EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 601 final

PART 1/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

{COM(2021) 551 final} - {SEC(2021) 551 final} - {SWD(2021) 557 final} -
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GLOSSARY

Term or acronym	Meaning or definition
Biofuels	Biofuels are liquid or gaseous transport fuels such as biodiesel and bioethanol which are made from biomass.
Biofuels (conventional)	Biofuels are produced from food and feed crops.
Biofuels (advanced)	Biofuels produced from a positive list of feedstock (mostly wastes and residues) set out in Part A of Annex IX of Directive (EU) 2018/2001.
CAPRI	Common Agricultural Policy Regionalised Impact model: a global multi-country agricultural sector model, supporting decision making related to the Common Agricultural Policy and environmental policy.
CBAM	Carbon border adjustment mechanism
CCFD	Carbon contract for difference
CCS	Carbon Capture and Storage: a set of technologies aimed at capturing, transporting, and storing CO_2 emitted from power plants and industrial facilities. The goal of CCS is to prevent CO_2 from reaching the atmosphere, by storing it in suitable underground geological formations.
CCU	Carbon Capture and Utilisation: the process of capturing carbon dioxide (CO_2) to be recycled for further usage.
CEF	Connecting Europe Facility: an EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level.
CGE	Computable General Equilibrium: a family of economic models.
CHP	Combined Heat and Power: a combined heat and power unit is an installation in which energy released from fuel combustion is partly used for generating electrical energy and partly for supplying heat for various purposes.
CLEF	Carbon leakage exposure factor: a factor that determines how much free allocation a sector or sub-sector may obtain. It depends on whether the sector or sub-sector is deemed to be at risk of carbon leakage or not.
CLI	Carbon leakage indicator: a number that indicates to which extent a sector or subsector is deemed to be at risk of carbon leakage. It is calculated by multiplying the trade intensity with the emission intensity.
CO_2-eq	Carbon dioxide-equivalent: a measure used to compare quantities of different greenhouse gases in a common unit on the basis of their global warming potential over a given time period.
COP	Conference of the Parties: decision-making body of the United Nations Framework Convention on Climate Change (see UNFCCC)
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation

COVID-19	Coronavirus disease: a global pandemic caused by a coronavirus unknown before the outbreak began in Wuhan, China, in December 2019.
CSCF	Cross-sectoral correction factor: a factor by which free allocation of emission allowances is reduced in a uniform manner across all industry sectors, if the demand for free allocation exceeds the total amount of available free allowances
CTP	2030 Climate Target Plan
DG ECFIN	Directorate General Economic and Financial Affairs
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortisation
EEA	European Economic Area
EED	Energy Efficiency Directive: Directive 2012/27/EU and amending Directive 2018/2002/EU
E-fuels	Liquid fuels produced on the basis of hydrogen obtained from electricity via electrolysis
EIB	European Investment Bank
EPBD	Energy Performance of Buildings Directive
ERDF	European Regional Development Fund
ESR	Effort Sharing Regulation: Regulation 2018/842/EU
ETD	Energy Taxation Directive: Directive 2003/96/EC
ETS	Emissions Trading System
EU, EU-27	European Union with 27 Member States since 1 February 2020
EU-28	European Union with 28 Member States from 1 July 2013 to 31 January 2020
EUA	European Union allowance: the tradable unit under the EU ETS, giving the holder the right to emit one tonne of CO_2-eq
EUTL	European Union Transaction Log: central transaction log, run by the European Commission, which checks, records and authorises all transactions between accounts in the Union Registry (see also EU ETS, NIMs)
GAINS	Greenhouse gas and Air Pollution Information and Simulation model
GDP	Gross Domestic Product
GEM-E3	General Equilibrium Model for Energy Economy Environment interactions: a computable general equilibrium model, version operated by E3Modelling, a company
GHG	Greenhouse gas

GLOBIOM	Global Biosphere Management Model: a model for land use of agriculture, bioenergy, and forestry.
GT	Gross Tonnage
GW	Gigawatt
GWh	Gigawatt hours
IA	Impact assessment
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
IF	Innovation fund
IMO	International Maritime Organization
JRC	Joint Research Centre of the European Commission
JRC-GEM-E3	General Equilibrium Model for Energy Economy Environment interactions: a computable general equilibrium model, version operated by the JRC
LDC	Least developed countries
LRF	Linear Reduction Factor: a factor by which the overall emissions cap of the ETS is reduced yearly
LULUCF	Land Use, Land-Use Change, and Forestry
MACC	Marginal abatement cost curve
MMF	Multiannual Financial Framework
MRV	Monitoring, reporting and verification
MS	EU Member State(s)
MSR	Market stability reserve
$MtCO_2$	Million tonnes of CO_2
MW	Megawatt
MWh	Megawatt hours
NACE	Statistical classification of economic activities in the European Community (from the French nomenclature statistique des activités économiques dans la Communauté européenne)
NECP	National Energy And Climate Plan
NIMs	National implementation measures, submitted under Article 11 of the ETS Directive
NPV	Net Present Value

OPC	Open Public Consultation
PRIMES	Price-Induced Market Equilibrium System: an energy system model for the European Union.
PRIMES-TREMOVE	Model for the transport sector, integrated in the PRIMES model.
RED / RED II	Renewable Energy Directives 2009/28/EC and 2018/2001/EU (recast)
RES	Renewable Energy Sources
SIDS	Small island developing states
SME	Small and Medium-sized Enterprise
SMSS	Sustainable and Smart Mobility Strategy
SWD	Staff working document
TEN-E	Trans-European Networks for Energy
TNAC	Total number of allowances in circulation
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax

1 INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1 Context of the initiative

The European Green Deal[1] aims to transform the EU into a fairer and more prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases by 2050 and where economic growth is decoupled from resource use. The climate neutrality objective has been endorsed by the European Council[2] and Parliament[3] and is laid down in a legally binding manner in the politically agreed European Climate Law[4]. The European Green Deal also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive.

The necessity and value of the European Green Deal have only grown in light of the very severe effects of the COVID-19 pandemic on our health and economic well-being. Unprecedented near term investments are needed to overcome the negative impact of the COVID-19 crisis on jobs, incomes and businesses, including in the sectors covered by the EU Emissions Trading System (ETS).

With the Communication on stepping up Europe’s 2030 climate ambition – the 2030 Climate Target Plan[5] (2030 CTP) the Commission has proposed an EU-wide, economy-wide net greenhouse gas emissions (GHG) reduction target by 2030 compared to 1990 of at least 55% that will set the Union onto the path to climate neutrality. The December 2020 European Council confirmed this ambition level[6] and the political agreement on the European Climate Law in April 2021 ensures that it is legally binding. The Union has updated its Nationally Determined Contribution[7] and called upon all other parties of the Paris Agreement to come forward with their own ambitious targets and policies.

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[1] COM(2019)650 final.
[2] European Council conclusions, 12 December 2019.
[3] European Parliament resolution of 14 March 2019 on climate change and resolution of 28 November 2019 on the 2019 UN Climate Change Conference in Madrid, Spain (COP 25).
[4] COM (2020)80 final; Council letter to EP on Climate Law agreement: https://data.consilium.europa.eu/doc/document/ST-8440-2021-INIT/en/pdf
[5] COM (2020) 562 final.
[6] European Council meeting (10 and 11 December 2020) – Conclusions; EUCO 22/20.
[7] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/European%20Union%20First/EU_NDC_Submission_December%202020.pdf

In line with the policy conclusions (see Annex 14), the Commission is reviewing all relevant climate and energy policies. This includes increasing the environmental contribution of the ETS in a manner commensurate with the overall target. The ETS is a cap-and-trade system that limits emissions from approximately 10000 energy intensive installations (power stations & industrial plants) and around 500 airlines[8]. The ETS covers 41% of the EU's greenhouse gas emissions.[9] The 2030 CTP indicates that increasing the EU's 2030 climate ambition requires a strengthened cap of the existing EU ETS, while its impact assessment provided estimates what this could mean.

Reducing maritime transport emissions is part of the EU economy-wide reduction commitment under the Paris Agreement. The co-legislators expressed in Regulation (EU) 2018/842 and the ETS Directive that all sectors of the economy should contribute to the reduction of greenhouse gas emissions. The ETS Directive also states that action from the International Maritime Organisation (IMO) or the Union should start from 2023, including preparatory work on adoption and implementation and due consideration being given by all stakeholders. The 2030 CTP states that the EU should include at least intra-EU maritime transport in the Emissions Trading System.

Furthermore, the impact assessment accompanying the 2030 CTP[10] has assessed carefully the possibility of reinforcing and expanding emissions trading as a tool to achieve greenhouse gas emission reductions at the EU level in an economically efficient manner. The 2030 CTP is clear that an expansion of emissions trading could include emissions from road transport and buildings, and that the Commission would look into covering all emissions of fossil fuel combustion[11]. The expansion could be developed as an upstream system and would need to appropriately address the relation to entities whose emissions from fuel combustion are covered by the existing downstream ETS. The CTP pointed to the benefit of transitional arrangements or a pilot period before gradually integrating the new sectors into the existing system.

The December 2020 European Council invited the Commission to consider exploring the ways to strengthen the ETS, in particular carbon pricing policies, while preserving its

[8] The ETS has been established by Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community, Official Journal L 275, 25.10.2003, p. 32–46.

[9] This percentage is based on the current EU 2020 and 2030 climate target scope, which includes all international aviation, excludes the international maritime sector and keeps LULUCF separate.

[10] SWD(2020) 176 final

[11] In addition to building and road transport emissions, this would include emissions from small non-ETS industries, fuel use in agriculture and non-electric railway.

integrity and taking into account the need to address distributional concerns and energy poverty. The European Council also invited the Commission to consider proposing measures that enable energy-intensive industries to develop and deploy innovative climate-neutral technologies while maintaining their industrial competitiveness.[12]

The European Parliament called on the Commission to rapidly review the ETS Directive to make it fit for purpose for the increased GHG targets, and welcomed the inclusion of the maritime sector in the ETS, and stressed that the EU should defend a high level of ambition for its GHG reductions. In general, it supported the idea of market-based measures as one of the tools to achieve climate objectives. However, the Parliament rejected an inclusion of road transport into EU emissions trading[13].

This impact assessment also includes the first review of the Market Stability Reserve (MSR). This review is foreseen by the legislation currently in force and has to take place within three years of the date of its start of operation on 1 January 2019. The MSR was established by Decision (EU) 2015/1814 ('MSR Decision') and amended by Directive (EU) 2018/410 to ensure the appropriate reduction of the large structural imbalance between the supply and demand of allowances which characterised the early phase 3 of the ETS, which ran from 2013 to 2020, and to improve the system's resilience to major shocks by adjusting the supply of allowances to be auctioned.

Aviation is already included in the ETS, though currently under some different rules, and with its scope currently restricted to intra-EU flights under the time-limited "stop the clock" derogation under Regulation (EU) 2017/2392, also under revision in 2021. The European Parliament and Council have set out very specific requirements to assess and make a proposal, as appropriate, relating to implementing the carbon offsetting and reduction scheme for international aviation (CORSIA) and to review the cost pass through 'with a view to increasing auctioning' taking into account other transport forms. Therefore a separate impact assessment is considering how aviation should (a) contribute to the EU's 2030 climate objectives and ambition through the ETS and any appropriate amendment, including through increasing the level of allowances auctioned under the system; (b) how the EU should implement CORSIA set up under the auspices of ICAO, in a manner consistent with the EU's 2030 climate objectives and ambition.

This impact assessment is coherent with the remainder of the 2030 climate, energy and transport framework, notably the impacts assessments related to the Effort Sharing

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[12] European Council conclusions, 10-12 December 2020.
[13] European Parliament resolution of 15 January 2020 on the European Green Deal (P9_TA(2020)0005)

Regulation (ESR); the Land Use, Land Use Change and Forestry (LULUCF) Regulation; CO_2 Emissions Performance Standards for Cars and Vans; the Renewable Energy Directive (RED II); the Energy Efficiency Directive (EED)[14]; and, at a later stage, the Energy Performance of Buildings Directive (EPBD). Other relevant initiatives include the revision of the Energy Taxation Directive; the Zero Pollution Action Plan and the revision of the Industrial Emissions Directive, where the Commission will examine options to achieve maximum synergies between the zero pollution and the decarbonisation goals; initiatives on mobility, such as those on transport fuels (FuelEU maritime initiative and ReFuelEU aviation initiative) and a proposal for a Carbon Border Adjustment Mechanism (CBAM). To ensure coherence, this impact assessment covers relevant interactions of the ETS revision with other policies, such as the complementarity between extending emission trading and the EED.

The EU budget plays an increasingly important role in the EU meeting its climate commitments. At least 30% of the expenditures under the Multiannual Financial Framework 2021-2027 (MFF) and at least 37% of national expenditures under the NextGenerationEU Recovery Instrument have to support climate objectives.

The European Council, the European Parliament and the Commission agreed in an inter-institutional agreement of 16 December 2020 to introduce over the MFF period new own resources that are sufficient to cover the repayment of the Recovery Instrument. The Commission committed to table by summer this year proposals for new own resources based on the revision of the Emissions Trading System, including its possible extension to maritime and reducing the allowances allocated for free to airlines, for a new Carbon Border Adjustment Mechanism and for a new digital levy, with a view to their introduction at the latest by 1 January 2023.

1.2 Current policies and progress achieved

The ETS started in 2005 and operates in all EU countries plus Iceland, Liechtenstein and Norway. Its third trading phase ran from 2013 until the end of 2020 (phase 3). During that period the cap on emissions was reduced by 1.74% per year to achieve a total emission reduction target of 21% compared to 2005 by 2020. In reality, emissions remained well below the cap, which means that the EU has surpassed its 2020 target and actual emissions from stationary sources (power and industry) have declined by around 35% between 2005 and 2019.

[14] Directive 2012/27/EU as amended by Directive 2018/2002

The fourth trading phase started on 1 January 2021 and is currently meant to run until the end of 2030 (phase 4). The revised rules governing this phase were finalised in March 2018 with the adoption of Directive (EU) 2018/410 amending Directive 2003/87/EC (ETS Directive).

The 2018 revision included a contribution by the ETS to the EU's 2030 economy-wide emissions reduction target of the time (at least -40% compared with 1990) of -43% compared to 2005. This meant that the cap on emissions had to decline at a faster rate than 1.74%. The reduction rate, or 'linear reduction factor', was revised accordingly and is now set to decline by 2.2% every year starting in 2021.

From 2009 to phase 3, a large surplus of allowances built up in the EU ETS. To address this surplus, a Market Stability Reserve (MSR) was created in 2015, and strengthened in the 2018 ETS revision. The MSR can reduce the total number of allowances in circulation (TNAC) by absorbing a part of the auction volumes, or increase the TNAC by releasing additional allowances for auctioning. The MSR absorbs or releases allowances if the TNAC is outside of a predefined range. If the TNAC is above a predefined upper threshold (833 million allowances), 24% (the intake rate) of the TNAC is removed from the volumes to be auctioned, and added to the MSR instead. If the TNAC is below a predefined lower threshold (400 million allowances), 100 million allowances are released from the MSR and auctioned. The strengthened MSR also has an invalidation rule - from 2023, allowances held in the MSR exceeding the previous year's auction volume will no longer be valid. The MSR began operating in 2019, and has already reduced the surplus to below 1.6 billion allowances.

