidies	-0.11%	-0.12%	-0.14%	-0.14%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.08%	-0.22%	-0.28%	-0.77%
3.2	*Recycling*	-0.10%	-0.34%	-0.76%	-1.64%
4	Tariffs + ENG's	-0.36%	-0.40%	-0.42%	-0.52%
5	Fossil Fuel Subsidies	-0.10%	-0.12%	-0.17%	-0.26%

Key Summary – Other Equipment Goods

- Downstream sectors are not benefited by the imposition of the CBAM as it increases productions costs of intermediate products. In all cases examined it is the consumption tax that performs best for manufactured products.
- Removal of fossil fuel and industrial subsidies are the measures with small or no impact on the economic performance of the equipment goods industry, while the former is projected to have the most pronounced impact on carbon leakage reduction.

Policy Ranking Matrix – Other Equipment Goods

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
Fossil Fuel Subsidies	15	13	15	1
Industrial Subsidies	14	9	14	2
COMBO - All	10	14	12	3
Tariffs + ENG's	12	10	13	4
Final Consumption Tax	13	8	11	5
COMBO - Final Consumption Tax & All	9	15	6	6
Final Consumption Tax & Recycling	11	7	7	7
CBAM on three sectors, No Recycling, No Retaliation	7	3	9	8
CBAM, No Recycling, With Retaliation	8	1	10	8
CBAM, No Recycling, No Retaliation	6	4	8	10
COMBO - CBAM & all without tariffs	2	12	2	11
CBAM, With Recycling, No Retaliation	4	5	4	12
COMBO - CBAM & all	1	11	1	12
CBAM + Domestic Subsidies, With Recycling, No Retaliation	3	6	3	14
CBAM, With Recycling, With Retaliation	5	2	5	15

Other Equipment Goods (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No		Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-1.20%	0.60%	-0.95%
	1.2	*With Recycling, No Retaliation*	-1.77%	0.59%	-1.53%
	1.3	*With Recycling, With Retaliation*	-1.66%	0.72%	-1.44%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-1.15%	0.60%	-0.90%
	1.5	*No Recycling, With Retaliation*	-1.09%	0.72%	-0.85%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-2.14%	0.55%	-1.90%
2		Industrial Subsidies	-0.10%	-0.46%	-0.10%
3		Final Consumption Tax			
	3.1	*No Recycling*	-0.25%	-0.07%	-0.76%
	3.2	*Recycling*	-0.52%	0.03%	-0.98%
4		Tariffs + ENG's	-0.36%	-0.61%	-0.26%
5		Fossil Fuel Subsidies	0.00%	-1.21%	0.01%

No	Other Equipment Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.05%	-0.29%	-1.29%	-2.39%
1.2	*With Recycling, No Retaliation*	-0.22%	-0.60%	-1.92%	-3.30%
1.3	*With Recycling, With Retaliation*	-0.20%	-0.54%	-1.78%	-3.16%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.05%	-0.28%	-1.24%	-2.29%
1.5	*No Recycling, With Retaliation*	-0.04%	-0.23%	-1.15%	-2.25%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.26%	-0.70%	-2.34%	-3.92%
2	Industrial Subsidies	-0.11%	-0.11%	-0.10%	-0.10%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.11%	-0.29%	-0.20%	-0.36%
3.2	*Recycling*	-0.13%	-0.36%	-0.48%	-0.89%
4	Tariffs + ENG's	-0.31%	-0.33%	-0.35%	-0.48%
5	Fossil Fuel Subsidies	0.00%	-0.01%	-0.01%	-0.01%

No	Other Equipment Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.03%	0.17%	0.61%	0.91%
1.2	*With Recycling, No Retaliation*	0.02%	0.18%	0.62%	0.86%
1.3	*With Recycling, With Retaliation*	0.02%	0.15%	0.68%	1.19%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.03%	0.17%	0.61%	0.91%
1.5	*No Recycling, With Retaliation*	0.02%	0.14%	0.66%	1.23%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.04%	0.20%	0.58%	0.75%
2	Industrial Subsidies	-0.35%	-0.41%	-0.48%	-0.48%
3	Final Consumption Tax				
3.1	*No Recycling*	0.06%	0.24%	-0.02%	-0.33%
3.2	*Recycling*	0.07%	0.26%	0.07%	-0.19%
4	Tariffs + ENG's	-0.36%	-0.46%	-0.63%	-0.73%
5	Fossil Fuel Subsidies	-1.51%	-1.43%	-1.19%	-1.06%

No	Other Equipment Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.04%	-0.25%	-1.09%	-2.05%
1.2	*With Recycling, No Retaliation*	-0.21%	-0.57%	-1.77%	-3.04%
1.3	*With Recycling, With Retaliation*	-0.20%	-0.51%	-1.64%	-2.91%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.04%	-0.24%	-1.04%	-1.94%
1.5	*No Recycling, With Retaliation*	-0.03%	-0.18%	-0.96%	-1.92%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.27%	-0.65%	-2.20%	-3.71%
2	Industrial Subsidies	-0.10%	-0.10%	-0.10%	-0.10%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.18%	-0.45%	-0.76%	-1.33%
3.2	*Recycling*	-0.19%	-0.52%	-1.01%	-1.78%
4	Tariffs + ENG's	-0.21%	-0.23%	-0.27%	-0.38%
5	Fossil Fuel Subsidies	0.01%	0.01%	0.01%	0.01%

Key Summary – Computer, Electronic and Optical

- The single instrument that is most beneficial for the production of computer and electronic equipment is the consumption tax. This ranking is buoyed by strong performance in terms of production and employment indicators, whereas the performance of the instrument as far as leakage reduction is relatively mediocre (6th out of 15 instruments).
- Downstream sectors do not benefit from the imposition of the CBAM as it increases productions costs of intermediate products. In all cases examined it is the consumption tax that performs best for manufactured products.

Policy Ranking Matrix – Computer, Electronic and Optical

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
Final Consumption Tax	15	9	15	1
Fossil Fuel Subsidies	14	11	14	2
Industrial Subsidies	12	10	13	3
Final Consumption Tax & Recycling	13	8	11	4
Tariffs + ENG's	11	7	12	5
COMBO - Final Consumption Tax & All	9	15	6	5
COMBO - All	6	14	7	7
CBAM, No Recycling, With Retaliation	10	5	10	8
CBAM on three sectors, No Recycling, No Retaliation	8	6	9	9
CBAM, No Recycling, No Retaliation	7	4	8	10
COMBO - CBAM & all without tariffs	2	13	2	11
COMBO - CBAM & all	1	12	1	12
CBAM, With Recycling, With Retaliation	5	3	5	13
CBAM, With Recycling, No Retaliation	4	2	4	14
CBAM + Domestic Subsidies, With Recycling, No Retaliation	3	1	3	15

Computer Electronic Optical (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No		Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-1.42%	0.16%	-1.29%
	1.2	*With Recycling, No Retaliation*	-2.31%	0.24%	-2.20%
	1.3	*With Recycling, With Retaliation*	-2.10%	0.23%	-2.00%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-1.35%	0.14%	-1.22%
	1.5	*No Recycling, With Retaliation*	-1.22%	0.15%	-1.09%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-2.84%	0.28%	-2.72%
2		Industrial Subsidies	-0.46%	-0.48%	-0.47%
3		Final Consumption Tax			
	3.1	*No Recycling*	0.29%	-0.07%	-0.06%
	3.2	*Recycling*	-0.33%	0.00%	-0.65%
4		Tariffs + ENG's	-0.69%	0.06%	-0.63%
5		Fossil Fuel Subsidies	-0.28%	-0.56%	-0.28%

	Computer Electronic Optical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.07%	-0.40%	-1.60%	-2.92%
1.2	*With Recycling, No Retaliation*	-0.40%	-0.94%	-2.62%	-4.24%
1.3	*With Recycling, With Retaliation*	-0.37%	-0.81%	-2.36%	-3.99%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.07%	-0.38%	-1.53%	-2.77%
1.5	*No Recycling, With Retaliation*	-0.04%	-0.26%	-1.34%	-2.67%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.50%	-1.12%	-3.23%	-5.04%
2	Industrial Subsidies	-0.49%	-0.49%	-0.46%	-0.40%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.07%	-0.55%	0.63%	0.39%
3.2	*Recycling*	-0.11%	-0.75%	-0.06%	-0.85%
4	Tariffs + ENG's	-0.66%	-0.69%	-0.69%	-0.81%
5	Fossil Fuel Subsidies	-0.24%	-0.25%	-0.28%	-0.34%

	Computer Electronic Optical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.01%	0.05%	0.17%	0.26%
1.2	*With Recycling, No Retaliation*	0.07%	0.13%	0.26%	0.33%
1.3	*With Recycling, With Retaliation*	0.06%	0.11%	0.24%	0.34%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.01%	0.05%	0.16%	0.23%
1.5	*No Recycling, With Retaliation*	0.01%	0.03%	0.15%	0.27%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.09%	0.16%	0.32%	0.36%
2	Industrial Subsidies	-0.48%	-0.49%	-0.49%	-0.44%
3	Final Consumption Tax				
3.1	*No Recycling*	0.01%	0.10%	-0.10%	-0.12%
3.2	*Recycling*	0.02%	0.12%	-0.02%	-0.02%
4	Tariffs + ENG's	0.09%	0.06%	0.05%	0.06%
5	Fossil Fuel Subsidies	-0.39%	-0.43%	-0.54%	-0.76%

	Computer Electronic Optical (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.07%	-0.38%	-1.56%	-2.85%
1.2	*With Recycling, No Retaliation*	-0.42%	-0.97%	-2.64%	-4.28%
1.3	*With Recycling, With Retaliation*	-0.38%	-0.83%	-2.38%	-4.03%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.07%	-0.37%	-1.48%	-2.69%
1.5	*No Recycling, With Retaliation*	-0.04%	-0.25%	-1.30%	-2.60%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.52%	-1.13%	-3.27%	-5.12%
2	Industrial Subsidies	-0.50%	-0.51%	-0.47%	-0.41%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.10%	-0.66%	0.31%	-0.31%
3.2	*Recycling*	-0.14%	-0.87%	-0.40%	-1.52%
4	Tariffs + ENG's	-0.60%	-0.62%	-0.63%	-0.74%
5	Fossil Fuel Subsidies	-0.25%	-0.25%	-0.29%	-0.34%

Key Summary – Air Transport

- The reduction of fossil fuel subsidies, industrial subsidies and preferential tariffs on environmental goods combined with the use of a consumption tax to reduce carbon leakage is the most beneficial instrument in terms of production and employment for the air transport industry.
- The consumption tax is the best performing option for the air transport industry as it increases both employment and production by ~5% for the years 2025-2050.
- CBAM with revenues recycling impacts positively production and employment. However, the sector is sensitive to retaliation action.
- CBAM is not as effective as the consumption tax as it increases intermediate production costs for firms.

Policy Ranking Matrix – Air Transport

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
COMBO - Final Consumption Tax & All	15	12	15	1
COMBO - CBAM & all without tariffs	12	15	12	2
Final Consumption Tax & Recycling	14	8	14	3
CBAM + Domestic Subsidies, With Recycling, No Retaliation	11	13	11	4
Final Consumption Tax	13	9	13	4
COMBO - CBAM & all	10	14	10	6
CBAM, With Recycling, No Retaliation	9	11	9	7
CBAM, No Recycling, No Retaliation	8	10	8	8
Industrial Subsidies	7	4	7	9
COMBO - All	6	5	6	10
CBAM on three sectors, No Recycling, No Retaliation	5	3	4	11
CBAM, With Recycling, With Retaliation	2	7	2	12
Tariffs + ENG's	3	1	5	13
Fossil Fuel Subsidies	4	2	3	13
CBAM, No Recycling, With Retaliation	1	6	1	15

Air Transport (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
No		Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	0.49%	-0.91%	0.45%
	1.2	*With Recycling, No Retaliation*	1.55%	-1.07%	1.00%
	1.3	*With Recycling, With Retaliation*	-0.42%	-0.68%	-0.67%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.21%	-0.07%	-0.18%
	1.5	*No Recycling, With Retaliation*	-1.41%	-0.54%	-1.17%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	2.71%	-1.22%	1.66%
2		Industrial Subsidies	0.05%	-0.10%	0.06%
3		Final Consumption Tax			
	3.1	*No Recycling*	3.99%	-0.77%	2.81%
	3.2	*Recycling*	4.00%	-0.76%	2.82%
4		Tariffs + ENG's	-0.25%	0.09%	-0.17%
5		Fossil Fuel Subsidies	-0.24%	-0.05%	-0.19%

	Air Transport (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Domestic Production**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.02%	0.10%	0.45%	1.13%
1.2	*With Recycling, No Retaliation*	0.41%	0.81%	1.62%	2.51%
1.3	*With Recycling, With Retaliation*	0.19%	-0.23%	-0.70%	-0.46%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.01%	-0.05%	-0.23%	-0.44%
1.5	*No Recycling, With Retaliation*	-0.21%	-0.93%	-1.78%	-1.69%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.86%	1.61%	2.87%	4.03%
2	Industrial Subsidies	0.06%	0.06%	0.05%	0.06%
3	Final Consumption Tax				
3.1	*No Recycling*	0.29%	2.85%	4.34%	5.81%
3.2	*Recycling*	0.29%	2.85%	4.34%	5.87%
4	Tariffs + ENG's	-0.25%	-0.28%	-0.26%	-0.21%
5	Fossil Fuel Subsidies	-0.21%	-0.22%	-0.26%	-0.26%

	Air Transport (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**GHG Emissions**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.04%	-0.24%	-1.01%	-1.75%
1.2	*With Recycling, No Retaliation*	-0.11%	-0.36%	-1.18%	-1.93%
1.3	*With Recycling, With Retaliation*	-0.06%	-0.15%	-0.73%	-1.34%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.00%	-0.02%	-0.08%	-0.14%
1.5	*No Recycling, With Retaliation*	0.00%	-0.04%	-0.58%	-1.18%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.19%	-0.50%	-1.33%	-2.07%
2	Industrial Subsidies	-0.09%	-0.10%	-0.10%	-0.11%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.06%	-0.53%	-0.82%	-1.19%
3.2	*Recycling*	-0.06%	-0.52%	-0.81%	-1.15%
4	Tariffs + ENG's	0.10%	0.10%	0.08%	0.08%
5	Fossil Fuel Subsidies	-0.03%	-0.03%	-0.05%	-0.07%

	Air Transport (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	**Employment**	**2025**	**2030**	**2040**	**2050**
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.02%	0.12%	0.48%	1.09%
1.2	*With Recycling, No Retaliation*	0.21%	0.49%	1.09%	1.83%
1.3	*With Recycling, With Retaliation*	0.01%	-0.47%	-0.98%	-0.82%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.01%	-0.05%	-0.21%	-0.39%
1.5	*No Recycling, With Retaliation*	-0.18%	-0.82%	-1.53%	-1.44%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.46%	0.96%	1.82%	2.75%
2	Industrial Subsidies	0.07%	0.07%	0.06%	0.06%
3	Final Consumption Tax				
3.1	*No Recycling*	0.24%	2.37%	3.20%	4.05%
3.2	*Recycling*	0.24%	2.35%	3.19%	4.13%
4	Tariffs + ENG's	-0.18%	-0.20%	-0.17%	-0.13%
5	Fossil Fuel Subsidies	-0.17%	-0.17%	-0.20%	-0.20%

Key Summary – Market Services

- Market services which is the largest sector in the EU economy (accounts for more than 60% of value added) is negatively affected by all instruments examined.
- The CBAM instrument increases production costs in downstream industries which further impacts demand for market services.
- The consumption tax also acts as friction to the operation of the market hence reducing economic performance and employment.
- The model results in an average of ~0.2% reduction in production and employment over the 2025-2050 period.

Policy Ranking Matrix – Market Services

Weighting Distribution : Equal Weighting				
Indicator	Prodcution	Leakage	Employment	Rank
Weights	0.33	0.33	0.33	
Industrial Subsidies	15	15	15	1
Tariffs + ENG's	14	12	14	2
Fossil Fuel Subsidies	13	14	12	3
COMBO - All	12	13	13	4
CBAM on three sectors, No Recycling, No Retaliation	11	9	10	5
CBAM, No Recycling, With Retaliation	10	10	7	6
CBAM, With Recycling, With Retaliation	8	6	9	7
CBAM, No Recycling, No Retaliation	9	7	6	8
CBAM, With Recycling, No Retaliation	7	5	8	9
CBAM + Domestic Subsidies, With Recycling, No Retaliation	6	2	11	10
Final Consumption Tax & Recycling	5	11	3	10
COMBO - CBAM & all without tariffs	4	3	5	12
Final Consumption Tax	2	8	1	13
COMBO - CBAM & all	3	1	4	14
COMBO - Final Consumption Tax & All	1	4	2	15

Market Services (EU27+UK)			(2025-2050) (% change from carbon neutrality scenario)		
	No	Instrument	Production	Emissions	Employment
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-0.14%	0.06%	-0.14%
	1.2	*With Recycling, No Retaliation*	-0.17%	0.09%	-0.13%
	1.3	*With Recycling, With Retaliation*	-0.16%	0.08%	-0.13%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.12%	0.05%	-0.12%
	1.5	*No Recycling, With Retaliation*	-0.13%	0.05%	-0.14%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.19%	0.12%	-0.11%
2		Industrial Subsidies	-0.01%	-0.03%	-0.01%
3		Final Consumption Tax			
	3.1	*No Recycling*	-0.34%	0.06%	-0.62%
	3.2	*Recycling*	-0.21%	0.04%	-0.46%
4		Tariffs + ENG's	-0.06%	0.04%	-0.03%
5		Fossil Fuel Subsidies	-0.07%	0.02%	-0.06%

	Market Services (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Domestic Production	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.01%	-0.03%	-0.14%	-0.29%
1.2	*With Recycling, No Retaliation*	-0.02%	-0.05%	-0.18%	-0.34%
1.3	*With Recycling, With Retaliation*	-0.01%	-0.05%	-0.17%	-0.32%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.00%	-0.03%	-0.12%	-0.24%
1.5	*No Recycling, With Retaliation*	0.00%	-0.02%	-0.13%	-0.27%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.02%	-0.06%	-0.20%	-0.35%
2	Industrial Subsidies	-0.01%	-0.01%	-0.01%	-0.01%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.04%	0.01%	-0.35%	-0.62%
3.2	*Recycling*	-0.03%	0.05%	-0.22%	-0.38%
4	Tariffs + ENG's	-0.05%	-0.05%	-0.06%	-0.07%
5	Fossil Fuel Subsidies	-0.05%	-0.05%	-0.08%	-0.09%

	Market Services (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	GHG Emissions	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	0.01%	0.03%	0.07%	0.08%
1.2	*With Recycling, No Retaliation*	0.03%	0.06%	0.11%	0.12%
1.3	*With Recycling, With Retaliation*	0.03%	0.05%	0.10%	0.11%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.01%	0.02%	0.07%	0.07%
1.5	*No Recycling, With Retaliation*	0.00%	0.02%	0.06%	0.07%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.04%	0.07%	0.15%	0.17%
2	Industrial Subsidies	-0.02%	-0.03%	-0.03%	-0.03%
3	Final Consumption Tax				
3.1	*No Recycling*	0.02%	0.07%	0.07%	0.02%
3.2	*Recycling*	0.02%	0.06%	0.06%	-0.01%
4	Tariffs + ENG's	0.04%	0.04%	0.04%	0.05%
5	Fossil Fuel Subsidies	0.06%	0.04%	0.02%	0.00%

	Market Services (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)			
No	Employment	2025	2030	2040	2050
1	CBAM				
1.1	*No Recycling, No Retaliation*	-0.01%	-0.03%	-0.13%	-0.13%
1.2	*With Recycling, No Retaliation*	0.02%	-0.02%	-0.13%	-0.15%
1.3	*With Recycling, With Retaliation*	0.02%	-0.02%	-0.13%	-0.15%
1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.00%	-0.03%	-0.11%	-0.10%
1.5	*No Recycling, With Retaliation*	-0.01%	-0.03%	-0.13%	-0.13%
1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.02%	-0.01%	-0.11%	-0.14%
2	Industrial Subsidies	-0.01%	-0.01%	0.00%	0.00%
3	Final Consumption Tax				
3.1	*No Recycling*	-0.05%	0.10%	-0.82%	-0.64%
3.2	*Recycling*	-0.04%	0.15%	-0.70%	-0.48%
4	Tariffs + ENG's	-0.02%	-0.03%	-0.01%	0.00%
5	Fossil Fuel Subsidies	-0.04%	-0.05%	-0.02%	-0.01%

Key Summary – Consumer Goods

- The impact on the economic performance and employment on the consumer goods industries is small but mixed across the different instruments examined.
- The consumption tax is favourable for consumer goods that are characterised by low carbon intensities. Recycling of consumption tax revenues does not have a substantial impact on the performance of the instrument.
- Most instruments examined tend towards a small increase in carbon leakage, whereas the reduction of fossil fuel subsidies is the only instrument that is projected to have a marked impact in terms of reducing leakage.

Policy Ranking Matrix – Consumer Goods

Weighting Distribution : Equal Weighting				
Indicator	**Prodcution**	**Leakage**	**Employment**	**Rank**
Weights	**0.33**	**0.33**	**0.33**	
Fossil Fuel Subsidies	12	15	13	1
Final Consumption Tax	15	9	15	2
COMBO - Final Consumption Tax & All	13	14	11	3
Final Consumption Tax & Recycling	14	10	14	4
Tariffs + ENG's	10	8	10	5
COMBO - All	6	13	6	6
Industrial Subsidies	11	1	12	7
CBAM on three sectors, No Recycling, No Retaliation	8	7	8	8
CBAM, No Recycling, With Retaliation	9	3	9	9
CBAM, No Recycling, No Retaliation	7	6	7	10
COMBO - CBAM & all without tariffs	2	12	2	11
CBAM, With Recycling, No Retaliation	4	5	4	12
COMBO - CBAM & all	1	11	1	12
CBAM, With Recycling, With Retaliation	5	2	5	14
CBAM + Domestic Subsidies, With Recycling, No Retaliation	3	4	3	15

Consumer Goods (EU27+UK)			**(2025-2050) (% change from carbon neutrality scenario)**		
No		**Instrument**	**Production**	**Emissions**	**Employment**
1		CBAM			
	1.1	*No Recycling, No Retaliation*	-0.53%	0.12%	-0.42%
	1.2	*With Recycling, No Retaliation*	-1.02%	0.14%	-0.96%
	1.3	*With Recycling, With Retaliation*	-0.94%	0.18%	-0.88%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.49%	0.12%	-0.37%
	1.5	*No Recycling, With Retaliation*	-0.45%	0.16%	-0.34%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-1.34%	0.15%	-1.28%
2		Industrial Subsidies	-0.17%	0.26%	-0.16%
3		Final Consumption Tax			
	3.1	*No Recycling*	0.71%	-0.12%	0.14%
	3.2	*Recycling*	0.66%	-0.12%	0.12%
4		Tariffs + ENG's	-0.23%	0.06%	-0.17%
5		Fossil Fuel Subsidies	-0.15%	-1.89%	-0.14%

	Consumer Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)				
No	Domestic Production		2025	2030	2040	2050
1	CBAM					
	1.1	*No Recycling, No Retaliation*	-0.02%	-0.14%	-0.57%	-1.08%
	1.2	*With Recycling, No Retaliation*	-0.20%	-0.43%	-1.12%	-1.81%
	1.3	*With Recycling, With Retaliation*	-0.19%	-0.39%	-1.02%	-1.71%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.02%	-0.13%	-0.53%	-0.98%
	1.5	*No Recycling, With Retaliation*	-0.01%	-0.09%	-0.48%	-0.98%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.24%	-0.52%	-1.48%	-2.32%
2	Industrial Subsidies		-0.18%	-0.17%	-0.16%	-0.16%
3	Final Consumption Tax					
	3.1	*No Recycling*	0.11%	0.70%	0.75%	0.97%
	3.2	*Recycling*	0.11%	0.69%	0.69%	0.86%
4	Tariffs + ENG's		-0.22%	-0.23%	-0.22%	-0.29%
5	Fossil Fuel Subsidies		-0.14%	-0.14%	-0.15%	-0.17%

	Consumer Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)				
No	GHG Emissions		2025	2030	2040	2050
1	CBAM					
	1.1	*No Recycling, No Retaliation*	0.01%	0.04%	0.14%	0.21%
	1.2	*With Recycling, No Retaliation*	0.03%	0.07%	0.16%	0.21%
	1.3	*With Recycling, With Retaliation*	0.03%	0.06%	0.19%	0.32%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	0.01%	0.04%	0.13%	0.19%
	1.5	*No Recycling, With Retaliation*	0.01%	0.03%	0.17%	0.32%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	0.04%	0.08%	0.18%	0.21%
2	Industrial Subsidies		0.26%	0.22%	0.27%	0.29%
3	Final Consumption Tax					
	3.1	*No Recycling*	-0.01%	-0.07%	-0.10%	-0.23%
	3.2	*Recycling*	-0.01%	-0.07%	-0.10%	-0.23%
4	Tariffs + ENG's		0.07%	0.06%	0.05%	0.07%
5	Fossil Fuel Subsidies		-1.50%	-1.69%	-1.90%	-2.19%

	Consumer Goods (EU27+UK)	(2025-2050) (% change from carbon neutrality scenario)				
No	Employment		2025	2030	2040	2050
1	CBAM					
	1.1	*No Recycling, No Retaliation*	-0.02%	-0.11%	-0.47%	-0.95%
	1.2	*With Recycling, No Retaliation*	-0.21%	-0.44%	-1.10%	-1.80%
	1.3	*With Recycling, With Retaliation*	-0.20%	-0.39%	-1.01%	-1.71%
	1.4	*Tax on Metals, chemicals, cement, No Recycling, No Retaliation*	-0.02%	-0.10%	-0.43%	-0.84%
	1.5	*No Recycling, With Retaliation*	-0.01%	-0.06%	-0.38%	-0.85%
	1.6	*ETS Recycling, CBAM Recycling, No Retaliation*	-0.26%	-0.52%	-1.50%	-2.37%
2	Industrial Subsidies		-0.17%	-0.16%	-0.16%	-0.16%
3	Final Consumption Tax					
	3.1	*No Recycling*	0.03%	0.48%	0.07%	0.08%
	3.2	*Recycling*	0.03%	0.47%	0.05%	0.06%
4	Tariffs + ENG's		-0.14%	-0.16%	-0.17%	-0.23%
5	Fossil Fuel Subsidies		-0.13%	-0.13%	-0.14%	-0.16%

2. Country Fiches

Performance of reporting countries for GDP, trade indicators, and carbon leakage, indexed to 2015 until 2050.

