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 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.
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 CO₂.
- To achieve the NDCs of China, South Korea, and Mexico, a de facto carbon price of approximately 26€ ($34) per tonne of CO₂ 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 CO₂.

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.

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:

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%3APHN]. 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.
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.

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

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 Directive.

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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\(^\text{17}\). Under the Baseline Scenario, the EU will then continue reducing GHG emissions at a rate of 114 megatonnes 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>
<thead>
<tr>
<th></th>
<th>GHG Emissions (megatonne CO(_2) equiv.)</th>
<th>% change from 2005</th>
<th>from 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ETS</td>
<td>Non-ETS</td>
<td>EU28</td>
</tr>
<tr>
<td>1990</td>
<td>5 693</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>2 502</td>
<td>2 894</td>
<td>5 396</td>
</tr>
<tr>
<td>2015</td>
<td>1 913</td>
<td>2 585</td>
<td>4 498</td>
</tr>
<tr>
<td>2020</td>
<td>1 660</td>
<td>2 477</td>
<td>4 136</td>
</tr>
<tr>
<td>2030</td>
<td>1 426</td>
<td>2 026</td>
<td>3 452</td>
</tr>
<tr>
<td>2050</td>
<td>1 138</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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\textsuperscript{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**

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

\textsuperscript{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)\textsuperscript{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 particularly 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 CO\textsubscript{2} 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.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Country} & \textbf{Target} \\
\hline
\textbf{China} & Peak GHG emissions before 2030 and carbon neutrality by 2060 \\
\hline
\textbf{Canada} & Carbon neutrality by 2050 (no 2030 target in draft legislation) \\
\hline
\textbf{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 \\
\hline
\textbf{Japan} & Carbon neutrality by 2050 \\
\hline
\textbf{United Kingdom} & Carbon neutrality by 2050 \\
\hline
\end{tabular}
\caption{Non-NDC GHG Emissions Reduction Targets in Non-EU Countries}
\end{table}

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

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For each country included in the model\textsuperscript{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

<table>
<thead>
<tr>
<th>Sector</th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refineries</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Power Supply</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Ferrous Metals</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Non-Ferrous Metals</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Paper</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Non-Metallic Minerals</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Air Transport</td>
<td>15%</td>
<td>15%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The Baseline Scenario is the reference to which the EU Carbon Neutrality Scenario\textsuperscript{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\textsuperscript{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.

\textsuperscript{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

\textsuperscript{21} Also referred to as Scenario (A+)* in technical annexes relating to the modelling.

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\(^\text{23}\). Over the same period, the world unemployment rate is assumed to be reduced to 4.6% converging toward the natural rate of unemployment.

Figure 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**

**EU Imports in 2020**

- **Countries**: CHN, USA, IND, TUR, RUS, JPN, CAN, KOR, BRA, SAF

**EU Exports in 2020**

- **Countries**: CHN, USA, IND, TUR, RUS, JPN, CAN, KOR, BRA, SAF

*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. 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. The effect of the carbon price, if not mitigated by countering 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).

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: (Imports+Exports) / GDP. GHG Intensity is calculated as: tCO2 / 1000’s $.

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. 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 CO₂ 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.

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


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**

![Graph showing GHG emissions and economic growth](image)

*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 CO₂, 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. 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 - €)

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

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)**

![World Sectoral Production Change](image)
France

Source: GEM-E3
EU Carbon Neutrality Scenario
Key Summary

EU Carbon Neutrality Scenario

- 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. 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.

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. 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.

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31 Also referred to as Scenario A+ for the purposes of the modelling.
Table 12: EU GHG emission reduction targets, EU Carbon Neutrality Scenario

<table>
<thead>
<tr>
<th></th>
<th>GHG Emissions (megatonne CO₂ equiv.)</th>
<th>% Change from 2005</th>
<th>Difference from Baseline Scenario (megatonne CO₂ equiv.)</th>
<th>% Difference from Baseline Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>2,562</td>
<td>-53%</td>
<td>-890</td>
<td>-26%</td>
</tr>
<tr>
<td>2050</td>
<td>569</td>
<td>-89%</td>
<td>-569</td>
<td>-50%</td>
</tr>
</tbody>
</table>

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 - $)

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU Carbon Neutrality Scenario</td>
<td>33</td>
<td>74</td>
<td>380</td>
<td>590</td>
</tr>
<tr>
<td>($ per tonne of CO₂)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference from Baseline Scenario ($ per tonne of CO₂)</td>
<td></td>
<td>35</td>
<td>167</td>
<td>356</td>
</tr>
<tr>
<td>% change between EU Carbon Neutrality &amp; Baseline Scenarios</td>
<td></td>
<td>53%</td>
<td>56%</td>
<td>40%</td>
</tr>
</tbody>
</table>

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.

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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. 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.

### 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 CO₂ equivalent

<table>
<thead>
<tr>
<th>Year</th>
<th>EU28 GHG Emissions in Carbon Neutrality Scenario</th>
<th>EU28 GHG Emissions in Baseline Scenario</th>
<th>EU28 GHG Emissions Reduction Target</th>
<th>Non-EU GHG Emissions (absolute change from Baseline Scenario)</th>
<th>Carbon Leakage rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>2,562</td>
<td>3,452</td>
<td>890</td>
<td>81</td>
<td>9%</td>
</tr>
<tr>
<td>2050</td>
<td>569</td>
<td>1,138</td>
<td>569</td>
<td>130</td>
<td>23%</td>
</tr>
</tbody>
</table>

* Full cost pass through rates have been assumed

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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
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. 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

Additional Investments

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)

* 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