The existence of the MSR also means that the ETS is now better equipped to handle the impacts of complementary policies, such as renewable energy policies or coal phase outs. Coal phase outs were driven in some cases by national policies and in other cases by lack of competitiveness of coal, in itself mainly driven by carbon prices. These policies reduced demand for ETS allowances and thereby had the undesired effect of increasing the surplus pushing the carbon price down. Today, if complementary policies have the effect of reducing demand for allowances, then the surplus is gradually absorbed by the MSR[15].

The reaction of the market to these 2018 reforms has been notable. In 2019, with carbon prices increasing from around EUR 6 at the beginning of 2018 to around EUR 25/tCO_2, these emissions saw a further drop of almost 9% year on year. In 2020, carbon prices

[15] SWD/2014/017 final

remained relatively stable despite estimated large emission reductions caused by the COVID-19 lockdown, sending a meaningful price signal both in the short term and in the long term. In the short term, coal-fired power plants have been and are being replaced by lower emissions technologies, including through an impressive development of renewable energies. In the long term perspective, the carbon price is now a more important element in the investment decisions of installations covered by the ETS.

A more ambitious ETS comes with a potentially increased risk of carbon leakage, either because production is transferred from the EU to other countries with lower ambition for emission reduction, or because EU products are replaced by more carbon-intensive imports. The 2018 revision targeted leakage protection better to the most exposed sectors, in a renewed carbon leakage protection framework, consisting of partial free allocation and allowing Member States (MS) to compensate higher electricity costs caused by the ETS under certain conditions ('indirect cost compensation').[16]

The ETS Directive also includes solidarity provisions, such as the redistribution of 10% of the auctioned allowances to the 16 lower income MS. In addition, a Modernisation Fund was set up to support the 10 lowest income MS to invest in their energy systems' modernisation, just transition and energy efficiency.

An Innovation Fund, moreover, is open to all MS. It supports investments in breakthrough low-carbon technologies, which despite the increased carbon price remain too expensive to compete with existing technologies, such as materials substitution and circular approaches, by contributing to de-risk their initial deployment in the market.

Sectors outside the ETS are presently covered by the Effort Sharing Regulation (ESR) which establishes an overall EU-wide greenhouse gas emission reductions target of -30% compared to 2005, as well as binding annual targets for individual MS to be achieved by 2030. The ESR covers among others the road transport and buildings sectors and therefore, in order to reach their national reduction targets, MS have to put in place climate and energy policies applicable to those sectors, including the possibility of pricing instruments at national level. These sectors have to contribute to the overall objective. Contrary to the ETS, the sectors covered by the ESR are not subject to an EU-wide carbon price signal.

As far as maritime transport is concerned, the ESR only covers emissions from domestic maritime transport. Since 2015, however the EU has legislation on monitoring, reporting

[16] Communication from the Commission. Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post 2021. OJ C 317/5, 25.9.2020.

and verification of emissions from maritime transport more broadly ('EU Maritime MRV Regulation')[17]. The IMO adopted its GHG reduction strategy in 2018.

2 PROBLEM DEFINITION

This section defines the problems, describes their underlying causes and looks at their expected evolution if the current regulatory framework remains untouched. The problems can be divided in three types: first, those associated with the increased climate target and the need to strengthen the existing ETS in a commensurate way (these are addressed in Sections 2.1 – 2.3); second, the issue of the stronger challenges faced by certain sectors to contribute sufficiently to the achievement of the increased target (described in Section 2.4); and third, those related to distributional and innovation aspects following both the required strengthening of the existing ETS and the possible expansion of emissions trading to additional sectors (in Section 2.5).

2.1 Current ETS legislation is not optimal for a balanced path towards a - 55% 2030 target

Higher 2030 climate ambition is needed to ensure the EU is set on a gradual and balanced trajectory to reach climate neutrality by 2050. If the legislation remains unchanged, sectors currently covered by the ETS would, according to the EU Reference Scenario 2020[18], together achieve a 2030 emission reduction of -51% compared to 2005 (see also Section 5.1). Even though this would mean outperforming the legislated contribution of -43%[19] referred to above, this would still be an insufficient contribution to an overall target of -55% compared to 1990. The policy scenarios that achieve around 55% reductions project a cost-effective contribution of the sectors currently covered by the ETS in the range of -62-63% compared to 2005. This problem was also recognised by stakeholders responding to the public consultation. As regards to the sustainability criteria for biomass under the Renewable Energy Directive 2018/2001 (RED II), there is coherence through the amended EU ETS Monitoring and Reporting Regulation (MRR – Commission Implementing Regulation (EU) 2018/2066 amended by Commission

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[17] Regulation (EU) 2015/757 on the monitoring, reporting and verification of CO_2 emissions from maritime transport, OJ L 123, 19.5.2015, p. 55–76

[18] The EU Reference Scenario projects the combined impacts currently adopted EU and Member State climate, energy and transport legislation. For more details see Section 5.1.

[19] The ETS cap only determines the maximum amount of emissions for the covered sectors. It is possible that the covered sectors emit less than the cap, for instance as a result of policies fostering the development of renewable power generation, energy efficiency or the circular economy.

Implementing Regulation (EU) 2020/2085), hence it is not further assessed in this initiative.

However, increasing the ambition is not as simple as lowering the cap on ETS allowances. A reduced amount of allowances available to the market affects other pillars of the ETS and the carbon price. It also impacts core principles such as the need for market stability, the protection against the risk of carbon leakage and the carefully balanced distributional effects between MS. These problems are described in the following paragraphs.

2.2 Continued risk of supply/demand imbalances of the carbon market and the review of the Market Stability Reserve

The MSR's main objective is to tackle the surplus of allowances in the carbon market, thus ensuring the delivery by the ETS of the necessary investment signal to reduce CO_2 emissions in a cost-effective manner. The MSR was also meant to make the ETS more resilient to the risk of supply-demand imbalances, so as to enable the market to function in an orderly manner.

In the coming decade the importance of the MSR is undiminished as part of the allowance surplus built up in the past still exists (approximately 1.578 billion allowances) and the risk of demand and supply shocks remains very real.

Article 3 of the MSR Decision[20] tasks the Commission with reviewing the functioning of the MSR before 1 January 2022, on the basis of an analysis of the orderly functioning of the European carbon market. The review must pay particular attention to the MSR's numerical parameters (its upper and lower threshold, and its intake rate) and to the invalidation rule; it must assess the impact of the reserve on growth, jobs, the Union's industrial competitiveness and the risk of carbon leakage.

On top of the results of the review, other elements may trigger a need for changes to the functioning of the MSR. The changes to the cap to increase ambition for 2030, as well as the impact of unknown external factors such as Covid-19 or national measures such as coal phase-outs, raise the question whether the basic rules of the MSR remain fit to continue tackling structural supply-demand imbalances throughout the decade.

[20] Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, OJ L 264 9.10.2015, p. 1

For these reasons, both a backward- and a forward-looking assessment are necessary to determine whether the MSR's design needs to be amended in order for it to continue to meet its objectives. The MSR can be considered as fairly recently in operation, [21] having started operation on 1 January 2019. Nevertheless, as part of the review, the Commission has carried out a study of the first two years of its functioning and of the expected performance of the MSR in years to come. The full outcome of the review is presented in Annexes 7 and 8.

The review of the MSR showed that it has fully achieved its objectives, since it began operating in January 2019, by reducing the historical surplus[22] and in general providing confidence to the market[23] that it can deal with unexpected events such as the recent demand shock related to Covid-19. Moreover, the MSR has so far functioned in a stable and predictable manner[24]. Also at least 70% of respondents to the open public consultation (OPC) agreed that the MSR has worked well in the past (while only 4% disagreed).

The analysis showed that the MSR's objectives of surplus reduction and market stabilisation not only remain valid, but should be adapted to the new policy and market conditions (set out in Annex 8), updated behaviour by market participants and in particular hedging needs (Annex 8, Section 24), and probable economic shocks (Annex 8, Section 22). All of these elements may ultimately result in decreasing needs for allowances in the future. The MSR thresholds and intake rate may be adjusted to ensure an optimal level of market liquidity, avoiding future surpluses and deficits of allowances. At the same time, if the MSR reduces the surplus too quickly, or does not fulfil a liquidity need, this could create uncertainty and significant price volatility on the market. The future evolution of these market conditions is also very uncertain.

The analysis outlined some points for improvement. One point is the need to improve the way the total number of allowances in circulation is calculated, by including net demand

[21] The changes adopted through Directive 410/2018 revising the EU ETS for the period from 2021 to 2030 will only be implemented as from 1 January 2021, while the Market Stability Reserve entered into operation in 2019. Therefore, while a full evaluation was not possible, a first analysis of the functioning of the reserve is included in the IA.
[22] See Annex 7, Section 20.4.
[23] See Annex 7.
[24] See Annex 7.

from the aviation sector,[25] which is not taken into account at the moment. The MSR should also take into account the maritime sector if it will be included in the EU ETS.

The analysis highlighted the possible existence of a threshold effect.[26] Each year the MSR either absorbs 24% of the TNAC or nothing at all, depending on whether the TNAC is above or below the upper threshold. In years when the TNAC is very close to the threshold, this can cause significant uncertainty on the market.[27]

Another possible cause for market uncertainty is the invalidation of allowances up to the auctioning level of the previous year. This level is uncertain, as it depends on the operation of the MSR itself.[28]

Finally, the analysis found[29] that if the MSR parameters are not adjusted appropriately and in a timely manner, the surplus could increase significantly in the coming years. Indeed, after 2023, the 24% intake rate reverts to only 12%. This lower rate would not be enough to reduce the surplus in an optimal manner in coming years.

2.3 There is potential for a higher risk of carbon leakage due to EU's increased climate ambition

Increased ambition requires lowering the ETS cap, which leads to a reduced overall amount of allowances. This in turn raises important questions as to the continued suitability of the carbon leakage protection framework currently included in the ETS Directive. A lower cap indeed means that fewer allowances may be available for free allocation. Moreover, the carbon price is expected to rise as a result of a reduced cap. Both developments could lead to higher compliance costs and an increased risk of carbon leakage. This impact assessment will therefore assess the effects of ETS strengthening in line with the -55% target on the risk of carbon leakage.

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[25] See Annex 7, 20.5.1.

[26] See Annex 7, 21.

[27] As an illustration for the threshold effect, if the TNAC is 834 million allowances, slightly higher than the upper threshold of 833 million, then according to the MSR rules, 24% of the TNAC is put in the MSR. However, if the TNAC is just below the threshold, at 832 million allowances, then the TNAC is not reduced at all.

[28] The MSR reduces the TNAC by reducing future auction volumes. For example, the level of auction volumes in year X is influenced by the MSR operations corresponding to the TNAC levels of years X-1 and X-2. The levels of the TNAC in years X-1 and X-2 depend also on the verified emissions of those years, which are by definition uncertain. Therefore, if an external event (such as COVID-19) reduces emissions significantly in X-2, this could result in a significantly higher TNAC, and a higher reduction of auction volumes in year X.

[29] See Annex 7, Section 21.

In this context, it is also important to analyse how the carbon leakage protection framework could strengthen incentives to reduce emissions, e.g. through investments in low-carbon technologies (see also Section 2.5.1), whereby it is important to recall that the power sector does not receive free allocation.

This impact assessment does not address the question whether and how a Carbon Border Adjustment Mechanism (CBAM) can be an effective alternative, as this is part of a separate impact assessment accompanying a separate legal proposal. However, impacts of a CBAM will be considered for the assessment of ETS policy options on the framework to address the risk of carbon leakage.

2.4 Sectors not covered by emissions trading face stronger challenges to contribute sufficiently to reduce emissions reductions

The impact assessment accompanying the 2030 CTP found that emissions in certain sectors, including buildings and road transport, in the absence of additional measures, would not decrease as much as required to be on a path to achieve an economy-wide 55% reduction in emissions. In fact, in road and maritime transport, emissions today are higher than in 1990. It also found that while a significant overachievement of emission reductions of 8 % points is projected for the current ETS sectors (see Section 2.1), effort sharing sectors are projected to decrease emissions by 31% compared to 2005[30], which is slightly better than the -30% EU ambition level of current ESR legislation.

This indicates that the current policy framework is more effective in reducing emissions in current ETS sectors and that it is warranted to focus the policy debate on the need for additional EU instruments in the ESR sectors. These sectors are subject to regulatory measures but generally not subject to a carbon price and may therefore not be sufficiently incentivised to reduce their emissions. The general analysis concerning this problem has been carried out already in the impact assessment for the 2030 CTP[31].

The modelling for that impact assessment showed that over-reliance on strengthened regulatory policies would lead to higher burdens on economic operators and more significant investment challenges. On the other hand, focusing more (or only) on economic incentives would imply overly high carbon prices, and carbon pricing alone will not allow overcoming persisting market failures and non-market barriers.

[30] SWD/2020/176 final, Section 6.7, confirmed by the new EU Reference Scenario 2020.
[31] SWD/2020/176 final, Section 6.7

The optimal policy mix should thus combine strengthened economic incentives, such as carbon pricing, to take action with updated regulatory policies notably concerning renewables, energy efficiency and sectoral policies such as CO_2 and cars, and possibly enhanced ESR incentivising national policies across sectors, and an enabling framework (e.g. R&D policies and financial support).

2.4.1 Minimal contribution of the maritime sector to emissions reductions

As highlighted in the 2030 Communication, climate action in the maritime transport sector is urgently needed. While the sector plays an essential role in the EU economy[32] and is one of the most energy-efficient modes of transport, it emits 3-4% of all EU CO_2 emissions (around 144 million tonnes of CO_2[33] in 2018) and its emissions are projected to grow quickly if mitigation measures are not swiftly introduced. Since 1990, CO_2 emissions from fuel sold in the EU for international navigation have grown by around 36%[34], contrary to domestic navigation emissions that have decreased by 26% over the same period[35]. Today, CO_2 emissions from international navigation represent close to 90% of all EU navigation emissions and according to projections, these could grow by around 14% between 2015 and 2030 and 34% between 2015 and 2050[36] in a business-as-usual scenario. Such a future growth would off-set the emissions reduction achieved in the sector since 2008.

There are different reasons for this expected increase in international navigation emissions. The single most important element is the foreseen increase in the demand of maritime transport services to cater for the demand for additional primary resources and containerised goods in Europe. This is aggravated by a range of barriers to the decarbonisation of the maritime transport sector. These barriers will need to be addressed by dedicated measures in order to achieve the full greenhouse gas emissions reductions potential of the sector.

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[32] Maritime transports 75% of EU's external trade, 36% of intra-EU trade flows and more than 400 million passengers each year at EU ports

[33] CO_2 emissions from maritime transport as reported under Regulation (EU) 2015/757 and including emissions from intra-EEA and extra-EEA voyages as well as emissions occurring at EEA berth.