2.1. EU27 + UK

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	109	126	145	169	1.45	1.36	1.58				
Exports	100	118	150	186	227	2.43	2.12	2.03				
Imports	100	117	151	186	228	2.57	2.10	2.07				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	109	126	144	168	1.41	1.33	1.59				
Exports	100	118	149	184	226	2.30	2.16	2.07				
Imports	100	117	151	186	228	2.54	2.12	2.06				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	143	168	1.41	1.32	1.58	0.00%	0.00%	0.00%	-0.20%
Exports	100	118	148	181	220	2.25	2.04	1.97	0.00%	0.00%	-0.46%	-2.66%
Imports	100	117	150	182	221	2.48	1.97	1.96	0.00%	0.00%	-0.61%	-3.03%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	168	1.42	1.32	1.58	0.00%	0.00%	0.13%	0.02%
Exports	100	118	148	181	219	2.26	2.02	1.96	0.00%	0.00%	-0.38%	-2.84%
Imports	100	117	150	182	221	2.47	1.98	1.96	0.00%	0.00%	-0.64%	-2.91%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	168	1.42	1.32	1.58	0.00%	0.00%	0.13%	0.01%
Exports	100	118	148	180	219	2.25	2.01	1.96	0.00%	0.00%	-0.51%	-3.10%
Imports	100	117	149	181	220	2.46	1.97	1.96	0.00%	0.00%	-0.77%	-3.18%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	143	168	1.45	1.36	1.58	0.00%	0.00%	-0.01%	-0.22%
Exports	100	118	148	180	219	2.43	2.12	2.03	0.00%	0.00%	-0.59%	-2.91%
Imports	100	117	149	181	220	2.57	2.10	2.07	0.00%	0.00%	-0.74%	-3.29%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	143	168	1.41	1.32	1.58	0.00%	0.00%	0.00%	-0.18%
Exports	100	118	148	181	220	2.25	2.04	1.97	0.00%	0.00%	-0.44%	-2.51%
Imports	100	117	150	182	221	2.48	1.98	1.97	0.00%	0.00%	-0.57%	-2.80%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	169	1.43	1.34	1.59	0.00%	0.00%	0.19%	0.39%
Exports	100	118	148	181	221	2.27	2.05	2.00	0.00%	0.00%	-0.31%	-2.15%
Imports	100	117	150	182	221	2.47	1.98	1.98	0.00%	0.00%	-0.64%	-2.75%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	143	167	1.42	1.30	1.56	0.00%	0.00%	0.09%	-0.44%
Exports	100	118	148	185	228	2.30	2.22	2.11	0.00%	0.00%	-0.04%	0.92%
Imports	100	117	151	185	225	2.57	2.04	1.99	0.00%	0.00%	0.26%	-1.15%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	143	167	1.42	1.31	1.56	0.00%	0.00%	0.10%	-0.37%
Exports	100	118	148	184	225	2.28	2.18	2.06	0.00%	0.00%	-0.22%	-0.17%
Imports	100	117	151	186	227	2.58	2.08	2.03	0.00%	0.00%	0.42%	-0.22%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	168	1.41	1.33	1.59	0.00%	0.00%	0.00%	0.01%
Exports	100	118	148	184	226	2.30	2.16	2.07	0.00%	0.00%	-0.03%	-0.04%
Imports	100	117	151	186	228	2.55	2.12	2.06	0.00%	0.00%	0.07%	0.05%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	168	1.41	1.33	1.59	0.00%	0.00%	0.00%	0.02%
Exports	100	118	149	185	227	2.36	2.16	2.08	0.00%	0.00%	0.61%	0.61%
Imports	100	117	151	187	229	2.60	2.11	2.07	0.00%	0.00%	0.62%	0.62%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	109	126	144	168	1.41	1.32	1.59	0.00%	0.00%	0.00%	0.00%
Exports	100	118	148	184	226	2.30	2.16	2.07	0.00%	0.00%	-0.02%	-0.05%
Imports	100	117	151	186	228	2.54	2.11	2.06	0.00%	0.00%	0.02%	-0.04%

2.2. France

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	108	121	140	168	1.14	1.44	1.83				
Exports	100	113	135	159	193	1.78	1.65	1.96				
Imports	100	112	132	154	185	1.65	1.53	1.88				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	108	121	139	167	1.09	1.42	1.84				
Exports	100	113	133	158	192	1.59	1.74	2.01				
Imports	100	112	131	153	185	1.57	1.59	1.88				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	166	1.09	1.41	1.83	0.00%	0.00%	0.00%	-0.14%
Exports	100	113	133	157	191	1.59	1.72	1.99	0.00%	0.00%	-0.04%	-0.44%
Imports	100	112	131	153	184	1.57	1.57	1.87	0.00%	0.00%	-0.07%	-0.48%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.10	1.42	1.83	0.00%	0.00%	0.12%	0.03%
Exports	100	113	133	158	193	1.64	1.74	2.00	0.00%	0.00%	0.47%	0.28%
Imports	100	112	131	154	186	1.60	1.59	1.89	0.00%	0.00%	0.30%	0.38%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.10	1.42	1.83	0.00%	0.00%	0.12%	0.02%
Exports	100	113	133	158	193	1.63	1.73	2.00	0.00%	0.00%	0.39%	0.14%
Imports	100	112	131	154	185	1.60	1.59	1.89	0.00%	0.00%	0.23%	0.25%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	166	1.45	1.36	1.58	0.00%	0.00%	-0.01%	-0.14%
Exports	100	113	132	157	191	2.43	2.12	2.03	0.00%	0.00%	-0.11%	-0.57%
Imports	100	112	131	153	184	2.57	2.10	2.07	0.00%	0.00%	-0.14%	-0.61%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	166	1.09	1.41	1.83	0.00%	0.00%	0.00%	-0.11%
Exports	100	113	133	157	192	1.59	1.72	1.99	0.00%	0.00%	-0.03%	-0.41%
Imports	100	112	131	153	184	1.57	1.57	1.87	0.00%	0.00%	-0.06%	-0.41%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.11	1.43	1.84	0.00%	0.00%	0.18%	0.23%
Exports	100	113	133	159	195	1.66	1.78	2.04	0.00%	0.00%	0.69%	1.34%
Imports	100	112	132	155	188	1.62	1.65	1.92	0.00%	0.00%	0.42%	1.42%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	166	1.11	1.40	1.81	0.00%	0.00%	0.15%	-0.36%
Exports	100	113	133	158	193	1.61	1.77	2.00	0.00%	0.00%	0.20%	0.35%
Imports	100	112	131	153	184	1.61	1.56	1.82	0.00%	0.00%	0.37%	-0.61%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	166	1.11	1.40	1.81	0.00%	0.00%	0.16%	-0.31%
Exports	100	113	133	158	191	1.60	1.74	1.96	0.00%	0.00%	0.08%	-0.44%
Imports	100	112	132	154	184	1.61	1.57	1.83	0.00%	0.00%	0.40%	-0.37%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.09	1.42	1.84	0.00%	0.00%	0.00%	0.01%
Exports	100	113	133	158	192	1.59	1.74	2.01	0.00%	0.00%	-0.02%	-0.04%
Imports	100	112	131	153	185	1.58	1.59	1.88	0.00%	0.00%	0.04%	0.03%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.09	1.42	1.84	0.00%	0.00%	0.01%	0.02%
Exports	100	113	133	158	193	1.62	1.74	2.01	0.00%	0.00%	0.23%	0.19%
Imports	100	112	131	154	185	1.59	1.59	1.88	0.00%	0.00%	0.18%	0.14%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	108	121	139	167	1.09	1.42	1.84	0.00%	0.00%	0.00%	0.00%
Exports	100	113	133	158	192	1.60	1.74	2.01	0.00%	0.00%	0.03%	0.01%
Imports	100	112	131	153	185	1.58	1.59	1.88	0.00%	0.00%	0.05%	0.03%

2.3. United States

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57				
Exports	100	117	163	216	279	3.36	2.88	2.58				
Imports	100	115	149	188	232	2.66	2.36	2.12				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	113	139	165	193	2.04	1.75	1.57				
Exports	100	117	164	218	280	3.42	2.89	2.56				
Imports	100	115	149	189	233	2.68	2.38	2.12				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	164	217	280	3.42	2.88	2.56	0.00%	0.00%	-0.02%	-0.05%
Imports	100	115	149	189	233	2.68	2.38	2.12	0.00%	0.00%	0.00%	-0.04%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57	0.00%	0.00%	0.00%	-0.02%
Exports	100	117	164	217	280	3.41	2.88	2.56	0.00%	0.00%	-0.11%	-0.13%
Imports	100	115	149	188	232	2.67	2.37	2.11	0.00%	0.00%	-0.04%	-0.16%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57	0.00%	0.00%	0.00%	-0.02%
Exports	100	117	164	217	280	3.41	2.88	2.56	0.00%	0.00%	-0.11%	-0.13%
Imports	100	115	149	188	232	2.67	2.37	2.12	0.00%	0.00%	-0.04%	-0.16%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	164	217	280	2.43	2.12	2.03	0.00%	0.00%	-0.02%	-0.04%
Imports	100	115	149	189	233	2.57	2.10	2.07	0.00%	0.00%	-0.01%	-0.04%
CBAM, on Three sectors	2015	2020	2030	2040	2050	20-30	30-40	40-50	2015	2020	2030	2050
Gross Domestic Product	100	113	139	165	193	2.04	1.75	1.57	0.00%	0.00%	0.00%	0.00%
Exports	100	117	164	218	280	3.42	2.89	2.56	0.00%	0.00%	0.00%	0.03%
Imports	100	115	149	189	233	2.68	2.38	2.12	0.00%	0.00%	0.01%	0.01%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57	0.00%	0.00%	-0.01%	-0.04%
Exports	100	117	163	217	279	3.40	2.87	2.55	0.00%	0.00%	-0.14%	-0.29%
Imports	100	115	149	188	232	2.67	2.37	2.12	0.00%	0.00%	-0.04%	-0.10%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.75	1.57	0.00%	0.00%	0.00%	0.01%
Exports	100	117	164	217	279	3.43	2.85	2.54	0.00%	0.00%	0.07%	-0.41%
Imports	100	115	149	189	233	2.68	2.39	2.13	0.00%	0.00%	0.00%	0.13%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.75	1.57	0.00%	0.00%	0.00%	0.00%
Exports	100	117	164	218	280	3.43	2.87	2.55	0.00%	0.00%	0.16%	-0.05%
Imports	100	115	149	189	233	2.67	2.38	2.12	0.00%	0.00%	-0.03%	0.02%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.05	1.75	1.57	0.00%	0.00%	0.00%	0.01%
Exports	100	117	163	217	280	3.40	2.88	2.56	0.00%	0.00%	-0.14%	-0.14%
Imports	100	115	149	189	233	2.68	2.38	2.12	0.00%	0.00%	0.08%	0.05%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.75	1.57	0.00%	0.00%	0.00%	0.00%
Exports	100	117	164	218	280	3.42	2.88	2.56	0.00%	0.00%	0.05%	0.04%
Imports	100	115	149	189	233	2.68	2.38	2.12	0.00%	0.00%	0.04%	0.04%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	113	139	165	193	2.04	1.74	1.57	0.00%	0.00%	0.00%	0.00%
Exports	100	117	164	217	280	3.41	2.88	2.55	0.00%	0.00%	-0.11%	-0.16%
Imports	100	115	149	189	233	2.68	2.37	2.12	0.00%	0.00%	0.00%	-0.07%

2.5. Japan

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.29				
Exports	100	112	137	162	194	2.01	1.74	1.79				
Imports	100	109	129	152	179	1.77	1.63	1.64				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28				
Exports	100	112	137	163	194	2.04	1.75	1.77				
Imports	100	109	130	153	179	1.78	1.64	1.63				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.00%	0.00%
Exports	100	112	137	163	194	2.04	1.75	1.77	0.00%	0.00%	0.00%	0.03%
Imports	100	109	130	153	179	1.78	1.65	1.63	0.00%	0.00%	0.02%	0.06%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.00%	-0.01%
Exports	100	112	137	163	194	2.02	1.74	1.77	0.00%	0.00%	-0.17%	-0.22%
Imports	100	109	129	152	179	1.76	1.63	1.62	0.00%	0.00%	-0.17%	-0.32%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.00%	-0.02%
Exports	100	112	137	163	194	2.02	1.74	1.77	0.00%	0.00%	-0.16%	-0.21%
Imports	100	109	129	152	179	1.76	1.63	1.62	0.00%	0.00%	-0.17%	-0.31%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	1.45	1.36	1.58	0.00%	0.00%	0.00%	0.00%
Exports	100	112	137	163	194	2.43	2.12	2.03	0.00%	0.00%	0.01%	0.04%
Imports	100	109	130	153	179	2.57	2.10	2.07	0.00%	0.00%	0.02%	0.07%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.00%	0.00%
Exports	100	112	137	163	194	2.04	1.75	1.77	0.00%	0.00%	0.00%	0.04%
Imports	100	109	130	153	179	1.78	1.65	1.63	0.00%	0.00%	0.02%	0.06%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.93	1.28	0.00%	0.00%	0.00%	-0.04%
Exports	100	112	137	162	193	2.01	1.72	1.76	0.00%	0.00%	-0.22%	-0.56%
Imports	100	109	129	152	178	1.76	1.61	1.62	0.00%	0.00%	-0.22%	-0.65%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.29	0.00%	0.00%	0.00%	0.01%
Exports	100	112	137	163	194	2.04	1.73	1.76	0.00%	0.00%	0.03%	-0.22%
Imports	100	109	130	153	180	1.78	1.65	1.64	0.00%	0.00%	0.00%	0.13%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.29	0.00%	0.00%	0.00%	0.00%
Exports	100	112	137	163	194	2.05	1.74	1.77	0.00%	0.00%	0.08%	0.00%
Imports	100	109	130	153	179	1.78	1.64	1.63	0.00%	0.00%	-0.02%	0.06%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.29	0.00%	0.00%	0.01%	0.01%
Exports	100	112	137	163	194	2.03	1.75	1.77	0.00%	0.00%	-0.06%	-0.06%
Imports	100	109	130	153	179	1.79	1.64	1.63	0.00%	0.00%	0.07%	0.06%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.00%	0.00%
Exports	100	112	137	163	194	2.03	1.75	1.77	0.00%	0.00%	-0.06%	-0.05%
Imports	100	109	130	152	179	1.77	1.64	1.63	0.00%	0.00%	-0.07%	-0.05%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	105	114	125	142	0.83	0.94	1.28	0.00%	0.00%	0.01%	0.01%
Exports	100	112	137	163	194	2.03	1.75	1.77	0.00%	0.00%	-0.04%	-0.08%
Imports	100	109	130	152	179	1.78	1.64	1.63	0.00%	0.00%	-0.01%	-0.06%

2.6. Canada

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	110	135	166	200	2.06	2.04	1.92				
Exports	100	117	148	184	226	2.38	2.20	2.08				
Imports	100	115	142	173	208	2.12	1.97	1.86				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92				
Exports	100	117	148	184	226	2.39	2.20	2.07				
Imports	100	115	142	173	208	2.11	1.97	1.86				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	148	184	226	2.39	2.20	2.08	0.00%	0.00%	0.00%	0.04%
Imports	100	115	142	173	208	2.11	1.97	1.86	0.00%	0.00%	0.01%	0.05%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	148	184	226	2.39	2.21	2.08	0.00%	0.00%	-0.01%	0.06%
Imports	100	115	142	173	208	2.12	1.97	1.86	0.00%	0.00%	0.02%	0.05%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	148	184	226	2.39	2.21	2.08	0.00%	0.00%	-0.01%	0.07%
Imports	100	115	142	173	208	2.12	1.97	1.86	0.00%	0.00%	0.02%	0.06%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.02%
Exports	100	117	148	184	226	2.43	2.12	2.03	0.00%	0.00%	0.00%	0.05%
Imports	100	115	142	173	208	2.57	2.10	2.07	0.00%	0.00%	0.01%	0.05%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	0.00%	0.00%
Exports	100	117	148	184	226	2.39	2.21	2.08	0.00%	0.00%	0.01%	0.08%
Imports	100	115	142	173	208	2.12	1.97	1.86	0.00%	0.00%	0.01%	0.07%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	0.00%	-0.01%
Exports	100	117	148	184	226	2.39	2.20	2.08	0.00%	0.00%	-0.02%	0.03%
Imports	100	115	142	173	208	2.12	1.97	1.87	0.00%	0.00%	0.03%	0.09%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	-0.01%	0.00%
Exports	100	117	148	184	225	2.39	2.19	2.07	0.00%	0.00%	-0.04%	-0.22%
Imports	100	115	142	173	208	2.11	1.97	1.87	0.00%	0.00%	-0.06%	0.04%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	-0.01%	-0.01%
Exports	100	117	148	184	226	2.39	2.20	2.08	0.00%	0.00%	-0.01%	-0.06%
Imports	100	115	142	173	208	2.11	1.97	1.86	0.00%	0.00%	-0.07%	-0.04%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.06	2.04	1.92	0.00%	0.00%	0.01%	0.01%
Exports	100	117	148	184	226	2.39	2.20	2.07	0.00%	0.00%	-0.01%	-0.03%
Imports	100	115	142	173	208	2.12	1.97	1.86	0.00%	0.00%	0.07%	0.06%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.05	2.04	1.92	0.00%	0.00%	-0.01%	-0.01%
Exports	100	117	148	184	226	2.39	2.20	2.07	0.00%	0.00%	-0.04%	-0.04%
Imports	100	115	142	173	208	2.11	1.97	1.86	0.00%	0.00%	-0.04%	-0.04%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	135	166	200	2.06	2.04	1.92	0.00%	0.00%	0.01%	0.00%
Exports	100	117	148	184	226	2.39	2.20	2.07	0.00%	0.00%	0.00%	-0.04%
Imports	100	115	142	173	208	2.12	1.97	1.86	0.00%	0.00%	0.03%	-0.01%

2.8. Brazil

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47				
Exports	100	120	168	229	299	3.40	3.12	2.70				
Imports	100	110	151	205	265	3.24	3.07	2.64				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47				
Exports	100	120	169	230	299	3.43	3.12	2.69				
Imports	100	110	151	205	266	3.24	3.08	2.64				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	-0.02%
Exports	100	120	169	229	299	3.43	3.11	2.69	0.00%	0.00%	-0.05%	-0.22%
Imports	100	110	151	205	265	3.24	3.07	2.63	0.00%	0.00%	-0.03%	-0.25%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	-0.03%
Exports	100	120	169	229	299	3.43	3.11	2.69	0.00%	0.00%	-0.07%	-0.20%
Imports	100	110	151	204	265	3.24	3.06	2.63	0.00%	0.00%	-0.03%	-0.33%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	-0.03%
Exports	100	120	169	229	299	3.43	3.11	2.69	0.00%	0.00%	-0.07%	-0.19%
Imports	100	110	151	204	265	3.24	3.06	2.63	0.00%	0.00%	-0.03%	-0.32%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.02%
Exports	100	120	169	229	299	2.43	2.12	2.03	0.00%	0.00%	-0.05%	-0.21%
Imports	100	110	151	205	265	2.57	2.10	2.07	0.00%	0.00%	-0.03%	-0.24%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	-0.02%
Exports	100	120	169	229	299	3.43	3.11	2.69	0.00%	0.00%	-0.04%	-0.19%
Imports	100	110	151	205	265	3.24	3.07	2.63	0.00%	0.00%	-0.02%	-0.24%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	-0.03%
Exports	100	120	169	229	299	3.42	3.11	2.69	0.00%	0.00%	-0.09%	-0.29%
Imports	100	110	151	204	265	3.24	3.06	2.63	0.00%	0.00%	-0.03%	-0.29%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	-0.01%	0.01%
Exports	100	120	169	229	298	3.43	3.09	2.68	0.00%	0.00%	0.00%	-0.45%
Imports	100	110	151	205	266	3.23	3.09	2.65	0.00%	0.00%	-0.11%	0.13%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	-0.01%	-0.02%
Exports	100	120	169	229	299	3.44	3.10	2.69	0.00%	0.00%	0.06%	-0.10%
Imports	100	110	151	205	265	3.23	3.08	2.64	0.00%	0.00%	-0.15%	-0.13%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.94	2.47	0.00%	0.00%	0.01%	0.02%
Exports	100	120	169	229	299	3.42	3.12	2.70	0.00%	0.00%	-0.16%	-0.16%
Imports	100	110	151	205	266	3.25	3.08	2.64	0.00%	0.00%	0.06%	0.08%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.44	2.93	2.47	0.00%	0.00%	0.01%	0.02%
Exports	100	120	169	230	300	3.47	3.11	2.70	0.00%	0.00%	0.30%	0.25%
Imports	100	110	152	205	267	3.28	3.07	2.64	0.00%	0.00%	0.35%	0.28%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	101	142	189	242	3.43	2.93	2.47	0.00%	0.00%	0.00%	0.00%
Exports	100	120	169	229	299	3.42	3.12	2.69	0.00%	0.00%	-0.14%	-0.19%
Imports	100	110	151	205	266	3.24	3.08	2.64	0.00%	0.00%	-0.01%	0.02%

