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EU Climate Policy in a Globalized World

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EU Climate Policy in a Globalized World[1]

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Abstract

In this EconPol Policy Report, we assess various options for EU climate policy utilizing a quantitative trade and environment model. We investigate the EU's 2030 emission reduction target, evaluate the impact of the newly introduced Carbon Border Adjustment Mechanism (CBAM), and analyze different climate coalitions with the EU at their core, including the recently launched "G7-led Climate Club." We thereby assess the impact on both national and global emissions accounting for carbon leakage, on international economic competitiveness and changes in the global market shares of the EU, as well as on aggregate income gains and losses.

Our findings indicate that EU climate policies do not impose substantial costs, have a limited impact on global emissions, but generate substantial gains from avoided climate damages. The only modest global emission reduction is primarily due to the EU's relatively small share in global emissions and carbon leakage in response to its climate policy. Our analysis demonstrates that the CBAM reduces, but does not entirely eliminate, carbon leakage and helps prevent income losses for the EU. In contrast to the low average costs for the EU across all scenarios, we show that the costs of climate policy are disproportionately borne by resource-rich countries. Achieving significant global emission reductions will require a climate coalition. However, our findings suggest that relying solely on a "G7-led Climate Club" is insufficient for the necessary global emission reductions. This underscores the need to foster a comprehensive global coalition.

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[1] This work builds on an ongoing research project and relates to the as yet unpublished paper "The Impact of Border Carbon Adjustment on Global Emissions Shifting" (Richter and Wanner 2024b). We thank Florian Dorn and Karen Pittel for their helpful comments.

Table of Contents

Executive Summary

The EU has set ambitious climate targets for itself. In the short term, it aims to reduce net greenhouse gas emissions by at least 55%, compared to the level in 1990. Based on current progress, achieving this target requires an additional emission reduction by one-third in the coming years. In the long term, the EU wants to become climate neutral by 2050.

- In this *EconPol Policy Report*, we assess various options for EU climate policy based on their impact on both national and global emissions accounting for carbon leakage as well as on economic competitiveness and changes in the EU's global market shares. We thereby evaluate aggregate income gains and losses for the EU and other countries. Moreover, we assess the role of international cooperation on these aspects.

- We utilize a quantitative trade and environment model, calibrated to trade, production, and emissions data from 14 sectors plus the intermediate energy sector and more than 150 countries or regions. This model enables us to simulate counterfactual scenarios, which we then compare to the current state of the world.

- We construct various scenarios to assess the effects of the EU's 2030 emission target, the newly introduced Carbon Border Adjustment Mechanism (CBAM), and different configurations of climate coalitions with the EU as one of the core members, including the recently launched "G7-led Climate Club."

- We present six key findings:
  1. **Unilateral EU climate policy reduces global emissions only modestly**
  2. **The EU does not incur substantial costs from ambitious climate policy**
  3. **Global gains from avoided damages far exceed the costs of EU climate policy**
  4. **The CBAM reduces carbon leakage and prevents income losses for the EU**
  5. **A "G7-led Climate Club" will not reduce global emissions sufficiently**
  6. **Resource-rich countries disproportionately bear the costs of climate policy**

- This *EconPol Policy Report* emphasizes the urgent need for climate diplomacy as the most effective – and indeed, the only – option for the EU to successfully limit climate change. In this regard, the EU must both pursue its emission reduction targets and foster ambitious international – ideally global – climate coalitions.

1 Introduction

The European Union pursues an ambitious climate policy agenda. It aims at climate neutrality ("net zero") by 2050 with intermediate targets to reduce (net) greenhouse gas (GHG) emissions by at least 55% by 2030 and 90% by 2040 compared to 1990.[2] Yet, there are two structural problems that need to be addressed to successfully limit climate change. First, the EU is acting in a globalized world, being deeply integrated into international markets itself. EU climate policy is, hence, subject to carbon leakage.[3] Second, the EU is small regarding its share in global GHG emissions, which today at about 7% has more than halved since 1990.[4] Consequently, the EU may not have much leverage if acting on its own. Climate policy ambition outside of the EU, however, is very heterogeneous and in parts potentially unreliable – as demonstrated for example by the temporary US withdrawal from the Paris Agreement or the Brazilian refusal to host the world climate summit in 2019.[5] Ambitious EU emission reduction targets raise a number of important questions. First, how effectively does EU climate policy reduce *global* emissions? Second, what is the cost of climate action in terms of real income in the EU and beyond? Third, how are different industries in the EU affected and – closely related – how do economic competitiveness and trade patterns react? Fourth, can a specific policy design lead to more favorable answers to the previous three questions? Fifth and finally, how do the answers to all the above questions depend on the climate policies of non-EU partner countries? In this *EconPol Policy Report*, we seek answers to these questions and assess various options for EU climate policy quantitatively. Specifically, we investigate the impacts of the EU's 2030 emission reduction targets, evaluate the newly introduced EU Carbon Border Adjustment Mechanism (CBAM) as

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[2] See https://climate.ec.europa.eu/eu-action/climate-strategies-targets_en.

[3] Carbon leakage refers to the phenomenon where a change in emissions in a non-regulating country is *caused* by the regulation in another country (cf. Felder and Rutherford, 1993). For instance, a climate-policy-induced reduction in European emissions may be partly offset by increased emissions in other countries; the effectiveness of national climate policy is thus reduced. While in a closed economy every ton of CO_2 saved nationally is saved globally, this simple logic does not hold in an open economy. This is due to two main channels: First, a higher European CO_2 price particularly increases the production costs in emission-intensive industries, making European producers in these sectors less competitive internationally. Consequently, production in these industries could partly shift to other, less climate ambitious, countries. Second, a climate-policy-induced decline in European demand for fossil fuels leads to lower world market prices for these fuels, which in turn results in other countries demanding (and burning) more fossil fuels.

[4] Throughout this report, we refer to the current EU-27, excluding the UK also in historical (emissions) data prior to Brexit.

[5] For insights on the "Climate Policy Priorities for the Next European Commission," please consult the recently published *EconPol Policy Report* No. 48 by Fuest, Marcu, and Mehling (2024).

part of the "Fit for 55" package,[6] and analyze different configurations of climate coalitions with the EU as one of the core members, including the recently launched "G7-led Climate Club."[7]

To this end, we utilize a quantitative trade and environment model. This model, an extension to Larch and Wanner (2024), can closely replicate observable international trade flows, production patterns, and emissions at the country-sector level. While abstracting from the adjustment path, it simulates counterfactual scenarios that can be compared to the model's baseline calibration of the state of the world. Importantly, the model incorporates the two main channels of carbon leakage: via the international goods market and the international fossil fuel market. This separation is a crucial feature for analyzing any form of a CBAM, which solely addresses the first type of carbon leakage. Our analysis is based on a model version with more than 150 separate countries or regions and 14 sectors, allowing us to evaluate in detail the direct and indirect effects of EU climate policy across various scenarios.

In our analyses, we highlight the impact on both national and global emissions accounting for carbon leakage. We thereby consider the impact on international competitiveness and investigate climate policy-induced changes in the global market shares of the EU. We assess changes in real wages and investigate the aggregate income gains and losses for the EU and other (groups of) countries. Additionally, using a range of current estimates of the *social costs of carbon* (SCC), we provide back-of-the-envelope estimates of the global benefits from avoided climate damages. Six key statements emerge from our findings:

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[6] The term CBAM is based on EU terminology for the previously more commonly used Border Carbon Adjustment (BCA) (see for instance Böhringer, Fischer, et al. 2022). As both terms imply, such a policy instrument serves to equalize the costs of CO_2 emissions for goods produced domestically, e.g., in the EU, and those produced abroad and exported to the same (e.g., the EU) market. This serves to "level the playing field" in the case of different emission prices for competing firms. Similarly, albeit likely incompatible with the WTO, a CBAM could also be extended to equalize the costs of exporting to a third market, which may imply a rebate of the emission costs in the reforming country. Carbon tariffs are a related concept mimicking a CBAM limited to imports, if the tariffs based on embodied carbon are designed to equalize the respective emissions price of imports and domestic production (see for instance Böhringer, Müller, and Schneider 2015; Larch and Wanner 2017). On related quantitative analyses of the EU CBAM, see for instance Korpar, Larch, and Stöllinger (2022) and Sogalla (2023).

[7] Proposed by Germany at the G7 meeting in 2022 and officially launched at COP28 in 2023, this initiative, co-chaired by Chile and Germany, currently has 38 members. See https://climate-club.org/. This "high-level forum" is a loose association that has not much in common – apart from its name – with the concept of a climate club outlined in the seminal paper by Nordhaus (2015). According to the latter, the members of a climate club agree on both a common carbon price and a uniform tariff on all imports from non-members. The introduced sanction mechanism for non-members serves to alter the incentive structure to encourage joining an ambitious coalition. In this *EconPol Policy Report*, we analyze a much stronger version of the "G7-led Climate Club," with a common ambitious emission reduction target, potentially complemented by a CBAM. However, we deviate from a "Nordhausian climate club" as our focus is not on club participation.

1. Unilateral EU climate policy reduces global emissions only modestly.
Accounting for carbon leakage, we find that a further one-third reduction in EU emissions from current levels (equivalent to the 55% target by 2030) results in a global emissions decline of just 2.5 %. This small effect is due to a combination of the relatively small EU share in global emissions and carbon leakage. In the absence of the CBAM, more than one-quarter of the emission reduction leaks to other countries, driven by (i) dirty industry competitiveness shifts towards EU competitors and (ii) higher fossil fuel demand outside the EU in response to falling fossil fuel prices.

2. The EU does not incur substantial costs from ambitious climate policy.
This general insight is consistent across all our scenarios, with varying coalition configurations and different levels of ambition. If the EU alone were to further reduce emissions by one-third from current levels, our results indicate only a minor real income loss of just −0.07% in the absence of the CBAM. We emphasize various underlying dimensions of heterogeneity: (i) across EU member states: some countries disproportionately lose, up to a maximum loss of −0.18% in Estonia; (ii) across types of income: real wages decline more strongly, averaging −0.57% for the EU, reaching up to −1.57% in Bulgaria, compared to real aggregate income, which includes revenues from carbon pricing; and (iii) across industries: the EU loses global market shares, particularly in the chemicals (−2.4%) and metals (−1.4%) sectors. Moreover, we observe significantly stronger income effects in certain sectors and countries if the reallocation of production factors across sectors is limited in flexibility.

3. Global gains from avoided damages far exceed the costs of EU climate policy.
A rough estimate of the global benefits from avoided climate damages indicates gains of USD 150–850 billion (based on an SCC range of USD 185–1,056/tCO_2) for the unilateral EU 33% target, and of USD 2–11 trillion for the global coalition 33% target. In both scenarios, the economic costs of climate policy to the regulating countries (USD 12.5 billion in the EU scenario, USD 1.3 trillion in the global coalition scenario) are far outweighed by these benefits, although the distribution of costs and benefits is not aligned.

4. The CBAM reduces carbon leakage and prevents income losses for the EU.
Complementing an emission reduction target with the CBAM significantly reduces carbon leakage, although it does not entirely eliminate it. This is because a CBAM targeting all imports to the EU based on embodied carbon emissions does not balance carbon price differences in goods exported to countries outside the regulating EU, nor does it address the second main channel of carbon leakage via the energy market. In response to an emission reduction of the EU by one-third, carbon leakage declines from more than 25% to approximately 18% due to the presence of the CBAM. Moreover, small

income losses effectively vanish, as the CBAM generates additional tariff revenue and mitigates losses of economic competitiveness in emission-intensive industries. For example, the EU's global market share in the chemical sector declines only by 0.2% with CBAM rather than by 2.4% without CBAM. We find that a CBAM targeting only the key emission-intensive sectors – chemicals, minerals, and metals – is similarly effective to a comprehensive CBAM.

5. A "G7-led Climate Club" cannot reduce global emissions sufficiently.
If the EU were to establish a climate coalition, a 33% emission reduction target for all members in the presence of a CBAM leads to a reduction of global emissions of only 7.1% (joint with the US), of 9.2% (joint with the remaining G7 members), or 12.5% (joint with additional members of the "G7-led Climate Club"). These reductions are slightly smaller in the absence of a CBAM and in either case clearly fall short of meeting global temperature targets of 2 or 1.5 °C. Our results demonstrate the essential role of China's membership, although this remains insufficient on its own: a climate coalition consisting of the EU, the US, and China has the potential to reduce global emissions by up to 16% in the case of a 33% emission reduction target and up to 23% with a 50% target.