[34] EU GHG inventory to UNFCCC, 1 A 3 d I, CO_2 equivalent, EU 27, 2018 vs 1990 emissions

[35] Domestic navigation emissions are covered under the Effort Sharing Regulation, statistics from the EU GHG inventory to UNFCCC, CO_2 equivalent, 2018 vs 1990

[36] Revised REF2020 scenario, PRIMES modelling, navigation

Part of these barriers are market-related and cover issues such as the problem of split incentives[37], the difficulty to access finance, the duration of vessel ownership or the long lifespan of ships. A number of these barriers explain why shipping companies are not sufficiently investing in readily available cost-effective energy efficient measures, despite energy costs accounting for 60-70% of their overall operating costs. Other barriers are more technology related. For instance, the majority of stakeholders[38] indicated that the current lack of viable solutions, and in particular the lack of market-ready renewable and low-carbon fuels, is a key barrier.

On top of these technological and market barriers, the deployment of low-carbon solutions is also slowed down by a range of economic barriers. Maritime transport is a sector where the “polluter-pays” principle is not applied and where the price of transport does not reflect the impact it has on climate and the environment. It is also a sector that relies on heavy fuel oil, at significantly cheaper costs than fuel used in other sectors, and where maritime bunker fuels benefit from a tax exemption under the Energy Taxation Directive. In this context, applying carbon pricing to maritime transport emissions would create a clear price signal that would make energy efficiency investments more cost-effective and that would reduce the price differential between alternative fuels and traditional maritime fuels and hence support their deployment.

The majority of stakeholders displayed positive views regarding the ability of carbon pricing to respond to the barriers to decarbonisation in the maritime sector, in particular when considering the possible use of revenues. However, views were more mixed as to whether carbon pricing could address the issue of split incentives.

Maritime transport lacks a strong enabling regulatory framework to ensure its fair contribution to the emission reductions needed in line with the increased EU climate objectives and Paris commitments, in particular when compared to the collective contribution expected from all ETS sectors.

At the global level, efforts to limit international maritime emissions through the International Maritime Organisation (IMO) are under way. In 2011, the IMO adopted a new regulatory framework on Energy efficiency. Since then, the IMO adopted in April 2018 an initial strategy on reduction of greenhouse gas emissions from ships, albeit without support from all States. It sets a greenhouse gas emission reduction objective of

[37] Some cost-effective solutions are not being implemented in some shipping industries because the maritime transport actor (e.g., the shipowner) making the investment in a solution does not always capture the benefit (e.g. fuel saving) of the investment.

[38] Targeted stakeholders’ consultation – enablers and barriers to decarbonisation of maritime transport

at least 50% by 2050 compared to 2008 levels coupled with a vision for the full decarbonisation of the sector as soon as possible in this century. It also sets an objective to reduce carbon intensity, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008. In November 2020, the IMO approved a technical and operational measure for existing ships with a view to implement the IMO Strategy and complement existing energy efficiency policies. While the recent progress achieved is welcome and provides a framework to make existing ships more energy efficient, these measures will not be sufficient to decarbonise international shipping in line with the IMO objective of 50% emission reductions by 2050 (from 2008 levels) and following a pathway consistent with the Paris agreement objectives.

At the EU level, the current regulatory framework to address maritime GHG emissions is limited. At present, only domestic navigation emissions are covered by mitigation measures at EU level (through the Effort Sharing Regulation) and international shipping remains the only means of transportation not included in the European Union's commitment to reduce greenhouse gas emissions. The current regulation focuses solely on the monitoring, reporting and verification of emissions from ships regardless of their flag, covering emissions in EEA ports[39], intra-EEA voyages and extra-EEA voyages[40], in line with the first step of the strategy set out by the Commission in 2013 to integrate progressively emissions from maritime transport into EU climate policy.

Given this situation, the European Commission undertook the commitment to propose a basket of EU measures to increase the contribution of maritime transport to the EU climate efforts, along with the measures agreed at global level within the IMO. This basket of measures is necessary because different policies are needed to address the various technological, market and regulatory barriers that hinder the decarbonisation of the sector.

The basket of measures is defined in the Sustainable and Smart Mobility Strategy as the combination of carbon pricing, research and development and sustainable fuels policies (regulatory and infrastructure development). In practice, it covers the ETS extension to maritime transport in line with the Climate Target Plan and it includes the launch of the FuelEU Maritime initiative to boost the demand for sustainable alternative fuels and accelerate the transition to new technologies. It also covers the review of existing

[39] Including emissions arising from ships at berth or moving within a port
[40] all incoming voyages from the last non-EEA port to the first EEA port of call and all outgoing voyages from a EEA port to the next non-EEA port of call

directives dealing with energy taxation, alternative fuel infrastructures or renewable energy.

2.4.2 Limited contribution of road transport and challenges to realise the contribution of buildings to the emission reductions needed for the 55% target

Direct emissions in the building sector, which mainly stem from heating, have decreased significantly compared to 1990 but increased from 2014 to 2018 by 3%, currently amounting to around 12% of EU GHG emissions[41]. However, according to the impact assessment for the 2030 CTP, the measures implemented in MS aimed at building renovation do not always reflect the full energy savings potential of the building stock. The energy efficiency level and deployment of renewable heating and cooling solutions with the existing 2030 climate and energy legislative framework are well below what is necessary to reach the higher greenhouse gas ambition. In the policy scenarios in the impact assessment accompanying the 2030 CTP that achieve around 55% GHG reductions below 1990, buildings' GHG emissions reduce through carbon pricing and/or energy policies by 60% between 2015 and 2030 through increased energy efficiency and stepping up of fuel switching, indicating a similar mitigation potential as stationary ETS sectors. Under current policies, emissions would only reduce by 33%.

Road transport is a particular challenge. Road transport emissions have increased compared to 1990, and by 6% from 2014 to 2018, amounting currently to around 20% of all EU GHG emissions. Within the 55% GHG reduction, road transport is projected to reduce its emissions less than buildings, by 23 to 25% in 2030 compared to 2015.

In both sectors, current EU policies focus on regulatory approaches and provide limited economic incentives to achieve the necessary emission reduction levels. Explicit carbon pricing at national level in these sectors is often absent or limited. In addition, the Impact Assessment accompanying the 2030 CTP found that the energy investments from households to achieve the higher ambition in both sectors would be higher in a regulatory-only approach (REG) than with a policy mix including carbon pricing.

At the same time, already now, the ETS directly or indirectly covers part of their emissions, resulting in an uneven playing field within the buildings sector and to a much lesser extent in the transport sector.

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[41] If the indirect emissions of buildings stemming from electricity and centralised heat consumption are included, buildings are responsible for 36% of energy-related GHG emissions.

In fact, the ETS covers around 30% of direct and indirect buildings emissions related to heating via fossil-fuel district heating, electric heating and electricity use of heat pumps, while the rest is covered by the ESR[42]. If compared to all direct and indirect energy-related GHG emissions of buildings, the existing ETS covers more than half.

Similarly, the ETS already indirectly covers some road transport emissions via electric vehicles (related emissions below 0.1%[43]), as well as electrified rail (around 80% of rail[44]), while fossil fuelled road transport and non-electrified rail are covered by the ESR. However, this uneven playing field is less of an issue than that between fossil fuel and electricity use for buildings heating, as on average road transport already implicitly pays a significant carbon price due to energy taxation, even though there are large national disparities in the levels of fossil fuel taxation.

Other emissions of fossil fuel combustion concern firstly small industrial installations, secondly CO_2 emissions from agriculture and thirdly small sources like non-electrified railways. These have decreased in the past and currently represent around 5% of EU GHG emissions. Within the overall 55% GHG reduction, other fossil fuel combustion is projected to reduce its emissions less than buildings but more than road transport, by around 40% in 2030 compared to 2015. For small industry, there is already currently the requirement for equivalent measures in order to remain excluded from the existing ETS.

The impact assessment accompanying the 2030 CTP examined the possibility of using carbon pricing as an additional tool to achieve greenhouse gas emission reductions at the EU level in these and other sectors. In line with the 2030 CTP, this impact assessment needs to examine further whether and how emissions from buildings and road transport or all emissions from fossil fuel combustion could be addressed efficiently by including them in European emissions trading, taking into consideration already existing measures, such as energy savings obligations under Article 7 of the EED or CO_2 standards for vehicles. This impact assessment does not examine the possible setting of minimum carbon content elements for excise duties in the revised EU Energy Taxation Directive, which is addressed in the impact assessment for that initiative.

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[42] ETS coverage of heating emissions in low-income Member States is with around 40% significantly above EU average, with ETS even exceeding ESR shares in Bulgaria, Czechia, Estonia and Latvia. Other Member States with higher ETS shares are Cyprus, Denmark, Finland, Greece and Sweden. See ICF et al. (2020): Possible extension of the EU Emissions Trading System (ETS) to cover emissions from the use of fossil fuels in particular in the road transport and the buildings sector, under DG CLIMA Framework Contract.

[43] ICF et al. (2020).

[44] Electrification of the Transport System, Expert group report, DG RTD 2017.

2.5 Reaching the -55% target will require increased investment and greater capacity to address the distribution of impacts of emissions reduction measures, while funds will remain limited

2.5.1 Need for faster investment in low-carbon technologies

The Impact Assessment accompanying the 2030 CTP shows that the increased contribution of current ETS sectors to the 2030 objective is expected to induce, over time, a strengthened carbon price signal, providing the necessary operational and investment incentive for operators to reduce their GHG emissions in line with the revised overall cap.

That Impact Assessment also identifies extra annual energy-related investment needs of EUR 350 billion in the period of 2021-2030 compared to the previous period of 2011-2020, of which the majority for buildings and road transport. Compared to the EUR 260 billion additional investments needed 2021 to 2030 to achieve the prior 2030 climate and energy targets, this figure represents an increase of around EUR 90 billion per year.

The energy sector has already decarbonised to a significant extent due to a combination of a strong ETS carbon price signal coupled with regulatory policies and public support for the deployment of renewable energy technologies. Also for industry, emissions have been decreasing, but to a smaller extent, even though many technological pathways for decarbonisation are available. These include use of green hydrogen and increased electrification (which however require a significant increase of clean energy available), as well as low-carbon circular production processes.[45]

In fact, in recent years, a substantial number of industrial break-through technologies and innovative renewable technologies have been identified and researched that are crucial to achieve deep decarbonisation. However, few have been scaled beyond the pilot phase, at best. The prime reason is that the current abatement costs for most technologies that achieve deep decarbonisation are substantially above current and even projected ETS prices. Market signals have been softened by free allocation to avoid the risk of carbon leakage. There remains a substantial uncertainty on breakthrough technologies costs, and the first investments may face higher abatement costs. At the same time, the uncertainty over a sustained trend towards increased carbon prices over longer periods may also reduce the commercial viability and bankability (willingness by third parties to finance) of such projects. The Impact Assessment accompanying the Innovation Fund delegated

[45] EEA (2020) Quantification methodology for, and analysis of, the decarbonisation benefits of sectoral circular economy actions, p.93-95

regulation published in 2019[46], as well as academic literature[47] converge on the conclusion that at the current levels, the carbon price on its own is not expected to trigger sufficient investment in many important breakthrough technologies in industry and energy (e.g. CCS, low-carbon technologies for cement, green hydrogen-based steel making, geothermal, recycling and circular economy solutions) as well as in the appropriate infrastructure, without further support.

Complementary policies to bridge the so-called 'valley of death' and bring innovative low-carbon technologies to market can thus be justified because of the need to lower costs through innovation, including economies of scale and uncertainty as regards carbon price developments over the next decade(s) and associated investment risks.

The Innovation Fund, set up as part of the 2018 revision of the ETS Directive, is one of the EU's prime instruments to bring such technologies closer to the market, complemented by multiple other instruments focusing on earlier research phases or on less innovative technologies[48]. In this Impact Assessment, key features of the Innovation Fund are being assessed in the light of the revised 2030 objective and the goal to achieve climate neutrality by 2050. These elements mainly concern its size and the level of support to projects, as both have a major effect on the required scale and pace of the deployment of innovative low-carbon technologies that are eligible in the Innovation Fund. Currently, the Innovation Fund is expected to mobilise around EUR 22.5 billion in the period 2020-2030 (assuming a carbon price of EUR 50/tonne) coming from the monetisation of ETS allowances. The first call for proposals of EUR 1 billion received 311 projects from all MS requesting almost 22 times the available budget.[49] This illustrates the appetite of companies to invest in clean tech projects all across Europe and the very high investment needs. This aspect is analysed together with the level and modalities of support that projects can receive in Annex 11.

2.5.2 Need to address the distribution of impacts of emissions reduction measures

The effects of raising the contribution of the ETS towards a higher emissions reduction target will not be felt equally across the EU. Some MS will be more affected than others.

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[46] https://ec.europa.eu/clima/sites/clima/files/innovation-fund/swd_2019_85_en.pdf

[47] https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Etude/201910-ST0619-CCfDs_0.pdf

[48] The EU makes funding available for green innovation via various support instruments, such as Horizon 2020 and Horizon Europe, European Innovation Accelerator and others. The green and digital transition is also an element strongly present in the Recovery and Resilience Plans of Member States.

[49] https://ec.europa.eu/clima/news/first-innovation-fund-call-large-scale-projects-311-applications-eur-1-billion-eu-funding-clean_en

Increasing the contribution to achieve the revised target will require investments in the energy systems and the greening of industrial processes in MS where modernisation needs are already the highest. Furthermore, there are distributional concerns within MS, as low-income households across the EU will bear a relatively higher burden notably in terms of heating fuel expenses compared to wealthier households. At the same time, there will be also positive social impacts, like an improvement concerning health issues linked with air pollution. Hence, there are likely to be different distributional issues that emerge if the EU emissions trading is expanded to new sectors.

The Modernisation Fund, set up as part of the 2018 revision of the ETS Directive, supports investments in modernising the power sector and wider energy systems, boosting energy efficiency, and facilitating a just transition in coal-dependent regions in 10 lower-income MS. Its initial size is 2% of the ETS cap equivalent to some 275 million allowances.[50] The current size of the Modernisation Fund is analysed together with defining the types of investments that it can finance in Annex 12, its distributional implications between MS are addressed in Annex 13.

The review will therefore need to address the solidarity provisions currently in place and the role of the Modernisation Fund in this respect, also taking into account that as new sectors are possibly covered by EU emissions trading, not only distributional challenges but also revenues may increase. The ETS review needs also to take into account and is relevant for the Commission's forthcoming proposal for an ETS-based own resource.

3 WHY SHOULD THE EU ACT?

3.1 Legal basis

Articles 191, 192 and 193 of the Treaty on the Functioning of the European Union[51] empower the EU to act to preserve, protect, and improve the quality of the environment; protect human health; and promote measures at the international level to deal with regional or worldwide environmental problems. The legal basis of this initiative is in Article 192(1), as this initiative is action being taken to combat climate change and to serve the other environmental objectives specified in Article 191.

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[50] This was de facto more than doubled to around 643 million allowances thanks to the choice of five Member States to transfer their solidarity allowances to this funding instrument. https://ec.europa.eu/clima/policies/budget/modernisation-fund_en

[51] Treaty on the Functioning of the European Union, OJ C 326, 26/10/2012, p.1–390.

The ETS has been operating on this legal basis since 2003. The European Parliament and Council agreed upon all amendments to the ETS Directive on this legal basis.