2.9. China

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04				
Exports	100	131	196	270	353	4.09	3.26	2.71				
Imports	100	135	207	293	385	4.37	3.52	2.78				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04				
Exports	100	131	197	271	354	4.11	3.26	2.70				
Imports	100	135	207	293	385	4.37	3.53	2.77				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	0.00%
Exports	100	131	197	271	354	4.11	3.26	2.70	0.00%	0.00%	-0.01%	-0.02%
Imports	100	135	207	293	385	4.37	3.53	2.77	0.00%	0.00%	0.01%	0.04%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	-0.01%
Exports	100	131	196	271	353	4.11	3.26	2.70	0.00%	0.00%	-0.06%	-0.09%
Imports	100	135	207	293	385	4.37	3.52	2.77	0.00%	0.00%	-0.03%	-0.15%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	-0.01%
Exports	100	131	196	271	353	4.11	3.26	2.70	0.00%	0.00%	-0.06%	-0.09%
Imports	100	135	207	293	385	4.37	3.52	2.77	0.00%	0.00%	-0.04%	-0.16%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	1.45	1.36	1.58	0.00%	0.00%	0.00%	0.00%
Exports	100	131	197	271	353	2.43	2.12	2.03	0.00%	0.00%	-0.02%	-0.02%
Imports	100	135	207	293	385	2.57	2.10	2.07	0.00%	0.00%	0.01%	0.04%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	0.00%
Exports	100	131	197	271	354	4.11	3.26	2.70	0.00%	0.00%	-0.01%	0.01%
Imports	100	135	207	293	386	4.37	3.53	2.77	0.00%	0.00%	0.02%	0.06%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	-0.02%
Exports	100	131	196	271	353	4.11	3.25	2.69	0.00%	0.00%	-0.07%	-0.24%
Imports	100	135	207	293	384	4.37	3.52	2.76	0.00%	0.00%	-0.04%	-0.27%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	-0.01%	0.00%
Exports	100	131	197	270	353	4.12	3.24	2.68	0.00%	0.00%	0.08%	-0.29%
Imports	100	135	207	293	386	4.37	3.53	2.78	0.00%	0.00%	-0.03%	0.11%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	-0.01%	-0.01%
Exports	100	131	197	271	354	4.13	3.25	2.70	0.00%	0.00%	0.14%	0.02%
Imports	100	135	207	293	385	4.37	3.53	2.78	0.00%	0.00%	-0.05%	-0.03%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	305	373	4.95	3.24	2.03	0.00%	0.00%	-0.16%	-0.25%
Exports	100	131	197	272	354	4.15	3.25	2.69	0.00%	0.00%	0.32%	0.21%
Imports	100	135	207	292	384	4.34	3.52	2.77	0.00%	0.00%	-0.34%	-0.38%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.01%	0.01%
Exports	100	131	197	271	354	4.13	3.26	2.70	0.00%	0.00%	0.17%	0.16%
Imports	100	135	208	294	386	4.39	3.53	2.77	0.00%	0.00%	0.19%	0.18%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	137	222	306	374	4.97	3.24	2.04	0.00%	0.00%	0.00%	0.00%
Exports	100	131	196	270	353	4.10	3.26	2.69	0.00%	0.00%	-0.17%	-0.25%
Imports	100	135	207	293	385	4.36	3.53	2.77	0.00%	0.00%	-0.08%	-0.10%

2.10. India

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50				
Exports	100	161	263	391	548	5.01	4.03	3.45				
Imports	100	153	268	430	652	5.81	4.83	4.25				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50				
Exports	100	161	264	392	549	5.05	4.03	3.42				
Imports	100	153	268	430	652	5.81	4.84	4.24				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	-0.01%	-0.09%
Exports	100	161	264	389	542	5.02	3.97	3.37	0.00%	0.00%	-0.24%	-1.30%
Imports	100	153	268	427	644	5.79	4.78	4.20	0.00%	0.00%	-0.22%	-1.13%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	-0.01%	-0.09%
Exports	100	161	263	389	542	5.02	3.97	3.38	0.00%	0.00%	-0.28%	-1.27%
Imports	100	153	268	427	644	5.79	4.78	4.20	0.00%	0.00%	-0.21%	-1.16%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	-0.01%	-0.09%
Exports	100	161	263	389	542	5.02	3.98	3.38	0.00%	0.00%	-0.27%	-1.23%
Imports	100	153	268	427	644	5.79	4.78	4.20	0.00%	0.00%	-0.21%	-1.13%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	1.45	1.36	1.58	0.00%	0.00%	-0.01%	-0.09%
Exports	100	161	264	389	542	2.43	2.12	2.03	0.00%	0.00%	-0.23%	-1.26%
Imports	100	153	268	427	645	2.57	2.10	2.07	0.00%	0.00%	-0.21%	-1.10%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	-0.01%	-0.08%
Exports	100	161	264	389	542	5.02	3.97	3.38	0.00%	0.00%	-0.23%	-1.22%
Imports	100	153	268	427	645	5.79	4.78	4.20	0.00%	0.00%	-0.21%	-1.07%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.28	4.50	0.00%	0.00%	-0.02%	-0.10%
Exports	100	161	263	389	542	5.02	3.97	3.37	0.00%	0.00%	-0.30%	-1.37%
Imports	100	153	268	427	645	5.79	4.78	4.20	0.00%	0.00%	-0.22%	-1.07%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	0.00%	0.01%
Exports	100	161	264	391	547	5.05	4.00	3.41	0.00%	0.00%	0.00%	-0.47%
Imports	100	153	268	430	653	5.80	4.84	4.26	0.00%	0.00%	-0.09%	0.14%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	790	6.97	5.29	4.50	0.00%	0.00%	0.00%	0.00%
Exports	100	161	264	392	549	5.06	4.02	3.43	0.00%	0.00%	0.08%	-0.02%
Imports	100	153	268	430	652	5.80	4.84	4.25	0.00%	0.00%	-0.10%	0.00%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	791	6.97	5.29	4.50	0.00%	0.00%	0.01%	0.02%
Exports	100	161	264	392	549	5.04	4.03	3.42	0.00%	0.00%	-0.05%	0.00%
Imports	100	153	269	431	653	5.83	4.84	4.24	0.00%	0.00%	0.15%	0.25%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	304	509	791	6.97	5.29	4.50	0.00%	0.00%	0.02%	0.03%
Exports	100	161	265	394	551	5.09	4.02	3.42	0.00%	0.00%	0.41%	0.28%
Imports	100	153	270	432	653	5.86	4.82	4.23	0.00%	0.00%	0.44%	0.25%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	155	303	508	788	6.95	5.28	4.49	0.00%	0.00%	-0.17%	-0.32%
Exports	100	161	262	387	539	4.96	3.99	3.37	0.00%	0.00%	-0.86%	-1.81%
Imports	100	153	265	424	639	5.70	4.79	4.19	0.00%	0.00%	-1.08%	-1.93%

2.11. Republic of Korea

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	123	174	214	249	3.51	2.09	1.53				
Exports	100	118	157	195	232	2.85	2.21	1.76				
Imports	100	117	155	195	232	2.90	2.29	1.78				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53				
Exports	100	118	157	196	233	2.89	2.23	1.75				
Imports	100	117	156	196	233	2.93	2.31	1.77				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.00%	0.01%
Exports	100	118	157	196	233	2.89	2.23	1.75	0.00%	0.00%	0.00%	-0.01%
Imports	100	117	156	196	233	2.93	2.31	1.77	0.00%	0.00%	0.02%	0.02%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.09	1.53	0.00%	0.00%	-0.01%	-0.03%
Exports	100	118	157	196	233	2.87	2.22	1.75	0.00%	0.00%	-0.11%	-0.21%
Imports	100	117	156	195	233	2.91	2.30	1.76	0.00%	0.00%	-0.13%	-0.28%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.09	1.53	0.00%	0.00%	-0.01%	-0.03%
Exports	100	118	157	196	233	2.88	2.22	1.75	0.00%	0.00%	-0.10%	-0.19%
Imports	100	117	156	195	233	2.91	2.30	1.76	0.00%	0.00%	-0.12%	-0.26%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	1.45	1.36	1.58	0.00%	0.00%	0.00%	0.00%
Exports	100	118	157	196	233	2.43	2.12	2.03	0.00%	0.00%	0.01%	0.02%
Imports	100	117	156	196	233	2.57	2.10	2.07	0.00%	0.00%	0.03%	0.05%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.00%	0.01%
Exports	100	118	157	196	233	2.89	2.23	1.75	0.00%	0.00%	0.00%	0.00%
Imports	100	117	156	196	233	2.93	2.31	1.77	0.00%	0.00%	0.01%	0.02%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.09	1.52	0.00%	0.00%	-0.01%	-0.10%
Exports	100	118	157	195	232	2.87	2.21	1.74	0.00%	0.00%	-0.15%	-0.45%
Imports	100	117	156	195	232	2.91	2.29	1.76	0.00%	0.00%	-0.16%	-0.47%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.00%	0.01%
Exports	100	118	157	196	233	2.89	2.22	1.75	0.00%	0.00%	0.00%	-0.16%
Imports	100	117	156	196	233	2.92	2.31	1.77	0.00%	0.00%	-0.03%	0.02%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	196	233	2.89	2.22	1.75	0.00%	0.00%	0.03%	-0.03%
Imports	100	117	156	196	233	2.92	2.31	1.77	0.00%	0.00%	-0.04%	-0.04%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.01%	0.02%
Exports	100	118	157	196	233	2.89	2.23	1.75	0.00%	0.00%	0.02%	0.00%
Imports	100	117	156	196	234	2.94	2.31	1.77	0.00%	0.00%	0.11%	0.09%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	0.00%	0.00%
Exports	100	118	157	196	233	2.89	2.23	1.74	0.00%	0.00%	0.07%	0.00%
Imports	100	117	156	196	233	2.93	2.31	1.76	0.00%	0.00%	0.08%	0.00%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	123	174	214	249	3.51	2.10	1.53	0.00%	0.00%	-0.02%	-0.04%
Exports	100	118	157	196	233	2.87	2.22	1.75	0.00%	0.00%	-0.13%	-0.20%
Imports	100	117	156	195	233	2.91	2.30	1.76	0.00%	0.00%	-0.15%	-0.24%

2.12. Indonesia

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.53				
Exports	100	123	188	270	375	4.37	3.68	3.31				
Imports	100	129	204	298	416	4.68	3.87	3.38				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52				
Exports	100	123	189	271	375	4.39	3.68	3.30				
Imports	100	129	204	298	416	4.68	3.87	3.38				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	189	271	375	4.39	3.67	3.30	0.00%	0.00%	-0.02%	-0.09%
Imports	100	129	204	298	415	4.68	3.86	3.37	0.00%	0.00%	-0.01%	-0.12%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	189	271	375	4.39	3.68	3.30	0.00%	0.00%	0.00%	0.01%
Imports	100	129	204	298	416	4.69	3.86	3.38	0.00%	0.00%	0.08%	-0.03%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	189	271	375	4.39	3.68	3.30	0.00%	0.00%	0.01%	0.02%
Imports	100	129	204	298	416	4.69	3.86	3.38	0.00%	0.00%	0.09%	-0.01%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	189	271	375	2.43	2.12	2.03	0.00%	0.00%	-0.02%	-0.08%
Imports	100	129	204	298	415	2.57	2.10	2.07	0.00%	0.00%	-0.01%	-0.11%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	0.00%
Exports	100	123	189	271	375	4.39	3.67	3.30	0.00%	0.00%	-0.01%	-0.01%
Imports	100	129	204	298	415	4.68	3.87	3.38	0.00%	0.00%	-0.01%	-0.06%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	189	271	375	4.39	3.68	3.30	0.00%	0.00%	0.00%	0.01%
Imports	100	129	204	299	416	4.69	3.87	3.38	0.00%	0.00%	0.11%	0.17%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.53	0.00%	0.00%	0.00%	0.01%
Exports	100	123	189	270	374	4.39	3.65	3.29	0.00%	0.00%	0.03%	-0.37%
Imports	100	129	204	298	416	4.67	3.88	3.39	0.00%	0.00%	-0.07%	0.11%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	-0.01%	-0.01%
Exports	100	123	189	271	375	4.40	3.67	3.30	0.00%	0.00%	0.09%	-0.05%
Imports	100	129	204	298	415	4.67	3.87	3.38	0.00%	0.00%	-0.10%	-0.07%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.53	0.00%	0.00%	0.01%	0.02%
Exports	100	123	189	271	374	4.38	3.67	3.30	0.00%	0.00%	-0.13%	-0.14%
Imports	100	129	204	298	416	4.69	3.87	3.38	0.00%	0.00%	0.07%	0.08%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	0.00%
Exports	100	123	189	271	375	4.39	3.67	3.30	0.00%	0.00%	0.00%	-0.02%
Imports	100	129	204	298	415	4.68	3.87	3.38	0.00%	0.00%	-0.02%	-0.05%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	125	195	287	405	4.55	3.92	3.52	0.00%	0.00%	0.00%	0.00%
Exports	100	123	188	270	374	4.37	3.67	3.30	0.00%	0.00%	-0.23%	-0.32%
Imports	100	129	204	298	415	4.66	3.87	3.38	0.00%	0.00%	-0.18%	-0.21%

2.13. Mexico

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	110	152	209	275	3.23	3.25	2.78				
Exports	100	118	159	209	269	3.04	2.78	2.54				
Imports	100	117	157	204	260	2.92	2.70	2.45				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78				
Exports	100	118	159	210	269	3.05	2.78	2.53				
Imports	100	117	156	204	260	2.92	2.70	2.45				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.00%
Exports	100	118	159	210	269	3.05	2.78	2.54	0.00%	0.00%	0.00%	0.03%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.00%	0.04%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.00%
Exports	100	118	159	210	269	3.05	2.78	2.54	0.00%	0.00%	0.00%	0.08%
Imports	100	117	157	204	260	2.92	2.70	2.45	0.00%	0.00%	0.02%	0.04%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	159	210	269	3.05	2.78	2.54	0.00%	0.00%	-0.01%	0.07%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.01%	0.03%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	1.45	1.36	1.58	0.00%	0.00%	0.00%	0.00%
Exports	100	118	159	210	269	2.43	2.12	2.03	0.00%	0.00%	-0.01%	0.02%
Imports	100	117	156	204	260	2.57	2.10	2.07	0.00%	0.00%	0.00%	0.03%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.00%
Exports	100	118	159	210	269	3.05	2.78	2.54	0.00%	0.00%	0.00%	0.03%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.00%	0.03%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	159	210	269	3.05	2.78	2.54	0.00%	0.00%	0.00%	0.04%
Imports	100	117	157	204	260	2.92	2.70	2.45	0.00%	0.00%	0.02%	0.08%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.01%
Exports	100	118	159	209	269	3.06	2.76	2.52	0.00%	0.00%	0.05%	-0.24%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.00%	0.05%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	151	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.00%
Exports	100	118	160	210	269	3.06	2.77	2.53	0.00%	0.00%	0.09%	0.01%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.00%	0.01%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.01%	0.01%
Exports	100	118	159	209	269	3.04	2.78	2.53	0.00%	0.00%	-0.11%	-0.12%
Imports	100	117	156	204	260	2.92	2.70	2.45	0.00%	0.00%	0.00%	0.00%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	151	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	0.00%
Exports	100	118	159	210	269	3.05	2.78	2.53	0.00%	0.00%	0.00%	0.00%
Imports	100	117	156	204	260	2.91	2.70	2.45	0.00%	0.00%	-0.02%	-0.02%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	110	152	209	274	3.23	3.25	2.78	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	159	209	269	3.04	2.78	2.53	0.00%	0.00%	-0.08%	-0.14%
Imports	100	117	156	204	260	2.91	2.70	2.44	0.00%	0.00%	-0.05%	-0.12%

2.14. Argentina

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	112	150	197	244	2.98	2.73	2.19				
Exports	100	113	163	223	291	3.77	3.16	2.68				
Imports	100	122	169	222	276	3.33	2.76	2.22				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	00	112	150	197	244	2.98	2.73	2.19				
Exports	100	113	164	224	291	3.81	3.15	2.67				
Imports	100	122	169	222	277	3.34	2.76	2.21				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	3.81	3.14	2.67	0.00%	0.00%	-0.04%	-0.13%
Imports	100	122	169	222	276	3.34	2.75	2.21	0.00%	0.00%	-0.02%	-0.14%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	3.81	3.14	2.67	0.00%	0.00%	-0.04%	-0.05%
Imports	100	122	169	222	276	3.34	2.75	2.21	0.00%	0.00%	0.02%	-0.13%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	3.81	3.15	2.67	0.00%	0.00%	-0.03%	-0.04%
Imports	100	122	169	222	276	3.34	2.75	2.21	0.00%	0.00%	0.02%	-0.12%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	2.43	2.12	2.03	0.00%	0.00%	-0.03%	-0.12%
Imports	100	122	169	222	276	2.57	2.10	2.07	0.00%	0.00%	-0.02%	-0.13%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	3.81	3.14	2.67	0.00%	0.00%	-0.04%	-0.10%
Imports	100	122	169	222	276	3.34	2.75	2.21	0.00%	0.00%	-0.02%	-0.12%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	197	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.02%
Exports	100	113	164	224	291	3.81	3.14	2.67	0.00%	0.00%	-0.04%	-0.07%
Imports	100	122	169	222	277	3.34	2.75	2.21	0.00%	0.00%	0.03%	-0.05%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	197	244	2.98	2.73	2.19	0.00%	0.00%	-0.01%	0.00%
Exports	100	113	164	223	290	3.81	3.12	2.66	0.00%	0.00%	0.00%	-0.45%
Imports	100	122	169	222	277	3.33	2.76	2.22	0.00%	0.00%	-0.09%	0.03%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	-0.01%	-0.02%
Exports	100	113	164	224	291	3.82	3.13	2.67	0.00%	0.00%	0.07%	-0.11%
Imports	100	122	169	222	276	3.33	2.76	2.21	0.00%	0.00%	-0.12%	-0.12%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	197	244	2.98	2.73	2.19	0.00%	0.00%	0.01%	0.01%
Exports	100	113	164	223	291	3.79	3.15	2.67	0.00%	0.00%	-0.17%	-0.16%
Imports	100	122	169	222	277	3.35	2.76	2.21	0.00%	0.00%	0.04%	0.05%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	196	244	2.98	2.73	2.19	0.00%	0.00%	-0.01%	-0.01%
Exports	100	113	164	224	291	3.80	3.15	2.67	0.00%	0.00%	-0.07%	-0.05%
Imports	100	122	169	222	277	3.33	2.76	2.21	0.00%	0.00%	-0.06%	-0.06%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	112	150	197	244	2.98	2.73	2.19	0.00%	0.00%	0.00%	-0.01%
Exports	100	113	164	223	291	3.80	3.14	2.67	0.00%	0.00%	-0.12%	-0.18%
Imports	100	122	169	222	277	3.34	2.75	2.21	0.00%	0.00%	-0.01%	-0.06%

2.15. Turkey

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	129	192	255	308	4.06	2.89	1.92				
Exports	100	134	186	247	312	3.36	2.86	2.38				
Imports	100	123	170	225	280	3.29	2.82	2.23				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92				
Exports	100	134	186	246	311	3.34	2.85	2.38				
Imports	100	123	170	224	279	3.25	2.82	2.24				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.91	0.00%	0.00%	0.00%	-0.02%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	-0.02%	-0.17%
Imports	100	123	170	224	279	3.25	2.81	2.22	0.00%	0.00%	-0.02%	-0.23%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.91	0.00%	0.00%	0.01%	-0.01%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	0.00%	-0.08%
Imports	100	123	170	224	279	3.25	2.81	2.22	0.00%	0.00%	0.02%	-0.17%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.91	0.00%	0.00%	0.00%	-0.02%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	-0.03%	-0.10%
Imports	100	123	170	224	279	3.25	2.81	2.22	0.00%	0.00%	-0.02%	-0.21%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.04%
Exports	100	134	186	246	310	2.43	2.12	2.03	0.00%	0.00%	-0.05%	-0.19%
Imports	100	123	170	224	279	2.57	2.10	2.07	0.00%	0.00%	-0.06%	-0.27%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.91	0.00%	0.00%	0.00%	-0.02%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	-0.02%	-0.16%
Imports	100	123	170	224	279	3.25	2.81	2.22	0.00%	0.00%	-0.02%	-0.22%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	0.01%	0.00%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	-0.01%	-0.07%
Imports	100	123	170	224	279	3.25	2.82	2.22	0.00%	0.00%	0.04%	-0.09%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	-0.01%	-0.01%
Exports	100	134	186	245	310	3.35	2.83	2.36	0.00%	0.00%	0.07%	-0.35%
Imports	100	123	170	224	279	3.25	2.82	2.23	0.00%	0.00%	0.02%	-0.04%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	-0.01%	-0.02%
Exports	100	134	186	246	311	3.36	2.84	2.37	0.00%	0.00%	0.13%	-0.09%
Imports	100	123	170	224	279	3.25	2.81	2.23	0.00%	0.00%	0.01%	-0.11%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	0.01%	0.01%
Exports	100	134	185	246	311	3.33	2.85	2.38	0.00%	0.00%	-0.09%	-0.08%
Imports	100	123	170	224	280	3.26	2.82	2.23	0.00%	0.00%	0.06%	0.05%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	0.00%	0.00%
Exports	100	134	186	246	311	3.34	2.85	2.38	0.00%	0.00%	-0.03%	-0.03%
Imports	100	123	170	224	279	3.25	2.82	2.23	0.00%	0.00%	-0.04%	-0.05%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	129	191	255	308	4.06	2.89	1.92	0.00%	0.00%	0.00%	0.00%
Exports	100	134	186	246	311	3.34	2.85	2.37	0.00%	0.00%	-0.05%	-0.09%
Imports	100	123	170	224	279	3.25	2.82	2.23	0.00%	0.00%	0.02%	-0.01%

2.16. Saudi Arabia

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	106	140	185	232	2.85	2.84	2.27				
Exports	100	106	146	189	231	3.26	2.63	2.03				
Imports	100	107	159	205	247	4.06	2.53	1.91				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.27				
Exports	100	106	145	188	230	3.23	2.63	2.02				
Imports	100	107	159	204	246	4.03	2.53	1.91				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.26	0.00%	0.00%	-0.01%	-0.10%
Exports	100	106	145	187	229	3.22	2.60	2.00	0.00%	0.00%	-0.09%	-0.54%
Imports	100	107	159	203	245	4.02	2.50	1.88	0.00%	0.00%	-0.12%	-0.64%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.26	0.00%	0.00%	-0.01%	-0.11%
Exports	100	106	145	187	229	3.21	2.60	2.00	0.00%	0.00%	-0.11%	-0.56%
Imports	100	107	159	203	245	4.02	2.50	1.88	0.00%	0.00%	-0.13%	-0.65%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.26	0.00%	0.00%	-0.01%	-0.11%
Exports	100	106	145	187	229	3.22	2.60	2.00	0.00%	0.00%	-0.10%	-0.55%
Imports	100	107	159	203	245	4.02	2.50	1.88	0.00%	0.00%	-0.11%	-0.68%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	1.45	1.36	1.58	0.00%	0.00%	-0.01%	-0.10%
Exports	100	106	145	188	229	2.43	2.12	2.03	0.00%	0.00%	-0.07%	-0.54%
Imports	100	107	159	203	245	2.57	2.10	2.07	0.00%	0.00%	-0.10%	-0.66%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.26	0.00%	0.00%	-0.01%	-0.10%
Exports	100	106	145	187	229	3.22	2.60	2.01	0.00%	0.00%	-0.09%	-0.50%
Imports	100	107	159	203	245	4.02	2.50	1.89	0.00%	0.00%	-0.11%	-0.59%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.26	0.00%	0.00%	-0.02%	-0.12%
Exports	100	106	145	187	228	3.21	2.60	2.00	0.00%	0.00%	-0.13%	-0.58%
Imports	100	107	159	203	245	4.02	2.50	1.89	0.00%	0.00%	-0.14%	-0.61%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.27	0.00%	0.00%	-0.01%	-0.01%
Exports	100	106	145	188	230	3.22	2.62	2.03	0.00%	0.00%	-0.07%	-0.05%
Imports	100	107	159	204	247	4.02	2.55	1.92	0.00%	0.00%	-0.10%	0.20%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.27	0.00%	0.00%	-0.01%	-0.02%
Exports	100	106	145	188	230	3.22	2.63	2.03	0.00%	0.00%	-0.06%	0.00%
Imports	100	107	159	204	247	4.02	2.54	1.91	0.00%	0.00%	-0.12%	0.08%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.27	0.00%	0.00%	-0.01%	0.03%
Exports	100	106	145	188	230	3.24	2.63	2.02	0.00%	0.00%	0.18%	0.19%
Imports	100	107	159	205	247	4.07	2.53	1.90	0.00%	0.00%	0.35%	0.34%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	140	185	231	2.84	2.84	2.27	0.00%	0.00%	0.00%	-0.05%
Exports	100	106	145	188	229	3.20	2.62	2.02	0.00%	0.00%	-0.21%	-0.30%
Imports	100	107	158	203	245	4.00	2.53	1.90	0.00%	0.00%	-0.33%	-0.39%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	106	139	184	231	2.83	2.84	2.27	0.00%	0.00%	-0.14%	-0.22%
Exports	100	106	145	188	230	3.23	2.63	2.02	0.00%	0.00%	0.05%	0.04%
Imports	100	107	160	205	248	4.08	2.54	1.92	0.00%	0.00%	0.50%	0.78%