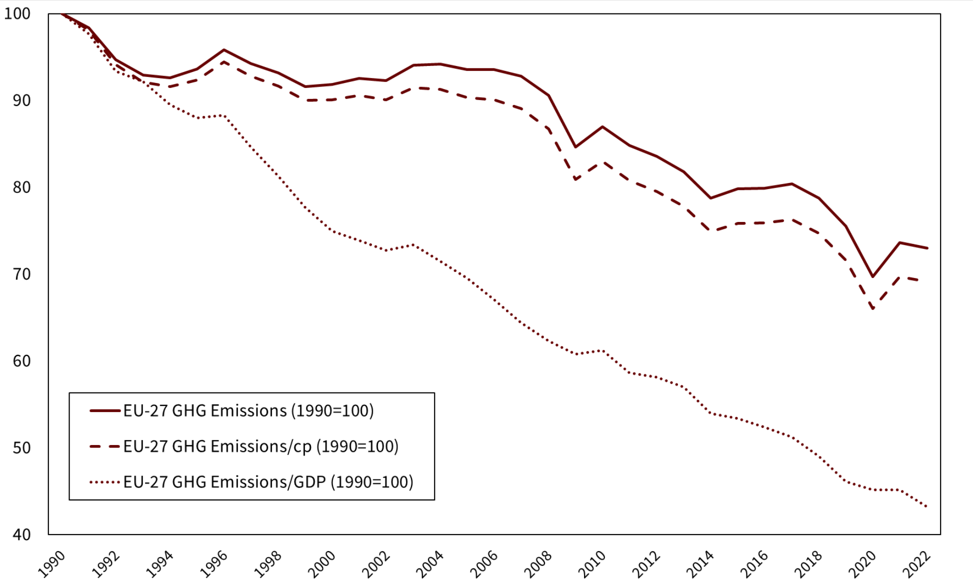
6. Resource-rich countries disproportionately bear the costs of climate policy.
This result holds true across all scenarios featuring standard demand-side climate policy, regardless of the countries targeting emission reductions, including resource-rich countries themselves. This is because an emission reduction target essentially imposes a cost on the usage of fossil fuels, thus resembling an import tariff on fossil fuels charged by countries that depend on imports of these goods. The real income losses of resource-rich countries are more than seven times larger than the global average, increasing in the size of the climate coalition and the level of climate policy ambition. For instance, given an emission reduction target of 33% in the absence of a CBAM, resource-rich countries lose real income of −0.7% (EU scenario), −1.7% (EU coalition with the US), −2.2% (EU coalition with the remaining G7 members), −2.9% (EU coalition with additional members of the "G7-led Climate Club"), and up to −8.3% (global coalition). The cost distribution of climate policy changes completely if the same global emission reduction target is achieved through a fossil fuel extraction tax imposed by resource-rich countries. In this case, resource-rich countries actually benefit on average due to a terms-of-trade improvement from reduced supply.

The remainder of this *EconPol Policy Report* is structured as follows. In Section 2, we present data on the development of GHG emissions, focusing on the EU and its share in global emissions. Section 3 introduces our quantitative trade and environment model and gives an overview of the analyzed scenarios. We stick to a non-technical presentation of key features and limitations of the model, and explain how we bring the model to the data. For the interested reader, we provide a reference to a detailed description of our model framework. In Section 4, we provide simulation results, structured into two main parts. First, we focus on unilateral EU climate policy and contrast our results across different implementation schemes of the EU CBAM. Second, we analyze EU climate policy in the context of differently composed climate coalitions. In additional *spotlights*, we illuminate specific aspects, such as the role of production factor mobility, the level of climate policy ambition, and the global distribution of the costs of climate policy. Section 5 concludes.

2 Background: EU GHG Emissions

GHG emissions in the EU have substantially declined since 1990. According to data provided by the Emissions Database for Global Atmospheric Research (EDGAR), generated emissions in 2022 were 27% lower than in 1990, or 3.6 $GtCO_2eq$ relative to 4.9 $GtCO_2eq$.[8] This is a sizable reduction, following a relatively stable – if not accelerating – negative trend, with marked dips during the financial and economic crisis in 2009 and the COVID-19 pandemic in 2020. Figure 1 shows this development of the EU's GHG emissions indexed to 1990 as the solid black line. Importantly, emissions decline despite a growing population and growing economic activity. Both emissions per capita (the dashed line) and emissions per GDP (the dotted line) decline more strongly than emissions. The latter, a measure of emission intensity, more than halved between 1990 and 2022 to about 43% of the level three decades ago. This shows a clear decoupling of emissions and economic activity.

Figure 1: Development of EU-27 GHG Emissions and EU-27 Share



Note: Based on GHG emissions without LULUCF. "EU27" with current member states.
Source: https://edgar.jrc.ec.europa.eu/report_2023. Own calculation and illustration.

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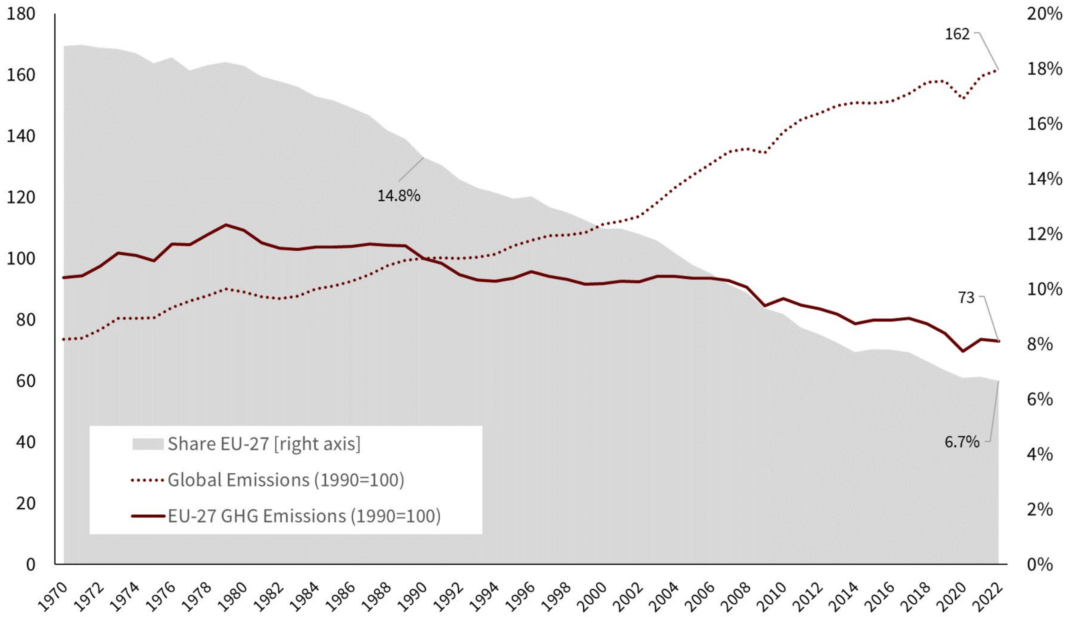
[8] These numbers exclude emissions from what is known as Land Use, Land Use-Change, and Forestry (LULUCF).

Despite this emission reduction in the EU and other world regions – for instance, emissions of the G7 declined by 10% – global emissions continued to rise over the decades.

Figure 2: Development of GHG Emissions and EU-27 Share



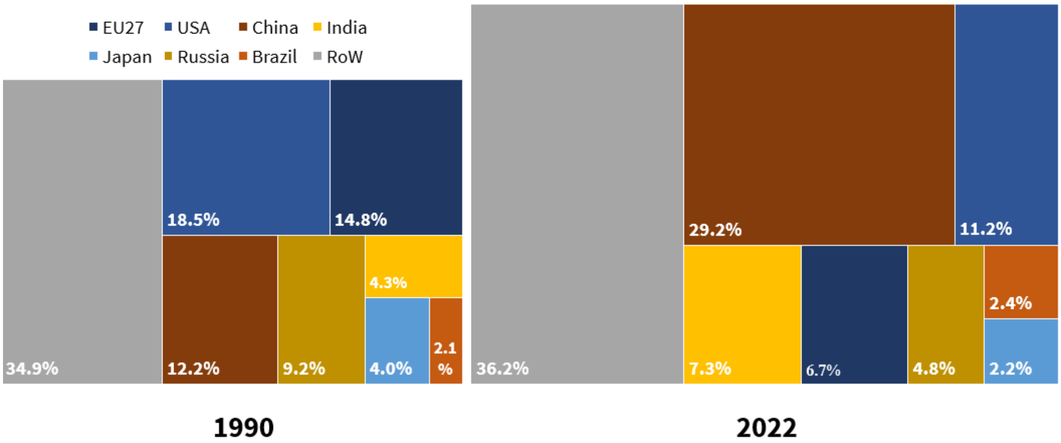
Note: Based on GHG emissions without LULUCF. "EU27" with current member states.
Source: https://edgar.jrc.ec.europa.eu/report_2023. Own calculation and illustration.

This trend is depicted in Figure 2 spanning from 1970 to 2022 (the dotted line). Additionally, the figure shows the development in the EU's emissions (solid black line) alongside the fluctuations in the EU's share of global emissions (depicted by the gray area). We note a stark contrast in emissions trajectories: while global emissions have surged by almost 62% since 1990, the EU has experienced a notable decline of 27%. Consequently, the EU's share of global emissions has plummeted from nearly 19% in the early 1970s to 6.7% in 2022, less than half of its share in 1990. Once a major emitter, second only to the US, the EU's importance has declined for two reasons. First, due to its success in reducing emissions and, second, due to the surge in emissions from emerging economies. This has implications for the impacts of its own climate policy on global emissions, an aspect we will delve into in the next sections.

Table 1 and Figure 3 give further information on the top emitters worldwide in 1990 and 2022. China clearly stands out with a rise in emissions by 285%, making it the world's largest emitter by a significant margin. Acknowledging its large population size and status as the manufacturing powerhouse for the world, it is still remarkable that Chinese emissions outweigh emissions of the next five largest emitters combined. With strong increases in line with economic development, Indonesia, Iran, Mexico, and Saudi

Arabia have entered the top 10 emitters. The concentration of emissions among the top 5 emitters, now with Brazil replacing Japan, has increased from a high level of approximately 50% in 1990 to nearly 55% in 2022. By contrast, the share of the G7 significantly declined from about one-third to less than one-fifth in this time period.

Figure 3: Shares in Global GHG Emissions



Note: Based on GHG emissions without LULUCF. Illustrated increase of global emissions by 62% between 1990 and 2022. "EU27" in 1990 and 2022 with current member states. "RoW" denotes Rest of the world. Source: https://edgar.jrc.ec.europa.eu/report_2023. Own calculation and illustration, following Richter and Wanner (2024a).