3.2 Subsidiarity: Necessity of EU action

Climate change is a trans-boundary problem and both international and EU action can effectively complement and reinforce regional, national and local action. Increasing the 2030 target for EU GHG reductions will impact many sectors across the EU economy and coordinated action at the EU level is therefore indispensable and has a much bigger chance of leading to the necessary transformation, acting as a strong driver for cost-effective change and upward convergence. Furthermore, many of the policy elements assessed in this initiative have an important internal market dimension, in particular the options related to the carbon leakage protection and the low-carbon funding mechanisms. EU action can also inspire and pave the way for the development of market based measures at global level, e.g. as regards the maritime transport within IMO.

3.3 Subsidiarity: Added value of EU action

As a carbon market, the ETS incentivises emission reductions to be made by the most cost-effective solutions first across the activities it covers, achieving greater efficiency by virtue of its scale. Implementing a similar measure nationally would result in smaller, fragmented carbon markets, risking distortions of competition and likely lead to higher overall abatement costs. The same logic holds for the extension of carbon pricing to new sectors.

4 OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1 General objectives

The general objective of this initiative is to revise the ETS Directive in a manner commensurate with the 2030 climate ambition to reach at least 55% net greenhouse gas emission reductions by 2030 below 1990 levels and with a gradual and balanced trajectory towards climate neutrality by 2050, in a cost-effective and coherent way while taking into account the need for a just transition and the need for all sectors to contribute to the EU climate efforts.

4.2 Specific objectives

- Strengthening the ETS in its current scope
- Reviewing the Market Stability Reserve in line with the corresponding legal obligation and examine possible amendments to its design, to fulfil the legal objectives in the MSR decision and to address any issues that may be raised in the context of the MSR review.

The objectives of the MSR, as they are set in the MSR decision, are to

- Tackle historical supply-demand imbalances, and
- make the ETS more resilient to supply-demand imbalances

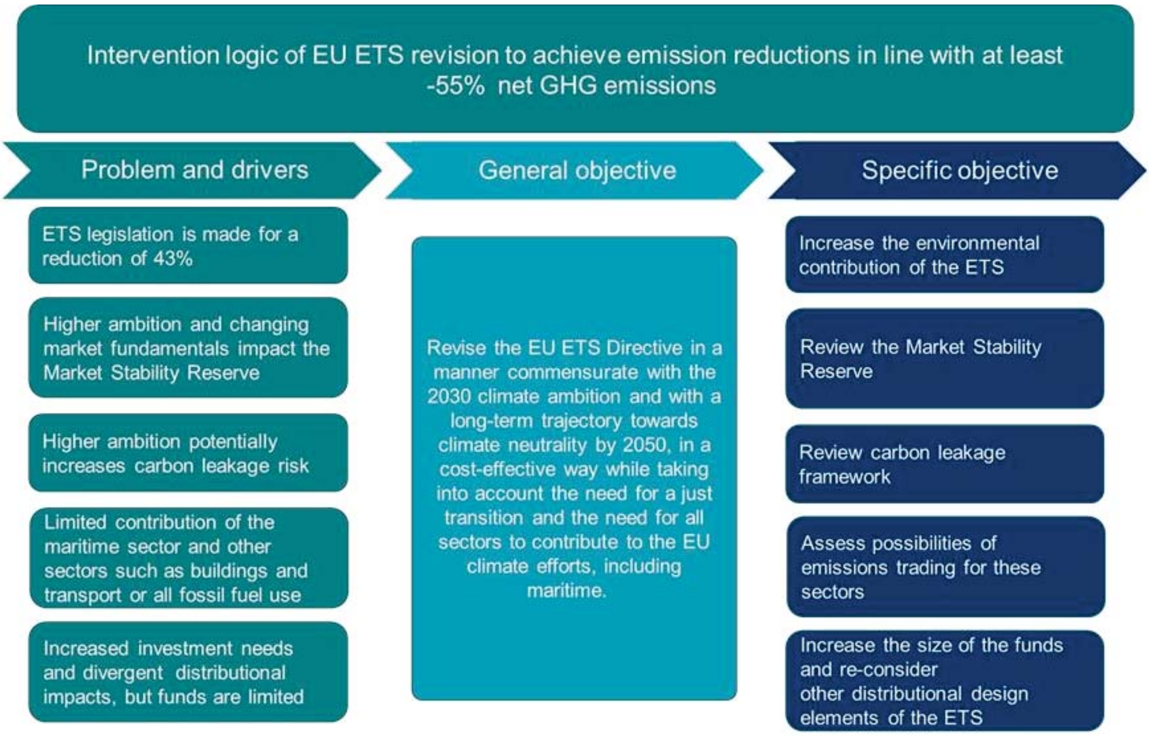
In addition, the mechanism must preserve regulatory stability and ensure long-term predictability.

- Ensuring continued effective protection for the sectors exposed to a significant risk of carbon leakage while incentivising the uptake of low-carbon technologies
- Ensuring that the maritime transport and other sectors contributes cost-effectively to the emission reductions needed in line with EU targets and Paris Agreement commitments by notably considering the inclusion of at least intra-EEA emissions of the maritime sector and possibly of emissions from other sectors such as buildings and road transport into EU emissions trading while ensuring synergies with complementary other policies targeting those sectors.
- Addressing the distributional and social effects of this transition, by reviewing, as appropriate, the use of auctioning revenues and the size and functioning of the low-carbon funding mechanisms

4.3 Intervention logic

Figure 1 shows the intervention logic of this impact assessment, from the general problem and problem drivers to the objectives. The policy options described in Section 5 are defined to address these objectives.

Figure 1: Intervention logic of the EU ETS revision



5 WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1 What is the baseline from which options are assessed?

The baseline for this initiative is the continuation of the Emissions Trading System covering power, centralised heat and industry in its current design as most recently amended by Directive (EU) 2018/410. The ETS cap trajectory for phase 4 (2021-2030) is reduced with a Linear Reduction Factor of 2.2% to achieve -43% GHG emission reduction by 2030 (compared to 2005). Under current legislation the Market Stability Reserve would gradually absorb the existing surplus allowances and invalidate them from 2023 onwards.

The risk of carbon leakage continues to be addressed through granting free allowances based on updated benchmarks. The auctioning revenues are distributed to MS. Before that the current solidarity mechanisms are applied and 450 million allowances are auctioned to finance the Innovation Fund.

The ETS coverage of buildings-related emissions remains limited to emissions related to fossil fuel-based district heating, electric heating and electricity use of heat pumps and its share is projected to remain stable at around 30% of total emissions related to buildings heating, cooling and cooking. The ETS coverage of transport-related emissions would remain focused on aviation. The ETS coverage of emissions related to electric vehicles and electrified rail would slightly increase but remain a small component of road transport emissions.

The new EU Reference Scenario 2020 (REF) published alongside the Fit for 55 package provides a model-based baseline projecting the impacts of the ETS and all other current policies and their interaction.

REF includes all EU climate legislation that implements the ‘at least 40% GHG reduction target’. Beyond the ETS, these are the Effort Sharing Regulation[52], currently covering non-ETS sectors such as non-electric direct heating of buildings, fossil fuel use in road and rail transport, domestic navigation, small emitters from the industry sector, agriculture and waste, and the LULUCF Regulation, covering emissions and removals from land use, land use change and forestry[53].

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[52] Regulation (EU) 2018/842
[53] Regulation (EU) 2018/841

In respect of energy, REF includes the Energy Efficiency Directive and the Renewable Energy Directive[54] as well as other key policies covered in the Energy Union and the "Clean Energy for All Europeans" package, including internal electricity market policy[55]. This includes the Regulation on the Governance of the Energy Union and Climate Action and its integrated National Energy and Climate Plans (NECPs). These are key instruments to achieve ESR, EED and renewable energy sources (RES) targets, covering, for the first period, the years 2021-2030 and allowing an update in the years 2023/2024.

The updated modelled baseline also includes relevant adopted national policies (as well as the national contributions contained in the NECPs) to achieve the EU level targets on renewable energy and energy efficiency. Draft MS specific REF results have been consulted with MS. Unlike the baseline used for the Impact Assessment for the Climate Target Plan, this updated baseline does not assume that the EU-level energy efficiency target is achieved. Based on modelling national policies, REF confirms a 3% gap to the at least 32.5% energy efficiency target for final energy use and a 1% overachievement of the target of at least 32% of renewable energy share in the energy mix[56].

On transport, the baseline includes measures from the three "Mobility Packages" published[57] in 2017-2018. Key measures include CO_2 standards for cars and vans[58], CO_2 standards for heavy duty vehicles[59], the Alternative Fuels Infrastructure Directive[60] and the Clean Vehicles Directive[61]. For maritime transport, the baseline reflects the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP) adopted by the IMO, as well as IMO MARPOL Annex VI rules as regards the reduction of nitrogen and sulphur oxides emissions. However, it does not include the short-term measures recently agreed at IMO that are not yet adopted and still under development.

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[54] Directive (EU) 2018/2001

[55] The adopted regulation on the electricity market design is reflected to the extent possible. However, the modelling work undertaken is not detailed enough to draw conclusion on the adequacy of specific elements of the current market design. Such issues will require further analysis in a dedicated study.

[56] COM(2020) 564 estimated based on NECP commitment aggregation a gap to the energy efficiency target between 2.8 and 3.1 percentage points and an overachievement of the renewables target between 1.1 and 1.7 percentage points.

[57] See for links to the different policy initiatives: https://ec.europa.eu/transport/modes/road/news/2018-05-17-europe-on-the-move-3_en

[58] Regulation (EU) 2019/631

[59] Regulation (EU) 2019/1242

[60] Directive 2014//94/EU

[61] Directive (EU) 2019/1161

In other sectors, the F-gas Regulation, the circular economy and waste legislation, notably including the Landfill Directive, the Nitrate Directive as well as the Common Agricultural Policy are worth highlighting in particular.

The impact of these combined measures is projected in REF with the use of the PRIMES (energy system and CO_2) – CAPRI (agriculture) – GAINS (non-CO_2) – GLOBIOM (LULUCF) modelling tools. This allows seeing economy-wide interactions for all sectors that emit and absorb emissions in a coherent manner. It builds on economic assumptions underpinning the Commission/DG ECFIN's Ageing Report 2021 which include impacts of the COVID-19 crisis. The extent of economic impacts of COVID-19 and their longer-term consequences, as well as the necessary assumptions on the development of international fuel prices and technology costs belong to the main sources of modelling uncertainty. For a description of the models and assumptions used and an overview of key results see Annex 4, Section 8.

The ETS contributes in relative terms more than proportionally to the projected total intra-EU GHG emission reductions in the baseline. With the existing ETS and MSR framework and the described other policies, the current ETS sectors are projected to achieve 51% emission reductions in 2030 compared to 2005[62], an overachievement of the 2030 ETS target by 8 percentage points.

At sectoral level, under current policies the power sector is projected to reduce emissions in 2030 by 60% compared to 2005, industrial combustion by 44%, district heating by 42%, industrial processes by 32% and the transformation sectors by 36%. Intra-EU aviation emissions are projected to increase by 12% compared to 2005, while intra-EU maritime emissions would decrease by 5%.

5.2 Description of the policy options

5.2.1 Overview of policy options and policy scenarios used for the analysis

The following table provides an initial overview of the policy options which are further described in this section and retained for assessment in Section 6. The discarded policy options are described in Section 5.3:

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[62] Aviation emissions are included in this figure in the intra-EU "stop the clock" scope. For comparison, the Climate Target Plan baseline projected a 54% reduction in 2030.

Table 1: Overview of policy options assessed

	ETS strengthening	Extension maritime	Extension buildings and road transport/ all fossil fuels
Baseline	ETS as legislated, partly assessed in -55% context (**MSR0+, IF0**)	Existing IMO measures but no new EU or global mitigation measures for maritime emissions	**EXT0** no extension
Core options	**AMB1** ETS 2030 ambition with LRF update in 2026 without rebasing **AMB2** ETS 2030 ambition with LRF update in 2024 without (AMB2a) or with rebasing (AMB2b,c) **AMB3** ETS 2030 ambition with LRF update with rebasing in 2026 (AMB3c as central variant)	**MAR1** Inclusion of maritime emissions in existing ETS **MAR2** A separate ETS for maritime **MAR3** Alternative carbon pricing policy option: levy on ship GHG emissions **MAR4** Extension of the ETS to maritime emissions in combination with standards	**EXT1** A separate EU-wide upstream ETS for buildings and road transport **EXT2** A separate EU-wide upstream ETS for all emissions from the combustion of fossil fuels not covered by the ETS
Other policy options	**MSR1** Update current parameter values **MSR2** More dynamic parameters **MSR3** Addition of short term response mechanism **CL1** More targeted free allocation with tiered approach **CL2** More targeted free allocation with strengthened benchmarks **IF1** Increase Innovation Fund to 550 million allowances **IF2** Increase the Innovation Fund to 700 million allowances	**MEXTRA100** Cover 100% of emissions from intra-EEA voyages, 100% of extra-EEA voyages (incoming and outgoing) and all emissions at berth in the EEA **MEXTRA50** Cover 100% of emissions from intra-EEA journeys, 50% of all incoming and outgoing extra-EEA voyages and all emissions at berth in the EEA **MINTRA** Cover 100% of emissions from intra-EEA journeys and all emissions at berth in the EEA	**ELINK1** Review in order to determine whether the integration is feasible and desirable **ELINK2** One or two-way flexibility with existing ETS that could increase over time to eventually lead to full integration with the current system

The following stylised general policy scenarios which achieve -55% net emission reductions compared to 1990 and represent in a coherent way a mix of climate, energy and other policies have been used to support the assessment of the outlined policy options:

- MIX, representing a policy mix of carbon price signal extension, strong intensification of energy and transport policies and increased energy taxation. With its uniform carbon price it can represent two separate ETS with caps set reflecting cost-effective contributions for each of the two ETS segments (similar incentive as one extended ETS),
- MIX-CP, representing a more carbon price driven policy mix with other policy drivers of the MIX scenario at a lower intensity. It illustrates a revision of the

EED and RED but limited to a lower intensification of current policies in addition to the carbon price signal applied to new sectors. Unlike MIX, this scenario allows to separate carbon price signals of existing and new ETS. The relative split of ambition in GHG reductions between existing ETS and new ETS remains, however, close in MIX-CP to the MIX scenario, leading to differentiated carbon prices between existing and new ETS.

These scenarios build on REF, further develop the policy scenarios modelled for the 2030 CTP and have been elaborated based on the same set of modelling tools. MIX and MIX-CP are two updated core scenarios used for assessing the climate and energy related Fit for 55 package initiatives, e.g. the Effort Sharing Regulation and the Energy Efficiency Directive. For a detailed description of the scenarios, see Annex 4, Section 8.5. The MIX scenario has also been the starting point for analysing the maritime transport extension and other options with the PRIMES maritime module.

These policy scenarios also serve to further assess impacts of the ETS revision. In policy terms, the MIX scenario broadly represents a policy mix envisaged in the 2030 CTP and is often used as central scenario for further analysis in this impact assessment. MIX-CP represents for the sectors covered by the new ETS a less balanced policy mix, requiring a stronger role of the new ETS to achieve the -55% 2030 target.