2.17. Oceania

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33				
Exports	100	118	157	206	266	2.85	2.80	2.57				
Imports	100	119	158	209	266	2.92	2.79	2.48				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33				
Exports	100	118	157	207	266	2.87	2.80	2.56				
Imports	100	119	158	208	267	2.91	2.80	2.49				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	206	266	2.87	2.79	2.56	0.00%	0.00%	-0.02%	-0.09%
Imports	100	119	158	208	266	2.91	2.79	2.49	0.00%	0.00%	-0.01%	-0.09%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	207	266	2.86	2.80	2.56	0.00%	0.00%	-0.04%	-0.06%
Imports	100	119	158	208	266	2.91	2.79	2.49	0.00%	0.00%	-0.01%	-0.14%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	207	266	2.87	2.80	2.56	0.00%	0.00%	-0.02%	-0.02%
Imports	100	119	158	208	266	2.91	2.79	2.49	0.00%	0.00%	0.00%	-0.10%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	207	266	2.43	2.12	2.03	0.00%	0.00%	-0.01%	-0.05%
Imports	100	119	158	208	267	2.57	2.10	2.07	0.00%	0.00%	0.00%	-0.05%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	207	266	2.87	2.80	2.56	0.00%	0.00%	-0.02%	-0.05%
Imports	100	119	158	208	266	2.91	2.80	2.49	0.00%	0.00%	-0.01%	-0.06%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	206	266	2.86	2.80	2.56	0.00%	0.00%	-0.05%	-0.10%
Imports	100	119	158	208	266	2.91	2.79	2.49	0.00%	0.00%	-0.02%	-0.12%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.74	2.67	2.33	0.00%	0.00%	-0.01%	0.01%
Exports	100	118	157	206	265	2.87	2.78	2.55	0.00%	0.00%	-0.01%	-0.34%
Imports	100	119	158	208	267	2.90	2.81	2.50	0.00%	0.00%	-0.08%	0.07%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.74	2.67	2.33	0.00%	0.00%	-0.01%	-0.01%
Exports	100	118	157	206	266	2.87	2.79	2.56	0.00%	0.00%	0.03%	-0.11%
Imports	100	119	158	208	266	2.90	2.80	2.49	0.00%	0.00%	-0.11%	-0.10%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	0.01%
Exports	100	118	157	206	266	2.86	2.80	2.56	0.00%	0.00%	-0.10%	-0.12%
Imports	100	119	158	209	267	2.92	2.80	2.49	0.00%	0.00%	0.06%	0.04%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	-0.01%
Exports	100	118	157	207	266	2.86	2.80	2.56	0.00%	0.00%	-0.05%	-0.04%
Imports	100	119	158	208	266	2.90	2.80	2.49	0.00%	0.00%	-0.08%	-0.08%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	115	151	197	248	2.75	2.67	2.33	0.00%	0.00%	0.00%	0.01%
Exports	100	118	157	206	266	2.86	2.80	2.56	0.00%	0.00%	-0.07%	-0.08%
Imports	100	119	158	209	267	2.92	2.80	2.49	0.00%	0.00%	0.05%	0.07%

2.18. Russian Federation

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	100	123	144	165	2.07	1.60	1.36				
Exports	100	109	140	169	200	2.52	1.93	1.71				
Imports	100	114	146	178	212	2.57	1.95	1.79				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	100	123	143	164	2.05	1.59	1.34				
Exports	100	109	139	168	198	2.46	1.92	1.69				
Imports	100	114	144	175	210	2.42	1.98	1.82				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	2.03	1.55	1.33	0.00%	0.00%	-0.18%	-0.66%
Exports	100	109	138	165	194	2.38	1.80	1.67	0.00%	0.00%	-0.79%	-2.05%
Imports	100	114	143	173	207	2.36	1.89	1.81	0.00%	0.00%	-0.64%	-1.64%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	2.03	1.55	1.33	0.00%	0.00%	-0.19%	-0.67%
Exports	100	109	138	165	194	2.37	1.81	1.68	0.00%	0.00%	-0.83%	-2.05%
Imports	100	114	143	173	207	2.36	1.88	1.81	0.00%	0.00%	-0.66%	-1.65%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	2.03	1.55	1.33	0.00%	0.00%	-0.19%	-0.67%
Exports	100	109	138	165	194	2.38	1.81	1.67	0.00%	0.00%	-0.82%	-2.04%
Imports	100	114	143	173	207	2.36	1.89	1.81	0.00%	0.00%	-0.66%	-1.65%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	1.45	1.36	1.58	0.00%	0.00%	-0.18%	-0.66%
Exports	100	109	138	165	194	2.43	2.12	2.03	0.00%	0.00%	-0.78%	-2.03%
Imports	100	114	143	173	207	2.57	2.10	2.07	0.00%	0.00%	-0.64%	-1.64%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	2.03	1.55	1.33	0.00%	0.00%	-0.18%	-0.63%
Exports	100	109	138	165	195	2.38	1.81	1.68	0.00%	0.00%	-0.77%	-1.96%
Imports	100	114	143	173	207	2.36	1.89	1.81	0.00%	0.00%	-0.61%	-1.54%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	122	143	163	2.03	1.55	1.33	0.00%	0.00%	-0.20%	-0.68%
Exports	100	109	138	165	194	2.37	1.80	1.68	0.00%	0.00%	-0.87%	-2.09%
Imports	100	114	143	173	207	2.35	1.89	1.81	0.00%	0.00%	-0.69%	-1.60%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	123	143	164	2.05	1.59	1.35	0.00%	0.00%	-0.03%	0.00%
Exports	100	109	139	168	198	2.45	1.92	1.69	0.00%	0.00%	-0.12%	-0.13%
Imports	100	114	144	175	210	2.41	1.99	1.83	0.00%	0.00%	-0.11%	0.08%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	123	143	164	2.05	1.59	1.35	0.00%	0.00%	-0.03%	-0.01%
Exports	100	109	139	168	198	2.45	1.92	1.69	0.00%	0.00%	-0.10%	-0.03%
Imports	100	114	144	175	210	2.41	1.98	1.82	0.00%	0.00%	-0.14%	-0.07%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	123	144	164	2.06	1.59	1.34	0.00%	0.00%	0.04%	0.07%
Exports	100	109	139	168	199	2.47	1.92	1.69	0.00%	0.00%	0.11%	0.11%
Imports	100	114	145	176	210	2.44	1.98	1.81	0.00%	0.00%	0.20%	0.16%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	123	143	164	2.05	1.59	1.34	0.00%	0.00%	-0.03%	-0.07%
Exports	100	109	139	168	198	2.45	1.92	1.68	0.00%	0.00%	-0.14%	-0.20%
Imports	100	114	144	175	210	2.41	1.98	1.81	0.00%	0.00%	-0.13%	-0.15%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	100	123	144	164	2.06	1.59	1.35	0.00%	0.00%	0.09%	0.23%
Exports	100	109	139	169	200	2.49	1.94	1.70	0.00%	0.00%	0.27%	0.60%
Imports	100	114	145	176	211	2.44	1.99	1.83	0.00%	0.00%	0.19%	0.34%

2.19. Rest of Energy Producing Countries

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	117	169	234	303	3.76	3.30	2.58				
Exports	100	113	166	231	308	3.87	3.41	2.91				
Imports	100	119	176	244	326	3.98	3.30	2.94				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58				
Exports	100	113	165	230	307	3.82	3.41	2.91				
Imports	100	119	175	243	325	3.92	3.31	2.95				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.06%
Exports	100	113	165	230	306	3.81	3.39	2.90	0.00%	0.00%	-0.09%	-0.42%
Imports	100	119	175	242	324	3.91	3.29	2.94	0.00%	0.00%	-0.09%	-0.44%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.07%
Exports	100	113	165	230	306	3.80	3.39	2.90	0.00%	0.00%	-0.13%	-0.42%
Imports	100	119	175	242	324	3.90	3.29	2.94	0.00%	0.00%	-0.10%	-0.46%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.08%
Exports	100	113	165	230	306	3.81	3.39	2.90	0.00%	0.00%	-0.12%	-0.44%
Imports	100	119	175	242	323	3.91	3.29	2.94	0.00%	0.00%	-0.10%	-0.49%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	1.45	1.36	1.58	0.00%	0.00%	-0.01%	-0.07%
Exports	100	113	165	230	306	2.43	2.12	2.03	0.00%	0.00%	-0.09%	-0.44%
Imports	100	119	175	242	324	2.57	2.10	2.07	0.00%	0.00%	-0.09%	-0.47%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.06%
Exports	100	113	165	230	306	3.81	3.39	2.90	0.00%	0.00%	-0.09%	-0.43%
Imports	100	119	175	242	324	3.91	3.29	2.94	0.00%	0.00%	-0.10%	-0.46%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.08%
Exports	100	113	164	230	306	3.80	3.39	2.90	0.00%	0.00%	-0.15%	-0.45%
Imports	100	119	175	242	324	3.90	3.29	2.94	0.00%	0.00%	-0.11%	-0.41%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	0.00%	0.02%
Exports	100	113	165	230	307	3.82	3.40	2.91	0.00%	0.00%	-0.03%	-0.12%
Imports	100	119	175	243	326	3.91	3.33	2.97	0.00%	0.00%	-0.06%	0.22%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	0.00%
Exports	100	113	165	230	307	3.82	3.41	2.92	0.00%	0.00%	0.00%	0.01%
Imports	100	119	175	243	325	3.91	3.32	2.96	0.00%	0.00%	-0.09%	0.07%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	0.00%	0.01%
Exports	100	113	165	231	307	3.83	3.41	2.91	0.00%	0.00%	0.09%	0.08%
Imports	100	119	176	244	326	3.94	3.31	2.95	0.00%	0.00%	0.25%	0.23%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	302	3.75	3.30	2.58	0.00%	0.00%	-0.01%	-0.03%
Exports	100	113	164	230	306	3.80	3.41	2.91	0.00%	0.00%	-0.22%	-0.26%
Imports	100	119	175	242	324	3.89	3.31	2.95	0.00%	0.00%	-0.26%	-0.29%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	117	169	234	301	3.74	3.30	2.57	0.00%	0.00%	-0.07%	-0.18%
Exports	100	113	164	230	306	3.80	3.40	2.90	0.00%	0.00%	-0.18%	-0.43%
Imports	100	119	175	243	325	3.92	3.31	2.95	0.00%	0.00%	0.01%	-0.08%

2.20. South Africa

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	107	132	175	221	2.17	2.83	2.35				
Exports	100	115	147	192	248	2.49	2.76	2.58				
Imports	100	115	150	199	255	2.69	2.83	2.50				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	107	132	175	221	2.17	2.82	2.35				
Exports	100	115	147	192	248	2.49	2.76	2.58				
Imports	100	115	150	199	255	2.67	2.84	2.52				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	2.17	2.82	2.35	0.00%	0.00%	-0.02%	-0.09%
Exports	100	115	146	192	247	2.48	2.73	2.58	0.00%	0.00%	-0.12%	-0.42%
Imports	100	115	150	198	253	2.66	2.81	2.51	0.00%	0.00%	-0.15%	-0.54%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	2.17	2.82	2.35	0.00%	0.00%	-0.02%	-0.08%
Exports	100	115	146	192	247	2.48	2.74	2.58	0.00%	0.00%	-0.12%	-0.39%
Imports	100	115	150	198	253	2.66	2.81	2.51	0.00%	0.00%	-0.11%	-0.50%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	2.17	2.82	2.35	0.00%	0.00%	-0.02%	-0.10%
Exports	100	115	146	192	247	2.48	2.74	2.58	0.00%	0.00%	-0.12%	-0.37%
Imports	100	115	150	198	254	2.66	2.81	2.51	0.00%	0.00%	-0.11%	-0.48%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	1.45	1.36	1.58	0.00%	0.00%	-0.02%	-0.10%
Exports	100	115	146	192	247	2.43	2.12	2.03	0.00%	0.00%	-0.12%	-0.40%
Imports	100	115	150	198	253	2.57	2.10	2.07	0.00%	0.00%	-0.15%	-0.52%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	2.17	2.82	2.35	0.00%	0.00%	-0.02%	-0.08%
Exports	100	115	146	192	247	2.48	2.74	2.58	0.00%	0.00%	-0.12%	-0.37%
Imports	100	115	150	198	253	2.66	2.81	2.51	0.00%	0.00%	-0.15%	-0.50%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	220	2.17	2.82	2.35	0.00%	0.00%	-0.01%	-0.08%
Exports	100	115	146	192	247	2.48	2.74	2.58	0.00%	0.00%	-0.12%	-0.38%
Imports	100	115	150	198	254	2.66	2.81	2.51	0.00%	0.00%	-0.10%	-0.40%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	221	2.17	2.82	2.35	0.00%	0.00%	0.00%	0.00%
Exports	100	115	147	192	248	2.49	2.75	2.57	0.00%	0.00%	-0.02%	-0.24%
Imports	100	115	150	199	255	2.67	2.84	2.52	0.00%	0.00%	-0.06%	-0.04%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	221	2.17	2.82	2.35	0.00%	0.00%	0.00%	-0.02%
Exports	100	115	147	192	248	2.49	2.75	2.58	0.00%	0.00%	0.00%	-0.14%
Imports	100	115	150	198	254	2.67	2.84	2.51	0.00%	0.00%	-0.07%	-0.16%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	221	2.17	2.83	2.35	0.00%	0.00%	0.00%	0.02%
Exports	100	115	147	192	248	2.49	2.76	2.58	0.00%	0.00%	-0.03%	-0.04%
Imports	100	115	150	199	255	2.68	2.84	2.52	0.00%	0.00%	0.08%	0.05%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	221	2.17	2.82	2.35	0.00%	0.00%	-0.01%	-0.02%
Exports	100	115	146	192	248	2.48	2.76	2.58	0.00%	0.00%	-0.11%	-0.11%
Imports	100	115	150	198	254	2.66	2.84	2.52	0.00%	0.00%	-0.14%	-0.14%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	107	132	175	221	2.17	2.82	2.35	0.00%	0.00%	0.00%	0.00%
Exports	100	115	146	192	248	2.49	2.76	2.58	0.00%	0.00%	-0.07%	-0.10%
Imports	100	115	150	199	255	2.67	2.84	2.52	0.00%	0.00%	-0.02%	-0.03%

2.21. Rest of Europe

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	116	158	202	239	3.14	2.50	1.72				
Exports	100	115	145	179	211	2.35	2.11	1.68				
Imports	100	116	147	182	214	2.43	2.16	1.63				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	116	157	202	239	3.14	2.50	1.71				
Exports	100	115	145	179	211	2.35	2.11	1.67				
Imports	100	116	147	182	214	2.41	2.17	1.63				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	3.13	2.50	1.71	0.00%	0.00%	-0.01%	-0.08%
Exports	100	115	145	178	210	2.33	2.07	1.65	0.00%	0.00%	-0.14%	-0.59%
Imports	100	116	146	181	212	2.39	2.13	1.61	0.00%	0.00%	-0.14%	-0.69%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	3.13	2.50	1.71	0.00%	0.00%	-0.01%	-0.08%
Exports	100	115	145	178	210	2.33	2.08	1.65	0.00%	0.00%	-0.17%	-0.61%
Imports	100	116	146	181	212	2.39	2.13	1.61	0.00%	0.00%	-0.13%	-0.68%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	3.13	2.49	1.71	0.00%	0.00%	-0.02%	-0.11%
Exports	100	115	145	178	209	2.33	2.07	1.65	0.00%	0.00%	-0.19%	-0.64%
Imports	100	116	146	181	212	2.39	2.13	1.61	0.00%	0.00%	-0.15%	-0.72%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	1.45	1.36	1.58	0.00%	0.00%	-0.02%	-0.11%
Exports	100	115	145	178	210	2.43	2.12	2.03	0.00%	0.00%	-0.16%	-0.62%
Imports	100	116	146	181	212	2.57	2.10	2.07	0.00%	0.00%	-0.17%	-0.72%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	3.13	2.50	1.71	0.00%	0.00%	-0.01%	-0.08%
Exports	100	115	145	178	210	2.33	2.08	1.65	0.00%	0.00%	-0.13%	-0.57%
Imports	100	116	146	181	212	2.39	2.13	1.61	0.00%	0.00%	-0.14%	-0.67%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	201	239	3.13	2.50	1.71	0.00%	0.00%	-0.01%	-0.08%
Exports	100	115	145	178	209	2.33	2.07	1.65	0.00%	0.00%	-0.19%	-0.65%
Imports	100	116	146	181	212	2.39	2.13	1.61	0.00%	0.00%	-0.12%	-0.61%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	202	239	3.14	2.50	1.71	0.00%	0.00%	0.01%	0.03%
Exports	100	115	145	179	211	2.34	2.10	1.66	0.00%	0.00%	-0.04%	-0.12%
Imports	100	116	147	182	214	2.40	2.18	1.64	0.00%	0.00%	-0.05%	0.12%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	202	239	3.14	2.50	1.71	0.00%	0.00%	0.00%	0.01%
Exports	100	115	145	179	211	2.35	2.10	1.67	0.00%	0.00%	-0.02%	-0.03%
Imports	100	116	146	182	213	2.40	2.17	1.63	0.00%	0.00%	-0.08%	-0.05%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	202	239	3.14	2.50	1.71	0.00%	0.00%	0.01%	0.02%
Exports	100	115	145	179	211	2.36	2.10	1.66	0.00%	0.00%	0.12%	0.09%
Imports	100	116	147	182	214	2.43	2.17	1.63	0.00%	0.00%	0.23%	0.21%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	202	239	3.13	2.50	1.71	0.00%	0.00%	-0.01%	-0.02%
Exports	100	115	145	178	210	2.33	2.11	1.67	0.00%	0.00%	-0.18%	-0.16%
Imports	100	116	146	181	213	2.39	2.17	1.63	0.00%	0.00%	-0.20%	-0.18%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	116	157	202	239	3.14	2.50	1.71	0.00%	0.00%	0.00%	0.00%
Exports	100	115	145	179	211	2.35	2.11	1.66	0.00%	0.00%	0.05%	0.04%
Imports	100	116	147	182	214	2.42	2.17	1.63	0.00%	0.00%	0.10%	0.11%

2.22. Rest of World

	Reference					Annual % Change			% Change from Carbon Neutrality			
	2015	2020	2030	2040	2050	20-30	30-40	40-50				
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86				
Exports	100	123	183	260	357	4.02	3.59	3.21				
Imports	100	126	183	254	344	3.78	3.36	3.05				
Carbon Neutrality	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**				
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86				
Exports	100	123	183	261	357	4.03	3.59	3.20				
Imports	100	126	183	254	343	3.77	3.36	3.05				
CBAM, No Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.85	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	183	261	357	4.03	3.59	3.20	0.00%	0.00%	0.00%	-0.04%
Imports	100	126	183	254	343	3.77	3.36	3.05	0.00%	0.00%	0.01%	-0.04%
CBAM, With Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.85	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	183	261	357	4.03	3.59	3.20	0.00%	0.00%	-0.02%	-0.04%
Imports	100	126	183	254	343	3.78	3.36	3.05	0.00%	0.00%	0.02%	-0.05%
CBAM, With Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.85	0.00%	0.00%	0.00%	-0.02%
Exports	100	123	183	261	357	4.03	3.59	3.20	0.00%	0.00%	-0.02%	-0.04%
Imports	100	126	183	254	343	3.78	3.36	3.05	0.00%	0.00%	0.02%	-0.05%
CBAM, No Recycling, With Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	1.45	1.36	1.58	0.00%	0.00%	0.00%	-0.02%
Exports	100	123	183	261	357	2.43	2.12	2.03	0.00%	0.00%	0.00%	-0.04%
Imports	100	126	183	254	343	2.57	2.10	2.07	0.00%	0.00%	0.01%	-0.04%
CBAM, on Three sectors	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.85	0.00%	0.00%	0.00%	-0.02%
Exports	100	123	183	261	357	4.03	3.58	3.20	0.00%	0.00%	-0.01%	-0.06%
Imports	100	126	183	254	343	3.77	3.36	3.05	0.00%	0.00%	0.00%	-0.07%
CBAM, ETS Recycling, CBAM Recycling, No Retaliation	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.85	0.00%	0.00%	0.00%	-0.01%
Exports	100	123	183	261	357	4.03	3.59	3.20	0.00%	0.00%	-0.03%	-0.08%
Imports	100	126	183	254	343	3.78	3.36	3.05	0.00%	0.00%	0.02%	-0.01%
Final Consumption Tax, No Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86	0.00%	0.00%	0.00%	0.02%
Exports	100	123	183	260	357	4.03	3.57	3.20	0.00%	0.00%	0.00%	-0.16%
Imports	100	126	183	254	344	3.77	3.37	3.06	0.00%	0.00%	-0.04%	0.04%
Final Consumption Tax, With Recycling	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86	0.00%	0.00%	0.00%	0.00%
Exports	100	123	183	261	357	4.04	3.58	3.20	0.00%	0.00%	0.04%	-0.03%
Imports	100	126	183	254	343	3.77	3.36	3.05	0.00%	0.00%	-0.05%	-0.04%
Industrial Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86	0.00%	0.00%	0.00%	0.00%
Exports	100	123	183	260	357	4.03	3.59	3.20	0.00%	0.00%	-0.04%	-0.05%
Imports	100	126	183	254	344	3.78	3.36	3.05	0.00%	0.00%	0.06%	0.03%
Tariffs + ENG's	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	330	3.74	3.16	2.86	0.00%	0.00%	0.02%	0.02%
Exports	100	123	183	261	358	4.05	3.59	3.20	0.00%	0.00%	0.13%	0.14%
Imports	100	126	183	255	344	3.79	3.36	3.05	0.00%	0.00%	0.14%	0.15%
Fossil Fuel Subsidies	**2015**	**2020**	**2030**	**2040**	**2050**	**20-30**	**30-40**	**40-50**	**2015**	**2020**	**2030**	**2050**
Gross Domestic Product	100	126	182	249	329	3.73	3.15	2.85	0.00%	0.00%	-0.11%	-0.20%
Exports	100	123	183	260	356	4.02	3.58	3.19	0.00%	0.00%	-0.14%	-0.27%
Imports	100	126	182	253	342	3.73	3.36	3.05	0.00%	0.00%	-0.38%	-0.44%

3. Study Methodology

The study methodology is designed according to two tiers. The first objective of the study is to establish an account of the balance of GHG emissions linked to the EU's foreign trade and investment. Here, two scenarios are considered reflecting different levels of EU ambition in reducing carbon emissions. Under the second objective of the study, six policy instruments are formulated targeting carbon leakage and economic competitiveness of EU enterprises.