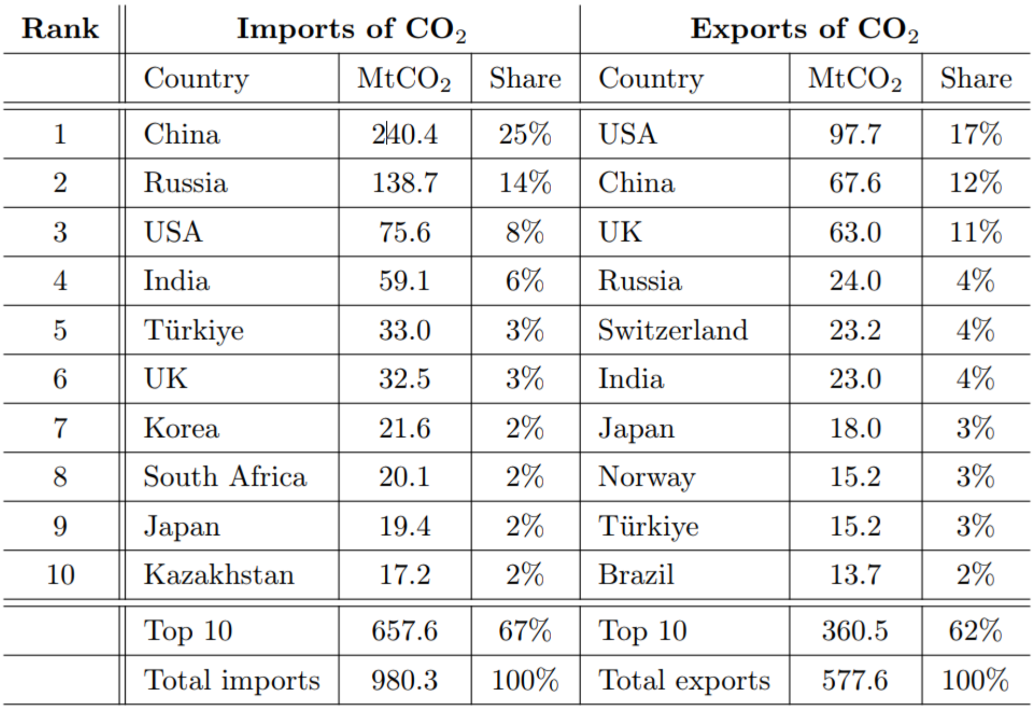
Table 1: Top World GHG Emitters in 1990 and 2022

Country /Region	1990			2022			Change 1990-2022	
	Rank (#)	Emissions ($MtCO_{2eq}$)	Share (%)	Rank (#)	Emissions ($MtCO_{2eq}$)	Share (%)	Emissions (%)	Share (%pt)
China	2	4,074	12.2	1	15,685	29.2	+285	+16.9
USA	1	6,164	18.5	2	6,017	11.2	-2	-7.3
India	4	1,437	4.3	3	3,943	7.3	+174	+3.0
Russia	3	3,053	9.2	4	2,580	4.8	-16	-4.4
Brazil	9	696	2.1	5	1,310	2.4	+88	+0.3
Indonesia	16	428	1.3	6	1,241	2.3	+190	+1.0
Japan	5	1,322	4.0	7	1,183	2.2	-11	-1.8
Iran	20	333	1.0	8	952	1.8	+186	+0.8
Mexico	14	466	1.4	9	820	1.5	+76	+0.1
Saudi Arabia	27	238	0.7	10	811	1.5	+240	+0.8
RoW		15,058	45.3		19,244	35,8	+28	-9.5
EU27	(2)	4,915	14.8	(4)	3588	6.7	-27	-8.1
G7	(1)	11,138	33.5	(2)	9,993	18.6	-10	-14.9
Top5		16,049	48.2		29,536	54.9	+84	+6.7
World		33,268	100		53,786	100	+62	

Based on GHG emissions without LULUCF. "EU27" with current member states. "RoW" denotes Rest of the world (here: World minus the ten detailed countries.). "Top5" corresponds to USA, China, Russia, India, and Japan in 1990 and China, USA, India, Russia, and Brazil in 2022.
Source: https://edgar.jrc.ec.europa.eu/report_2023. Own calculation and illustration.

However, there is a disconnect between territorial emissions and emission footprints, made possible through international trade (cf. Copeland, Shapiro, and Taylor 2022; Mahlkow and Wanner 2023). Accordingly, a part of the EU's emission reduction may actually have been achieved via pollution outsourcing to other countries. The OECD's "Trade in embodied CO_2 ($TeCO_2$) Database" provides data on imported and exported CO_2 emissions embodied in traded goods. Specifically, if a product is not consumed domestically but exported, the CO_2 emissions generated from fuel combustion are attributed to the importing country. Table 2 highlights embodied emissions in the EU's trade, based on the most recent data available for the year 2018 from this source. It gives a good idea of the EU's trade in embodied CO_2 and its primary sources and sinks. Overall, in 2018, the EU imported almost 1,000 $MtCO_2$, corresponding to more than one-quarter of EU GHG emissions in that year. More than 50% of these imported emissions come from just four countries: China, Russia, the US, and India. As a key player in global trade in goods, the EU also exports embodied CO_2 emissions, totaling almost 600 $MtCO_2$ in 2018. We hence observe that the EU's footprint is larger than indicated by generated emissions. In 2018, the net imports of CO_2 amounted to a substantial 402.7 $MtCO_2$.

Table 2: CO_2 Emissions Embodied in the EU's Imports and Exports in 2018



Rank	Imports of CO_2			Exports of CO_2		
	Country	$MtCO_2$	Share	Country	$MtCO_2$	Share
1	China	240.4	25%	USA	97.7	17%
2	Russia	138.7	14%	China	67.6	12%
3	USA	75.6	8%	UK	63.0	11%
4	India	59.1	6%	Russia	24.0	4%
5	Türkiye	33.0	3%	Switzerland	23.2	4%
6	UK	32.5	3%	India	23.0	4%
7	Korea	21.6	2%	Japan	18.0	3%
8	South Africa	20.1	2%	Norway	15.2	3%
9	Japan	19.4	2%	Türkiye	15.2	3%
10	Kazakhstan	17.2	2%	Brazil	13.7	2%
	Top 10	657.6	67%	Top 10	360.5	62%
	Total imports	980.3	100%	Total exports	577.6	100%

Source: Trade in embodied CO_2 ($TeCO_2$) Database. https://www.oecd.org/sti/ind/carbondioxideemissionsembodiedininternationaltrade.htm. Own illustration.

3 Model and Scenario Description

In this section, we introduce the quantitative trade and environment model, followed by a description of the model calibration, and a presentation of the different climate policy scenarios we will examine.

3.1 A Quantitative Trade and Environment Model

Our model is based on Larch and Wanner (2024), extending their structural gravity model with five distinct modifications, which will be explained below.[9]

In this multi-country, multi-product model, each country produces a unique variety within each sector, using several standard national production factors such as labor and capital, as well as an energy input.[10] Production capacity is endogenous and responds to (climate) policy shocks, constrained by country-specific fixed factor endowments and sector-specific productivities. Production factors are fully employed and mobile across sectors but immobile internationally. Therefore, the model also abstracts from multinational firms that reallocate capital within the firm. Plant-level changes, such as closures or openings, expansions or contractions, are aggregated within sector-level production changes. The energy intensity of production varies across countries and sectors. Consequently, international trade can push countries toward specialization in sectors with different energy use, and climate policy can lead to relocation of industries globally.

Energy itself is produced using national production factors and a fossil resource, which is an aggregate of crude oil, natural gas, and coal. This resource can be purchased from a fully integrated global market. Carbon emissions are directly linked to the usage of the fossil resource. By capturing the international linkage of countries via the energy market, the model can speak to an important source of carbon leakage: lower demand for fossil fuels in one country drives down the world price for fossil fuels, subsequently leading to higher demand in other countries.

International trade in all other goods and services follows a standard gravity equation as in Eaton and Kortum (2002). Accordingly, bilateral trade is determined by countries' comparative advantages, which arise from differences in productivity and in our case also factor endowments, as well as by geography due to trade costs. This gravity component of the model incorporates the second key leakage channel: climate policy

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[9] A detailed model description, including its mathematical formulation, can be found here.

[10] The production structure abstracts from produced intermediate inputs other than the energy input.

that raises production costs in energy-intensive industries alters international comparative advantage patterns. In consequence, emission-intensive production, rather than being reduced or made cleaner, may end up being shifted to countries without strict climate policy that gain comparative advantage in polluting industries exactly by this lack of climate policy ambition.

Climate policy in the model is represented by input taxes on the fossil resource, which are endogenously set to achieve exogenous CO_2 emission reduction targets. Climate policy accounts only for CO_2 emissions from fuel combustion as GHG emissions. Tax revenue generated is assumed to be efficiently redistributed in a non-distorting way.

Compared to Larch and Wanner (2024), the model is first extended by production functions that can more flexibly capture the fact that energy is difficult to substitute in production processes (cf. Bretschger and Jo 2024) and fossil fuels in turn are difficult to replace within the energy mix (cf. Golosov et al. 2014). For a given carbon price shock, these substitutabilities are crucial in determining how strongly comparative advantages are changing. Consequently, they play an important role in quantifying carbon leakage effects via international goods markets.

Second, the implementation of climate policy is generalized to allow joint emission reduction targets for a group of countries. We model this by an implicit common emission trading scheme leading to identical carbon prices across the respective countries with income accruing to the country where the emissions are generated. Third, the climate policy modeling is further expanded by the possibility that a country with ambitious climate policy can charge import tariffs based on the embodied CO_2 emissions that vary by country of origin and sector. These two changes allow the consideration of a wider range of climate policy scenarios and in particular enable us to quantify scenarios that are tailored to the EU context – with the joint EU ETS and the introduction of the CBAM.[11]

Fourth, also related to the implementation of climate policy in the model, we incorporate the option of a global fossil fuel extraction tax. Such a tax increases the costs of the fossil resource and consequently the price of carbon emissions. Unlike an input tax on the fossil resource, which is our default, it generates income in the countries extracting the resource rather than in those using it. We will discuss this extension in detail in a *spotlight* in Section 4.2.2. It will help illuminate the distribution of climate rents and will be relevant for the geographical incidence of climate policy costs.

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[11] Strictly speaking, our modeling choice goes beyond the current EU ETS and EU Effort Sharing Regulation, as it covers all emissions within the EU under a single price.

Fifth and finally, we introduce a model version with rigidity in factor reallocation across sectors (cf. Dekle, Eaton, and Kortum, 2008). The standard assumption in this class of quantitative trade models – and our default – is that production factors can reallocate freely across industries. While plausible in the medium to long run, which is of key interest in the climate policy arena, short-run adjustment processes are also an important part of the effects of climate policy and are unlikely to be appropriately captured by freely mobile workers and other production factors. We therefore consider the alternative extreme scenario in which all production inputs, other than energy, are “stuck” in their current sector. This way, we can examine whether certain workers or other factor owners in specific industries disproportionately suffer from a climate policy shock, connecting to the literature on “stranded assets.” These insights can be valuable for policy guidance for supporting or complementing policies.

3.2 Model Calibration and Scenarios Description

In the following section, we base our analysis on a model version that includes 159 separate countries or regions[12] and 14 sectors.[13] We do not account for within-sector heterogeneity, instead aggregating each sector into a single country-specific variety, such as one aggregated chemical product. This restriction is important to consider regarding the assumed CBAM: if a sector is included in the policy, the CBAM is applied to the entire sector in the model simulations.

We calibrate the model to the GTAP-11 database, which uses 2017 as the reference year.[14] We complement data on trade, production, and emissions with parameter estimates from various research papers and employ data from the Penn World Tables (PWT) and the World Bank’s World Developments Indicators (WDI) for measures of real GDP based on purchasing power parity (PPP).[15]

The model closely replicates observed production, international trade, and emission data. As a quantitative general equilibrium model, it allows the *ex ante* simulation of counterfactual policy scenarios. It hence enables us to evaluate the direct and indirect effects of (EU) climate policy. Importantly, the model can shed light on the two main

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[12] Among those, 141 individual countries and 18 regions, generally comprised of smaller countries with limited data availability. For example, Libya and Western Sahara are categorized within the region “Rest of North Africa.”

[13] These sectors are: agriculture, apparel, chemicals, equipment, food, machinery, metals, minerals, paper, services, textiles, wood, nontradable aggregates, and others.

[14] This deviates from the most recent year considered in Section 2, implying i.a. a slightly larger EU share in global emissions in our baseline equilibrium.

[15] In particular, we make use of the statistic “expenditure-side real GDP at chained PPPs (in mil. 2017US$), *rgdpe*” from PWT (cf. Feenstra, Inklaar, and Timmer, 2015), while missing data is filled with GDP (PPP) from WDI.

channels of carbon leakage – via international goods markets and the international fossil fuel market. The model, however, does not incorporate dynamics, such as technological improvements or frictional unemployment. Instead, our analysis relies on comparing different equilibria: the baseline and a counterfactual outcome. For this reason, we refrain from constructing very long-term or extreme climate policy scenarios, such as complete decarbonization, which would realistically require new technologies like the large-scale use of hydrogen.