The Vivid EU ETS model[63] was used for the MSR analysis, focusing directly on the interaction between MSR dynamics and market equilibrium within the EU ETS; this model provided also some indications of the direction of carbon prices in the existing ETS in the analysis period if carbon pricing were the key driver of additional emission reductions (on carbon price impacts in existing and new ETS sectors see also Sections 6.1.2.1.2 and 6.3.2.1). Although the modelling approach was different, some of the assumptions of the MSR model were based on results of the REF and MIX scenarios described above. The differences between the model used for the MSR, and the models referred to here, as well as the assumptions of the model and general guidelines for interpreting the results are set out in Annex 4, section 9.1.

The ETS carbon price in REF which only reflects currently adopted policies averages at €29 for the period 2021 to 2030 and €30 for the period 2026 to 2030. Currently observed carbon market prices already respond to the increased GHG target and vary between €40 and €55. Future carbon prices are by nature uncertain and impacted by policy choices and market developments. The policy scenarios modelled project for the period 2026 to 2030

[63] See Annex 4, Section 9.1.

average carbon price ranges between €45 and €70, with projected carbon prices in the year 2030 ranging between €50 and €85. This is broadly in line with external analyses, for which the average of price forecasts for 2030 is €71, with a large range between €42 and €89[64], all prices recalculated in $€_{2020}$.

For the assessment of some impacts, e.g. on auctioning revenues, a carbon price *assumption* over the period 2021 to 2030 reflecting the -55% policy context is necessary. The following rounded central carbon price assumptions are used, derived on the basis of current ETS carbon market prices, the average of short-term forecasts of different carbon market analysts of April 2021 and the abovementioned modelled -55% scenarios for 2030[65]:

- €50 as average for the whole period 2021 to 2030,
- €55 as average for the period 2026 to 2030,
- €45 as average for the period 2021 to 2025 (all values expressed in $€_{2020}$).

5.2.2 Strengthening of the existing ETS (power and industry installations)

Strengthening of the existing ETS entails a number of elements: a tighter emission cap, a review of the Market Stability reserve, an improved framework against the risk of carbon leakages and a review of the Innovation Fund. There are different policy options for each of these elements which are described below and then first assessed separately. In Section 7.1.2 possible packages of these options are assessed. The Modernisation Fund and other elements addressing distributional concerns are covered separately in Section 5.2.5.

[64] Summarised in Carbon Pulse Daily of 8 April 2021: POLL: Big boost for EU carbon price forecasts as several analysts see EUAs topping €100 this decade. See also section 7.3 of ERCST, Wegener Center, BloombergNEFand Ecoact: 2021 State of the EU ETS Report, April 2021, and ICIS: European carbon market to shift gear, February 2021. All these publications use nominal carbon prices (not deflated).

[65] Market analysts average: €43 for 2021 and €53 for 2025 (Carbon Pulse Daily poll of 8 April 2021). Average of MIX and MIX-CP in 2025 for existing ETS €37, in 2030 for existing and new ETS €53, for new ETS €71, Vivid existing EU ETS model average €56 for 2025 and €77 for 2030.

5.2.2.1 Strengthening of the ETS target/cap

The ETS cap on emissions determines the ambition level of the ETS. Decreasing linearly by an annual amount, the cap trajectory is referred to as the linear reduction factor (LRF), currently set at 2.2% per year[66].

To determine an ETS ambition in line with the 2030-target of -55% requires lowering the ETS cap. This in turn impacts the distribution of ETS building blocks and the protection against the risk of carbon leakage. A revised ETS ambition (cap) depends strongly on the 2030 EU wide ambition but also on the following elements:

1. Scope of ETS sector emissions: The current ETS scope includes stationary (power and industry sector) installations and intra EU aviation. For the analysis, this current scope is assumed during the 2021-30 period, so without any extension to new sectors[67].

2. Ambition distribution between the existing ETS and non-ETS sectors: The following analysis is based on the cost-effective reduction potential in the sectors covered by the existing ETS compared to the non-ETS sectors[68].

3. Starting year of cap changes: The year from when a new cap trajectory should be applied for the first time to reach the 2030 ETS cap impacts the overall ETS ambition. The later the new cap trajectory is applied for the same 2030 ambition, the steeper it needs to be. To note that for the same 2030 cap (ambition), a later start of a new trajectory results in a lower overall ambition, because the sum of the yearly caps for the entire phase 4 (2021-30) is lower[69].

4. Possible rebasing: the ETS cap decreases linearly by an annual amount. The LRF is applied to the cap of the previous year. Currently, the cap is higher than real emissions, because over the past decade real emissions have reduced faster than the cap. To better align the cap (historically set up) with the current emission

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[66] The LRF is applied from the mid-point of the period from 2008 to 2012 and is calculated for the ETS emission and sector scope (i.e. stationary power and industry sector and intra EU aviation) based on the cost-effective ambition result for this scope from the -55% modelling scenarios. The LRF is then applied to the ETS cap reference.

[67] Options to extend emissions trading to maritime transport are analysed in Sections 5.2.3.1, 6.2 and Annex 6, Section 18. In terms of emissions and increase of ETS cap and free allocation, the impact of including maritime into the existing ETS would depend on the maritime scope applied.

[68] See Section 6.7 of the Impact Assessment accompanying the 2030 Communication for further discussion.

[69] The cumulative cap is an indicator of the overall emission ambition over the period 2021-30.

profile, it is possible to have a one-off reduction of the cap ("rebasing"), from where a new LRF would apply, an option already indicated in the 2030 CTP. This would lead to a lower LRF.

Regarding the geographical scope, the ETS scope applies to EU MS and EEA countries. Up to 2020, the UK was a full ETS member and from 2021 the ETS cap was updated to account for the UK's withdrawal from the EU and the Northern Ireland protocol[70,71].

The first element is to determine the contribution of the current ETS sectors (including intra-EU aviation) to the increased 2030 target of -55%. An analysis conducted in the IA accompanying the 2030 CTP[72] determined a cost-effective ETS ambition level of between -63% and -64% as compared to 2005. The modelling refinement based on the EU Reference Scenario 2020 resulted in a similar ambition level ranging between -62% and -63%. The MIX scenario which is considered as best reflecting the 2030 CTP results in -62%. Therefore, an ETS cost-effective ambition of -62% with current coverage as compared to 2005 is assumed for the quantification of all of the following options.

Different trajectory approaches can be used to reach the 2030 cap. The following options are assessed:

Option 1: ETS 2030 ambition with LRF update in 2026 without rebasing (*AMB1*)

The current ETS phase 4 framework is maintained for the period 2021-2025, with a 2.2% LRF, and as of 2026 an LRF of 6.24% applies. Applying a revised LRF as of 2026 accommodates the existing ETS phase 4 free allocation implementation that has two defined periods (2021-25; 2026-30).

Option 2: ETS 2030 ambition with LRF update in 2024 with/without rebasing (**AMB2**)

Taking into account the proposal timeline and subsequent legislative process, 2024 is assumed to be the earliest possible start date for a modified cap. Therefore, the current ETS phase 4 framework is maintained for the period 2021-2023, with a 2.2% LRF and in 2024 the cap trajectory is updated by:

- A linear trajectory with a LRF of 5.09%– *AMB2a*.

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[70] Commission Decision on the Union-wide quantity of allowances to be issued under the EU Emissions Trading System for 2021 (C(2020) 7704 final)

[71] Northern Ireland installations producing electricity are within the ETS scope

[72] Refer to table 26 on *ETS scope extension and projected ambition levels in ETS and ESR for different sectoral coverages*

- Emissions are adjusted downwards to better reflect the emission profile. The rebasing reference is the difference of ETS verified emissions to the annual cap for the period 2013-2019, on average 163 million EU allowances (EUAs) below the ETS annual cap, and a new LRF of 3.90% then applies – *AMB2b*
- Apply a 4,22% LRF from 2021, though delaying its implementation which results de facto in a rebasing correction of 119 million EUAs in 2024 – AMB2c

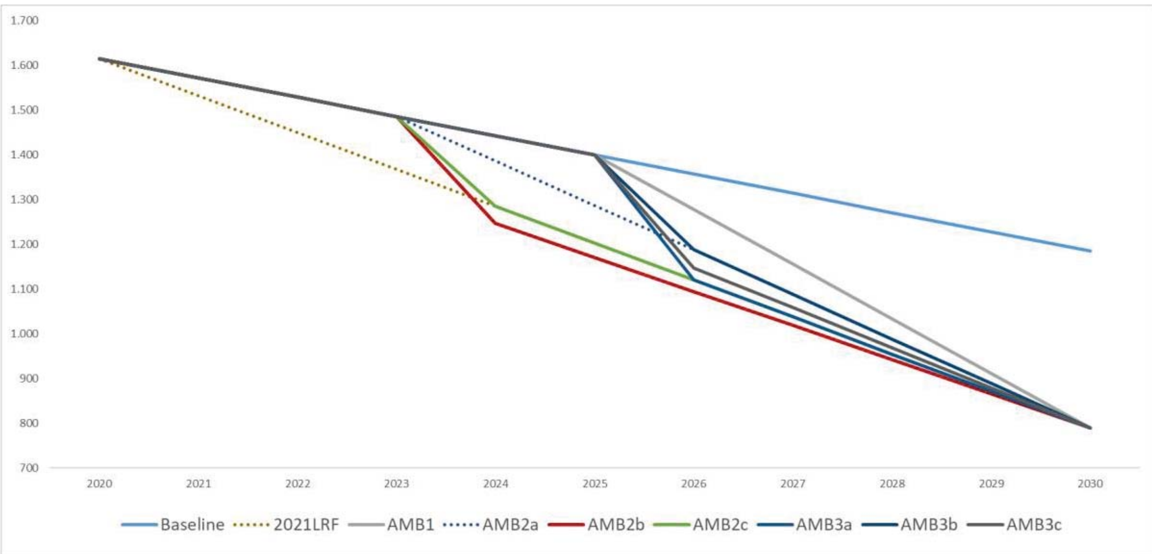
Option 3: ETS 2030 ambition with LRF update with rebasing in 2026 (**AMB3**)

The current ETS phase 4 framework is maintained for the period 2021-2025, with a 2.2% LRF. In 2026, a new LRF applies and the base year reference is adjusted downwards to better reflect the emission profile.

In terms of rebasing, i.e. the adjusted reference from where to apply the new LRF, there are different references to consider:

- Apply a LRF from an early starting year, though delaying its implementation which results de facto in a rebasing correction in the year it starts applying – AMB3a (2021 base; 4,22% LRF and 198 million EUAs rebase); AMB3b (2024 base; 5,09% LRF and 113 million EUAs rebase)
- Emissions are adjusted downwards by the difference of ETS verified emissions to the annual cap for the period 2013-2019163 million – AMB3c. Deducting this amount in 2026 would lead to new LRF of 4.57%.

Figure 2: ETS cap under the different options



Generally speaking, cap options including rebasing are favoured by NGOs and clean energy/technology/service providers. Industry stakeholders rather tend to support options based on an increased LRF, to avoid big step-changes that are considered to impact predictability in terms of price and free allocation. This was also confirmed by the OPC survey (see Annex 2 for a comprehensive overview on the results of the stakeholder consultation). The majority of respondents from all stakeholder groups indicated that the increase of the LRF is the most relevant factor to strengthen the ETS ambition. While a one-off cap reduction in combination with increasing the LRF was also found important by a wide range of stakeholder groups (including NGOs, environmental organisations, academic/research institutions, EU citizens and public authorities), this was not the case for the private sector, notably not for the manufacturing sector.

5.2.2.2 Market Stability Reserve

The main purpose of the MSR is to reduce the surplus of allowances in the ETS and therefore the rules on when and how the MSR absorbs allowances are crucial to its functioning. Currently, allowances are put in the reserve if the total number of allowances in circulation (TNAC) is above a predefined upper threshold (833 million allowances) and are released from the reserve, if the TNAC is below a predefined lower threshold (below 400 million allowances). These thresholds are based on an assessment of how much liquidity the market needs to function well, which crucially depends on the need for installations to manage their carbon price risks through 'hedging' part of their need for allowances in advance.

If the TNAC is above 833 million, then 24% of it is placed in the reserve (the 'intake rate'). The 24% intake rate is lowered to 12% after 2023. If the TNAC is lower than 400 million, then 100 million allowances (the release amount) are released from the MSR and put on the market (auctioned) immediately. The MSR also features an invalidation mechanism: after 2023, allowances held in the reserve above the total number of allowances auctioned during the previous year would be invalidated.

While the MSR has wide support across stakeholder groups, there was no consensus about the future changes of the MSR. Overall, civil society, including NGOs and EU citizens, expressed relatively more support for a strengthening of the parameters of the MSR than the private sector[73].

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[73] As regards the thresholds, 46% of respondents to the OPC, including the majority of private sector respondents, public authorities and trade unions, considered that they should not be changed, compared to 37% that thought the thresholds should be decreased, including the majority of NGOs, environmental organisations and parts of the private sector (in particular the energy sector). A minority of 18% respondents from different stakeholder groups considered that the thresholds should be increased. There was also no agreement about maintaining, increasing or decreasing the intake rate. The private sector and trade unions preferred to keep the intake rate as per the current regulation at 12% beyond 2023 (followed by the option to keep it at 24%), while NGOs' and environmental organisations' preferred option was to increase the intake rate above 24%. Finally, a minority of respondents (11%) pointed to

Possible options for these fundamental MSR design elements are presented and combined in three policy options, which are summarised in the table below:

Table 2: Summary of the MSR options

	MSR0+[74] ***MSR as legislated + aviation***	**MSR1** ***Update current parameter values (from 2024) + aviation***	**MSR2** ***More dynamic parameters (starting from 2024) + aviation***	**MSR3** ***MSR2 with addition of short term response mechanism (from 2024) + aviation***
Intake[75]	12% of TNAC	24% of TNAC	33% of TNAC minus upper threshold[76]	33% of TNAC minus upper threshold
Injections[77]	100m	100m	25% of lower threshold	25% of lower threshold
Upper threshold	833m	700m	700m in 2024, declines with cap after 2025	700m, either fixed or declining with cap after 2025
Lower threshold	400m	400m	400m in 2024, declines with cap after 2025	400m, either fixed or declining with cap after 2025

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the need for the MSR to be able to react faster to address unexpected demand or supply shocks, while 12% of respondents considered that a carbon price floor would also be necessary. There was support across stakeholder groups for maintaining the invalidation rule: the majority (63%) of respondents suggest that the invalidation rule should remain in place, either unreservedly (38%) or with an amendment (25%). 27% of respondents were instead in favour of abolishing the invalidation rule, including parts of the private sector (in particular the manufacturing sector). Participants at the two MSR expert workshops organised by Vivid Economics as part of the MSR review study also generally supported keeping the thresholds in line with future hedging needs, including aviation in the TNAC calculation, removing the dependency of the invalidation rule on past auction volumes, and updating the intake rate, in particular in order to remove the threshold effect.

[74] In particular for the MSR, the performance of the current MSR as legislated was assessed in option MSR0+. In order to render all options comparable, aviation was considered as included in the calculation of the TNAC in all options.

[75] For example, for a given TNAC of 1 000 allowances, the intake for MSR0+ would be 12% * 1 000 = 120 million allowances, for MSR1 24% * 1 000 = 240 million allowances, and for MSR2 and MSR3, 33% * (1 000 – 833) = 55.11 million allowances.