Assessing the Interactions between International Trade, Investment, and Climate Change

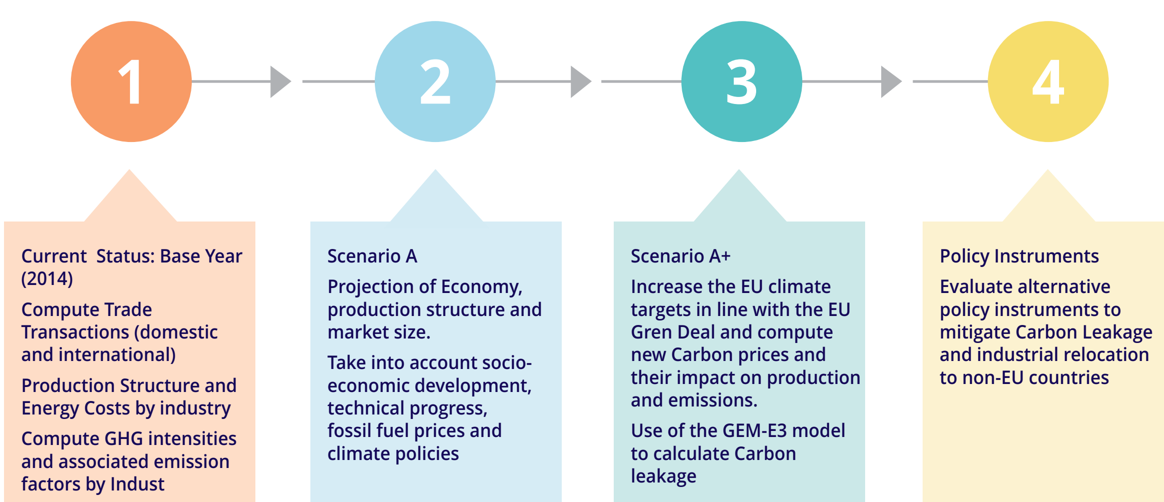
This study assesses the balance of carbon emissions linked to the EU's international trade and investment, and an account of carbon leakage that occurs when the EU increases its GHG abatement target in line with the EU Green Deal. To this end two alternative policy scenarios have been designed:

i) **Baseline Scenario (A):** Is the scenario where the EU28 reduces GHG emissions by 40% in 2030 and 80% in the 2050 (compared to 1990). Non-EU countries implement their NDCs until 2030. For non-EU Countries the carbon price that is required to meet their NDC targets is calculated for 2030 and then held constant until 2050.

ii) **EU Carbon Neutrality Scenario (A+):** In this scenario the EU28 increases its GHG emission reduction targets to 55% and 90% in 2030 and 2050 respectively (compared to 1990 levels). It corresponds to net zero emissions in 2050. Non-EU countries retain the carbon prices calculated in Scenario A.

A global multi-sectoral CGE model is used to assess the carbon leakage. In the model, carbon leakage is captured by the substitution of domestic production with imported goods and the associated increase in GHG emissions in non-EU countries (industry channel[1]).

Annex Figure 1: Methodological Steps



1 Carbon leakage can take place either by changes in competitiveness of firms (industry channel) or by changes in prices of fossil fuels (lower prices due to slackened demand – Energy Channel)

In our modelling approach, carbon leakage is driven by the following factors:

a) **The baseline projection of economic activity:** The EU and international market shares of the industries that are vulnerable to carbon leakage (e.g. basic metals, cement, chemicals, paper, pulp) and the regional distribution /development of their respective trade partners (base year of 2014).

b) **The baseline projection of technology costs and energy prices:** Increasing fossil fuel prices and decreasing costs of renewable energy sources (RES) and energy efficient equipment drive substitution towards low carbon technologies across the globe. Carbon leakage can be limited in economies that are characterised by energy efficient and low carbon energy systems already in the Baseline Scenario.

c) **The carbon price differential between the Baseline Scenario and EU Carbon Neutrality scenarios:** The higher the difference in the carbon price the higher the changes in comparative production costs and hence in leakage.

Measuring Carbon Leakage

- Asymmetrical GHG mitigation efforts can lead to significant carbon price differences among countries and hence to carbon leakage. **Carbon leakage in this study is measured as the increase of GHG emissions in non-EU countries as a result of EU GHG mitigation action**. The leakage is calculated both in terms of **absolute GHG emissions** and as a **ratio of the increases in non-EU GHG emissions resulting from abatements in the EU**.
- **Carbon leakage in this study is captured when two scenarios of different EU GHG emission reduction efforts are compared** - here, the **Baseline Scenario and EU Carbon Neutrality Scenario**. Subsequently, **leakage induced by the trade- and tax- related policy measures is measured against the EU Carbon Neutrality Scenario**.
- The study captures the leakage through the **industrial channel** and not through the energy channel. In the Baseline Scenario, asymmetrical policies lead to carbon leakage however this is not measured within the scope of the study as a **reference counterfactual scenario is needed** (for example, a BAU scenario where the EU would undertake lower GHG mitigation action than the Baseline).

Trade Policy Instruments, Domestic Measures and Climate Change

At the outset of the study, a wide range of different unilateral and plurilateral instruments were considered for their potential to deter lost competitiveness and carbon leakage, as well as their political feasibility within the EU and expected compatibility with international trade rules. A shortlist of up to nine possible instruments was compiled, culminating in a final selection of the six that are presented below.

Policy Instruments Evaluated

1. **Carbon Border Adjustment Mechanism (CBAM)**: A de facto tax equal to the ETS carbon price[2] is applied to non-EU imports (of ETS products) that are above a certain GHG intensity threshold. The CBAM revenues are used to promote the deployment of clean energy technologies.

2 The difference of the carbon price between scenario A and scenario A+. The GEM-E3 model computes endogenously the carbon price so as to achieve exogenously determined GHG emission reduction targets. In the model, a constraint on GHG emissions is imposed (Supply of Emission Allowances greater or equal to the Demand of Emission Allowances) and the associated variable to this constraint is a carbon price that drives firms and households to substitute high carbon intensive equipment with low/zero carbon equipment.

2. **Domestic subsidies for low-carbon technologies:** ETS revenues are used to promote the deployment of clean energy technologies directed to the following uses: energy efficiency in households and firms, renewable energy deployment, and public investment in research and development on photovoltaic (PV), wind energy, and batteries.
3. **Final Consumption Tax on Carbon:** A final consumption tax is imposed based on the carbon content of goods sold in the EU. In this scenario, EU households pay the final consumption tax to national governments. Where goods are produced domestically and covered under the ETS, a rebate mechanism is in-place (free allowances) to avoid double taxation. The measure applies equally to domestically produced and imported products, both ETS and non-ETS sectors, presuming that all EUAs are provided for free .
4. **Carbon Content-modulated Tariffs and Zero Duties on Environmental Goods:** Preferential tariffs on products that are considered as environmental goods or which entail a carbon footprint below a certain threshold, as well as zero tariffs applied to a defined list of environmental goods taking the APEC List of 54 HS Codes as the basis .
5. **Plurilateral Agreement on the Reduction of Industrial Subsidies:** In-line with the January 2020 trilateral statement by the EU, US, and Japan, an expansion of the scope of prohibited subsidies under the WTO Agreement on Subsidies and Countervailing Measures (ASCM) whereby China, recognized as the leading user of these measures, scales back subsidies to local industries.
6. **Plurilateral Agreement on the Reduction of Fossil fuel subsidies:** Removal of all production related fossil fuel subsidies at the global level.

The key features of the policy instruments are described in Annex Table 1.

Annex Table 1: Key features of policy instruments

N°	Measure	Comments on key features
1	**CBAM**	Eliminates the competitiveness loss within the EU market. Firms whose production is mainly directed to exports (non-EU) are not protected. Pricing based on EU ETS carbon price, particularly the difference between EU Best Available Technology (BAT) and carbon profiles for trading partner countries and sectors.
2	**Domestic Subsidies for Low-Carbon Technologies**	Affects/Lowers the carbon price. Affects both domestic and foreign RES and Energy Efficiency (EE) equipment producers
3	**Horizontal Carbon Tax**	Captures both domestic and international markets. Must be combined with free allowances to avoid double taxation.
4	**Tariff-Modulation & Environmental Goods List**	Applies to domestic and international markets. Limited to current size of tariffs. Pricing not necessarily comparable to ETS carbon pricing.
5	**Reduction of Industrial Subsidies**	Primary focus limited to one EU trade partner. Not necessarily comparable pricing.
6	**Reduction of Fossil Fuel Subsidies**	Not comparable with ETS price. Subsidies not necessarily large in countries where leakage potential is high. It also affects the carbon price as competing options to fossil fuels become more favourable. Its effectiveness depends on whether they are consumption or production based subsidies.

3 Free allocation of allowances is required in order to avoid double taxation whereas the international competitiveness of the industry is ensured.
4 Annex C – APEC List of Environmental Goods. Available at: https://www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexC.aspx.
5 This instrument is crafted as a plurilateral agreement among countries
6 Only production related subsidies have been selected as these affect industrial competition and are enablers for industry relocation.

Analytical Framework

Overview of GEM-E3

The calculation of the carbon leakage that is generated as a result of the decarbonisation of the EU energy system is a complex task as it requires consideration of the interactions and responses of all economic agents involved against the implementation of unprecedented climate and energy policies and regulations. The modelling approach used in this study is a global CGE model (GEM-E3[7]) that features feedback loops among agents, market imperfections and technology dynamics within a consistent unified framework built on verifiable assumptions.

The GEM-E3 model is a global, multi-regional, multi-sectoral, recursive dynamic[8] computable general equilibrium (CGE) model which provides details on the macro-economy and its interaction with the environment and the energy system. It formulates separately the supply and demand behaviour of the economic agents who are assumed to exhibit optimising behaviour while market derived prices are adjusted to clear markets (demand=supply), allowing for consistent evaluation of distributional effects of policies. The model formulates production technologies in an endogenous manner allowing for price-driven derivation of all intermediate consumption and the services from capital and labour. In the electricity sector, a bottom-up approach is adopted for the representation of the different power producing technologies. For the demand-side, the model formulates consumer behaviour and distinguishes between durable (equipment) and consumable goods and services. The model is calibrated according to national input-output tables that provide an accounting of firms' production structures, households' consumption, gross fixed capital formation, trade and sectoral value added. The national input-output tables are combined with national energy balances so that the energy consumption of each economic agent is taken into account in physical units.

In the model, firms maximize their profits, constrained by the physical capital stock (fixed within the current period) and the available technology. Producers can change their physical capital stock over time through investment. According to the standard neoclassical approach, agents' investment decisions depend on the rental cost of capital in the presence of adjustment costs and on its replacement cost. Households maximize their inter-temporal utility under an inter-temporal budget constraint. The demand of products by the consumers, the producers (for intermediate consumption and investment) and the public sector constitutes the total domestic demand. This total demand is allocated between domestic products and imported products, following the Armington specification. In this specification, branches and sectors use a composite commodity which combines domestically produced and imported goods, which are considered as imperfect substitutes (Armington assumption).

Each firm and household in the model decides endogenously on its imports by origin. Bilateral trade transactions among regions are therefore endogenous and depend on relative prices/ production costs, transportation costs and consumer preferences (as the latter have been captured by the national account statistics on trade). Each country buys and imports at the prices set by the supplying countries following their export supply behaviour. The buyer of the composite good[9] seeks to minimise his total cost and decides the mix of imported and domestic products so that the marginal rate of substitution equals the ratio of domestic to imported product prices.

The model captures both energy- and process-related GHG emissions. CO_2 energy emissions are calculated by applying appropriate emission factors to the consumption of different fuels by

7 See manual at https://e3modelling.com/modelling-tools/gem-e3/
8 The model is dynamic, recursive over time, driven by accumulation of capital and equipment. Technology progress is explicitly represented in the production function, either exogenous or endogenous, depending on R&D expenditure by private and public sector and taking into account spillover effects.
9 The composite good is composed of domestic production and imports.

each economic agent (firms and households). Process-related emissions are calculated using emission factors that are connected directly to the level of production (e.g., CO_2 from clinker is linked to the production level of cement). The abatement potential of the energy related emissions depends on the substitution possibilities among fuels and between energy and equipment that characterizes each economic activity. In the model, industrial production is characterized by a constant elasticity production function whose substitution elasticity determines the firms' GHG mitigation possibilities. The internalization of environmental externalities is achieved either through taxation or global/regional/sectoral system constraints, the shadow costs of which affect the decision of the economic agents.

There are three mechanisms which enable the reduction of emissions in the model, as outlined in the following section.

Emission Abatement Mechanisms

1. **End-of-pipe abatement:** end-of-pipe abatement technologies are formulated explicitly by bottom-up derived abatement cost functions that differ between sectors, durable goods, pollutants and between countries. The marginal costs of abatement are increasing functions of the degree of abatement. These costs differ between sectors and countries according to the country- or sector-specific abatement efforts already undertaken. End-of-pipe abatement technologies refer only to non-CO_2 emissions.
2. **Substitution of fuels and energy efficiency (substitution of fuels with capital/equipment)**: as the production of the sectors is specified in nested CES-functions, there is (at least for a substitution elasticity greater than 0) some flexibility on the decision of intermediates. The input demand is linked to the relative prices of these inputs. Hence, if there is an extra cost on energy inputs, there will be a shift in the intermediate demand away from 'expensive' energy inputs towards less costly inputs. A politically imposed cost on emissions (e.g. a carbon price) therefore drives substitution towards less emission intensive inputs, e.g. from coal to gas or electricity or from energy to materials, labour or capital (i.e. energy efficiency).
3. **Decrease of production:** in a general system that covers the interdependency of agents' decisions, imposing an environmental constraint (through standards, taxes or other instruments) causes additional costs to production (which is linked to the costs of substitution or abatement installation). An increasing selling price decreases demand of these goods even if this demand is inelastic to price changes (which is usually not the case) due to budget constraints. This lowers production and accordingly the demand for intermediates. As a result, there is an emission reduction due to a demand driven decline in production.

The abatement activities are modelled so as to increase the user cost of the polluting input (here the price of energy) in the decision process of the firm. When an environmental tax is imposed, it is paid to the government by the firm causing the pollution. This has the following implications for the energy price modelling:

- The price of energy, inclusive abatement cost and taxes, is used in the decision by the firm on production factors (at the energy level and implicitly at the level of aggregates, according to the CES levels of aggregation); it represents the user's cost of energy
- The price of energy, exclusive taxes and abatement cost, is used to value the delivery of the energy sectors to the other sectors
- A price for the abatement cost per unit of energy has been defined, because the abatement cost is defined in constant price

In the modelling of the abatement activities, installing abatement technologies has been considered as an intermediate input for the firms and not as investment demand of the firms. The total delivery for abatement is added to the intermediate demand and these inputs are priced as other intermediate deliveries. The major advantage of this formulation is that with this framework the abatement costs do not directly increase GDP as it would if modelled as investment but only indirectly as additional intermediate demand. In order for the firm and/or the household to decide on the optimal level of abatement through end-of-pipe technologies, the endogenous or exogenous price of emission allowances (opportunity cost for the firm and/or household to emit less) is taken into consideration. The decision is taken so as to abate emissions, according to the marginal abatement cost curve, up to a level which is seen as cost-effective, i.e. up to the level that the cost to abate the last tonne of emissions equals the price of emission allowances. Above that level, the firm and/or household find it most cost-efficient to emit rather than abate. End-of-pipe technologies can only abate non-CO_2 emissions since carbon dioxide emissions are directly related to fuel combustion and can only be abated through fuel substitution (or power generation via non-emitting technologies like renewable power) or through a reduction in production (or improved energy efficiency).

In the GEM-E3 model, a GHG reduction policy can be implemented either through exogenous tax enforcement (thereby the level of the exogenous tax is given in advance but the level of emission reductions is unknown and is endogenously estimated), or through an exogenous implementation of an emission cap – namely an endogenous tax enforcement (thereby the level of the tax is originally unknown and endogenously estimated in order to achieve a specific emission reduction target). The estimation of the endogenous tax level ensues as the clearing price of demand and supply for emission permits.

For power generation, a bottom up approach is adopted where individual power generation technologies are represented (Fossil fuel fired, RES, Nuclear, CCS etc). The choice of power generation technologies depends on their relative electricity production costs but also on their characteristics such as base or peak load technologies.

Prices in the model are indexes which in the base year are set to 1 (net of any taxes). Prices change over time as a result of technical progress, resource efficiency and resource reallocation. The main drivers of changes in prices are capital costs, wages and taxes.

Model Input Requirements

The GEM-E3 model requires three types of inputs in order to be calibrated and become operational:

i) Statistical data that fall under the following categories: i) National Accounts, ii) Input-output tables, iii) Energy Balances, iv) GHG emission inventories, v) Bilateral Trade, vi) Labour Market – Population, vii) Fuel Prices, viii) Capital costs of power generation technologies, ix) Institutional transfers, generation of income, saving and interest rates, tax rates, fiscal revenues, R&D expenditures, x) Household budget surveys, xi) Investment matrices and xii) Consumption matrices.

ii) Engineering / Physical conversion rates / data: i) Emission factors, ii) Heat rates for energy-related technologies, iii) capacity/load factors for power generation technologies

iii) Behavioural / Econometrical estimated inputs: Elasticities of substitution, Income and price elasticities, Elasticities of transformation and Trade elasticities.

Data

The model requires a large set of data that covers both economic and energy systems. The key datasets that are used in the model are presented in Annex Table 2.

Annex Table 2: GEM-E3 data sources

Source	Comments on key features
GTAP[10] v10	The Global Trade Analysis Package (GTAP) includes (beyond the CGE model) a global database containing complete bilateral trade information, transport and protection linkages. The database covers the world economy for 4 reference years (2004, 2007, 2011, and 2014) and distinguishes 65 sectors across its 141 countries/regions. The countries in the database account for 98% of the world's GDP and 92% of its population. For each country/region, the database reports production, intermediate and final uses, international trade and transport margins, and taxes/subsidies. From this dataset the following data are used in the GEM-E3 model: - IO tables - Bilateral Trade - Energy Consumption - CO_2 emissions - Bilateral duty rates - Transport Margins - Taxes and Subsidies
WIOD[11]	The World Input-Output Database (WIOD) consists of a series of databases and covers 28 EU countries and 15 other major countries in the world for the period 2000 to 2014. From this dataset, the following data are used in the GEM-E3 model: - Taxes - Origin – Destination trade flows (for ex-ante calculations)
EUROSTAT	EUROSTAT dataset is used to extract data for EU28 countries. Data that overlap with GTAP are used to cross check. The key data used are: Energy balances, population and labour market (employment, active population, unemployment rate), institutional transactions (generation of income, transactions between households, government, firms and RoW), interest rates and inflation.
EDGAR	GHG emissions for non – EU countries (cross check with GTAP)
ILO	Population and labour market (employment, active population, unemployment rate)
IEA	Energy balances, energy prices

Other Input Requirements

Beyond statistical data, the model requires elasticities and other economic and engineering/technical information such as cost pass through rates, emission factors, power generation capital costs and technology load factors. This section describes key sources for such information.

The model uses two main groups of elasticities[12] : (i) Trade Elasticities and (ii) Substitution elasticities. Despite the popularity of the Armington concept, only a handful of studies have been published that provide direct econometric estimates of substitution elasticities. Elasticities of upper-level substitution between imported and domestic goods have been estimated, for example, by Reinert and Roland-Holst (1992), Shiells et al. (1986) and Lächler (1985). Shiells and Reinert (1993) have estimated lower-level elasticities and non-nested elasticities, as well as Sobarzo (1994), and Roland-Holst et al (1994). Unfortunately, the estimated values from the literature are difficult to compare, as the sectoral aggregation levels differ according to the statistical database used. The GTAP (2010) database is a source of trade elasticities at two levels: i) Domestic/Imported and ii) imports among different countries. These elasticities are provided for

10 See: https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx. This database "underlies most, if not all, applied global general equilibrium models" and has been recently used to "to examine the evolution of carbon dioxide emissions embodied in bilateral merchandise and services trade over the 2004-2014 period", Angel Aguiar, Maksym Chepeliev, Erwin Corong, Robert McDougall, Dominique van der Mensbrugghe (2019) "The GTAP Data Base: Version 10", Journal of global economic analysis.
11 See: http://www.wiod.org/home. The WIOD database is widely used in applied economic analysis and a recent application on global value chains is Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", Review of International Economics., 23: 575–605
12 The exact elasticities are available in the Annex III of this report.

each commodity included in the GTAP database.

Numerous econometric studies have attempted to estimate the substitution possibilities between the production factors within an integrated production model. They point to the importance of the number of production factors specified and of the specification of technical progress. The distinction between electricity and other fuels is necessary because the substitution mechanism and possibilities between these energy factors and the other production factors are different. The specification of the technical progress has a clear impact on the estimated substitution elasticities. In the GEM-E3 model we used the Fragkiadakis et al (2016) estimates which are consistent with previous empirical results published by Berndt (1976) and by Antras (2004). In fact, the elasticity values based on the marginal product of labour equations tend to be higher than the values based on the marginal product of capital equations.

Cost pass through rates

The cost pass-through (CPT) rate is the extent to which additional costs induced by the EU ETS (or another environmental policy) can be passed through to the final consumer. It is defined as the increase in the final price of the product divided by the additional carbon costs in production (e.g. Sijm and Chen (2009)). The CPT rate can range between 0 and 100 percent.
The possibility to pass the carbon costs through to product prices is an important element in the discussion on carbon leakage. The cost pass through rates used for the modelling have been identified from a literature review. The following cost pass-through rates were used for the modelling.

Annex Table 3: CPT rates

Sector	CPT Rate
Metallurgical industries (ferrous and non-ferrous metals)	55%
Chemicals	90%
Cement	90%
Refineries	75%
Electricity	50%
Aerospace (manufacturing and/or commercial aviation services)	75%
Automotives (carmakers and car parts)	75%
Railway industry	70%
Shipping operators	70%
Electrical appliances	70%
IT sector (telecoms, internet economy and data centers)	70%
Air transport	45%

It should be noted that the literature presents a range of CPT rates[13]; therefore, the rates used for each industry sector represent average values as determined to the best ability of the study team.

Modelling Caveats

It should be noted that the modelling approach adopted does not take into account the following.

i) The energy channel: Rebound effect of increased fossil fuel consumption in non-abating countries due to lower international fossil fuel prices driven by slackened EU fossil fuel demand

ii) Sectoral granularity: The model's sectoral detail is arranged around industries rather than products.

iii) Price-level changes to competitiveness: The model captures changes in competitiveness arising from changes in relative prices rather than price levels.

iv) Quality standards and transaction costs: Industrial relocation is often constrained by the quality procedures and standards employed by different countries. This barrier is not explicitly modelled.

v) Bottom-up processes: The model is top-down in representing simultaneously all economic activities – hence, their production structure is proxied using Input-Output tables[14] and constant elasticity of substitution production functions.

Further Research

The modelling results greatly depend on the elasticities of the model (mainly the Armington/trade elasticities and price elasticities). The study has benefited from the most recent estimates on elasticities available in the scholarly literature but as a direct estimation of the elasticities for each sector and each country is virtually impossible it is suggested to develop a sensitivity analysis around the core elasticities used.

The production relocation choices do not depend only on transportation costs and wages but also on other non-quantifiable indicators (such as quality and production standards concerns). These are implicitly captured (but to a small extent) by the respective parameters of the Armington/trade function but are not explicitly modelled. Hence the degree of flexibility in substituting products among regions may be overestimated.

The calculation of the horizontal tax in the final consumption is complex as it requires the complete carbon footprint of the product, the identification of origin/destination trade flow and the transformation of consumption by purpose to consumption by product. In our study we have assumed a uniform composite good both in intermediate and final consumption whereas representative consumption matrices have been used for countries when original statistical information was not available. Empirical studies confirm that households are not always rational and fully informed when making decisions (lower price elasticities than firms) hence the performance of the horizontal tax measure may be overestimated.

In domestic subsidies scenario the results are quite sensitive on the performance of low-carbon R&D and the link between energy efficiency expenditures and potential savings. As the uncertainty between R&D spending and gains in terms of productivity is large (both at sectoral and regional level) a sensitivity analysis is required. The same holds for the energy efficiency cost curve by country and sector.

For fossil fuel subsidies there is not a complete comprehensive global dataset. Our estimations have been based on IEA publications and on the fiscal accounting approach (not on the opportunity cost). The IMF (opportunity cost) generates more than 10 times larger effects/fossil subsidies.