We develop a variety of scenarios, dividing them into two parts. The first part focuses on unilateral EU climate policy, where we assume that other countries do not implement policies aiming at further reducing emissions. This is an extreme assumption aimed at isolating the impacts of the EU's own climate efforts. According to the *EU Climate Action Progress Report 2023*, in 2022, total GHG emissions were 32.5% lower than the 1990 level.[16] Based on this achievement, to reach the 55%-reduction target by 2030, emissions need to be reduced further by 33.3% from the level in 2022.[17] Accordingly, in our EU scenarios, we apply a joint target of emission reduction of one-third. This generates a uniform carbon price shock across EU member states, while its impact may vary significantly due to differences in sector specializations and emission intensities in production. We detail this scenario with different options for a CBAM: no CBAM, a partial CBAM affecting only imports in the sectors of "chemicals," "metals," and "minerals," and a comprehensive CBAM covering the entire embodied carbon emissions of all EU imports.[18] Moreover, in a *spotlight*, we evaluate the role of flexible reallocation of production factors across sectors within a country by examining scenarios where this factor mobility is (completely) restricted.

The second part assesses EU climate policy within different configurations of climate coalitions. We assume that all members share the same emission reduction target, treating the EU as a single member of a respective climate coalition. In our default setting, we continue to analyze a reduction of current emissions by one-third, as in the EU only scenarios. We examine the impact of all climate coalitions both with and without the implementation of a CBAM. We analyze climate coalitions of the EU with the

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[16] This corresponds to the emissions data reported by the EU to the UNFCCC and includes emissions from LULUCF. See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023DC0653. The reduction of EU emissions appears less pronounced when considering data from EDGAR, which also serves as the source for Section 2 of this *EconPol Policy Report*: Including LULUFC, the emission reduction by 2022 stands at only 26.2% using this data source. Note that "EDGAR provides independent emission estimates compared to what reported by European Member States or by Parties under the United Nations Framework Convention on Climate Change (UNFCCC), using international statistics and a consistent IPCC methodology." For more details, see https://edgar.jrc.ec.europa.eu/.

[17] This follows from calculating (55−32.5)/(100−32.5).

[18] We do not further evaluate an EU CBAM that affects both imports and exports. Refunding carbon costs on exports is not considered a viable option for the EU due to concerns about WTO compatibility.

US, the remaining G7 countries, and the "G7-led Climate Club,"[19] and compare those to a climate coalition comprising the EU, the US, and China, as well as a global cooperative effort. In two additional *spotlights*, we shed light on the outcomes of a more ambitious emission reduction target and contrast the cost distributions of climate policy between a classic demand-side climate policy approach and a supply-side alternative, in which the *extraction* of fossil fuels is taxed rather than their use.

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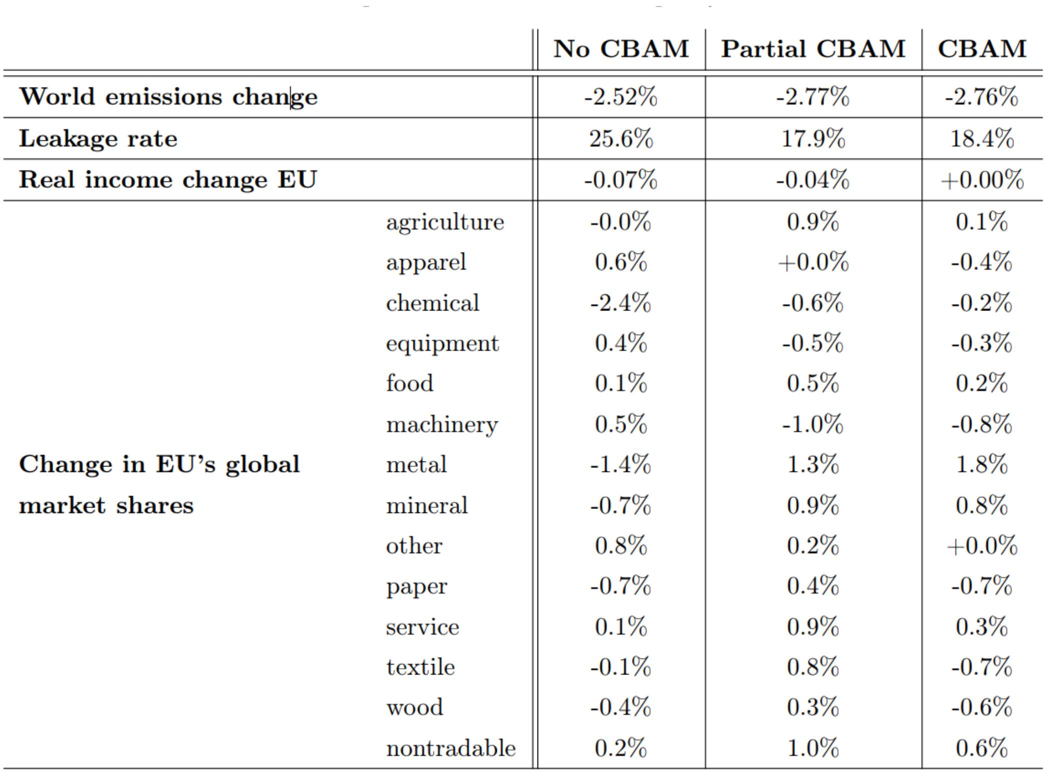
[19] In our application, we incorporate all current members of this association into a climate coalition with joint emission reduction target, except for Vanuatu, which is part of the broader region XOC (Rest of Oceania). Additional to all EU member states, these are Argentina, Australia, Canada, Chile, Colombia, Costa Rica, Egypt, Indonesia, Japan, Kazakhstan, Kenya, Korea, Mozambique, Morocco, Norway, Peru, Singapore, Switzerland, Thailand, Türkiye, Ukraine, Uruguay, the United Kingdom, and the US. See https://climate-club.org/.

4 Results

4.1 The EU Acting on its Own

We begin by examining scenarios where only the EU implements more ambitious climate policy in isolation. Specifically, the EU member states implement a joint carbon price set at a level to lower EU emissions by one-third. All non-EU countries do not undertake any new climate policy initiatives. Toward these countries, the EU either takes no measures at all, implements a "partial CBAM" on select, highly emission-intensive industries, or enforces a "comprehensive CBAM" that covers all embodied emissions going into the EU. Table 3 summarizes some of the key model outcomes for these three different scenario specifications, which we will discuss in the following.

Table 3: Comparison across EU Climate Policy Scenarios



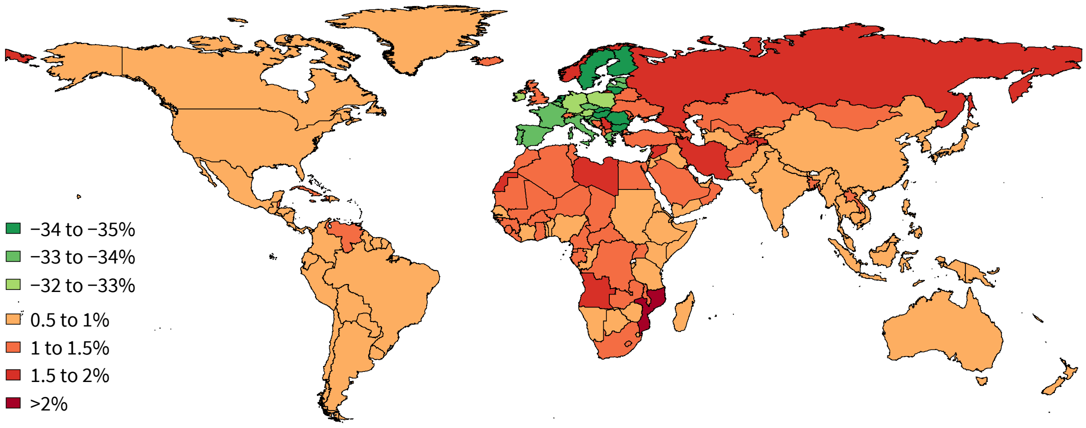
		No CBAM	Partial CBAM	CBAM
World emissions change		-2.52%	-2.77%	-2.76%
Leakage rate		25.6%	17.9%	18.4%
Real income change EU		-0.07%	-0.04%	+0.00%
Change in EU's global market shares	agriculture	-0.0%	0.9%	0.1%
	apparel	0.6%	+0.0%	-0.4%
	chemical	-2.4%	-0.6%	-0.2%
	equipment	0.4%	-0.5%	-0.3%
	food	0.1%	0.5%	0.2%
	machinery	0.5%	-1.0%	-0.8%
	metal	-1.4%	1.3%	1.8%
	mineral	-0.7%	0.9%	0.8%
	other	0.8%	0.2%	+0.0%
	paper	-0.7%	0.4%	-0.7%
	service	0.1%	0.9%	0.3%
	textile	-0.1%	0.8%	-0.7%
	wood	-0.4%	0.3%	-0.6%
	nontradable	0.2%	1.0%	0.6%

Note: The EU's assumed emission reduction target is one-third, while no other country implements additional climate policies. The partial CBAM is employed for imports into the EU in the sectors chemicals, metals, and minerals only.

Let us first take a closer look at the impact of EU climate policy in the absence of an accompanying CBAM (corresponding to the first model specification in Table 3). As per our analysis, the EU's total emission reduction is exogenously fixed at one-third. The common carbon price change resulting from this joint target, however, implies heterogeneous cost shocks on the different EU member states, leading to varying emission reductions. The extent to which an individual country is affected depends on its sectoral specialization, its energy intensity of production, as well as the emission intensity of its energy mix. We find substantial reductions in emissions across all EU member states, ranging from 32.3% in Poland to 34.8% in Romania.

This is illustrated in Figure 4, which also depicts changes in national emissions of all other countries that, by assumption, do not change their climate policies. These countries merely respond to the EU climate policy shock, resulting in increased emissions across all of them. This can be attributed to two effects. First, EU member states lose competitiveness in emission-intensive industries, creating incentives for other countries to specialize in these relatively dirty industries. Second, reduced demand for fossil fuels in Europe drives down the real-world fuel price (by 1.1% in this specific scenario), inducing higher fossil fuel demand outside of the EU. Together, these two causes of carbon leakage drive up emissions in other countries, in most cases by between 1 and 2 percent.

Figure 4: Changes in Emissions across Countries Subject to an EU Target of 33% with No CBAM



Note: The EU's assumed emission reduction target is one-third, while no other country implements additional climate policies.

As is evident from Figure 4, emissions tend to increase most strongly in European countries that are not EU member states, in West Asian countries, and in some African countries. These are countries for which the EU market is a major export destination and for which EU producers are particularly prominent competitors on both domestic and key export markets. As EU producers face a cost shock that is most pronounced in emission-intensive industries, these countries experience a relatively strong push toward these industries. Consequently, they adjust their sectoral composition toward dirty sectors more strongly than other countries that are less dependent on the EU market and less exposed to EU competition.

While Figure 4 highlights the percentage effects on national emissions, Table 4 stresses the absolute magnitude by also taking into account the initial emission level in the different non-EU countries. It provides information on the top five countries that increase emissions the most in response to EU climate policy and shows the aggregate amount of leaked emissions.

Table 4: The Top 5 Countries of Emissions Leakage across EU Climate Policy Scenarios

Rank	**No CBAM**			**Partial CBAM**			**CBAM**		
	Country	MtCO$_2$	Share	Country	MtCO$_2$	Share	Country	MtCO$_2$	Share
1	CHN	75.6	27%	CHN	74.9	38.5%	CHN	78.9	39.4%
2	USA	41.4	15%	USA	46.5	23.9%	USA	48.7	24.3%
3	RUS	26.0	9%	IND	17.3	8.9%	IND	18.0	9.0%
4	IND	19.6	7%	JPN	11.7	6.0%	JPN	12.4	6.2%
5	JPN	10.3	4%	KOR	5.6	2.9%	KOR	5.9	3.0%
...	World	277.7	100%	World	194.6	100%	World	200.3	100%

Note: The EU's assumed emission reduction target is one-third, while no other country implements additional climate policies. The partial CBAM is employed for imports into the EU in the sectors chemicals, metals, and minerals only. The three-letter ISO country codes given are CHN=China, IND=India, JPN=Japan, KOR=Republic of Korea, RUS=Russia, and USA=United States of America.