[76] In this case, if the TNAC is above the upper threshold, 33% of the difference between the calculated TNAC and the upper threshold would be put in the MSR. This option is different from MSR1, where simply 24% of the TNAC is put in reserve if the TNAC is above the upper threshold.

[77] In this case, if the TNAC is below the lower threshold, the amount shown on the line « injections » is « released » by being auctioned o during the next 12 months. For MSR0+ and MSR1, if the TNAC were lower than 400 million allowances, 100 million allowances would be released from the MSR and auctioned in the next 12 months. For MSR2 and MSR3, if the lower threshold were 360 million allowances and if the TNAC were lower than 360 million allowances, then 25% of 360 million, or 90 million would be released from the MSR and auctioned during the next 12 months.

	MSR0+[74] ***MSR as legislated + aviation***	**MSR1** ***Update current parameter values (from 2024) + aviation***	**MSR2** ***More dynamic parameters (starting from 2024) + aviation***	**MSR3** ***MSR2 with addition of short term response mechanism (from 2024) + aviation***
Invalidation mechanism[78]	Invalidate excess above prior year auction volume	Invalidate excess above prior year auction volume	Invalidate allowances up to the level of the lower threshold	Invalidate allowances up to the level of the lower threshold
Auction reserve price[79]	-	-	-	25€ in 2025, increasing by 3% year-on-year in real terms

The updated levels of the thresholds are based on estimates of future hedging needs, which are expected to change over time, for example because the reduction of free allocation increases the carbon price risk of industrial installations. The assessment of future hedging needs is presented in Annex 8, Section 24.

MSR1 simply updates the values of the parameters (threshold, intake rate) based on this analysis.

MSR2 adjusts the thresholds such that they remain a constant share of the cap. This links the thresholds to the main supply parameter in the ETS: as the cap is lowered, so are the MSR thresholds. This option calculates intakes as a proportion of the TNAC in excess of the upper threshold. The intake rate is set at 33% of the difference between the surplus and the upper threshold. This means that with an upper threshold of 700 million allowances, a TNAC of 800 million allowances would result in the MSR taking in 33 million allowances the following year.

This option invalidates allowances held in excess of the MSR lower threshold, decoupling invalidation from auction volumes. This change is proposed because there is

[78] For example, if there were 2 billion allowances in the reserve, and the auction volume of the previous year were 500 million allowances, while the lower threshold were 400 million allowances, for MSR 0+ and MSR1, 1.5 billion allowances would be invalidated, and 500 million allowances would remain in the reserve. For MSR2 and MSR3, 1.6 billion allowances would be invalidated, and 400 million allowances would remain in the reserve.

[79] An auction reserve prices means that, if the clearing price of an auction of allowances does not reach the auction reserve price, then the auction is cancelled. In that case, the corresponding volume of allowances to be auctioned would be added to the MSR, thereby quickly decreasing the supply of allowances to the market.

no clear rationale to let the invalidation volume be determined by the auction volumes in the previous year, especially since these auction volumes are themselves influenced by the MSR's intakes or releases.

Option MSR3 introduces an auction reserve price, as an additional short-term response mechanism. The MSR in its current structure is not meant to address short term volatility and disturbances. In particular when carbon prices were low, different groups of stakeholders have asked the Commission to look into the possible implementation of a carbon price floor. Under this option, on top of the changes brought by MSR1 or MSR2, a minimum price level would be set at a fixed or dynamic level. If the clearing price of an auction does not reach this level, the auction is cancelled, and the auction volume would be added to the MSR instead. The level of this price would be set at 25 euros to begin with, with annual increases of 3%.

5.2.2.3 Framework to address the risk of carbon leakage

The level of free allocation granted to a stationary installation to address the risk of carbon leakage is the result of a calculation which takes into consideration the relevant benchmark values, the historic activity level of the installations, the carbon leakage exposure factor (CLEF) and the cross-sectoral correction factor (CSCF). The value used for the CLEF depends on if a sector is deemed to be at risk of carbon leakage or not. The CSCF is a factor which, if applied, reduces free allocation in a uniform manner across all sectors (see Annex 9 for more details). The free allocation rules were updated as a result of the previous review of the ETS Directive and are applicable for phase 4. However, a more ambitious emission reduction target implies that these rules may need to be updated. The options analysed in this impact assessment include:

Baseline CL0: The baseline relies on the current post-2020 free allocation rules combined with an overall GHG emission reduction target of -55% compared to 1990. This baseline was chosen to compare the impacts of options to modify the framework to address the risk of carbon leakage. Different cap trajectories were considered to reflect the ETS contribution to the overall -55% emission reduction objective (see Section 5.2.1.1).

Option CL1: More targeted free allocation with tiered approach

Considering that the overall number of free allowances is limited, in particular in view of the increased level of ambition of EU climate policies, policy option CL1 aims at better targeting free allocation to those sectors at higher risk of carbon leakage. The current ETS legislation foresees only two groups with respect to the risk of carbon leakage. A sector or subsector is deemed to be at risk if the carbon leakage indicator, defined as the trade intensity multiplied by the emission intensity, exceeds a value of 0.2. Otherwise, the concerned sector or sub-sector is not deemed to be at risk except if other, more detailed criteria are met. The assessment of sectors or subsectors against these more detailed criteria resulted in significant additional work and protracted discussions. In practice, the impact of the distinction between sectors at risk of carbon leakage and sectors not at risk is limited, as around 94% of the emissions from industrial installations originate from sectors at risk.[80]

A total of 63 sectors and subsectors is deemed to be at risk of carbon leakage in phase 4. This approach does not take into account that there are significant differences in the trade and emissions intensities between industry sectors deemed to be at risk, as can be seen from the large variations in the values of the carbon leakage indicator ranging from 0.2 to more than 20 (see Annex 9). In order to better target free allocation,[90] tiers with carbon leakage indicator thresholds and more differentiated carbon leakage exposure factors could be introduced. This was already contemplated in the 2015 impact assessment for the revision of the ETS Directive. Under this option, three tiers are considered.

The tiered approach is assessed from 2026 onwards, as free allocation for the period from 2021 to 2025 will be granted in 2021 based on the current ETS Directive. The free allocation at benchmark level (i.e. the carbon leakage exposure factors) for sectors at medium risk was chosen at an intermediate level of the current legislation which applies 30% (no risk) and 100% (risk) of the relevant benchmark levels. The thresholds were chosen in order to allow for a reasonable differentiation between sectors. Sectors with a carbon leakage indicator of more than 2 would represent approximately 72% of the emissions, while sectors with a factor of more than 1 would represent approximately 91%. A threshold of 1 was discarded, as it would only provide a marginally improved differentiation compared to the current threshold of 0.2 for which the concerned sectors represent 94% of the emissions.

Table 3: Tiered approach assessed

Baseline		**Tiered approach**	
Risk categories and thresholds	**Carbon leakage exposure factor (CLEF)**	**Risk categories and thresholds**	**Carbon leakage exposure factor (CLEF)**
No risk: CLI ≤ 0.2	30% (1)	No risk: CLI ≤ 0.2	30% (1)

[80] European Court of Auditors, The EU's Emissions Trading System: free allocation of allowances needed better targeting, 2020.

Risk: CLI > 0.2	100%	Medium risk: 0.2 < CLI ≤ 2	60%
		High risk: CLI > 2	100%
NB: CLI = carbon leakage indicator. (1) Declining from 30% in 2026 to 0% in 2030, as in the current ETS Directive.			

Option CL2: More targeted free allocation with strengthened benchmarks

More targeted free allocation could also be achieved by addressing another element of the allocation formula: the benchmarks. The present rules for the benchmark value updates foresee an annual reduction within the range between 0.2% and 1.6%, compared to phase 3 values which were based on the average performance of the 10% most efficient installations in 2007/2008. This approach avoids abrupt changes of benchmark values, but does not fully reflect the technological progress. For the update of the benchmark values for the period from 2021 to 2025, the maximum update rate has been applied for 31 out of 54 benchmarks. For a number of benchmarks, the average emission factor of the 10% most efficient installations in 2016/2017 is already lower than the updated benchmark values for the period from 2021 to 2025.[81]

An increase of the maximum annual update rate from 1.6% to 2.5%[82] would better reflect the actual emissions of the different sectors, while also reduce the total free allocation. A maximum update rate of 2.5% would also better align free allocation with the need to decarbonise industry in view of reaching zero emissions by 2050, as it is close to a linear trajectory to zero in 2050.

A **design element** which can be changed for options CL1 and CL2 is to make free allocation conditional on decarbonisation efforts. Such conditionality provisions could be similar to the ones that were recently introduced with the revised state aid rules for indirect cost compensation.[16] The conditionality of free allocation is assessed in Annex 9.

Another **design element** which can be changed for options CL1 and CL2 is the broadening of the scope of free allocation. Ongoing and future technological

[81] Commission Implementing Regulation (EU) 2021/447 of 12 March 2021 determining revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025 pursuant to Article 10a(2) of Directive 2003/87/EC of the European Parliament and of the Council. OJ L 87/29, 15.3.2021.

[82] For the period from 2026 to 2030, the application of a maximum annual update rate of 2.5% would lead to a reduction of the benchmark values of 50% compared to phase 3 values, while a maximum annual update rate of 1.6% would instead lead to a reduction of 32% compared to phase 3 values.

developments to reduce GHG emissions might lead to situations where installations would partly or completely lose their free allocation when decarbonising their production activities. In such cases, the free allocation regime could lead to unequal treatment of industrial installations and effectively act as a barrier to the use of decarbonisation techniques such as green hydrogen and the electrification of industrial processes. Possibilities to broaden the scope of free allocation are assessed in Annex 9.

The framework to address the risk of carbon leakage due to indirect carbon costs is assessed in Annex 9.

The Commission will also present a proposal for a Carbon Border Adjustment Mechanism (CBAM). Depending on the options chosen, CBAM may replace free allocation in the selected sectors. The impact of CBAM as well as the transition between CBAM and free allocation is presented in the CBAM impact assessment. This impact assessment presents options for free allocation that would apply for sectors outside CBAM, or until the entry into force of CBAM for selected sectors.

A large majority of replies to the OPC, around 80%, were in favour of amending the current carbon leakage framework, while 20% preferred to keep it as it is. However, opinions on the modification options were divided. The introduction of other measures to further incentivise GHG reductions received comparatively highest support (31%). On the other hand, the introduction of conditionality (14%) or of a tiered approach (17%) as well as the replacement of the current carbon leakage framework with a CBAM for selected sectors (18%) each were favoured by less than 20% of the replies. Preferred options varied by stakeholder type. Both NGOs' and private sector respondents' most selected option was the introduction of other measures to further incentivise GHG reductions, however, for NGOs followed by all of the other amending or replacing options, while for the private sector followed by the option to maintain the current carbon leakage framework without changes. Among trade unions, the introduction of other measures or no changes received the most support. This outcome of the OPC survey is also in line with the positions expressed by social partners from both the employer and employee side in a meeting with the Commission. For other stakeholder groups, including academic/research institutes, EU citizens, and environmental organisations, the replacement of free allocation with a CBAM for selected sectors was the most selected option.

Regarding possible changes to benchmark-based allocation, stakeholders were divided whether a modified method to determine benchmark values should be introduced to ensure faster incorporation of innovation and technological progress. This option obtained support from a wide range of stakeholder groups but not from the private sector.

5.2.2.4 Improving support for low-carbon investment and innovation through the existing Innovation Fund

The current ETS Directive sets the size of the Innovation Fund at 325 million allowances from the free allocation share, 75 million allowances from the auction share, 50 million allowances from the MSR and the leftovers from the NER300 programme, to a total size of over 450 million allowances.

The main policy options analysed for the Innovation Fund concern increasing its size while keeping its sourcing the same in terms of proportions, complemented with changes to certain design elements improving its functioning. 83% of OPC respondents from a wide range of stakeholder groups argued that the size of the Innovation Fund should be increased.

Option IF0: Baseline

No change to current Innovation Fund size, as well as main design elements (funding rate stays at maximum 60% of the additional cost of the innovation technology and not of the total financial gap to the market price). With a carbon price of EUR 50, the total size of the Innovation Fund for the period 2021-2030 amounts to EUR 22.5 billion.

The first call for large scale projects was significantly oversubscribed (over 20 times the available budget) with projects across all sectors, technologies, and MS. The Innovation Fund is running two calls per year (one for large-scale and one for small-scale projects) of total value around EUR 1.3 billion. By 2026 it will have run around 12 calls for around EUR 7.5 billion. Assuming an average grant size of EUR 100 million, by 2026 the IF may be expected to have financed around 75 clean tech projects covering a good mix of first-of-a-kind commercial projects across all sectors (based on the applications to the first call[83]).

Option IF1: Increasing the size of the Innovation Fund to 550 million allowances

Increasing the size of the Innovation Fund to 550 million allowances is expected to generate EUR 27.5 billion (with a EUR 50 carbon price which takes into account the increased carbon price as a result of the reduced cap). The additional 100 million allowances would come from the extension of the scope of emissions trading. The increase can be implemented once the revision of the ETS Directive is concluded, the required implementing legislation is put in place, and the allowances are monetized. This would allow running call for projects with the additional amounts in the second half of the decade, and may also require increasing the size of the actual calls. The monetization of the additional allowances would need to take place with due care for the stability of the carbon market. The increase of the size can be combined with the enhancement of the functioning of the instrument via an increased funding rate combined with additional instruments. Administrative capacity will need to be strengthened accordingly.

Option IF2: Further increasing the size of the Innovation Fund to 700 million allowances

Increasing the size of the Innovation Fund to 700 million allowances is expected to generate EUR 35 billion with a EUR 50 carbon price. The additional 250 million allowances can come mostly from the extension of the ETS (200 million) and from free allocation (50 million). Out of the 83% respondents to the OPC in favour of an increase of the Innovation Fund, 45% indicated that it should be increased by using more allowances from the auction share, while 9% indicated that the allowances should come from free allocation. The same considerations as for Option IF1 are valid to an even greater extent. However, the management of such a significantly increased programme would require significantly reinforced administrative capacity.

A **design element** which can be changed across all options is the **funding rate** of the Innovation Fund which can be increased to ensure a full coverage of the financial gap that would speed up the deployment of innovative technologies. This can be done with a direct increase of the percentage, possibly coupled with introduction of complementary **carbon contracts for difference (CCfDs)**[84]. CCfDs are similar to the support to renewables auctions: they are long term contracts with a public counterpart paying the difference between an agreed CO_2 strike price and the actual CO_2 price in the ETS and thus minimise the required amount of funding and optimise the use of the available resources. The producer of the low-carbon product would effectively benefit from a guaranteed carbon price for a certain limited period of time. The extra funding required needs to be assessed against potential benefits, such as the use of competitive tendering

[84] The relevance of these possible changes to design elements was confirmed by the results of the OPC. 74% of respondents argued for the maximum funding rate to be increased, 55% highlighting the need to allow better risk-sharing for risky and complex projects and 19%, including the majority of NGOs indicating that it should only be increased in case of competitive bidding (e.g. CCfDs). 88% of respondents from a wide range of stakeholder groups were in favour of introducing such additional supporting instruments to support full market deployment of low-carbon products through the Innovation Fund.

processes, the reduction of regulatory risk for the investor, the reduction of financing costs (enhanced bankability), the creation of a one-stop shop, and build-in reduction of support with increasing carbon prices (see Annex 11 for more analysis).