13 *In the scenario variants where the CPR rates are used they are applied to all countries (uniform by industry).*
14 *Industry by Industry*

References

Capital Trade Incorporated (without year): An Assessment of China's Subsidies to Strategic and Heavyweight Industries

Haley, U. C. Putting the Pedal to the Metal, Subsidies to China's Auto-Parts Industry from 2001 to 2011 2012

Hong, L., Liang, D. and Di, W. Economic and environmental gains of China's fossil energy subsidies reform: A rebound effect case study with EIMO model Energy Policy, Elsevier BV, 2013, Vol. 54, pp. 335-342

Hu, J., Jiang, H. and Holmes, M. Government subsidies and corporate investment efficiency: Evidence from China Emerging Markets Review, Elsevier BV, 2019, Vol. 41, pp. 100658

Hu, W. Industrial Subsidies, State-Owned Enterprises and Market Distortions: Problems, Proposals and a Path Forward University of ADELAIDE, University of ADELAIDE, 2019

Jiang, C., Zhang, Y., Bu, M. and Liu, W. The Effectiveness of Government Subsidies on Manufacturing Innovation: Evidence from the New Energy Vehicle Industry in China Sustainability, MDPI AG, 2018, Vol. 10(6), pp. 1692

Jiang, Z. and Lin, B. The perverse fossil fuel subsidies in China—The scale and effects Energy, Elsevier BV, 2014, Vol. 70, pp. 411-419

Kalouptsidi, M. Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding the Review of Economic Studies, Oxford University Press (OUP), 2017, Vol. 85(2), pp. 1111-1158needed

4. Technical Implementation

CBAM

In the CBAM scenario the EU-ETS carbon price is applied to non-EU imported goods whose carbon intensity exceeds a certain threshold. This threshold was computed using the lowest carbon intensity (by industry) across EU Member States. As the model is calibrated on monetary IO tables the carbon intensity was computed as the ratio of GHG emissions per $ of product produced in 2014 prices. The calculated carbon intensities are presented in Annex Table 4.

Calculation of Carbon Intensity:

$$CI_{s,c,t} = \frac{EM_{s,c,t}}{PROD_{s,c,t}}$$

Where:

CI: Is the Carbon intensity by sector(s), country(c) and year(t).

EM: The Scope 1 emissions at year t from sector s and country c.

PROD: The value of the production at year t for sector s and country c.

Calculation of CBAM:

$$CBAM_{s,eu,noneu,t} = IMP_{s,eu,noneu,t} \cdot CI_{s,noneu,t} \cdot DCP_{s,eu,t}$$

Where:

CBAM: CBAM revenues of the EU countries (eu) at year *t* from non-EU countries (noneu) and sector *s*.

IMP: Value of EU imports for sector s at year t from non-EU countries.

CI: Carbon intensity of non-EU countries for sector *s*, at year *t*.

DCP: The EU carbon price difference between EU carbon neutrality scenario and baseline scenario.

Annex Table 4: BAT carbon Intensity in Carbon Neutrality Scenario

tn CO_2 eq / 1 000$	2025	2030	2050
Refineries	0.064	0.056	0.013
Ferrous Metals	0.024	0.018	0.001
Non-ferrous metals	0.002	0.002	0.000
Chemical Products	0.023	0.016	0.004
Paper products	0.003	0.001	0.000
Cement	0.187	0.155	0.013
Air Transport	0.249	0.200	0.049

Source: Based on GEM-E3 results

The resulting CBAM rates[15] that were applied to imports according to their carbon intensity are presented in Annex Table 5.

15 The product of ETS carbon price and emissions divided by the value of the imported good.

Annex Table 5: CBAM Rates

2030	USA	JPN	CAN	BRA	CHN	IND	KOR	IDN	MEX	ARG	TUR	SAR	OCE	RUS	REP	SAF	REU	ROW
Refineries	0,5%	0,4%	0,6%	0,5%	0,9%	0,3%	0,4%	1,2%	0,9%	1,3%	0,4%	0,3%	0,4%	1,2%	0,9%	0,5%	1,5%	1,0%
Ferrous metals	0,9%	0,8%	2,5%	2,1%	2,4%	7,0%	0,9%	2,0%	2,0%	4,4%	1,4%	1,7%	1,3%	6,9%	1,5%	6,0%	4,0%	2,5%
Non-ferrous metals	0,2%	0,1%	0,2%	1,2%	0,2%	0,5%	0,1%	0,7%	0,1%	0,5%	0,4%	1,9%	0,6%	0,3%	0,9%	0,8%	0,1%	0,3%
Chemical Products	0,8%	0,7%	1,0%	0,6%	0,8%	1,7%	0,6%	0,9%	2,6%	1,0%	1,1%	2,0%	1,7%	6,0%	2,3%	2,2%	2,1%	1,0%
Paper products, publishing	0,2%	0,3%	0,3%	0,2%	0,2%	0,7%	0,1%	0,5%	0,5%	0,3%	0,3%	2,9%	0,1%	0,3%	1,5%	0,2%	0,1%	0,5%
Non-metallic minerals	1,8%	1,6%	2,4%	2,4%	2,7%	6,8%	1,0%	4,5%	3,6%	4,4%	4,0%	3,6%	0,1%	3,9%	4,2%	7,3%	0,8%	3,2%
Air transport	2,1%		3,1%	1,0%	1,1%		0,1%	2,1%		0,7%	0,1%	1,8%	0,7%	0,8%		0,6%		
2050	**USA**	**JPN**	**CAN**	**BRA**	**CHN**	**IND**	**KOR**	**IDN**	**MEX**	**ARG**	**TUR**	**SAR**	**OCE**	**RUS**	**REP**	**SAF**	**REU**	**ROW**
Refineries	4,8%	5,6%	6,0%	4,9%	9,7%	4,4%	5,2%	9,1%	8,2%	12,7%	5,2%	2,9%	4,6%	11,4%	8,2%	6,4%	16,2%	8,3%
Ferrous metals	8,3%	8,2%	18,7%	17,1%	15,4%	48,4%	7,3%	15,9%	15,8%	40,6%	13,3%	14,8%	9,3%	54,7%	13,2%	62,0%	30,5%	22,9%
Non-ferrous metals	1,6%	1,1%	1,2%	8,9%	1,1%	3,7%	1,2%	5,7%	0,8%	4,8%	4,1%	16,5%	4,6%	2,7%	7,9%	7,5%	0,9%	2,5%
Chemical Products	6,7%	7,2%	8,1%	5,1%	6,0%	12,4%	5,8%	7,4%	23,0%	10,4%	10,4%	21,4%	15,8%	52,0%	22,2%	23,5%	22,7%	10,9%
Paper products, publishing	1,7%	3,4%	2,1%	1,7%	1,4%	5,1%	1,4%	3,9%	4,1%	2,4%	3,4%	28,3%	0,9%	2,9%	15,4%	2,0%	1,4%	5,2%
Non-metallic minerals	18,7%	19,2%	21,4%	23,8%	20,9%	44,0%	11,8%	38,5%	32,8%	45,6%	32,5%	33,1%	3,9%	37,7%	30,3%	91,3%	12,1%	31,3%
Air transport	20,2%	2,9%	28,4%	11,2%	12,5%	2,8%	4,5%	19,2%		9,5%	4,4%	18,5%	9,0%	10,4%	1,1%	8,2%	2,4%	1,3%

The revenues collected from the border tax adjustment are presented in Annex Table 6.

Annex Table 6: CBAM revenues by Sector and Trading Partner

BCA Revenues (bn $)

2030	Refineries	Ferrous metals	Non-ferrous metals	Chemical Products	Paper products	Non-metallic minerals	Air transport
USA	0,08	0,02	0,02	0,14	0,01	0,08	0,38
JPN	0,00	0,01	0,00	0,02	0,00	0,02	0,00
CAN	0,00	0,01	0,02	0,01	0,00	0,08	0,04
BRA	0,00	0,04	0,01	0,01	0,01	0,21	0,01
CHN	0,01	0,44	0,04	0,25	0,03	0,35	0,04
IND	0,01	1,07	0,09	0,92	0,08	0,84	0,00
KOR	0,00	0,03	0,00	0,02	0,00	0,00	0,00
IDN	0,00	0,01	0,01	0,01	0,00	0,03	0,03
MEX	0,00	0,00	0,00	0,02	0,00	0,03	0,00
ARG	0,00	0,01	0,00	0,01	0,00	0,03	0,00
TUR	0,00	0,07	0,02	0,03	0,00	0,12	0,00
SAR	0,02	0,00	0,01	0,30	0,00	0,00	0,02
OCE	0,00	0,00	0,01	0,00	0,00	0,00	0,02
RUS	0,48	0,58	0,02	1,58	0,00	0,24	0,02
REP	0,10	0,04	0,04	0,32	0,00	0,22	0,00
SAF	0,00	0,06	0,03	0,01	0,00	0,15	0,01
REU	0,12	0,64	0,03	0,35	0,01	0,06	0,00
ROW	0,05	0,16	0,04	0,23	0,01	0,60	0,00
Total	0,87	3,19	0,39	4,25	0,17	3,07	0,57
2030	**Refineries**	**Ferrous metals**	**Non-ferrous metals**	**Chemical Products**	**Paper products**	**Non-metallic minerals**	**Air transport**
USA	0,23	0,16	0,14	0,95	0,15	0,87	3<4
JPN	0,00	0,07	0,00	0,18	0,01	0,17	0,08
CAN	0,01	0,03	0,25	0,05	0,03	0,68	0,28
BRA	0,00	0,28	0,05	0,06	0,07	2,02	0,09
CHN	0,02	3,18	0,35	2,02	0,45	3,07	0,54
IND	0,03	2,48	1,65	10,08	1,38	4,37	0,01
KOR	0,01	0,33	0,01	0,18	0,00	0,04	0,11
IDN	0,00	0,08	0,05	0,15	0,06	0,16	0,28
MEX	0,01	0,03	0,00	0,08	0,01	0,28	0,00
ARG	0,00	0,02	0,00	0,05	0,00	0,17	0,08
TUR	0,00	0,55	0,11	0,25	0,08	0,76	0,29
SAR	0,05	0,02	0,03	0,98	0,01	0,03	0,20
OCE	0,00	0,03	0,08	0,02	0,00	0,16	0,41
RUS	1,43	0,72	0,20	0,80	0,08	1,57	0,41
REP	0,28	0,50	0,36	0,99	0,03	1,57	0,11
SAF	0,00	0,07	0,10	0,05	0,02	0,36	0,14
REU	0,38	2,04	0,29	1,04	0,08	1,20	0,14
ROW	0,13	0,99	0,43	1,91	0,26	5,21	0,80
Total	2,58	11,58	4,11	19,85	2,71	22,69	7,31

The carbon intensity of the key non-EU trading partners is shown in the following table presenting Non-EU countries in an ranking order.

Annex Table 7: Non–EU carbon intensities

Carbon Intensity	Refineries	Ferrous metals	Non-ferrous metals	Chemical Products	Paper products	Non-metallic minerals	Air transport
Lowest	JPN	JPN	KOR	KOR	KOR	OCE	MEX
	KOR	OCE	REU	BRA	REU	REU	REP
	IND	USA	JPN	USA	OCE	CAN	ROW
	TUR	KOR	MEX	CAN	SAF	USA	REU
	BRA	TUR	USA	JPN	RUS	BRA	JPN
	SAR	REP	ROW	IDN	BRA	KOR	IND
	USA	MEX	CHN	SAF	ARG	JPN	TUR
	RUS	CAN	CAN	ROW	USA	MEX	KOR
	CHN	SAR	TUR	ARG	TUR	SAF	SAF
	OCE	BRA	ARG	CHN	JPN	ARG	ARG
	ARG	IDN	REP	OCE	CAN	IDN	RUS
	REU	ROW	SAF	REU	CHN	ROW	OCE
	ROW	REU	IND	SAR	ROW	SAR	CHN
	CAN	CHN	RUS	IND	MEX	RUS	BRA
	MEX	SAF	OCE	TUR	IDN	REP	SAR
	IDN	ARG	IDN	REP	IND	CHN	USA
	REP	RUS	SAR	RUS	REP	TUR	IDN
Highest	SAF	IND	BRA	MEX	SAR	IND	CAN

Retaliation against a CBAM can be assumed to result, with partner countries applying comparable duties on a symmetric basis (i.e., on the same set of products). One important question is how trade partners will respond to the combination of the allocation of free carbon credits and CBAMs.

The level of retaliation from partner countries are determined based on results from the reference scenario. Where the EU applies adjustments on imports, those countries whose imports are "taxed" retaliate in a symmetric, mirrored manner. Particular emphasis will be given to applying retaliation (where warranted) on EU imports from China and the United States. Symmetrical, mirrored retaliation is taken to represent the average of retaliation across products and sectors to be applied by EU trading partner countries.

CBAM plus Domestic Subsidies to Low-Carbon Technologies

In this scenario the CBAM and ETS revenues are used to finance energy efficiency and R&D in renewable energy technologies. The respective expenditures are presented in the Annex Table 8.

Annex Table 8: Domestic Subsidies by ETS Revenues

bn $ 2014	Energy efficiency	Renewable R&D	Total
2030	2.43	1.62	4.05
2050	8.98	5.99	14.96

EU-wide Final Consumption Tax on Carbon Content

The calculation of the horizontal carbon tax is based on the carbon content of the products consumed by the EU28 households. From a modelling perspective the EU-ETS carbon price is used as an end – user consumption tax. In the model the free allowance mechanism is introduced in the following way: A carbon price is introduced in each firm in order to drive fuel substitution. In this ways required emissions reductions are associated with a respective carbon price/shadow value/ opportunity cost. Firms do not pay for the emissions they generate they only face the opportunity costs

Calculation of Carbon Intensity:

$$CI\_H_{s,c,t} = (I-A)^{-1}_{s,b,c} \cdot \frac{EM_{b,c,t}}{PROD_{b,c,t}}$$

Where:

$(I-A)^{-1}_{s,b,c}$**:** Is the inverse Leontief Multiplier.

EM: The Scope 1 emissions at year t from sector s and country c.

PROD: The value of the production at year t for sector s and country c.scenario.

$(I-A)^{-1}_{s,b,c} \cdot EM$**:** Is the Carbon footprint in Sector s for Country c.

Calculation of Total Horizontal Tax:

$$H\_TAX_{s,eu,t} = DCP_{s,eu,t}$$
$$\cdot (CI\_H_{s,eu,t} \cdot DOM\_SHR_{s,eu,t} \cdot Cons_{s,eu,t} + \sum_{noneu} CI\_H_{s,noneu,t} \cdot IMP\_SHR_{s,eu,t} \cdot Cons_{s,eu,t}$$

Where:

CI_H: Carbon intensity of EU countries and non-EU countries for sector s, at year t.

DCP: The EU carbon price difference between EU carbon neutrality scenario and baseline scenario.

DOM_SHR: Domestic share of the final composite good.

IMP_SHR: Imported share of the final composite good.

Cons: The value of the final consumption.

Annex Table 9: Domestic and Imported Final Consumption EU28

Bn $ 2014	2030		2050	
Final Consumption	Domestic	Imported	Domestic	Imported
Other Equipment Goods	181152	203	239	
Electrical equipment	59118	57	164	
Cement	2813	33	19	
Transport equipment	247522	168	439	
Paper	5326	61	41	
Chemical Products	66115	64	137	
Metals	9141	104	67	
Refineries	6423	13	4	
Market Services	6418	612	8713	1078
Air Transport	8764	139	87	
Total	18634	4065	24198	6069

Annex Table 10: Horizontal Tax Rates in EU27+UK

Horizontal Tax rates in households EU27+UK	2030	2050
Oil	1.3%	9.2%
Ferrous metals	4.7%	40.0%
Non-ferrous metals	0.4%	3.4%
Metal products	0.1%	0.8%
Chemical Products	2.5%	23.6%
Basic pharmaceutical products	0.1%	1.2%
Rubber and plastic products	0.2%	2.0%
Paper products, publishing	0.2%	1.5%
Non-metallic minerals	3.9%	19.3%
Computer, electronic and optical products	0.3%	2.3%
Electrical equipment	0.4%	5.3%
Machinery and equipment	0.1%	0.5%
Transport equipment (excluding EV)	0.0%	0.3%
Other Equipment Goods	0.1%	1.1%
Consumer Goods Industries	0.1%	0.7%
Air transport	4.7%	18.1%
Trade	0.0%	0.1%
Accommodation, Food and service activities	0.1%	0.2%
Financial services	0.0%	0.0%
Insurance	0.0%	0.1%
Recreational and other services	0.0%	0.1%
Other Market Services	0.1%	1.3%
Other Non Market Services	0.0%	0.0%
EV Transport Equipment	0.0%	0.0%
Advanced Electric Appliances	0.1%	1.0%
Advanced Heating and Cooking Appliances	0.1%	0.9%

Annex Table 11: Horizontal Tax Revenues EU28

Horizontal Tax Revenues (bn $ 2014)	2030	2050
Other Equipment Goods	0.25	4.89
Electrical equipment	0.71	11.59
Cement	1.63	10.08
Transport equipment	0.31	1.66
Paper	0.14	1.54
Chemical Products	4.60	47.86
Metals	0.25	2.42
Refineries	1.17	1.61
Market Services	7.53	81.30
Air Transport	7.02	41.00
Total	45.61	346.30

Carbon Content-modulated Tariff Reductions

In this scenario bilateral trade tariffs are reduced or eliminated for low-carbon goods[16]. Bilateral trade tariffs were extracted from the GTAP database v10. Bilateral duty rates are presented in the below table.

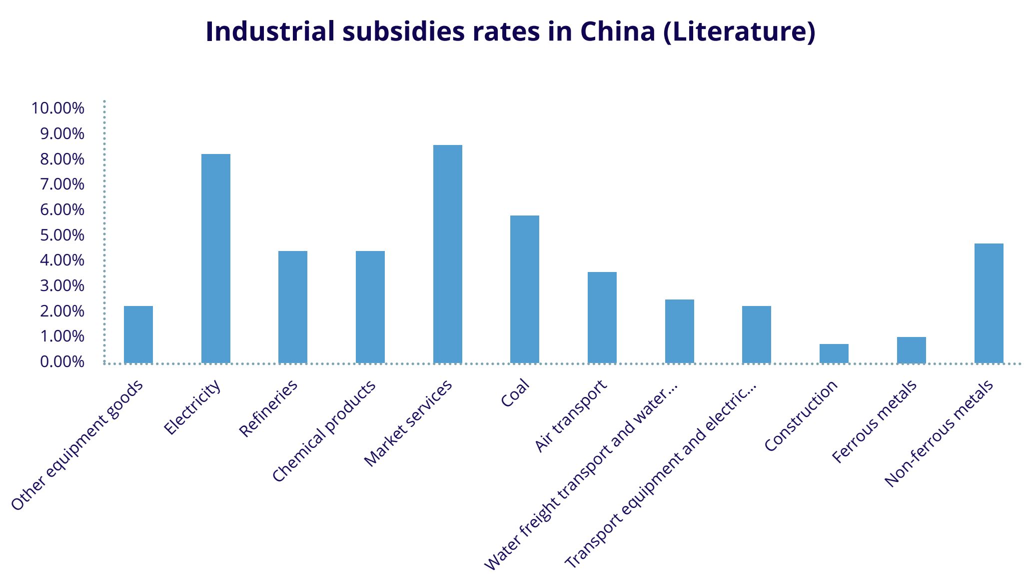
Annex Table 12: Bilateral Duty rates

2015	USA	JPN	CAN	BRA	CHN	IND	KOR	IDN	MEX	ARG	TUR	SAR	OCE	RUS	REP	SAF	REU	ROW
Refin/es	1,49%	2,08%	1,26%	3,53%	0,01%	1,91%	0,00%			1,64%		1,48%	1,83%	2,02%	0,85%	0,02%	0,63%	0,73%
Ferrous metals	0,63%	0,13%	0,32%	1,03%	0,70%	0,03%	0,00%	0,00%	0,00%	0,87%		2,12%	0,05%	0,36%	0,23%	0,00%	0,01%	0,36%
Non -Ferrous metals	1,37%	1,56%	0,14%	0,28%	5,32%	1,56%	0,04%	0,33%		0,40%		1,02%	0,40%	2,37%	3,72%	0,06%	0,02%	0,45%
Chem/ls	4,45%	4,60%	2,68%	6,03%	5,36%	5,11%	0,32%	4,05%	0,01%	6,03%	0,00%	5,30%	3,36%	3,25%	2,79%	0,41%	0,20%	2,26%
Paper	0,05%	0,14%	0,16%	0,00%	0,06%	0,01%	0,00%	0,01%	0,00%	0,02%		0,04%	0,08%	0,13%	0,03%	0,00%	0,00%	0,02%
Cement	2,17%	2,97%	0,07%	0,06%	5,04%	0,54%	0,09%	0,69%		0,04%		1,71%	0,07%	0,15%	0,48%	0,00%	0,08%	0,25%

Reduction of Industrial Subsidies

In this scenario industrial subsidies applied to ETS sectors in China are removed. Available data on industrial subsidies is very limited therefore E3 Modelling reviewed available literature to derive subsidy rates used for the modelling. Assessing subsidy rates is methodologically challenging as subsidies are applied in various forms: Direct subsidies exist (ad quantum/ad valorem) but also a range of indirect subsidies are applied, e.g. in the form of preferential loans, bank guarantees, public grants, interest rate subsidies, preferential tax rates, debt forgiveness, deduction or refund of VAT and in the form of cross subsidisation (i.e. subsidising power generation to support energy intensive industries). The following figure depicts the industrial subsidy rates in China found in literature.

Annex Figure 2: Industrial Subsidy Rates observed in Literature



16 The threshold is the same as in the CBAM case.

Annex Table 13: Industrial Subsidy rates used in the GEM-E3 model

	CHN
Coal	-1.97%
Refineries	-1.50%
Electricity	-2.77%
Ferrous metals	-0.37%
Non-ferrous metals	-1.58%
Chemical Products	-1.50%
Transport equipment	-0.77%
Other Equipment Goods	-0.77%
Air Transport	-1.20%
Water - Freight transport	-0.83%

The following information was assessed and used for the purpose of deriving the above subsidy reduction rates.

The US department of Commerce made an extensive survey on direct and indirect industrial subsidies in China. In the survey explicit rates for a number of companies including AviChina, Air China, CASIL, HPI, PetroChina, BlueChem, CTC, COSCO, JTM, DMG, CEC, IGE and CSCI are available.

Annex Table 14: Subsidy rates for Selected Products (2008) as determined by the US department of Commerce

Case/Industry	Range of rates
Coated Free Sheet Paper	7.4 to 44.25
Circular Welded Pipe	29.62 to 616.93
Off-The-Road Tires	2.45 to 14.00
Light-walled Rectangular Pipe	2.17 to 200.58
Woven Sacks	29.54 to 352.82
Magnets	109,95
Light weight Thermal Paper	0.57 to 138.53
Sodium Nitrate	169,01
Circular Welded Austenitic Stainless Pressure Pipe 1/	1.47 to 105.73
Circular Welded Line Pipe	35.63 to 40.05
Citric Acid and Citrate Salts 1/	1.41 to 97.72
Tow-Behind Lawn Groomers 1/	0.95 to 254.52
Certain Kitchen Appliance Shelving and Racks 1/	13.22 to 197.14

Annex Table 15: Industries receiving subsidies

Industry	Company A	Company B
Armaments	China Aerospace International Holdings Ltd	AviChina Industry & Techonology Co Ltd
Power generation and distribution	Huaneng Power International Inc	
Oil & petrochemicals	PetroChina	Bluechem
Telecommunications	China Telecom Corporation Limited	
Coal	China Shenhua Energy Company Limited	
Civil aviation	Air China	
Shipping	COSCO	
Machinery	Jingwei Textile Machinery Company Limited	
Automobiles	Dongfeng Motor Company	
Information technology	China Electronics Corporation Holdings Co. Ltd.	IRICO Group Electronincs Co Ltd
Construction	China State Construction International Holdings Limited	
Iron & steel & non-ferrous metals	Angang Steel Co Ltd	Aluminum Corporation of China Ltd

Additional information on subsidies was extracted from a review of the respective scholar literature. In the below tables below, different rates and types of subsidies available in the literature are listed.