Despite its relatively mild percentage increase, Chinese emissions increase substantially by 75 MtCO$_2$, accounting for 27% of global emissions leakage.[20] Following in second to fifth place, the US, Russia, India, and Japan also contribute large shares to total carbon leakage, even though emissions in all these countries, except Russia, rise by less than 1 percent.[21] Together, these five countries account for more than 60% of the total leaked emissions of 278 MtCO$_2$ in the "No CBAM" specification. This amount corresponds to a carbon leakage rate of more than 25%. Accordingly, for every 100 MtCO$_2$ of reduced emissions in the EU, more than 25 MtCO$_2$ are additionally generated elsewhere. For this reason and considering the small share of the EU in global emissions as discussed in Section 2, we observe only a modest reduction by around 800 MtCO$_2$, or about 2.5%, of global emissions from the EU's 33% emission reduction target (see Table 3). This leads us to:

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[20] To put this into perspective, this amount exceeds the annual GHG emissions of most EU member states and is comparable to the levels in Austria or Greece.

[21] Our analysis builds on a reference case using data from before Russia's invasion of Ukraine. As a result of Western sanctions, however, trade with Russia has decreased, which likely impacts the results on carbon leakage into Russia in response to EU climate policy.

➔ **Key Finding 1: Unilateral EU Climate Policy Reduces Global Emissions Only Modestly**

Next, we turn to the costs of climate policy, specifically focusing on the real income losses incurred by EU member states when jointly reducing their emissions by one-third. These losses range from a very modest 0.18% in Estonia (followed by other Eastern European EU member states) to a tiny real income *gain* of 0.01% in Malta. To aggregate real income changes across EU member states, we compute a weighted average based on their shares in the EU's real GDP (PPP). In doing so, we find that the EU's overall real income loss is very small, amounting to just 0.07% (see Table 3). Featured similarly in all other presented scenarios in this *EconPol Policy Report*, this implies our:

➔ **Key Finding 2: The EU Does Not Incur Substantial Costs from Ambitious Climate Policy**

This second key finding requires further discussion, as the low costs of the EU's climate policy, even when implemented unilaterally, may seem counterintuitive. Before qualifying this result, let us examine its origins.

On the one hand, the results arise from key assumptions standard in quantitative trade models. The model focuses on long-term equilibria, abstracting from short-term adjustment processes that may impose high costs on parts of society, such as unemployment.[22] Additionally, the model assumes that capital is internationally immobile. While sector-specific production capacities can adjust to climate policy in both regulated and unregulated regions, the employed factors are not mobile across countries. As a result, firm relocation and capital shifts within multinational firms are not considered, which could lead to higher economic costs of climate policy if included.

Beyond the implications of our key model assumptions, two additional conceptual arguments support the finding of low costs for the EU. First, a seemingly strict climate policy target does not necessarily result in a substantial cost shock to the economy. The impact depends on the significance of energy in a sector's production. In the model, the emissions target leads to an emissions price shock, which, due to reduced demand, causes a decline in fossil fuel prices. The combination of the rising emissions price and

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[22] In contrast, other neglected dynamics, such as technological innovation or spillovers, may actually result in lower costs of climate policy.

the falling fuel price affects energy costs, influencing production costs across industries differently.[23]

Second, the result of low aggregate costs reflects a well-known terms-of-trade argument. The EU's climate policy reduces fossil fuel prices, which contributes to carbon leakage via the energy market channel but also lowers the cost of the imported fossil resource. This aligns with the economic reasoning that a "large" country has an incentive to improve its terms of trade by imposing a (small) import tariff. As a major importer of fossil fuels, the EU's climate policy efforts improve its terms of trade. From a non-cooperative perspective, a (small) climate policy shock can be justified by non-climate-related economic benefits. However, this comes at the expense of other countries, particularly of those rich in natural resources. Accordingly, we note that while the costs of EU climate policy on the EU are relatively small, this does not imply that there are no considerable costs at all. We will come back to the incidence of climate policy costs in more detail in Section 4.2.

To further put the relatively small income losses for the EU into context, we make three observations.

First, real factor income from production (i.e., real wages, real rents on capital, land, and natural resources other than fossil fuels) declines more noticeably than average real income. For the EU, we observe a loss of 0.57% (compared to the mentioned 0.07% in total real income), with heterogeneity across EU member states, ranging from 0.20% in Sweden to 1.59% in Bulgaria. However, this loss in production income is largely offset by the revenue generated from carbon pricing. Thus, our optimistic take on the costs of climate policy in the EU hinges on the efficient use of carbon tax revenues, which are an important component of aggregate income with stringent climate policy.

Second, the small aggregate real income loss masks notable heterogeneity across industries within the EU. As shown in Table 3, some sectors face considerable losses in global market shares following the climate policy shock. The EU's chemical sector is the most affected, experiencing a 2.4% reduction in its global market share, followed by the metal industry (−1.4%) and the mineral and paper sectors (both −0.7%). As long as workers can move freely between industries without frictions and find employment in one of the expanding industries (such as apparel, machinery, or equipment), these

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[23] Consider the case of the German chemical industry: To meet its reduction target, our simulation indicates that the EU needs to levy an 83% tax on the fossil fuel input. After equilibrium adjustments, this translates into a 36% increase in the real energy price in Germany. Accounting for the energy cost share in production, factor price adjustments, and the reallocation across production factors, this results in a relatively modest overall increase in real production cost of 1.3%. In contrast, countries with higher fossil fuel shares in energy production and/or sectors with higher energy cost shares may experience larger cost shocks. For instance, real production costs in Poland's mineral industry rise by 2.2%. Most industries, however, have considerably smaller energy cost shares and the average real energy price increase across the EU (30.4%) is lower than in Germany (36.3%) and Poland (56.8%) due to cleaner initial energy mixes. As a result, the overall production cost shocks are relatively small on average.

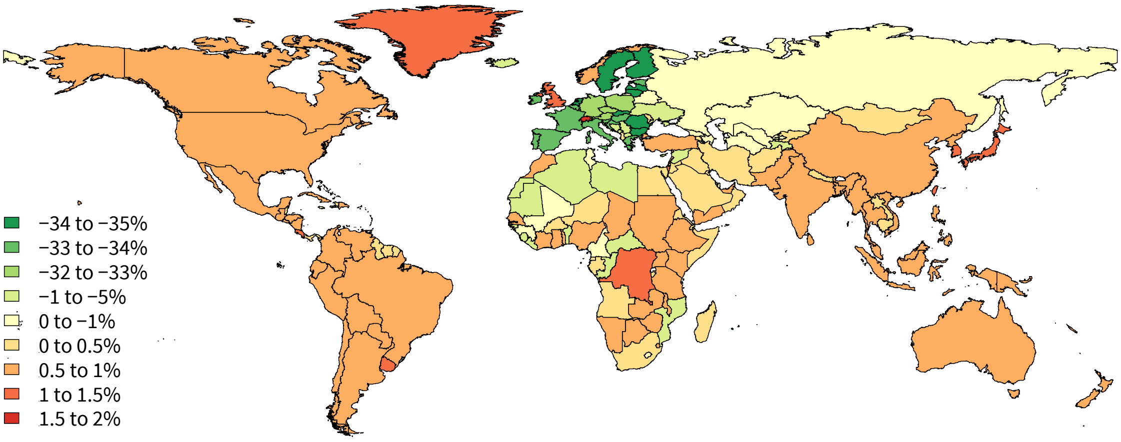
differential effects across industries do not make some workers worse off than others. A *spotlight* in Section 4.1.1 will explore how workers' real wages are affected if they are (at least temporarily) stuck in their initial sector of employment.

Finally, the income losses for the EU are not only small but also reflect only the direct economic costs of climate policy, excluding the benefits from avoided climate damages. By means of a back-of-the-envelope calculation, we estimate that the avoided climate damages range from USD 150 billion (based on an estimated SCC of 185 USD/tCO_2, Rennert et al. 2022) to more than USD 850 billion (SCC of 1,056 USD/tCO_2, estimated by Bilal and Känzig 2024). This global gain far exceeds the costs borne by the regulating EU, which amount to approximately USD 12.5 billion. This brings us to:

➔ **Key Finding 3: Global Gains from Avoided Damages Far Exceed the Costs of EU Climate Policy**

Continuing our analysis of unilateral EU climate policy, we turn our attention to the effects of the CBAM. Figure 5 mirrors Figure 4, depicting national emission changes around the world. However, in this specification the EU not only imposes a domestic carbon price, but also taxes all emissions embodied in its imports from non-EU countries at this same price.

Figure 5: Changes in Emissions across Countries Subject to an EU Target of 33% with the CBAM



Note: The EU's assumed emission reduction target is one-third, while no other country implements additional climate policies

Naturally, EU emissions are once again substantially reduced, with some fluctuations across EU member states around the common target of −33%. Most non-EU countries (including major emitters such as China and the US) increase their emissions at a comparable rate to the scenario specification of EU climate policy without a CBAM (see also Table 4, third row). These countries face two opposing effects compared to the scenario without a CBAM. On the one hand, they lose their climate-policy-induced competitive advantage in emission-intensive industries in the EU market, resulting in less specialization in these sectors. On the other hand, however, they also experience a sharper drop in the real fossil fuel price (1.2% vs. 1.1%), drawing them toward more emission-intensive production techniques.

Countries that experienced particularly pronounced emission increases under the “No CBAM” scenario specification tend to either increase emissions less or even decrease them when EU climate policy includes a CBAM. For these countries, the reduction of their climate policy cost advantage in the EU market due to the CBAM appears severe.

This is because applying the same carbon price to all EU production and imports implies different competitiveness shocks for different exporters. In particular, countries with more energy-intensive production techniques and/or a more carbon-intensive energy mix than EU member states will actually lose competitiveness, as the same carbon price translates into a larger cost increase for them. If sales to the EU market previously made up a substantial share of the production in emission-intensive industries, losing EU market share can drive these countries to reduce their dirty production significantly, thereby lowering their overall emissions.

In summary, while emissions outside the EU still increase in response to EU climate policy, this increase is weaker once the CBAM is implemented. Specifically, non-EU emissions increase by 278 $MtCO_2$ without the CBAM and by 200 $MtCO_2$ with it. This translates into a reduction of the leakage rate from 25.6% to 18.4%.

Table 4 illustrates that the CBAM fails to prevent carbon leakage into most of the countries that account for the largest leakage shares, with Russia being the notable exception among the top five leakage countries. Generally, most of the (remaining) leakage becomes even more concentrated in a few large countries, with the five largest leakage destinations accounting for more than 80% of the outside-EU emission increase, in comparison to 62% in the scenario without a CBAM.

As discussed above, the overall EU real income losses are already minuscule in the “No CBAM” scenario specification. In the case of a complementary CBAM, additional revenue from import taxes more than compensates for the negative effects of higher import prices, effectively eliminating the EU’s real income losses (see Table 3).

Combining this insight with our results on the emission effects of the CBAM, we obtain our:

- **Key Finding 4: The CBAM Reduces Carbon Leakage and Prevents Income Losses for the EU**

This key finding holds true even if the CBAM covers only a few selected emission-intensive sectors, completely in terms of carbon leakage and partly in terms of real income. If only the chemicals, minerals, and metals sectors are covered, the computed leakage rate is below 18%,[24] while real income in the EU declines by only 0.04% (see Table 3).

We end our discussion of the CBAM's effects with a brief examination of how the CBAM affects the industrial structure within the EU. Both partial and comprehensive CBAM implementations provide relief to the key emission-intensive sectors covered by both types of CBAM. As shown in Table 3, the loss in the global market share of the EU in the chemicals sector decreases from 2.4% to 0.6% ("Partial CBAM") and to 0.2% ("CBAM"). The effect becomes remarkably small, considering the substantial climate policy shock and given the limited scope of the CBAM, which addresses only imports to the EU. However, as the CBAM may actually impose greater costs on foreign, more emission-intensive exporters to the EU, the relative competitiveness of EU chemical producers is only weakly reduced. Similarly, but even more pronouncedly, we observe *increases* in the EU's global market shares in the minerals and metals sectors for both types of CBAM. In the context of an economy-wide scarcity of production factors, such as skilled workers, overall, we observe reallocation of these factors across sectors, resulting in winners and losers in global market shares within a general equilibrium framework.