5.2.3 Extension of emissions trading to maritime transport and alternatives

5.2.3.1 Architectural options

Following the 2030 CTP, this impact assessment looks at the options detailed below as regards the extension of emissions trading to maritime transport. All options are based on maritime emissions linked to the EEA (i.e. route-based scope), regardless of the nationality of the ship or where the company has been registered in order to avoid evasion through reflagging of ships and distortion of competition. In addition, they reflect the impact of the FuelEU Maritime initiative by considering higher shares of renewable and low-carbon fuels, in line with the MIX scenario.

Option 1: Inclusion of maritime transport emissions in the existing ETS (**MAR1**)

This policy option would extend the ETS to cover maritime transport emissions. It would work by setting a cap on GHG emissions from the maritime sector and creating new emission rights in the Union registry. Regulated entities from the maritime sector would then need to acquire and surrender emission allowances for each tonne of reported GHG emissions. The amount of allowances to be surrendered would be derived from the emissions data coming from the EU maritime transport monitoring, reporting and verification (MRV) system. The system could allow both maritime regulated entities and ETS operators to purchase and surrender the same type of allowances, or alternatively, it could only give that flexibility to maritime operators (similar to what was done initially for aviation in the ETS).

Option 2: A separate ETS for maritime transport (**MAR2**)

Under this option, maritime transport emissions would be capped and included under a separate emissions trading system, not part of the existing ETS. A new market would be designed for the maritime allowances and exist in parallel to the existing ETS. The amount of allowances to be surrendered would be derived from the EU maritime MRV system. Regulated entities would only be able to trade maritime allowances amongst themselves as no out-of-sector emission reductions would be rewarded, unlike in MAR1. All emission reductions would happen in the maritime sector. In the future, a possible linkage of the separate maritime ETS with the ETS could be envisaged if desirable, following the same linking options as envisaged for the ETS extension to other sectors than maritime transport.

Option 3: Alternative carbon pricing option: levy on ship GHG emissions (**MAR3**)

This measure would impose a levy on maritime emissions reported by eligible entities as part of the EU maritime MRV system. As opposed to the maritime fuel tax option assessed under the revision of the Energy Tax Directive 2003/96/EC, the levy on ship GHG emissions would be applied to ship operators/owners based on their reported annual emissions and not on the quantity of fuel bunkered in EU ports. It would therefore take the form of an annual payment. The levy rate could be reviewed regularly (e.g. up to yearly adjustments) and gradually increased to send an appropriate price signal and accelerate the uptake of mitigation measures in the sector. A levy on CO_2 emissions is one of the market-based-measures contemplated by some market actors at global level, as an alternative to cap-and-trade system.

Option 4: Extension of the ETS to maritime emissions in combination with standards (**MAR4**)

This policy option considers complementing the extension of the ETS to maritime as described in MAR1 with an **operational carbon intensity standard**, whereby vessels calling at EEA ports would be obliged to meet a certain level of carbon intensity to be defined in the legislation (expressed as the amount of GHG emissions per transport work and defined for every ship size and type). By mandating a certain level of carbon intensity improvements, such a standard would complement the price signal coming from the ETS, while leaving it to shipping companies to decide which measures to implement to achieve the standard. It would thereby contribute to further accelerate the implementation of mitigation measures in the maritime sector, such as energy efficiency improvements or the uptake of renewable or low-carbon fuels. A similar standard is being discussed at IMO for ships of 5,000 gross tonnage and above based on a new operational carbon intensity indicator.

5.2.3.2 Key common design variants for all maritime transport options

The effectiveness and efficiency of the identified policy options are highly dependent on the following key design elements (see Annex 6 for further details).

(a) Options for the maritime geographical scope

The geographical scope is defined by the starting and finishing point of the covered ship movements (based on the first and last port of call within or outside the EEA, as detailed in Annex 6) and thus defines the level of emissions covered. In line with the 2030 Communication calling for the coverage of at least intra-EU voyages, there are a variety of options in terms of the ship movements linked to the EEA that could be covered:

- ***Option 1***: Cover 100% of emissions from intra-EEA voyages, 100% of extra-EEA voyages (incoming and outgoing) and all emissions at EEA berth (**MEXTRA100**) – *follows the same scope as the EU maritime transport MRV Regulation*;
- ***Option 2***: Cover 100% of emissions from intra-EEA voyages, 50% of all incoming and outgoing extra-EEA voyages (one of the options considered in UNFCCC, or 100% of all incoming extra-EEA voyages, or 100% of all outgoing extra-EEA voyages) and all emissions at EEA berth (**MEXTRA50**);
- ***Option 3***: Cover 100% of emissions from intra-EEA voyages and all emissions at EEA berth (**MINTRA**) – *similar to the scope of aviation in the ETS under the time-limited derogation that is currently being applied and in line with the minimum scope foreseen in the 2030 CTP.*

It should be noted that emissions from intra-EEA voyages include both emissions from domestic voyages (that depart and arrive in the same MS) as well as emissions from voyages between two distinct MS. Domestic emissions are covered by the Effort Sharing Regulation (ESR) and represent around 10% of the sum of domestic and international navigation emissions reported in the EU GHG inventory. A substantial part of these emissions would not be covered by the proposed policy options. These uncovered emissions would typically include emissions from various ship types involved in domestic navigation such as inland waterway vessels or small ferries, motor boats or workboats not covered under the EU maritime transport MRV regulation.

(b) Regulated entities and ships

The companies liable under the EU maritime transport MRV regulation would be the regulated entity held accountable to comply with the legislation. These companies are defined as the legal entities owning the ship and any other organisation or person which has assumed the responsibility for the operation of the ship from the shipowner, such as the manager or the bareboat charterer. These companies would also be the ones that have agreed to take over all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention. This is in line with the new definition of companies proposed by the European Commission in its proposal to amend the EU maritime transport MRV regulation[85]. In addition, implementing the policy at company level instead of ship level would considerably

[85] Proposal for amending Regulation (EU) 2015/757 in order to take appropriate account of the global data collection system for ship fuel oil consumption data, COM(2019) 38 final, 2019/0017 (COD)

reduce the number of entities involved in each policy option (from around 12.000 to 1.600).

In terms of regulated ships, all options would apply the scope of the EU maritime transport MRV regulation that excludes ships below 5.000 gross tonnage[86] and exempts specific ship categories such as warships, naval auxiliaries, fishing vessels or government ships used for non-commercial purposes. It also excludes inland waterway transport and all voyages for purposes other than transporting cargo or passengers for commercial reasons.

(c) Type of greenhouse gas emissions

All policy options should progressively cover the broader range of GHG emissions. While CO_2 emissions are the primary GHG emitted through maritime transport activities, other GHGs, such as methane and nitrous oxide are getting increasingly important, notably in view of the increasing uptake of LNG[87]. Due to the EU maritime transport MRV Regulation currently being limited to CO_2 emissions, other GHGs would have to be included in a later phase once the monitoring approaches and emission factors of these gases have been agreed. A similar approach is taken in the FuelEU maritime initiative, which envisages including other non-CO_2 greenhouse gases, in particular methane and nitrous oxide.

(d) Phase-in period with a gradual coverage of maritime emissions

To ensure a smooth transition, a phase-in period of e.g. 3 years could be envisaged where regulated entities would only be obliged to purchase allowances (or pay a levy in case of MAR3) for a portion of their emissions, gradually rising to 100%. This transition period could help market actors get acquainted with the new system. In the targeted stakeholders' consultation, the majority of stakeholders expressed the need for a transition period for the maritime sector with some arguing that the maritime sector is complex and requires time to adapt.

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[86] By limiting the monitoring requirements to ships above 5.000 gross tonnage, the Regulation covers around 90% of all CO_2 emissions, whilst only including around 55% of all ships calling into EEA ports.

[87] CO_2 emissions cover 98% of current GHG shipping emissions, According to the 4th IMO GHG study, methane emissions from ships have increased by more than 150% from 2012 to 2018, largely due to a surge in the number of LNG ships. Such a trend could have a significant climate impact as over a 100-year period methane the global warming potential of methane is 28 times higher than of CO_2.

5.2.3.3 Design elements specific to maritime ETS options (MAR1, MAR2, MAR4)

a) Method for cap setting

The emission cap for ETS allowances for maritime transport can be determined using historical maritime transport emissions. Historical maritime emissions could be based on the reporting years 2018-2019, on the basis of the data collected under the EU maritime transport MRV system while taking into account the impact of the UK's withdrawal from the EU.

In addition, a trajectory from current emission levels to the target level in future years will need to be constructed so that a linear reduction factor for the cap can be set for each year. In this assessment, we consider that the number of allowances allocated to maritime emissions should be reduced in line with the same linear reduction factor applicable to stationary installations and aviation, in a manner commensurate with the 2030 climate ambition and with a long-term trajectory towards climate neutrality by 2050. This would ensure that maritime transport contributes to the EU climate efforts in line with the collective ETS emission reduction objective, which applies to all ETS sectors.

b) Allocation of allowances

Maritime allowances could be auctioned, which is the basic principle for allocation in the ETS, as it is generally considered to be the most economically efficient system[88]. It also eliminates possible windfall profits and puts new entrants on the same competitive footing as existing operators. Moreover, the application of the flag neutrality principle would already virtually eliminate the risk of competitive distortion between ships/companies and therefore no free allowance allocation is needed to safeguard a level playing field. Auctioning could also raise revenues to support climate action and other purposes (see Section 5.2.4.3). Free allocation of maritime allowances will thus not be analysed under this impact assessment.

c) Simplified measures

Some simplification could be thought for the regulated entities responsible for small amounts of emissions, including specific exemption rules or exclusion criteria subject to equivalent measures (see Annex 6).

5.2.4 *Extension of emissions trading to the buildings and road transport sectors or to all combustion fuels outside the existing ETS*

5.2.4.1 Scope options

The 2030 CTP announced that a further expansion of emissions trading could be envisaged but left open if the scope would cover emissions from road transport and buildings or all emissions of fossil fuel combustion. As the existing ETS has shown, the development of a new market requires setting up functioning monitoring, reporting and verification and can benefit from transitional arrangements or a pilot period before being gradually integrated into the existing system, as indicated in the 2030 CTP. In light of these considerations, an immediate extension of the existing ETS as well as a downstream approach have been discarded (see Sections 5.3.3.1 and 5.3.3.2) and this impact assessment looks at the options detailed below as regards the scope of a separate EU-wide emissions trading.

Baseline**:** No expansion of emissions trading (**EXT0**).

Fossil fuel emissions from road transport, direct heating of buildings and other sectors would be regulated only by the ESR and EU and MS sector specific legislation with MS deciding if their policy instruments include carbon pricing.

Option 1: A separate EU-wide upstream emissions trading system for buildings and road transport (**EXT1**)

Under this option direct CO_2 emissions from buildings and road transport are included under a new emissions trading system which is distinct from the existing ETS. This would cover around a third of EU GHG emissions in 2030. The new ETS and the existing ETS run in parallel at least until 2030.

Option 2*:* A separate EU-wide upstream emissions trading system for all emissions from the combustion of fossil fuels not covered by the ETS (**EXT2**)

Under this option, all GHG emissions from the combustion of fossil fuels not covered by the existing ETS would be covered by a new emissions trading system, covering in addition to EXT1 small non-ETS industries, fossil fuel use in agriculture and forestry and off-road machinery, non-electric railway, and the military sector. The new emissions trading system and the current ETS would run in parallel at least until 2030.

This approach for a separate emissions trading system for buildings and road transport (or all combustion of fossil fuels) is supported by the results of the OPC, where respondents, including the majority of NGOs and private sector respondents and trade unions clearly preferred a separate EU-wide system among the presented policy options. The majority of the responses, including from NGOs, private sector respondents and trade unions, expressed a negative view on the integration of new sectors into the current ETS. Only less than one-third of responses, including the majority of EU citizens and academic/research institutions, saw an integration favourable. 18% of responses referred to "other" (positive or negative) effects, with half of them arguing against the introduction of emission trading for new sectors and the other half being open to consider an extension as an option, generally either after a careful assessment of the impacts and a trial period or in a separate temporary or permanent ETS. In the OPC and beyond, several stakeholders also expressed more general scepticism with regard to the extension of emissions trading to buildings and road transport, even if in a separate system. Such concerns were, for instance, expressed in a meeting between the Commission and social partners from both the employer and employee side, who pointed in particular to the impact of rising heating or transport fuel prices on consumers.

Only very few MS participated in the OPC survey, while some MS responded with a position paper. Overall, MS' views on the extension of emissions trading to the buildings and road transport sectors (or all combustion of fossil fuels) were mixed with some MS in favour, some against and several MS stressing the need for a thorough impact assessment. Also in the European Parliament, views of the political groups differ. The Parliament supported as of early 2020 market-based measures, expressed reservations and asked for further analysis on the ETS inclusion of buildings, while rejecting the setting-up of a separate ETS system or direct ETS inclusion for the transport sector[89].

5.2.4.2 Linking options with the existing ETS

For EXT1 and EXT2 options, the possible linking or merging of the existing ETS with the new ETS could happen in different ways.

Option 1: As part of a general review clause at the end of phase 4 (in 2030) of the existing ETS, determine whether and under which conditions the merging of the two systems could happen (**ELINK1**). This would be justified by the need for a sufficient period to understand the functioning of the new market.

Option 2: Provisions for development of one-way or two-way flexibility with existing ETS that could increase over time to eventually lead to full integration with the current system (**ELINK2**).

[89] European Parliament resolution of 15 January 2020 on the European Green Deal (P9_TA(2020)0005)

For both linking options a new type of allowance is created, as currently for aviation. If and when the systems are linked, one would need to determine to what extent the allowances of one system can be used for compliance in the other system.

In the OPC, most respondents (46%), including the majority of NGOs, private sector respondents and trade unions, indicated that both systems should stay independent. Only 19% of respondents, including the majority of EU citizens, argued in favour of two-way flexibilities between the two systems to increase cost-efficiency considerations. Further 33%, including most of academic institutions, gave various replies, in particular stressing the need for a thorough impact assessment before integrating the two systems.

As regards the question whether a gradual integration of the two systems should already be foreseen in the ETS revision, views were divided. 45% of respondents, including the vast majority of NGOs, environmental organisations and trade unions and almost half of private sector respondents (in particular from the manufacturing sector), replied that the risks associated with an integration are too high and that the legislation should not pursue such a step. However, 43% of respondents, including the majority of academic/research institutions, public authorities and EU citizens as well as the slight majority of private sector respondents (in particular from the energy sector), were open to a possible gradual integration. These respondents preferred to foresee a review to determine whether and when integration is desirable (26%) over a fixed date for such an integration (17%).

5.2.4.3 Design elements on the possible ETS extensions

The environmental effectiveness and practicability of the policy options depends on some key design elements which are set out below. Technical details on the design elements and their impacts are analysed in Annex 5.

a) Cap setting and linear reduction factor

Extension of emissions trading through a separate ETS will require to set a cap for those sectors. The later the system starts to apply, the higher its cap trajectory referred to as the linear reduction factor (LRF) will have to be to achieve the necessary ambition reduction by 2030, therefore a cap with LRF should apply as soon practically feasible.