Annex Table 16: Review of Industrial Subsidies in China.

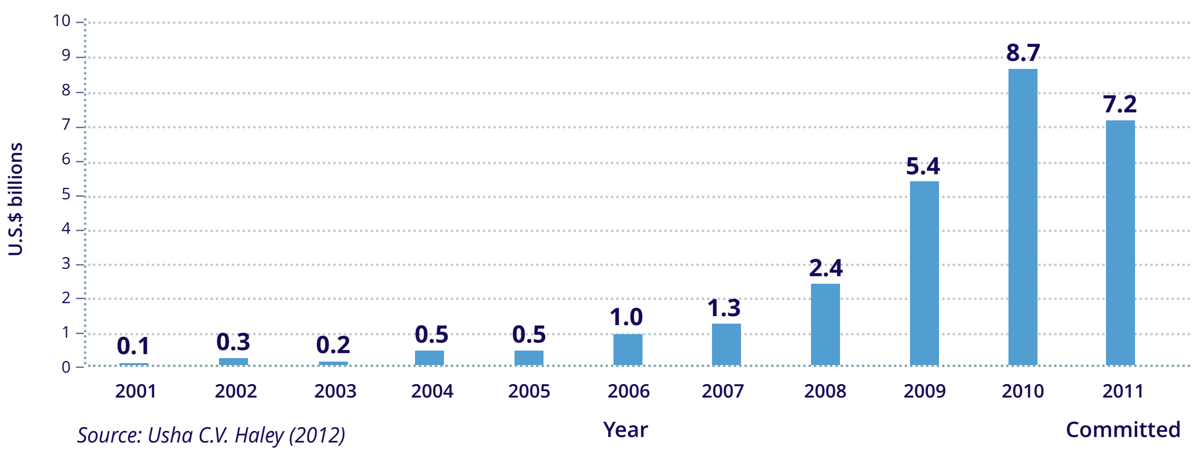
Source	Industry	Year	Information	Subsidies (millions $)	Subsidy Rate
Capital Trade Incorporated	-Armaments -Power Supply -Oil and Petrochemicals -Telecommunications -Coal -Civil aviation -Shipping -Machinery -Automobiles -Information technology -Construction -Iron, Steel and non-ferrous metals	2007	Collected data from annual reports of selected companies for each industry.	57.2 and 12.8 256.9 4 927.4 and 224.6 695.9 633.1 242.7 361 16.6 182.8 4.4 and 46.5 11.3 95 and 475.2	2.6% and 5.9% 8.3% 4.5% and 39.4% 14.3% 5.9% 3.6% 2.5% 2.3% 2.3% 1.1% and 10.5% 0.9% 1.1% and 4.75%
Usha C.V. Haley (2012)	Auto-parts	2001-2011 2009 2010 2011	Price Gap approach	27.5 5.4 8.7 7.2	-
Zhao and Zhou (2019)	-	2015	590 firms 36 firms 3 firms From 2828 listed companies	3 690 >16 >200	-
Financial Times	Total	2018	-	22 000	-

Annex Table 16: Review of Industrial Subsidies in China.

Source	Industry	Year	Information	Subsidies (millions $)	Subsidy Rate
Myrto Kaloupt-sidi (2017)	Shipyard	2006-2012	Government subsidies decrease cost of production 13-20% or 1.5-4.5 billion dollars	-	-
Lion and Kuang (2020)	Natural gas	2010-2015	-	15 870	-
Lin and Jiang (2011)	Energy subsidies	2007	Price Gap approach	356 730 CNY	(1.43% of GDP)
Hong, Liang and DI (2013)	Energy subsidies	2007	Price Gap approach	582 000 CNY	-
Lin and Quyang (2014)	Fossil fuel subsidies	2006 2007 2008 2009 2010	Price Gap approach	603 500 CNY 772 040 CNY 1 039 240 CNY 628 370 CNY 881 940 CNY	2.79 (% of GDP) 2.9% 3.31% 1.84% 2.59%
Lin and Jiang (2011)	-Coal -Gasoline -Diesel oil -Fuel oil -Natural Gas -Electricity	2007	Price Gap approach	53 200 CNY 77 260 CNY 94 590 CNY 17 180 CNY 38 110 CNY 76 390 CNY	-
Hong, Liang and Di (2013)	-Coal -Oil Products -Gasoline -Diesel -Fuel oil -Aviation Kerosene -Natural Gas -Electricity	2007	Price Gap approach	43 000 CNY 271 800 CNY 65 900 CNY 194 300 CNY 10 800 CNY 800 CNY 71 600 CNY 195 600 CNY	-
Li and Li (2019)	-Coal	2008 2012	Inventory approach	6 300 Yuan 16 400 Yuan	-
Hu, Jiang and Holmes (2019):	-	2007-2015	Unbalanced Panel Data	-	0.4% (over total assets of firm)
Jiang and Lin (2014)	-Agriculture -Light Industry -Heavy Industry -Transportation -Commerce and others -Resident Total	2008	Price gap approach - Net subsidies	45 910 CNY 15 580 CNY 180 620 CNY 267 770 CNY 15 180 CNY 307 410 CNY 832 550 CNY	0.15 (% of GDP) 0.05 (% of GDP) 0.6 (% of GDP) 0.89 (% of GDP) 0.05 (% of GDP) 1.02 (% of GDP) 2.76 (% of GDP)
Jiang and Lin (2014)	-Coal -Gasoline -Diesel oil -Fuel oil -Kerosene -Natural Gas -Electricity Total	2008	Price gap approach Perverse energy subsi-dies	87 190 CNY 136 360 CNY 181 040 CNY 16 490 CNY 24 510 CNY 73 230 CNY -9 610 CNY 509 220 CNY	0.29 (% of GDP) 0.45 (% of GDP) 0.6 (% of GDP) 0.05 (% of GDP) 0.08 (% of GDP) 0.24 (% of GDP) - 1.69 (% of GDP)

The study conducted by Usha C.V. Haley (2012) finds that from 2001 to 2011 27.5 billion USD were spent in auto-parts industries by the China Central Government and committed an additional 10.95 billion USD in subsidies for the period 2012 to 2020. The authors collected data from several sources such as China government agencies, US government agencies, Chinese think tanks, international governmental agencies, international investment houses and individual companies. The authors estimated subsidies using a price gap approach.

Annex Figure 3: Total identified subsidies to China auto-parts industry 2001-2011



Source: Usha C.V. Haley (2012)

Using the price gap approach Lin and Jiang (2014) found that perverse fossil fuels subsidies amounted to 509.22 billion CNY for 2008 which corresponds to 61.2% of total fossil fuel subsidies and 1.69% of GDP. They also used a computable general equilibrium model and found that removing these perverse fossil fuel subsidies corresponds to a decline in energy demand and CO_2 emissions.

The study of Lim, Wang and Zeng (2017) used a two staged OLS estimation to examine the relationship of government subsidies to the cost of debt and the financial performance of a firm. They gathered data from annual reports, China securities market and Accounting resource database for 2007 to 2011. They mention that the percentage of government subsidies over total assets is 0.4%. They found that government subsidies negatively affect the cost of debt and the relationship with the financial performance of a firm have mixed results.

Myrto Kalouptsidi (2017) estimates that government subsidies have possibly contributed to the expansion of capital-intensive industries in China. They also state that government subsidies lead to a decrease in cost of production in Chinese shipyards by 13-20% corresponding to a total of 1.5-4.5 billion USD between 2006 and 2012.

The study of Jiang, Zhang, Bu and Liu (2018) investigates the relationship between government subsidies and research and development intensity of China's new energy vehicle (NEV) enterprises. They used an annual panel dataset from 2010 to 2015 and found a positive impact of government subsidies to the research and development intensity.

Zhao, Zhou, Zhao and Zhou (2019) found that among the 2828 listed companies in China 590 companies received 3.69 billion USD of government subsidies , 36 firms received more than 16 million USD and 3 other firms more than 200 million USD in 2015.

Financial Times reports that China paid 22 billion USD in corporate subsidies in 2018.

Lin and Kuang (2020) estimate that China natural gas subsidies were 57.54 billion USD accounting for 10.68% of the total fossil fuel subsidies in

2007 while the proportion of natural gas increased to 50% of total fossil fuels subsidies in 2013. The average annual subsidy of natural gas in China's industrial sector in 2010–2015 was about 15.87 billion USD.

Lin and Jiang (2011) estimated pre-tax energy subsidies of China in 2007 at 356.73 CNY billion (1.43% of GDP) while Li et al. (2013) found pre-tax energy subsidies at 582 CNY billion. Lin and Quyang (2014) estimated the scale of fossil fuels subsidies for China at an amount of 881.94 CNY billion on 2010. Xiang and Kuang (2019) used a computable partial equilibrium model with monopolistic competition simulated the economic and welfare impact of China's coal subsidies at an industry level.

Li and Li (2019) used an inventory approach to estimate the fossil energy subsidies in the coal chemical sector. They found that in 2018 the total coal consumption subsidy in the coal to liquid industry was 6.3 billion Yuan and will reach 16.4 billion Yuan in 2022.

Hu, Jiang and Holmes (2019): Examined the relationship between government subsidies and firm investment efficiency by collecting data on subsidies from WIND for the period 2007-2015. They found that government subsidies have a negative effect on the efficiency of firm investments especially if firms that are financially less constraint. They also mention that the average firm have a subsidy rate of 0.4% over total assets.

References on industrial subsidies in China

1. Haley, U. C. Putting the Pedal to the Metal, Subsidies to China's Auto-Parts Industry from 2001 to 2011 2012

2. Hong, L., Liang, D. and Di, W. Economic and environmental gains of China's fossil energy subsidies reform: A rebound effect case study with EIMO model Energy Policy, Elsevier BV, 2013, Vol. 54, pp. 335-342

3. Hu, J., Jiang, H. and Holmes, M. Government subsidies and corporate investment efficiency: Evidence from China Emerging Markets Review, Elsevier BV, 2019, Vol. 41, pp. 100658

4. Hu, W. Industrial Subsidies, Stated-Owned Enterprises and Market Distortions: Problems, Proposals and a Path Forward University of ADELAIDE, University of ADELAIDE, 2019

5. Jiang, C., Zhang, Y., Bu, M. and Liu, W. The Effectiveness of Government Subsidies on Manufacturing Innovation: Evidence from the New Energy Vehicle Industry in China Sustainability, MDPI AG, 2018, Vol. 10(6), pp. 1692

6. Jiang, Z. and Lin, B. The perverse fossil fuel subsidies in China—The scale and effects Energy, Elsevier BV, 2014, Vol. 70, pp. 411-419

7. Kalouptsidi, M. Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding the Review of Economic Studies, Oxford University Press (OUP), 2017, Vol. 85(2), pp. 1111-1158

8. Lee, E., Walker, M. and Zeng, C. (C. Do Chinese state subsidies affect voluntary corporate social responsibility disclosure? Journal of Accounting and Public Policy, Elsevier BV, 2017, Vol. 36(3), pp. 179-200

9. Li, Y. and Li, C. Fossil energy subsidies in China's modern coal chemical industry Energy Policy, Elsevier BV, 2019, Vol. 135, pp. 111015

10. Lim, C. Y., Wang, J. and Zeng, C. (C. China's "Mercantilist" Government Subsidies, the Cost of Debt and Firm Performance Journal of Banking & Finance, Elsevier BV, 2018, Vol. 86, pp. 37-52

11. Lin, B. and Jiang, Z. Estimates of energy subsidies in China and impact of energy subsidy reform Energy Economics, Elsevier BV, 2011, Vol. 33(2), pp. 273-283

12. Lin, B. and Kuang, Y. Natural gas subsidies in the industrial sector in China: National and regional perspectives Applied Energy, Elsevier BV, 2020, Vol. 260, pp. 114329

13. Lin, B. and Luan, R. Are government subsidies effective in improving innovation efficiency? Based on the research of China's wind power industry Science of The Total Environment, Elsevier BV, 2020, Vol. 710, pp. 136339

14. Lin, B. and Ouyang, X. A revisit of fossil-fuel subsidies in China: Challenges and opportunities for energy price reform Energy Conversion and Management, Elsevier BV, 2014, Vol. 82, pp. 124-134

15. Xiang, H. and Kuang, Y. Who benefits from China's coal subsidy policies? A computable partial equilibrium analysis Resource and Energy Economics, Elsevier BV, 2020, Vol. 59, pp. 101124

16. Zhao, Y., Zhou, D., Zhao, K. and Zhou, P. Is the squeaky wheel getting the grease? Earnings management and government subsidies International Review of Economics & Finance, Elsevier BV, 2019, Vol. 63, pp. 297-312

17. An Assessment of China's Subsidies to Strategic and Heavyweight Industries Capital Trade Incorporated, Capital Trade Incorporated,

Reduction of Fossil Fuel Subsidies

No comprehensive global dataset exists on fossil fuel subsidies (by industry, fuel and country). For the modelling, aggregate data from the following sources was used:

(1) IEA: https://www.iea.org/topics/energy-subsidies

(2) OECD: https://stats.oecd.org/Index.aspx?DataSetCode=FFS_DEU

(3) IMF: https://www.imf.org/en/Publications/WP/Issues/2019/05/02/Global-Fossil-Fuel-Subsidies-Remain-Large-An-Update-Based-on-Country-Level-Estimates-46509

The fossil fuel subsidy rates used in this study are presented in Annex Table 17.

Annex Table 17: Fossil fuel subsidy rates

	Households			Industries		
	Oil	**Gas**	**Electricity**	**Coal**	**Oil**	**Gas**
USA	0.00	-0.03		0.00	0.00	0.00
CHN	-0.16	-0.05	-0.07	0.00	-0.01	0.00
IND		-0.31	-0.14	-0.03	-0.21	-0.10
KOR	-0.02	-0.11		-0.01	-0.03	-0.01
IDN			-0.45			
TUR		-0.06				
ROW	-0.23		-0.16	-0.03	-0.19	-0.04

5. Technical Information on Cost Pass Through (CPT) and Price Elasticity

Cost Pass Through rates

The ability of a firm to pass through cost changes to their prices as observed by consumers is referred to as cost pass through (CPT). Cost pass through mainly depends on the type of competition (monopolistic, oligopolistic and perfect competition), the elasticity of demand and supply and the reason that triggers the cost increase. The application of a carbon price in those sectors covered by the EU ETS will increase unit cost of a product, therefore it is important to know to what extent the increase can be passed through to consumers prices for the sectors covered by the study.

There are two ways to measure cost pass through:

1) **Cost pass through rate:** If a 1$ unit cost increase for the producers leads to an increase of consumer prices of 0.5$, the cost pass through rate is 0.5 (50%).

2) **Cost pass through rate elasticity:** A 10% increase of unit costs for producers causes a 10% increase in consumer prices (cost pass through elasticity is 1).

The Herfindahl-Hirschman Index (HHI) is a concentration index to measure the type of competition:

$$HHI_i = \sum_{j=1}^{n} MS^2{}_{i,j}$$

Where:

i: is the sector.

j: a firm of the sector.

n: number of the firms in that sector.

MS: market share of the firm in the sector.

As mentioned by Koopmans (2016), if HHI is below 1000 the market is assumed to be in perfect competition, if it is between 1000 and 1800 it is considered as a moderate concentrated market and if it is above 1800 it is assumed to be a concentrated market. Also, Kroopmans (2016) states that the average HHI across aviation markets is 4600 indicating that most of the aviation markets are monopolistic however these markets are small in size with a low number of passengers and the big aviation markets are considered oligopolies.

The following tables present estimations for cost pass-through computed in different reports by sector.

Annex Table 18: Estimation of Cost pass through as observed in literature

Report	Sector	Type of Cost	Type of Competition	CPT
Kroopmans (2016)	Air Transport	Firm-Specific Sector Wide	Oligopoly	20%-50% >50%
Kroopmans (2016)	Air Transport	Firm-Specific Sector Wide	Perfect Competition	0% 100%
CE Delft/Oeko-institut (2015)	Cement Portland cement	-	-	20%-40% 90%-100%
E Delft/Oeko-institut (2015)	Petrochemicals	-	-	100% and over
E Delft/Oeko-institut (2015)	Fertilizers	-	-	100% and over
E Delft/Oeko-institut (2015)	Iron and Steel	-	-	55%-85%
E Delft/Oeko-institut (2015)	Refineries	-	-	80%-100%
Fabra and Reguant (2014)	Electricity Market	-	-	86.2%
Ganapati, Shapiro and Walker (2016)	Cement	-	Imperfect Competition	178% and 184%
Alexeeva and Talebi (2010)	Fertilizers and nitrogen compound	-	Oligopoly	16%
Alexeeva and Talebi (2010)	Plastics in primary forms	-	Oligopoly	42%
Alexeeva and Talebi (2010)	Other Rubber products	-	Oligopoly	75%
Alexeeva and Talebi (2010)	Cement, lime and plaster	-	Oligopoly	73%
Gron and Swenson (2000)	Automobile	-	-	14% to 18%
Alexeeva and Talebi (2010)	Paper and paperboard	-	Oligopoly	0%

Koopmans and Lieshout (2013) present the likely cost pass through rate per market structure observed in literature and in the aviation sector. Also, they stated that many studies (Anger en Kohler, 2010; Boon et al., 2007; European Commission, 2006; Frontier Economics, 2006; Lowe et al., 2007; Mayor en Tol, 2010; Mendes en Santos, 2008; Morrell, 2007; PWC, 2005; Scheelhaase et al., 2010; Scheelhaase en Grimme, 2007; Vivid Economics, 2007; Wit et al., 2005) assume that ETS costs are fully passed through in the aviation sector based on the assumption of perfect competition, while other research that assume oligopolistic or monopolistic competition comes up with estimations of between 29% and 35%.

Annex Table 19: CPT by market structure observed in literature

Authors	Market type	Assumptions	CPT
Bulow and Pfleiderer (1983)	Perfect Competition	One-firm cost change	0%
Zimmerman and Carlson (2010)	Perfect Competition	Sector wide	100%
Ten Kate and Niels (2005)	Oligopoly (cournot type)	One-firm cost change Sector wide	1/(N+1) N/(N+1)
Zimmerman and Carlson (2010)	Oligopoly (cournot type)	One-firm cost change Sector wide	20%-50% Larger than 20%-50%
Zimmerman and Carlson (2010)	Oligopoly (bertrand type)	One-firm cost change Sector wide	0%-50% Larger than 50%
Varian (1992) Monopoly	Linear Demand	50%	
Bulow and Pfleiderer (1983)	Monopoly	Log Demand Curve	100%

A summary of CPT rates per sector as found in literature and the CPT rates used in the modelling of this study are presented in the following table.

Annex Table 20: CPT Rates by literature

Sector	CP Rates			
Oil	0.9	1	0.8	0.75
Power Supply	0.862	0.862	0.862	0.50
Ferrous metals	0.7	0.85	0.55	0.55
Non-ferrous metals	0.7	0.85	0.55	0.55
Chemical Products	0.58	1	0.16	0.9
Paper Products	0	0	0	-
Non-metallic minerals	0.96	1.81	0.3	0.9
Air transport	0.75	1	0.5	0.45

References on Cost Pass Through Rates

1. Alexeeva-Talebi, V. Cost Pass-Through in Strategic Oligopoly: Sectoral Evidence for the EU ETS SSRN Electronic Journal, Elsevier BV, 2010

2. Fabra, N. and Reguant, M. Pass-Through of Emissions Costs in Electricity Markets American Economic Review, American Economic Association, 2014, Vol. 104(9), pp. 2872-2899

3. Francois, J. and Manchin, M. Market power in distribution and pass-through for consumers and producers Review of International Economics, Wiley, 2018, Vol. 27(1), pp. 290-312

4. Ganapati, S., Shapiro, J. and Walker, R. Energy Cost Pass-Through in U.S. Manufacturing: Estimates and Implications for Carbon Taxes National Bureau of Economic Research, 2016

5. Gron, A. and Swenson, D. L. Cost Pass-Through in the U.S. Automobile Market Review of Economics and Statistics, MIT Press - Journals, 2000, Vol. 82(2), pp. 316-324

6. Hintermann, B. Pass-Through of CO2 Emission Costs to Hourly Electricity Prices in Germany Journal of the Association of Environmental and Resource Economists, University of Chicago Press, 2016, Vol. 3(4), pp. 857-891

7. Jouvet, P.-A. and Solier, B. An overview of CO2 cost pass-through to electricity prices in Europe Energy Policy, Elsevier BV, 2013, Vol. 61, pp. 1370-1376

8. Koopmans, C. and Lieshout, R. Airline cost changes: To what extent are they passed through to the passenger? Journal of Air Transport Management, Elsevier BV, 2016, Vol. 53, pp. 1-11

9. Loecker, J. D., Goldberg, P. K., Khandelwal, A. K. and Pavcnik, N. Prices, Markups, and Trade Reform Econometrica, The Econometric Society, 2016, Vol. 84(2), pp. 445-510

10. Miller, N. H., Osborne, M. and Sheu, G. Pass-through in a concentrated industry: empirical evidence and regulatory implications The RAND Journal of Economics, Wiley, 2017, Vol. 48(1), pp. 69-93

11. Muehlegger, E. and Sweeney, R. Pass-Through of Own and Rival Cost Shocks: Evidence from the U.S. Fracking Boom National Bureau of Economic Research, 2017

12. S.M. de Bruyn, R. Vergeer, E. S., M.'t Hoen, M. K., J. Cludius, K. S. and C. Zell-Ziegler, S. H. Ex-post investigation of cost pass-through in the EU ETS CE Delft and Oeko-Institut, CE Delft and Oeko-Institut, 2015

13. Sijm, J., Neuhoff, K. and Chen, Y. CO2 cost pass-through and windfall profits in the power sector Climate Policy, Informa UK Limited, 2006, Vol. 6(1), pp. 49-72

14. Wang, B., O'Sullivan, A., Dray, L. and Schäfer, A. W. Modeling Airline Cost Pass-Through within Regional Aviation Markets Transportation Research Record: Journal of the Transportation Research Board, SAGE Publications, 2018, Vol. 2672(23), pp. 146-157

15. Williams, I., Durand, B., Majumdar, A., Alvim, N., Armstrong, R., Manganelli, A., Reuter, T. Sodano, V., Stoddart, P. and Whelan, C. Cost pass-through: theory, measurement, and potential policy implications RBB Economics, RBB Economics, 2014

16. Zamani, O., Bittmann, T. and Loy, J.-P. Search costs and cost pass-through: Evidence for the Iranian poultry market Economics Letters, Elsevier BV, 2018, Vol. 171, pp. 119-122

Elasticities

Annex Table 21: Armington Elasticities used in GEM-E3

	Armington Elasticities
Oil	1.05
Ferrous metals	2.95
Non-ferrous metals	4.2
Metal products	3.75
Chemical Products	3.3
Basic pharmaceutical products	3.3
Paper products, publishing	2.95
Non-metallic minerals	1.9
Computer, electronic and optical products	4.4
Electrical equipment	4.4
Machinery and equipment	4.05
Transport equipment (excluding EV)	3.55
Other Equipment Goods	3.75
Air transport	1.9
Trade	1.9
Accommodation, Food and service activities	1.9
Financial services	1.9
Insurance	1.9
Recreational and other services	1.9
Other Market Services	2.08
Batteries	4.4
EV Transport Equipment	3.55
Advanced Electric Appliances	3.75
Advanced Heating and Cooking Appliances	3.75
Equipment for wind power technology	4.05
Equipment for PV panels	4.05
Equipment for CCS power technology	3.75

Annex Table 22: Regions/Countries in the GEM-E3 model

Country / Region All EU member states + UK
USA
Japan
Canada
Brazil
China
India
South Korea
Indonesia
Mexico
Argentina
Turkey
Saudi Arabia
Oceania
Russian Federation
Rest of energy producing countries
South Africa
Rest of Europe
Rest of the World

6. Literature Review

A number of studies explore the effect of trade on climate change. Although this literature generally finds that global growth in emissions over the last several decades is primarily attributable to growth in consumption – particularly within emerging economics (see, e.g., Inaki and Dietzenbacher, 2014) – trade is also found to be a significant contributor (e.g., de Vries and Ferrarini, 2016), accounting for roughly one-quarter of global emissions (Sakai and Barrett, 2016; Wiedmann, 2016).