4.1.1 Spotlight: Immobile Production Factors across Sectors

In the default specification presented so far, we assume production factors to be mobile across sectors. As previously discussed, a unilateral EU climate policy targeting a one-third emission reduction leads to a negligible EU real income loss of 0.07%, without any CBAM, while real production factor income declines to a larger extent by 0.57%. Table 5 shows the changes in real production income for the six largest EU member states by current GDP: Germany, France, Italy, Spain, the Netherlands, and Poland, along with the EU average. In these six countries, real production income declines modestly, by

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[24] The attentive reader will notice an even smaller leakage rate compared to that of a comprehensive CBAM. The partial CBAM counteracts EU competitiveness losses *only in the dirty industries* and hence shifts comparative advantage of the partner countries toward the cleaner industries with correspondingly less emissions.

around 0.5%, similar to the EU average, except for Poland, where it falls by 1.4% (see the first row).

Table 5: Changes in Real Production Income: Mobile vs. Immobile Factors across Sectors

		DEU	FRA	ITA	ESP	NLD	POL	EU avg.
Mobile		-0.52%	-0.37%	-0.45%	-0.54%	-0.50%	-1.37%	-0.57%
Immobile	agriculture	-0.45%	-0.72%	-0.87%	-0.87%	-1.30%	-2.05%	-0.81%
	apparel	-0.53%	-0.52%	-0.49%	-0.61%	-0.42%	-0.91%	-0.56%
	chemical	-1.94%	-1.35%	-1.42%	-1.39%	-3.30%	-3.33%	-1.87%
	equipment	-0.56%	-0.53%	-0.63%	-0.66%	-0.47%	-1.04%	-0.60%
	food	-0.60%	-0.50%	-0.54%	-0.51%	-0.50%	-1.08%	-0.61%
	machinery	-0.61%	-0.60%	-0.74%	-0.68%	-0.49%	-1.05%	-0.65%
	metal	-1.21%	-1.14%	-1.04%	-1.71%	-0.85%	-2.47%	-1.36%
	mineral	-1.18%	-1.22%	-1.29%	-1.86%	-0.77%	-3.13%	-1.62%
	other	-0.46%	-0.50%	-0.45%	-0.53%	-0.41%	-0.76%	-0.47%
	paper	-1.18%	-0.64%	-1.32%	-1.17%	-0.35%	-2.13%	-1.14%
	service	-0.49%	-0.39%	-0.44%	-0.62%	-0.44%	-1.66%	-0.62%
	textile	-0.64%	-0.77%	-0.80%	-0.80%	-0.41%	-1.24%	-0.78%
	wood	-0.81%	-0.65%	-0.85%	-1.22%	-0.24%	-2.18%	-0.93%
	nontradable	-0.17%	-0.12%	-0.14%	-0.14%	-0.13%	-0.43%	-0.18%

Note: The EU’s assumed emission reduction target is one-third, while no other country implements additional climate policies. Results are shown for the scenario “No CBAM”.

In contrast, with immobile factors, the carbon price shock cannot be absorbed through the reallocation of production factors across the economy, as it can with mobile factors. Instead, sector-specific factor prices adjust to maintain the pre-policy-shock employment levels of production factors across sectors. This results in a slight increase in the aggregate EU real income loss to 4%. Although still small, the loss is more concentrated among production factors in emission-intensive sectors and countries, with certain groups being particularly affected:[25] chemical workers (e.g., −3.3% in Poland; −3.2% in the Netherlands; −1.9% in Germany; −1.9% for the EU), mineral workers (e.g., −3.1% in Poland; −1.9% in Spain; −1.6% for the EU), metal workers (e.g., −2.5% in Poland; −1.7% in Spain; −1.4% for the EU), or paper workers (e.g., −2.1% in Poland; −1.3% in Italy; −1.1% for the EU) in all countries. Additionally, the agriculture sector in Poland (−2%) and the Netherlands (−1.3%) and the wood and services sectors in Poland (−2.2% and −1.7%, respectively) are notably affected. By contrast, France does not exhibit particularly high real wage losses across sectors, with the highest being

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[25] In the following, workers represent other production factor owners, and real wages represent other production factor income, respectively. This is because within our model all factor owners within a sector are proportionately affected.

−1.4% in chemicals, while the other five countries are more affected. This is plausibly linked to France's relatively low carbon-intensive energy/electricity mix.

Across all countries, employed production factors in the nontradable sector are less affected by the climate policy shock than in any other sector, with the impact also smaller than the average factor income change in the case of mobile factors (0.18% vs. 0.57% for the EU). While the cost shock reduces factor productivity and, hence, lowers factor remuneration, this decline is less pronounced in the relatively low-emission-intensive nontradable sector. In contrast to tradable sectors, the nontradable sector does not face external competitive pressure. An induced reallocation of production factors across sectors and, hence, a domestic factor supply shock in the relatively less affected nontradable sector is absent in the case of immobile factors.

Although this analysis is based on the extreme assumption of no factor mobility across sectors, the findings provide valuable insights into which groups would be most affected by a further significant EU climate policy shock.

4.2 The EU at the Core of a Climate Coalition

Building on our "Key finding 1: Unilateral EU climate policy reduces global emissions only modestly," we now consider scenarios where the EU does not reduce its emissions unilaterally but instead participates in a climate coalition that jointly implements ambitious climate policy.

Specifically, we investigate scenarios where the EU forms a coalition with either the US alone, the entire G7, the "G7-led Climate Club (CC)," or both the US and China. For any coalition setup, we distinguish between a coalition without and with an accompanying CBAM. As in Section 4.1, we continue to assume that the EU jointly lowers its carbon emissions by one-third. Other coalition members individually adopt the same target by setting a domestic carbon price.

Table 6: Emission Reductions and Carbon Leakage across Scenarios under a Coalition's 33% Target

Coalition	World emissions change		Carbon leakage rate	
	no CBAM	CBAM	no CBAM	CBAM
EU	-2.5%	-2.8%	25.6%	18.4%
EU+USA	-6.7%	-7.1%	22.3%	16.9%
EU+G7	-8.6%	-9.2%	21.0%	15.4%
EU+G7-led CC	-11.6%	-12.5%	19.3%	13.2%
EU+USA+CHN	-14.8%	-15.7%	17.8%	12.6%

Table 6 summarizes the global emission effects and carbon leakage rates across the different coalition setups. As expected, global emission reductions increase with the size of the coalition. Adding the US to the EU's policy effort raises the effect by more than a factor of 2.5 (6.7% instead of a 2.5% reduction). Most of this effect is due to the reduction targets now covering a larger fraction of global initial emissions. Additionally, the larger coalition also brings the benefit of a more than 10 percent lower carbon leakage rate (22.3% compared to 25.6%). As shown in the previous section, the US ranks as the second highest "leakage destination country" in the case of unilateral EU climate action. With the US joining a climate coalition, a smaller share of emissions saved within the climate-ambitious countries is offset by increases in non-coalition countries.

If the remaining G7 countries join the climate effort, the global reduction increases to 8.6%, while the leakage rate declines to 21%. Assuming all "G7-led Climate Club" participating countries commit to an ambitious 33% CO_2 emission reduction target, the global reduction is pushed into double digits (11.6%) and the leakage rate drops below one-fifth (19.3%). This reduction is more than four times larger than what the EU achieves unilaterally with the same target. However, according to UNEP's "Emissions Gap Report 2023," a climate-science-based assessment suggests that by 2030, GHG emissions must decrease from 2022 levels by 29% for the Paris Agreement's 2°C pathway and 43% for the 1.5°C pathway.[26] From this perspective, even the relatively large "G7-led Climate Club" with the current level of EU ambition falls short of meeting the global requirements:

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[26] According to this report from November last year, global GHG emissions (including LULUFC) reached 57.4 $GtCO_2$*eq*. The median levels of scenario analyses consistent with the 2°C and 1.5°pathways are 41 $GtCO_2$*eq* and 33 $GtCO_2$*eq*, respectively. See https://www.unep.org/resources/emissions-gap-report-2023.

➔ Key Finding 5: A "G7-led Climate Club" Will Not Reduce Global Emissions Sufficiently.

The last row of Table 6 considers a coalition consisting of the EU, the US, and China. While it further strengthens the global emission reduction to almost 15%, this still represents only 44% of what a global coalition with the same target ambition could achieve.

It is also evident from Table 6 that a CBAM successfully lowers leakage and hence raises the effectiveness in all coalition constellations. In line with what we found in the case of unilateral EU policy, a CBAM cuts leakage by around one-third to one-quarter in all cases. Intuitively, the lowest leakage occurs when a large coalition and a CBAM are combined. This is illustrated nicely by the EU-US-Chinese climate coalition with a CBAM, which faces a leakage rate less than half the one the EU experiences for unilateral policy without a CBAM (12.6% vs. 25.6%). The resulting global emission reduction in this case is 15.7%, which is still far from what is needed to put the world on track for keeping global warming below 2°C (let alone 1.5°C). Naturally, this is partly driven by the assumed coalition's emission reduction by one-third. In the spotlight in Section 4.2.1, we consider scenarios in which the coalition members implement more ambitious emission targets to begin with.

Next, we revisit the costs of climate policy by examining the real income changes induced by the different coalitions. We reconsider the EU's income effects, but broaden our scope to include the impact on other coalition members as well as non-coalition countries. Additionally, we zoom in on one specific group: countries particularly rich in fossil fuel resources.[27] To aggregate real income changes across countries into different groups, we again use their shares in real GDP (PPP) as weights.

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[27] We classify countries as resource-rich if fossil fuel income accounts for more than 10% of their total income in the reference year. Led by Kuwait and Qatar, both with more than 35%, this group comprises 22 countries or regions. Specifically, the countries are ARE, AZE, BHR, BRN, COG, DZA, GAB, GNQ, IRN, IRQ, KAZ, KWT, MNG, OMN, QAT, RUS, SAU, TCD, TTO, XAC (Rest of South and Central Africa), XNF (Rest of North Africa), and XSU (Rest of Former Soviet Union).

Table 7: Changes in Real Income across Scenarios under a Coalition's 33% Target

Coalition	CBAM	World	EU	Coalition	Non-Coalition	Resource-rich
EU	no	-0.09%	-0.07%	-0.07%	-0.09%	-0.65%
	partial	-0.11%	-0.04%	-0.04%	-0.12%	-0.78%
	yes	-0.11%	+0.00%	+0.00%	-0.14%	-0.84%
EU+USA	no	-0.23%	-0.07%	-0.11%	-0.29%	-1.69%
	yes	-0.27%	+0.00%	-0.06%	-0.37%	-1.98%
EU+G7	no	-0.29%	-0.07%	-0.13%	-0.41%	-2.17%
	yes	-0.35%	-0.00%	-0.09%	-0.52%	-2.53%
EU+G7-led CC	no	-0.41%	-0.07%	-0.23%	-0.61%	-2.94%
	yes	-0.47%	-0.01%	-0.19%	-0.79%	-3.44%
EU+USA+CHN	no	-0.50%	-0.06%	-0.20%	-0.79%	-3.65%
	yes	-0.57%	0.02%	-0.15%	-0.98%	-4.17%
World	no	-1.13%	-0.04%	-1.13%	n/a	-8.25%

Table 7 displays the real income changes for the whole world, the EU, coalition countries, non-coalition countries, and resource-rich countries across the different policy constellations. We make five observations.

First, resource-rich countries' real income is most negatively affected in all coalition setups. In the case of unilateral EU climate policy, the EU experiences a slight real income loss of 0.07%, while resource-rich countries face a 0.65% loss. Any tax on the usage of fossil fuels decreases demand and, hence, lowers prices. Countries that generate a large share of their income from selling said fuels, such as Saudi Arabia, Russia, or Qatar, suffer from this price fall and pay most of the bill of EU climate policy. As global emission reductions become larger, so do the income losses for resource-rich countries. In the case of a global coalition in which the entire world lowers carbon emissions by one-third, resource-rich countries face a significant income reduction of 8.25%.

Second, the insight from unilateral EU climate policy carries over to scenarios in which the EU's policy is embedded into a larger coalition's efforts: climate policy incurs no significant aggregate costs in the EU. The tiny loss of 0.07% is very stable across the different coalitions. However, behind this stable aggregate effect, there are different counteracting mechanisms in action: increased competitiveness relative to other coalition members and lower fossil fuel prices on the one hand, and higher import prices and the need for a higher carbon price to meet the reduction target on the other hand.[28]

Third, real income losses for the coalition are small in all sub-global coalitions we consider. These losses increase slightly when countries that produce more emission-intensively or rely more heavily on income from fossil fuel extraction than the EU join the coalition. For all coalitions considered, real income losses are larger for non-coalition countries than for coalition countries. This outcome hinges on the assumption that most resource-rich countries are not part of any climate coalitions – Kazakhstan in the “G7-led Climate Club” being the exception.

Fourth, and importantly, Table 7 shows that the global costs of climate action are very manageable. In all sub-global coalitions without a CBAM, the global real income loss is half a percent or less. Even in the global coalition scenario, global costs are rather mild at 1.13%, which translates into a loss of approximately USD 1.3 trillion. To put this number into perspective, the benefits from avoided climate damages are in the range from approximately USD 2 trillion (SCC of 185 USD/tCO_2) to more than USD 11 trillion (SCC of 1,056 USD/tCO_2). From a global perspective, the benefits of ambitious climate policy clearly outweigh the costs, in line with Key Finding 3.

Finally, we examine how the introduction of a CBAM affects climate policy costs and their distribution. In all coalitions, accompanying the carbon pricing with a CBAM reduces income losses within the coalition, while increasing income losses in non-coalition countries. From a global perspective, overall costs are always higher when a CBAM is introduced. Resource-rich countries are particularly affected. As for all non-coalition countries, their competitiveness on the coalition’s markets is reduced because they have to pay a tariff. Additionally, the CBAM lowers leakage and, hence, contributes to a greater reduction in carbon emissions – and therefore in fossil fuel use – further driving down fossil fuel prices and revenues.

Overall, from Table 7 and our discussion, we can conclude:

➔ **Key Finding 6: Resource-Rich Countries Disproportionately Bear the Costs of Climate Policy**

To further illustrate the geographical incidence of climate policy costs, we compare the real income effects for two different coalitions in detail. Specifically, Figure 6 shows real

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[28] To illustrate the last point, consider the coalition between the EU, the US, and China. As two major economies join the EU’s efforts to reduce emissions, the potential for carbon leakage decreases, while additional pressure on the fossil fuel price arises. This, however, creates an incentive for EU producers to increase their emission intensity. To counteract this temptation and still meet the same reduction target, the EU must raise its emission tax. Specifically, in this scenario the EU’s emission tax increases from 83% with unilateral EU climate policy to 96%.

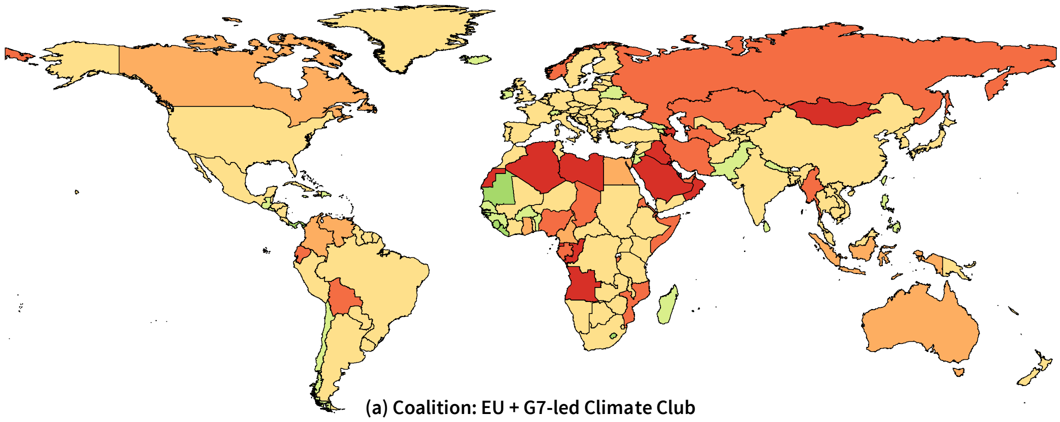
income changes worldwide for the “G7-led Climate Club” scenario (Subfigure 6a) and for the coalition formed by the EU, US, and China (Subfigure 6b).

Focusing first on Subfigure 6a, it is evident that most countries experience real income losses in response to the Club’s emission reduction efforts. For the vast majority, these losses are mild. In line with Key Finding 6, the largest income losses occur in Arabian, African, and Central Asian countries that rely heavily on fossil fuel revenue. The three countries with the greatest losses are Kuwait (6.5%), Qatar (6.1%), and Brunei (5.9%). Some countries gain real income after the climate policy shock, profiting from relative competitiveness gains and lower fossil fuel prices, but these gains are small and mostly negligible.

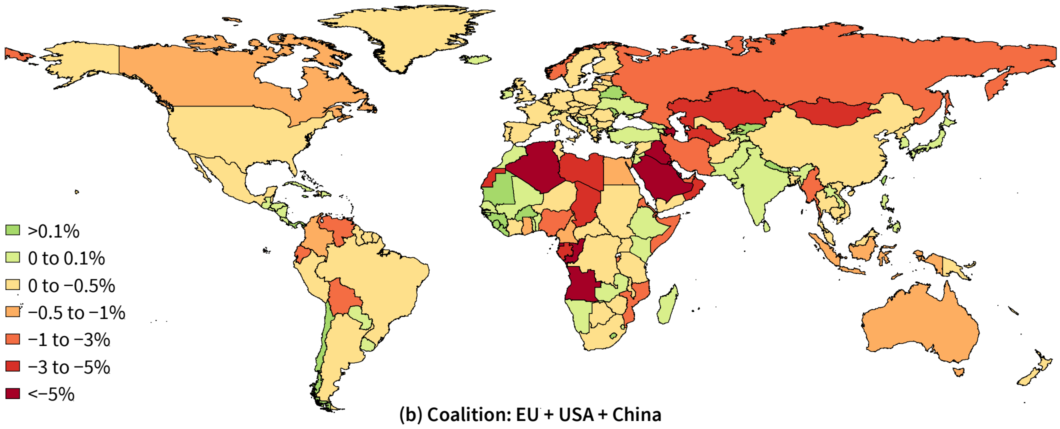
Zooming in on the coalition countries, we see that most do not pay a high price for their climate ambition, with real income losses mostly falling short of 0.5%. Coalition countries with stronger losses are those that have substantial fossil fuel reserves themselves. Kazakhstan is at the top of this list (−2.9%), followed by Mozambique (−1.9%) and Norway (−1.6%). Larger coalition countries like Australia (−0.8%) and Canada (−0.7%) also stand out on the world map for similar reasons.

Turning to Subfigure 6b, the first thing to note is the remarkably similar overall pattern, despite the substantially different coalition membership: China is now included, while all previous non-EU coalition member countries, except for the US, are no longer part of this coalition. Darker shades of red indicate that resource-rich countries suffer even more in this second coalition setup. As discussed above, the coalition including China achieves a larger global emission reduction. The associated stronger drop in fossil fuel demand amplifies the real income losses in resource-rich countries.

Figure 6: Changes in Real Income Level across Countries (Different Coalitions) under a Coalition's 33% Target



(a) Coalition: EU + G7-led Climate Club



(b) Coalition: EU + USA + China

China, on the other hand, is not strongly affected by participating in a climate coalition. Its real income loss increases from almost zero (−0.02%) to a still fairly mild −0.31%. Real income changes also tend not to differ much for countries that were part of the coalition in Subfigure 6a, but are not in 6b. Some of these countries are slightly better off; for example, Japan's real income effect turns slightly positive as it benefits from lower fossil fuel prices and increased competitiveness relative to China, its large neighbor. A similar pattern is observed for Türkiye, which also turns green in Subfigure 6b due to gains from lower fossil fuel prices and enhanced competitiveness against the EU. At the other end of the spectrum, Kazakhstan, the previous largest loser within the coalition, does not fare better outside the new coalition. Instead, it suffers an even stronger real income loss of 3.1%, driven by the decline in Chinese fossil fuel demand.

Throughout our analysis, we have assumed that emission reduction targets are achieved through demand-side climate policies in the coalition countries. This is in line with the real-world focus on carbon taxes and emission trading schemes. However, emission reductions can also be achieved by targeting the supply of fossil fuels, which may have very different implications for real income losses across countries. We will explore the comparison between demand- and supply-side climate policies and their real income effects in a spotlight in Section 4.2.2.

In the discussion of unilateral EU policy in Section 4.1, we showed that despite the absence of large aggregate income losses, EU producers faced considerable competitiveness challenges, leading to noticeable market share losses in emission-intensive industries. We also observed that the EU CBAM, aside from reducing carbon leakage, mitigated and in many cases even reversed these market share losses. In the final part of this section, we consider how different coalition setups affect the competitiveness of, and hence the industrial structure within, the EU. Table 8 presents the EU's global market share changes in four selected emission-intensive industries across the different climate coalitions.

Table 8: Changes in the EU's Global Market Share in Selected Sectors across Scenarios

Coalition	CBAM	Chemicals	Metals	Minerals	Paper
EU	no	-2.4%	-1.4%	-0.7%	-0.7%
	yes	-0.6%	1.3%	0.9%	0.4%
EU+USA	no	-2.0%	-1.4%	-0.7%	-0.6%
EU+G7	no	-1.6%	-1.2%	-0.6%	-0.4%
EU+G7-led CC	no	-1.1%	-0.5%	-0.2%	-0.2%
EU+USA+CHN	no	-1.5%	-0.7%	-0.8%	-0.8%
World	no	2.1%	2.2%	0.5%	0.2%

Note: The coalition's emission target is 33%.

Under unilateral EU climate policy, EU producers lose 2.4%, 1.4%, 0.7%, and 0.7% of their global market shares in the chemicals, metals, minerals, and paper industries, respectively. When the EU is joined by other countries in a climate coalition, these EU market share losses in emission-intensive industries tend to become less pronounced. However, counteracting climate-policy-induced changes in the EU's industrial structure is harder to achieve by adding coalition members than by introducing a CBAM. The magnitude of the impact strongly depends on the specific coalition constellation.

Adding only the US lowers emission-intensive market share losses in the EU to a limited extent. The chemical industry benefits slightly, losing only 1.6% of its global market share due to less competition from the US, but losses in the other dirty industries remain almost unchanged. Section 4.1 showed that the US – in relative terms – does not increase emissions very strongly in response to unilateral EU climate policy. This indicated that the US mostly reacts to the lower fossil fuel price with more emission-intensive production techniques (just as all countries around the world do) rather than taking over previously EU-supplied emission-intensive markets.[29] Therefore, incorporating the US into the coalition does not significantly recover the EU's lost market shares.

Including the remaining G7 countries and, more importantly, the other members of the "G7-led Climate Club" mitigates EU competitiveness losses in dirty industries more effectively. In all four industries considered, EU market share losses are cut by more than half to almost three-quarters once this larger coalition implements emission reduction targets, rather than the EU acting unilaterally.

Interestingly, although adding China to an EU-US coalition has a greater effect on global emissions than adding all the other "G7-led Climate Club" countries, it affects the EU's competitiveness in emission-intensive sectors less strongly. In the minerals and paper sectors, EU market share losses are even slightly larger once China joins the coalition. This suggest that cheap Chinese competition was not the primary concern for EU producers in these sectors under unilateral EU climate policy.

Additionally, with China in the coalition, the fossil fuel price drop is even stronger. Non-coalition countries not counteracting this price drop with a higher carbon price therefore experience an even larger cost advantage over EU producers and capture more market share.

We have seen above that if the EU wants to successfully lower global emissions, finding additional coalition partners is much more fruitful than accompanying unilateral EU policies with a CBAM.

However, this is not the case for securing EU competitiveness in emission-intensive industries. The two policies imply very different coverage of carbon pricing outside the EU. With a CBAM, emissions from all other countries are covered by an emission price only if they are embodied in products for the EU market. The home market is sufficiently important for EU producers for this coverage to make a big difference in terms of saving the EU's global market shares. In contrast, a larger coalition extends carbon pricing only to specific countries, the new coalition members, covering *all* their emissions. This broader coverage in partner countries is decisive in bringing down global emissions more significantly.