Research finds that trade primarily exacerbates climate change through two channels. Firstly, trade directly produces carbon emissions through the transport of goods and services across geographically distant locations. These emissions have increased over time due to greater intensification of international supply chains that have led to significant increases in the trafficking of goods and services across increasingly wider distances (Wiedmann and Lenzen, 2018).

Second, in the context of a more liberalised global trade environment, climate change can become further exacerbated in instances where production shifts towards jurisdictions with less stringent environmental regulations and manufacturers that employ production processes with larger carbon footprints (Moran et al., 2013). This issue becomes particularly problematic in instances where governments attempt to enact regulations to combat climate change, thereby imposing additional costs on domestic producers that reduce their international competitiveness and promote additional incentives to relocate production to jurisdictions with less stringent environmental standards and regulations.

Research finds that developed countries have become net importers of embodied carbon from developing economies (Peters and Hertwich, 2008; Peters et al., 2011; Kanemoto et al., 2014; Wood et al., 2019a; Hoekstra et al., 2016; Wood et al., 2018; Jiang and Green, 2017; Wu and Chen, 2017; Liu et al. 2017; Wiedmann and Lenzen, 2018; Steen-Olsen et al., 2012; Zhang et al., 2017; Plank et al., 2018). Hoekstra et al. (2016), for example, find that changes in sourcing patterns contributed to 18 percent of the total global growth in emissions between 1995 and 2007, while Wu and Chen (2017) find that only 15 percent of energy use embodied in trade is induced by final consumption.

Among developed economies, Tukker et al. (2016) find that the EU is the most heavily reliant on net embodied imports, though Wood et al. (2019b) find that the EU carbon footprint has decreased by 8 percent between 1995 and 2016 as a result of improvements in technology (both within the EU and among international suppliers). Wood et al. (2019b), moreover, find that the role of trade in EU carbon emissions has stabilized since 2008 and appears to be largely unavoidable given the need to import certain products with higher carbon footprints (e.g., mining and agriculture).

These findings support concerns that international trade may undermine national and regional policies designed to mitigate climate change (Zhang et al., 2017; Peters and Hertwich, 2008; Peters et al., 2011; Kanemoto et al., 2014; Kuik and Hofkes, 2010). Kanemoto et al. (2014), for example, demonstrate that countries' reductions in carbon emissions can be shown to have increased when accounting for carbon embodied in trade.

Wood et al. (2019a), however, note that transfers of embodied emissions appear to have peaked in 2006, citing both the post-2008 deceleration of trade as well as the rapid improvement in carbon efficiency in developing economies as a result. This former point is supported by Pan et al. (2017), who specifically credit this plateauing of carbon emissions associated with trade as a result of China's improvements in carbon intensity. Both studies appear to support claims that trade could potentially be beneficial for efforts to mitigate climate change through its ability to facilitate the diffusion of environmental goods and less carbon intensive production methods. To this end, findings from Sauvauge (2014) suggest that trade, if coupled with effectively enforced environmental regulations, can drive the development of a market for environmental goods and services. Early action on climate and environmental measures can also be associated with benefits in export competitiveness, particularly in the case of EU high-technology and research-intensive sectors, while stimulating a diffusion effect (Costantini and Mazzanti, 2011).

7. Policy Measures not Pursued

Carbon Content-modulated Preferential Rules of Origin

The policy would (i) create a system of climate-modulated Preferential Rules of Origin (PROOs) applied within future FTAs negotiated by the EU and which places carbon emissions caps on some set of products; (ii) define a good as 'originating' from one of the signatory countries where the carbon embodied in its production does not exceed this cap; and (iii) grant preferential tariffs to those goods that qualify as 'originating'. Where a good cannot demonstrate compliance, it will be subject to MFN rates.

The approach that was considered for this scenario involves several steps. As a first step, it is necessary to determine the countries that would be subject to this policy – particularly since it is conceived of as a bilateral tool applied between the EU and partner countries. In discussions between the study team and AFEP it was further agreed that the best approach would be to use those countries that have already launched FTA talks. This has led to the identification of 17 potential partners that could conceivably reach such an agreement with the EU (in principle)[17].

In practice, however, incorporating each of these partner countries into the model is complicated by the limitations on the regional aggregations available. Instead, based on the list of available countries, countries included in the model will be Brazil, China, India, South Korea, Indonesia, Vietnam, and the United States. The modelling approach will use the above data sources to compile carbon profiles that identify the carbon content[18] for each of the covered sectors in each of the targeted countries. The calculation is made according to Equation 1 described in the section above.

As a second step, a threshold will be applied which will inform the model when imports from the flagged countries will receive preferential tariff rates and when they will instead remain subject to existing rates (either MFN or rates applied under an existing preferential agreement). This threshold will again be made according to EU ETS benchmarks, which are calculated to reflect the best available technology in terms of lowest carbon intensity across countries. This calculation is reflected in Equation 2 under the policy for CBAM.

As a third step, calibrations will be made to the

17 *These countries include: Australia, New Zealand, Philippines, Thailand, Malaysia, Gulf Coast Countries (Kuwait, Oman, Qatar, Saudi Arabia), India, United States, Chile, Mexico, Turkey, Morocco, Tunisia, and the UK.*
18 *Note: this does not reflect the carbon content associated with the complete value chain.*

model so that it is aware that these preferential tariffs are tied to the carbon content of the covered products. This step is essential to ensure that firms within the model are capable of adjusting their production decisions over time (i.e. so that they can opt to reduce the carbon embodied in production) in line with the incentives provided by the policy.

Limitations and Reason for non-Selection

From a perspective on the analytical framework, the model currently has limits on the number of countries/regions for which this policy can be applied. Furthermore, the model utilizes a representative firm, which is standard for global models of this type. This implies that a single carbon profile will be used to represent all firms within a sector operating in a single region/country. As such, either all firms or no firms from flagged countries will be subject to preferential tariffs in a given period.

While Carbon Content-modulated PROOs were generally deemed to be compliant with the existing WTO framework and in-line with EU political priorities, the instrument was not pursued further due to the unlikelihood of trading partner countries agreeing to the provisions in future FTAs with the EU. Most if not all of the candidate trading partner countries would but subjecting their domestic industries to a disadvantage compared to the relatively low-carbon composition of the EU economy.

Carbon Content-modulated Anti-dumping Rules

Climate-modulated Anti-dumping Rules can be used to mitigate 'environmental dumping. 'Environmental dumping' can occur if prices of imports do not include the social and environmental costs of the carbon emitted during the production process. To counter the competitive disadvantages that more stringent environmental policies may engender, EU could, in principle, impose climate-modulated anti-dumping duties on these imports.

EU-wide anti-dumping policy oriented towards climate change and which would permit EU officials to factor in the 'carbon edge' (based on a reference country) provided to foreign imports in order to determine the extent of environmental dumping. Where environmental dumping occurs, the EU would impose additional duties on these products.

Limitations and Reason for non-Selection

In practice, the study team has been unable to find an appropriate way to implement this policy. In principle, it is envisaged that such a policy would be implemented by basing the carbon edge/dumping margin in comparison to a reference country with stricter environmental standards. However, this would require detailed information on the production costs for all sectors in these reference countries as well as in the list of flagged countries. Such data is not available in the model and compiling it would be expected to require significant additional effort. Without a comparison 'normal value' and 'carbon edge', the model would, in turn, not be to determine whether environmental dumping is occurring nor would it be able to determine the antidumping duties to apply.

Furthermore, the study addresses other aspects of price distortions for products originating outside of the EU through the reduction on industrial and fossil fuel subsidies scenarios, which are similar in purpose to the anti-dumping rules considered however focus on cooperative reduction as opposed to enforcement.

Domestic Technical Standards encouraging Low-carbon Technology

As a means of improving the efficiency or environmental performance many countries set a number of technical standards (e.g. IMO Sulphur 2020 on shipping, CO2 on car industry, ECO design etc.) as they are compliant with WTO rules when they are non-discriminatory and based on meeting scientifically supported objectives with respect to public well-being. With respect to EU environmental goals, there are grounds for imposing technical standards in a non-discriminatory way as a means of ensuring that climate objectives can be reached. Non-EU products that are above this threshold for carbon content are prohibited from being imported. Products below the threshold are permitted entry but without any change to existing tariffs. The likelihood of retaliation by trading partner countries whose market access to the EU would be affected was also considered for this scenario.

In principle, the instrument considered an acceleration of EU industry's improvement in carbon efficiency through the imposition of domestic standards and imorts are in turn required to keep pace with these standards to be granted entry into the EU market. A variant comprising the possibility for a plurilateral agreement in which technical standards led by the EU were agreed by a range of partner countries was also considered.

Technical standards can be applied either on manufacturers/producers or at customs level. Once the standard is decided (i.e. carbon content of product) an out of the model calculation would then be required in order to derive in a bottom-up way how many products within an industry fail to meet the standard. As in the model each industry produces one product a measurement outside the model is required to approximate the share of products by industry and country that meet the technical standard.

Then this share is used in the model as a capacity constraint in the respective industry. If the standard applies to trade transactions (i.e. it is imposed in the customs) then a constraint in import capacity is imposed (in volume).

Limitations and Reason for non-Selection

The scenario was not pursued primarily due to the limitations and technical challenge of determining standards across the different sectors. The realistic modelling of the scenario would benefit from sectoral data on the rates of non-conformity that would be expected from imported products not meeting the EU standards, as well as sectoral definition of which standards to apply.

CBAM based on EU ETS Extension or Mirroring for Imported Goods

The final policy scenario evaluated by the Study Team considers extension of the EU ETS or an ETS-equivalent mechanism for purchasing allowances to clear imported goods. While this bears similarity to other policy scenarios evaluated by the study – notably the CBAM – in that it specifically targets the carbon emissions gap between EU and foreign-based production methods, several key differences are outlined below.

The policy would target goods imported into the EU and falling under product categories covered by the ETS. Importers will therefore be responsible for demonstrating that they have obtained the requisite allowances based on ETS benchmarks for each kind of product. Conceivably, these allowances could be in the form of standard EU ETS allowances, alternatively the system would need to include a kind of virtual arrangement which kept regular EU allowances separate from those available to producers of imported goods. Either approach requires the calculation of the additional number of allowances that would need to be introduced to reflect the coverage of the EU ETS extended to imported products originating outside the EU.

The application of the EU ETS or an ETS-equivalent mechanism for carbon allowances exclusive to imported goods would require to first endogenously calculate the number of the quantity of foreign-produced emissions linked to EU imports during a given base year. This would determine the starting number of allowances, virtual or otherwise, corresponding with the foreign production of imported goods into the EU.

Carbon profiles would then be developed for each of the covered sectors in each of the countries covered by the scope of the study. These are then compared with the EU threshold, based on EU ETS benchmarks calculated to reflect the best available technology $(BAT_{(i,t)})$ in terms of lowest carbon intensity across countries.

Imports from trading partner countries where the carbon profile is determined to be equivalent to or less intensive than the EU ETS reference will not be required to provide allowances to enter the EU, however for imports where the carbon intensity in the country of origin is determined to be greater than the EU ETS reference the importer will be required to submit allowances that are pro-rated to the carbon difference.

The calculations are broadly similar to the approach taken under the CBAM mechansim, with the main distinction that the adjustment is not made in the form of a direct financial levy but rather in the form of equivalent allowances. The number of allowances is finite, creating greater pressure to innovate and select carbon-efficient production methods over time.

Limitations and Reason for non-Selection

Crucially, the difference between this ETS Extension or Mirroring variant of the CBAM not pursued differs from the CBAM in Section 4.1 mainly in form rather than in function. The comparison between EU carbon intensity of a given product and the reference rate of emissions associated with the sector and trading partner country is common to both scenarios. While some additional transaction costs would be presumed for the ETS Extension or Mirroing variant, the overall rate of adjustment applied – either in the form of the border tax or allowances – would be the same, meaning the CBAM scenario results modelled are representative of an ETS Extension or Mirroring variant also under consideration.

The ETS mirroring or extension variant of a CBAM scenario bears the advantage at an EU political level of not being a tax-based instrument, and therefore not requiring unanimity between Member States in order to implement. That said, were the number of allowances to be changed, a process of negotiation between Member States would be expected to occur to agree on a revision.

At the international level, care is needed to construct the policy in such a manner that does not create divergent requirements on imported and domestic goods. In this regard, a configuration in which importers procured EU ETS allowances based on a default carbon emissions output per product and trading partner country would appear to satisfy National Treatment provisions under the GATT/WTO framework. By comparison, a system of parallel allowances linked to the EU ETS would likely involve some divergence in price between domestic and imported products and would face greater risk of challenge by international trading partner countries. Any variation of the scenario where imported products originating outside of the EU faced a different carbon price than levied on EU domestic producers through the ETS would be likely to incur legal challenges on the part of EU trading partners.

8. Supplemental Note on Subsidies

The starting point for any assessment of World Trade Organization (WTO) compatibility of green subsidies is the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement). 32 The SCM Agreement attempts to minimize trade distortions arising from the subsidization of specific firms or industry groups. At EU-level, the response to the COVID-19-crisis may open up ways for subsidizing or 'investing in' low-carbon technologies. Regarding WTO compliance, the paragraph above already indicates that the starting point for assessing WTO compatibility is the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement).

Article 1 of the SCM Agreement defines a subsidy as having three necessary elements:

a) a financial contribution has been provided (this can be a direct transfer of funds but also a tax that is foregone or the provision of a government service);

b) the contribution was made by a government or a public body within the territory of a WTO member; and

c) the contribution confers a benefit (the financial contribution makes a recipient better off than it otherwise would have been).

The SCM Agreement makes a distinction between two categories of subsidies:

i. prohibited subsidies (i.e. subsidies contingent upon the export or use of domestic rather than imported products); and

ii. actionable subsidies (i.e. subsidies that cause adverse effects to the interests of other WTO members). The SCM Agreement allows other countries to impose countervailing measures against the subsidized products.33

Subsidies in the second category are open to challenge by other members only if they are believed to cause adverse effects. In either case, the complaining member may challenge the subsidizing member's subsidies in WTO dispute settlement. It prohibits the use of certain subsidies (subsidies contingent on export performance or use of domestic content).

The question is whether the SCM Agreement would act as a barrier to subsidies aimed at promoting a greener economy.

Green Subsidies

It remains unclear to what degree the SCM Agreement impedes WTO members from subsidizing green industries. The WTO Panel in the dispute Canada—Feed-in Tariff Program34 found that Ontario's FIT Program violated the national treatment measure in the GATT and the Trade-Related Investment Measures Agreement, but not the SCM Agreement. Indeed, the complainants (the EU and Japan) had failed to show that the FIT Program constituted a subsidy under the SCM Agreement. This case at least suggested that the SCM Agreement may not be a major obstacle to green subsidies.

There is also ambiguity over whether GATT article XX on general exceptions applies to the SCM Agreement.35 Article XX allows for derogation from the GATT 1947 trade rules for certain reasons, such as the protection of public morals or the environment. Traditional thinking holds that article XX applies only to disputes arising out of alleged breaches of GATT 1947 provisions and not to other WTO agreements such as the SCM Agreement. If the article XX exceptions are not available to WTO members whose green subsidies are alleged to have violated the SCM Agreement, then the SCM agreement might well represent a significant limitation on the ability of countries to subsidize green technology and industries.

1. Ways forward: policy options

- Overall, the SCM Agreement might benefit from **amendments** that give greater recognition to environmental purposes. The purpose of subsidies is to address market failures. Since climate change represents one of the greatest market failures in human history, there should be room for government intervention to account for externalities of carbon-emitting activity.
- In the absence of amendments to the SCM agreement, policy makers might consider whether there is potential to slot **green subsidies under section 1.1(a)(1)(iii)**, which exempts the provision of "general infrastructure" from the definition of subsidy. Governments could potentially put at least some green subsidies beyond the reach of the SCM Agreement by promoting the notion of "environmental infrastructure" as an integral part of general infrastructure.
- The SCM Agreement originally provided some space for green subsidies under article 8, but this provision was allowed to lapse in 2000. It may be time to consider **bringing back article 8**. Still, it was noted that article 8 had only ever provided a highly circumscribed amount of policy space for green subsidies. If article 8 were reintroduced in some form, it would need to be far more permissive.
- The best, most efficient, and least trade-distorting approach to green subsidization is to **support basic research and development** related to green technology, rather than support specific firms. R&D used to fall under the exception of Article 8 and is now actionable.
- WTO rules should **draw a clear distinction between permissible "good subsidies," such as green subsidies** untainted by domestic content requirements, and "bad subsidies," such as those subsidizing fossil fuels or tied to discriminatory domestic content requirements.
- The **WTO Agreement on Agriculture** may be relevant: it contains a category of permissible green subsidies, known as Green Box, which could allow countries to pursue climate adaptation and mitigation measures in the area of agriculture.
- An important way forward could be a '**climate waive**r'. Such a waiver would fall under Article IX:3 and Article IX:4 of the WTO Agreement. It would enable countries to impose trade-restrictive measures that are in line with Paris Agreement obligations, based on the amount of carbon used or emitted in making the products concerned. It would enable members of the WTO to lawfully take measures that, without the waiver, might be found to be violating WTO law (or which members may perceive to violate WTO law).

Crucially, a climate waiver should not permit countries to pass measures that "unjustifiably or arbitrarily" discriminate between products or countries, as their UNFCCC obligations make clear.

Passing a climate waiver would also be a considerable challenge. A permanent WTO climate waiver would require support from three-quarters of WTO members. To overcome this challenge, the climate waiver would need to be carefully worded and could include links to Nationally Determined Contributions (NDCs) that consider developing country challenges.

- The SCM Agreement does not prohibit **subsidies paid directly to individual consumers, nor does it cover the services sector**. These two destinations of subsidy could this freely be supported in their climate actions.
- The **EU's Free Trade Agreements (FTAs) could go further in terms of explicitly permitting subsidies for low-carbon development**, albeit under certain conditions. CETA includes a direct link between exceptions to subsidy rules and countries' climate change goals. It affirms countries' commitments under the SCM, but acknowledges their right to use exceptions for

environmental measures, including those related to MEAs.36 These provisions are binding and enforceable. Similarly, the EU–Singapore agreement allows governments to grant subsidies for "environmental purposes" when they are necessary to achieve a public interest objective, when the amounts are limited to the minimum needed, when their effects on trade are limited, and when they do not affect the conditions of trade of either party or competition between the parties.37

In terms of the recycling of revenues from a Carbon Border Adjustment Mechanism (CBAM), i.e. using the revenues derived through a CBAM as subsidy for low-carbon technologies, one could imagine including provisions on this in the policy options listed above. Currently, the use of CBAM revenues as a subsidy does not have any impact on the applicability of WTO subsidy rules.

Countries that also have carbon pricing schemes and CBAMs in place might more easily accept this approach (for example in FTAs or other bilateral or plurilateral arrangements). On the other hand, countries that take no action on climate change may see the recycling of CBAM revenues as a subsidy as a double offense: first, their exports would face an additional tariff and that tariff would be used to subsidize foreign industries.

In designing the functioning of the subsidies in the model, priority will be given to those that are compatible with the 'Green box' configuration, directed to Research and Development and investments in low carbon technologies.

Matrix of Policy Space for Green Subsidies under SCM Rules

Green (probably allowed)	• Payment for ecosystem services Government procurement at market prices • Government expenditure on general infrastructure such as a power grid • Energy and climate research conducted by a government • Renewable energy portfolio regulation • Government-funded technology prize awarded competitively • overnment subsidy to service providers
Yellow (questionable)	• Income or price support for environmental purposes • Setting of FIT contract prices • Interest rates in Green Bank lending Technology and sector specific subsidies • Energy and climate research funded by a government but conducted independently • Assistance for research activities conducted by firms for industrial research or pre-competitive development activity • Grant of marketable emission allowances or other intangibles • Assistance to promote adaptation of existing facilities to new environmental requirements • Subsidies to foreign countries linked to exporting country content requirement (tied aid) • Subsidy to subnational governments linked to buy-domestic requirements • Subsidy allegedly causing adverse effects on other countries (allegedly actionable subsidies)
Red (forbidden)	• Export subsidy • Subsidy linked to domestic content requirements

Five features of a fossil fuel subsidy reduction regime:

First, it is necessary to have a definition of fossil fuel "subsidy." As noted in the previous paragraph, some changes to the WTO definition of "subsidy" would need to be negotiated.

Second, what makes a subsidy a "fossil fuel" subsidy? The best answer is that it is found in the effects on fossil fuel use. The precise effects may be difficult to calculate so some proxies may be used. These could include the type of recipient of the subsidy, the conditions for grant of the subsidy, or the effects on prices. For example, if a subsidy is granted to a firm previously identified as being in the fossil fuel business, or if it is conditioned on fossil fuel exploration or production, it could be assumed to have effects on fossil fuel use. If price is used as a reference, it should be based on world market prices rather than domestic prices that may be distorted by cheap government supply of fuels. The IMF, OECD, IEA and the Global Subsidies Initiative already conduct a good deal of work to estimate the amounts and effects of fossil fuel subsidies.

Third, aggregate limits on each WTO member's fossil fuel subsidies would need to be negotiated. This is a mechanism introduced in the WTO Agreement on Agriculture. These limits could be scheduled to be progressively reduced over time.

Fourth, exceptions would need to be crafted for subsidies that are needed to support the poor, and for subsidies that assist transition to more efficient use or to renewable fuels. The Agreement on Agriculture also addresses similar issues.

Fifth, effective provisions for notification, auditing, dispute settlement, and remedies would be important to ensure compliance. Although the WTO subsidies notification mechanism is criticized by some, the WTO's Trade Policy Review Mechanism, notification regimes, and dispute settlement system could be adapted for use in the context of fossil fuel subsidies[19].

***19** International Centre for Trade and Sustainable Development (2017): The WTO Subsidies Agreement can be Changed to Discipline Fossil Fuel Subsidies. Available at: https://ictsd.iisd.org/opinion/the-wto-subsidies-agreement-can-be-changed-to-discipline-fossil-fuel-subsidies.*

Contributors

Consulting Team

Dimitris FRAGKIADAKIS
Junior Researcher

dfragkiadakis@e3modelling.com

Leonidas PAROUSSOS
Lead Modelling Expert

+30 210 6775696

+30 210 6774726

Skype: leonidas.paroussos

paroussos@e3modelling.gr

Adam BLESER
Research Manager

+55 2199 860 8490

Skype: a.bleser

ableser@gmail.com

Matthew LANGDON
Project Manager

+32 484 45 1207

+32 2 463 13 33

Skype: mflangdon

matthew.langdon
@development-solutions.eu

Joachim MONKELBAAN
Trade & Climate Policy Expert

+41 76 725 3394

Skype: ictsd.joachim.monkelbaan

jmonkelbaan@gmail.com

Afep coordinating team

Marc POULAIN
International Trade Negotiation Director

+33(0)143596535 (FR)
+32(0)22275726 (BE)
+33 (0)669441630 (MO)

m.poulain@afep.com

François-Nicolas BOQUET
Environment and Energy Director

+33(0)143597138 (FR)
+33(0)628091143 (MO)

fn.boquet@afep.com

Justine RICHARD MORIN
European Affairs Deputy Director

+32(0)22275725 (BE)
+32(0)497408253 (MO)

j.richard-morin@afep.com

afep

www.afep.com

French association of large companies

11 avenue Delcassé - 75008 Paris
+33(0)1 43 59 65 35

4-6 rue Belliard - 1040 Brussels
+32(0)2 219 90 20/ europe@afep.com

This study is commissioned by the Association française des entreprises privées (AFEP) with the financial support of ICC France and several AFEP member companies. It is implemented by Development Solutions in partnership with E3 Modelling. The views expressed are those of the consultants and do not necessarily reflect those of AFEP.

ICC FRANCE CHAMBRE DE COMMERCE INTERNATIONALE
L'organisation mondiale des entreprises

DEVELOPMENT Solutions

E3 Modelling