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[29] This is in line with Larch and Wanner (2024), who find that the US emission increase following a withdrawal from the Paris Agreement is primarily driven by the energy market leakage channel.

4.2.1 Spotlight: Increasing the Level of Ambition

In all scenarios, we considered an emission target in line with the EU's "Fit for 55" plan, specifically a reduction by one-third. However, this target proved insufficient for achieving needed global emission reductions, even in scenarios where large and/or many countries joined the EU in a climate coalition. In this *spotlight*, we reconsider all the previous coalition setups but with a more ambitious 50% emission reduction target. For the EU, a 50% reduction from current emission levels corresponds to a reduction of almost two-thirds from the level of 1990.[30]

Table 9 compares the global emission effects and leakage rates for the different climate coalitions with and without a CBAM, for the previous reduction target of one-third and the new, more ambitious reduction target of one-half.

Table 9: Emission Reductions and Carbon Leakage across Scenarios

Coalition	Target	World emissions change		Carbon leakage rate	
		no CBAM	CBAM	no CBAM	CBAM
EU	33%	-2.5%	-2.8%	25.6%	18.4%
	50%	-3.7%	-4.1%	26.1%	18.6%
EU+USA	33%	-6.7%	-7.1%	22.3%	16.9%
	50%	-9.9%	-10.7%	23.0%	16.9%
EU+G7	33%	-8.6%	-9.2%	21.0%	15.4%
	50%	-12.7%	-13.8%	21.9%	15.6%
EU+G7-led CC	33%	-11.6%	-12.5%	19.3%	13.2%
	50%	-17.2%	-18.7%	20.4%	13.4%
EU+USA+CHN	33%	-14.8%	-15.7%	17.8%	12.6%
	50%	-21.8%	-23.4%	19.0%	13.0%

The leakage rates are slightly higher for the stronger reduction target, but the higher ambition mostly translates into stronger global emission reductions. In the unilateral EU case, however, this still implies only a 3.75% reduction in global emissions. An accompanying CBAM helps lower leakage and hence increases global effectiveness across all coalition constellations. The maximum unilateral EU effect on global emissions then rises to a 4.1% reduction. Implementing the ambitious target within the "G7-led Climate Club" brings the global emission reduction up to 17.2%, or 18.7% if combined with a CBAM. In the EU-US-China coalition, the effects on global emissions are −21.8 and −23.4%, respectively. However, even these strongest reductions found in

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[30] This results from (100 − 32.5) × 0.5 + 32.5 = 66.25, considering the EU's attained emission reduction of 32.5% by 2022, compared to the 1990 level.

any of our scenarios fall short of putting the world on track for at least a 2°C temperature path.

Table 10 displays the real income changes for different groups of countries across the five coalition setups, with targets of either one-third or one-half (without a CBAM). Our previous key insights on the income costs of climate policy continue to hold: the EU does not incur large losses, even with the ambitious target, regardless of whether it acts alone or as part of a coalition. Global income losses are manageable in all scenarios, including the largest coalitions with the stronger emission reductions; and the costs are mostly borne by resource-rich countries. Specifically, EU income losses rise to up to a quarter percent, the global cost increases to 0.85% in the case of the strongest global effort, and resource-rich countries lose about 1 percent with strong unilateral EU action and up to more than 5 percent in the two cases of the largest ambitious coalitions.

Table 10: Change in Real Income across Scenarios

Coalition	Target	World	EU	Coalition	Non-Coalition	Resource-rich
EU	33%	-0.09%	-0.07%	-0.07%	-0.09%	-0.65%
	50%	-0.15%	-0.24%	-0.24%	-0.14%	-0.97%
EU+USA	33%	-0.23%	-0.07%	-0.11%	-0.29%	-1.69%
	50%	-0.39%	-0.24%	-0.34%	-0.42%	-2.49%
EU+G7	33%	-0.29%	-0.07%	-0.13%	-0.41%	-2.17%
	50%	-0.50%	-0.24%	-0.36%	-0.59%	-3.19%
EU+G7-led CC	33%	-0.41%	-0.07%	-0.23%	-0.61%	-2.94%
	50%	-0.82%	-0.17%	-0.49%	-1.21%	-5.19%
EU+USA+CHN	33%	-0.50%	-0.06%	-0.20%	-0.79%	-3.65%
	50%	-0.85%	-0.24%	-0.56%	-1.12%	-5.27%

Note: All results shown here depict scenarios implemented without a CBAM.

4.2.2 Spotlight: Distribution of Climate Rents

In all simulations so far, we have followed the standard assumption of demand-side climate policy, where emission reductions are achieved through carbon pricing in the country where the emissions occur as fossil fuels are burnt. However, the type of climate policy may decisively impact the distributional effects of climate policy shocks. Climate policy creates “climate rents,” i.e., scarcity rents for the right to emit some of the remaining allowed pollution (cf. Kalkuhl and Brecha, 2013). Under demand-side climate policy, countries implementing the emission reductions collect these rents. Alternatively, fossil fuel supply countries can capture the climate rent, e.g., by imposing fossil fuel *extraction* taxes. To compare demand- and supply-side climate policies, we examine two scenarios considering a global coalition with a joint carbon price that achieves a 33% global emission reduction. In the first scenario, the reduction is achieved through a global fossil fuel *use* tax, with revenue collected in the countries burning the fuels. In the second scenario, the reduction is achieved through a common global fossil fuel *extraction* tax, with revenue collected in the countries producing the fuels.

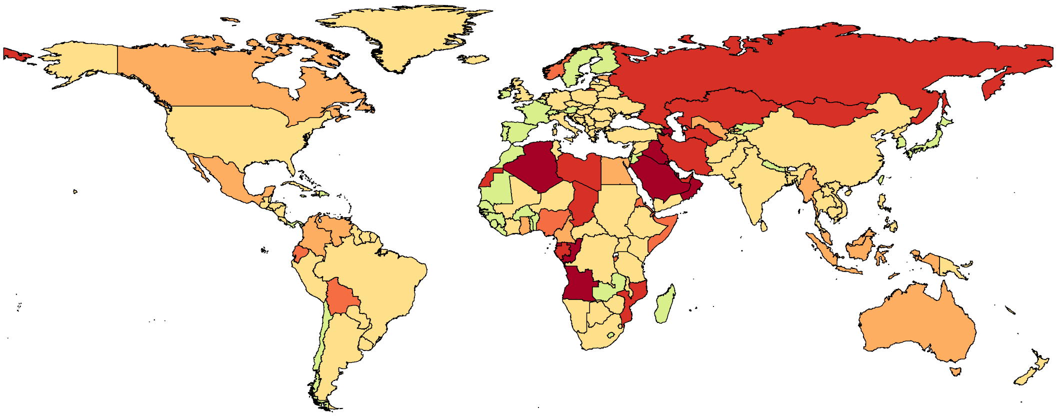
Figure 7 shows the real income changes in all countries for these two policy setups. It is immediately evident that supply-side climate policy has very different global distributional implications. Subfigure 7a is in line with previously discussed patterns: most countries experience very small income losses (or even slight gains), while countries heavily dependent on revenues from fossil fuel sales suffer significant losses. Subfigure 7b, however, changes the picture dramatically. Globally, real income losses become larger, except in fossil-fuel rich countries: as they now capture the climate rents, many experience substantial real income gains. The three most extreme examples are Kuwait, Qatar, and Brunei, where drastic real income losses of 18.4%, 17.1%, and 16.7% are reversed into very considerable gains of 5.5%, 5.6%, and 5.2%, respectively. On average, resource-rich countries shift from an 8.5% loss to a 1.2% real income gain.

The two most populous countries, China and India, take part in the global coalition at relatively low cost under demand-side climate policy. However, if they lose out on tax revenue from domestic carbon pricing due to fossil fuels being taxed at source instead, their income losses increase substantially – by a factor higher than five, from 0.3% to 1.5% in China and from 0.5% to 2.2% in India.

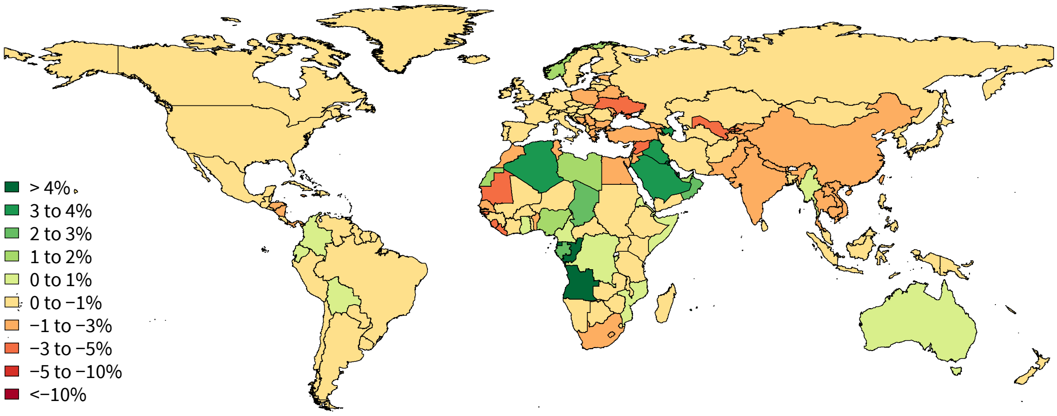
Finally, we note that supply-side climate policy challenges our “Key Finding 2.” While EU real income losses are still not dramatically high, they do increase from a minor 0.04% loss to a noticeable drop in real income of 0.6%.

Overall, this final scenario comparison illustrates a significant shift in who bears the cost of climate policy, depending on the type of policy implemented. Focusing on its own costs, the EU has a clear interest in keeping policy on the demand side. However, a willingness to give up part of the climate rents could facilitate greater global cooperation.

Figure 7: Changes in Real Income Level across Countries (Input vs. Extraction Taxes)



(a) Scenario: Demand-side policy of a global coalition



(b) Scenario: Supply-side policy of a global coalition

5 Conclusions

This *EconPol Policy Report* focuses on EU climate policy in a globalized world. By pursuing ambitious emission reduction targets, the EU aims to help limit the most severe climate impacts as agreed upon by the international community in the Paris Agreement. However, not every country has implemented stringent climate policies, and the gap between *nationally determined contributions* and the necessary emissions cuts remains substantial. Moreover, the EU, besides accounting for less than 7% of global GHG emissions, faces the problem of carbon leakage in response to its own climate policy.

Against this backdrop, we assess various options for EU climate policy, seeking answers to the question of how effectively the EU can reduce global emissions and at what costs.

For this purpose, we utilize a state-of-the-art quantitative trade and environment model, specifically tailored to our analyses. We investigate the effects of the EU's target to reduce emissions by 55% by 2030 compared to 1990 and evaluate the newly introduced EU CBAM. Additionally, we analyze different configurations of climate coalitions with the EU at their core, including the recently launched "G7-led Climate Club." In doing so, we compare outcomes on EU and global emissions, shifts in international competitiveness, changes in the EU's global market shares across different sectors, and the impact on real income for the EU and beyond.

We condense our main results into six key findings:

1. **Unilateral EU climate policy reduces global emissions only modestly**
2. **The EU does not incur substantial costs from ambitious climate policy**
3. **Global gains from avoided damages far exceed the costs of EU climate policy**
4. **The CBAM reduces carbon leakage and prevents income losses for the EU**
5. **A "G7-led Climate Club" will not reduce global emissions sufficiently**
6. **Resource-rich countries disproportionately bear the costs of climate policy**

Despite looming uncertainties, such as the (climate) policy agenda of the newly elected European Commission, the upcoming US presidential election in November, and an increasing number of global conflicts, our key findings underscore the urgent need for climate diplomacy as the most effective – and indeed, the only – option for the EU to successfully mitigate climate change. This *EconPol Policy Report* demonstrates that climate policy is economically viable despite great challenges ahead. Consequently, it is vital that the EU pursue its emission reduction targets, while recognizing *broad-and-deep* climate coalitions as being both of critical importance and worth forging.

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List of Figures

List of Tables

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