The cap and LRF for the separate ETS would be set in line with cost-effective emission reductions in 2030 resulting from a mix of carbon pricing and other policies in the sectors concerned. Applying a LRF from 2026 would deliver a clear signal about the trajectory needed for emissions reductions in the new sectors. A consistent LRF with a trajectory starting from ESR ambition levels in 2024 is for EXT1 5.15%, corresponding to 5.43% if compared to 2025, the year for which MRV based emissions would be available. The corresponding EXT2 LRF would be 5.14% compared to the ESR ambition level for 2024, corresponding to 5.42% compared to 2025.

For further analysis of cap setting and the LRF see Annex 5, Section 10.

b) Regulated entities

When designing an emissions trading system, the point at which regulation applies is a key element. Emissions considered under the new system under EXT1 and EXT2 are combustion emissions from fossil fuels. As already indicated in the 2030 CTP and its impact assessment, an upstream system lowers significantly the number of participants, thus limiting participant transaction costs and administrative costs. While a downstream design would present advantages in terms of direct citizen involvement, its complexity and the heavy administration needed have led to discard this option (see also Section 5.3.3.2 and Annex 5, Section 12).

In the upstream system the act triggering a compliance obligation is not the emission of GHG but the releasing on the market of fuels for combustion in the sectors concerned. Emissions would be determined indirectly via the fuel quantities put on the market. To the extent possible and subject to further analysis, the existing ETS system of standardised fuel emission factors per energy content would be applied. The precise point for regulation to apply would be identified in terms of technical feasibility, the ability to pass-on the ETS related carbon costs to the consumers, and the administrative costs.

The system of excise duty of Council Directive (EU) 2020/262[90], with the necessary adaptations, is a useful anchor to identify the regulated entities in the new system, as this Directive has already set a robust control system for quantities of fuels released for consumption for the purposes of paying excise duties.

In the case of oil, there is a European harmonized excise duty system operated through the existence of tax warehouses. As tax warehouse operators already have in place an MRV system for tax reasons, regulation can be set at their level. For gas, the point of regulation considered most appropriate are the fuel suppliers that supply directly the end-users. In most MS gas suppliers are the entities obliged to pay the excise duty.

With respect to coal, the market is complex and less regulated than the markets for oil and gas. Not all coal products necessarily pass through an excise duty point and where they do practices are not harmonised at EU level. There are many and often small end suppliers of coal, which makes it challenging to regulate coal supplies in a manner that limits administrative burden and minimises the risk of fraud. The excise duty

[90] Council Directive (EU) 2020/262 of 19 December 2019 laying down the general arrangements for excise duty (OJ L 058 27.2.2020, p. 4).

infrastructure could also play a role in identifying the regulated entities and monitoring of the end use of coal. In most MS that do apply excise duty to coal, the seller to the final customer is the excise duty payer, but there are exceptions[91]. The excise duty payers are subject to registration in accordance with Directive 2003/96/EC on energy taxation. For any cases not covered by these options, or if several persons are jointly and severally liable for payment of the same excise duty, the MS should be able to designate the regulated entities in accordance with their national law.

Additionally, it should be recalled in this respect that at the European level coal plays only a small role in heating and small industry and is been phased out, whereas in some MS coal still plays a considerable role.

If the level of regulation is set at tax warehouses for oil (about 7.000), regional and local suppliers for gas (about 1.400), and for coal (about 3.000) there would be 11.400[92] regulated entities under the new ETS. This compares with 9.200 to 9.500 regulated entities in the existing ETS (11.000 before UK's withdrawal from the EU).

When establishing the point of regulation for the different fuel types, it has to be kept in mind that the model needs to fit the different EU MS.

Annex 5, Section 12 contains further analysis on the regulated entities.

c) Allocation method and auction starting phase

The method of allocation in the new ETS under option **EXT1** would be auctioning, as the risk of carbon leakage in the transport and building sectors is small or zero[93].

Under option **EXT2** there would be the need for a limited quantity of free allocation or another compensation mechanism in order to address the risk of carbon leakage due to

[91] In Czechia, France, Croatia, Italy, Latvia and Slovakia the supplier to end-consumer of coal is the party that pays the tax whereas in Germany, Ireland and Spain the first supplier of coal is appointed as the responsible party for paying the tax. In the vast majority of countries multiple entities can be liable for paying the tax depending, amongst others, on the moment when the coal duty/tax becomes chargeable. This includes parties such as tax warehouse owners, producers, importers, suppliers, traders, consumers or the tax representative of one of these parties.

[92] Sources: ICF et al. (2020); CEER, Enstog, Eurostat.

.[93] The road transport sector has no significant competitive pressure from outside the EU, except some tank tourism in limited border regions. For the buildings sector, competitive pressure is not relevant.

competitiveness impacts on small industry which is currently excluded from the ETS Directive if under a certain size or under Art. 27 and 27a[94].

The compliance cycle would be identical to the existing ETS, with an obligation to surrender allowances equal to the emissions from the regulated entities during the preceding calendar year by 30 April each year at the latest.

In order to ensure a smooth start of the system and taking into account the need for regulated entities to hedge or bank allowances in order to mitigate their liquidity risk under the new system, auctions of the ETS in the first year would start with a higher volume than the cap of the first year[95]. This front-loading of auctioning volume would be deducted from auctioning volumes in future years to preserve environmental integrity. For further analysis see Annex 5, Section 11.

d) Market Stability Mechanism

In order to avoid the risk of significant market imbalances (whether a surplus or a deficit of allowances) and a resulting too weak or too strong price signal, a rules-based market stability instrument similar to the MSR for the existing ETS system could be introduced. This is important for market participants as it helps manage market expectations about future market supply and may mitigate excessive price movements linked to market fundamentals. It is thus suggested to use the same instrument as in the current ETS with features adapted to the new sectors.

A certain quantity of allowances should be placed in the reserve at the start of its operation. In addition, a provision allowing to react to excessive price fluctuations would be necessary in order to contribute further to market stability[96]. These elements are further detailed in Annex 5 Section 11.

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[94] In some sectors only plants above a certain size are included. Furthermore, Articles 27 and 27a of the Directive were added because transaction costs for MRV were considered too high for small installations compared to larger emitters in the EU ETS. By introducing the option to opt out these small installations, the articles aimed to improve the cost-effectiveness of the system for these installations.

[95] Similar to the start of phase3 of the EU ETS when "early auctions" took place to allow regulated entities to purchase allowances at the time they sell their output (often on a forward basis for some sectors) to mitigate the risk of price fluctuations.

[96] A provision which would make it possible to adapt the supply if the price evolution does not correspond to changing market fundamentals.

5.2.5 Using ETS revenues to address distributional aspects between Member States

A strengthening and possible extension of the ETS will generate significant revenues (see Section 6.3.2 and Annex 13 for an overview), and the use of these revenues is an important element of the policy debate, notably as a tool to address distributional impacts between MS.

The discussion on use of ETS revenues is linked with the discussions on using ETS auction revenues as an EU own resource. According to the inter-institutional agreement of 16 December 2020 between the European Parliament, the Council and the Commission, the Commission will propose a new own resource based on the ETS for repayment of the borrowings for the NextGenerationEU Recovery and Resilience Facility, of which 37% are allocated to support the green transition.

In this impact assessment therefore no assumptions are taken on which amount of auctioning revenues will be available for which purpose. The assessment assumes that the allowances needed for the Innovation and Modernisation Funds and other solidarity provisions are not affected by the own resource needs. 53% of respondents to the OPC argued for an increase in the Modernisation Fund, with further 4% indicating that the size of the Modernisation Fund should remain unchanged in terms of the absolute amount. 36% of respondents replied that the Modernisation Fund should remain at a 2% cap. The table below describes the needs and current instruments provided by the ETS Directive for the period 2021-2030 to address distributional aspects, which have to be considered for the development of options on the use of revenues.

Table 4: Needs and instruments to address distributional aspects

Need	Instruments
With a strengthened ETS cap the adequacy of existing *solidarity and support provisions* need to be assessed Moreover, some MS are questioning the overall distribution of auction revenues in the existing ETS more	Solidarity redistribution provision consisting of the redistribution of 10% of the auctioned allowances to 16 low income MS (around 5% of the current overall cap or around 700 million allowances over the 2021-30 period) Modernisation Fund (2% of the overall cap or around 275 million allowances over the 2021-30 period)[97]

[97] In addition, Member States had the possibility to transfer own Article 10c and solidarity allowances to the Modernisation Fund, and five of the beneficiaries (CZ, HR, LT, RO and SK) took advantage of this option, leading to a total size of the Modernisation Fund of 643 million allowances amounting to more than EUR 25 billion (at EUR 40 carbon price). These transfers are not "additional" revenue for those Member States.

generally, and are requesting a bigger role of the support and solidarity mechanisms in addressing that.	The MSR intake until 2025 is only based on the 90% regular auctioning shares, exempting the 10% solidarity shares. Article 10c derogation applies to 10 low income MS[69] that can opt to give free allocation (of up to 40% of their regular auction volume) to investments in power generation for the modernisation of the energy sector (totaling about 630 million allowances over the 2021-30 period)
In the perspective of a possible transitionary ETS system for new sectors with specific distributional characteristics, the need for solidarity and support mechanisms should be assessed.	By definition, no solidarity and support mechanisms exist today. The potential new sectors have very different characteristics: • If the shipping sector were to be brought into the existing ETS, this would add the question if existing mechanisms are adequate for this sector. • For the buildings sector, the availability of finance for renovations is an issue, and more so the risk of energy poor and low income households. The possibility of ETS revenues contributing to addressing at least the latter needs to be borne in mind. • For the road transport sector, there could also be a need for specific solidarity mechanisms. While the lowest income groups might partly have no or small cars, they also use less fuel efficient second hand cars. Some households are capable of switching to zero emission vehicles, hence there may be a need for measures supporting the competitive supply of zero carbon vehicles and adequate charging infrastructure, also in rural areas. In addition, support measures could be envisaged that encourage a shift to public forms of transport.

Annex 13 further analyses mechanisms for the distribution of ETS revenues between MS in the existing ETS and illustrations for the use of revenues of a new ETS based on existing mechanisms to address distributional impacts between MS.

5.3 Discarded policy options in the context of this impact assessment

5.3.1 Discarded options to strengthen of the existing ETS (power and industry installations)

Strengthening options that go beyond the -62% (compared to 2005) cost-effective emission reduction are discarded since it would require an increased emission reduction burden to ETS sectors which is expected to result in unbalanced distribution of efforts between sectors.

This approach is also supported by the results of the OPC. In fact, only about 10% of respondents, mainly NGOs, environmental organisations and EU citizens, argued for a higher contribution of the current ETS sectors beyond what their potential for cost-effective emission reductions would indicate. About 40% of respondents from a wide range of stakeholder groups indicated that the current ETS sectors should increase their contribution in line with the new target and based on cost-efficiency considerations (another 40%, mainly from the private sector, replied “other”, with many respondents agreeing with the cost-efficiency principle but arguing for a thorough impact assessment). About 10% of respondents, mainly from the private sector, argued for a lower contribution.

The strengthening options starting earlier than 2024 are discarded in view of the legislative process required for the revision. Similarly, an update later than 2026, though possible to achieve the -62% ETS ambition, would translate into a steeper LRF update and a less gradual transition. Additionally, the assessment of strengthening options starting in 2026 with rebasing has been limited to AMB3c because other options (AMB3a and AMB3b) are considered to fall under the analysis interval.

Also an increase of the current 57% auction share independently from possible adaptations to the initiative on a Carbon Border Adjustment Mechanism (see Section 6.1.2.2.5) is discarded. While some stakeholders, including the majority of EU citizens and academic/research institutes, argued for an increase in the auction share, many private sector respondents preferred the continuation of the current auction share of 57%. Initial assessment, presented in Annex 9, Section 25, for the example of an increase to 70%, demonstrates that such increase would have disproportionate effects on the risk of carbon leakage and more specifically the ability to avoid a cross-sectoral correction factor, which may be triggered between 2 and 5 years earlier and lead to a 20% to 31% lower free allocation budget compared to the baseline.

5.3.2 Discarded maritime options in the context of this impact assessment

Two maritime policy options have been discarded, namely the use of a “baseline and credit” system and the establishment of “GHG Emission Control Areas”. The option of taxing bunker fuels sold at EU ports has not been considered as it is assessed in the impact assessment accompanying the revision of the Energy Taxation Directive.

5.3.2.1 Baseline and credit system

This measure would set an operational carbon intensity baseline for each ship type and size. Any improvements below the baseline would be certified as tradable credits. The baseline-and-credit system is similar to the ETS in a way that it allows for emission reductions to happen where it is the cheapest. However, given that this policy option relies on a metric based on carbon intensity and that it includes a buy-out option, it does not provide certainty in terms of absolute GHG emissions reduction. It provides a clear emission intensity reduction pathway.

This option would require significant effort for development and implementation due to its complexity. Some of the preparation steps would include calculation of the emission pathways for each ship type and size, establishment of a trading system as well as issuance and trade supervision of credits. This would result in increased cost and administrative burden, which would undermine its implementation feasibility, its cost-effectiveness and acceptability.

5.3.2.2 GHG Emission Control Areas

This measure would expand the scope of Emission Control Areas (ECAs) by including a carbon intensity requirement. The legal feasibility of such an option is weak as it would require a decision at IMO. However, emission restrictions can also be introduced by the EU in its territorial waters, which then may or may not be formalised by the IMO as part of the ECAs.

Current legislation only allows for specific control of NOx and SOx, and it would therefore require amendments to include carbon intensity standards. The environmental impact of such a measure would highly depend on the share of GHG emissions covered under the ECAs and it would require additional monitoring efforts to track the carbon intensity of ships in the selected areas. For all these reasons, this measure has been discarded in the context of this impact assessment.

5.3.3 Discarded options for the extension of emissions trading to buildings and transport or all fossil fuels

5.3.3.1 Expansion of emissions trading through the existing ETS

The Impact Assessment underpinning the 2030 CTP included an analysis of the option to expand emissions trading through inclusion in the existing ETS. The 2030 CTP is clear that the development of a new carbon market can benefit from transitional arrangements or a pilot period before being gradually integrated into the existing ETS. The extension to buildings and transport or all fossil fuels requires an upstream approach to regulated entities and the set-up of a new system for monitoring, reporting and verification. Therefore, the extension of emissions trading to the new sectors needs to start with a separate EU emissions trading system with, depending on the assessment of the linking options ELINK1 to ELINK2, the possibility to merge this new ETS with the existing one at some point in time.

This approach is founded on the potential impacts on the sectors already covered by the existing ETS and differences in abatement costs among sectors, in investment cycles, implementation and administrative challenges, as well as in the cost-effective sectoral potentials for decarbonisation and the related reduction path for greenhouse gas emissions.

As described in Section 5.2.3.1, the approach to start with a separate emissions trading system for the new sectors is also supported by the majority of stakeholders responding to the OPC.

5.3.3.2 Downstream approach

A downstream design of the ETS extension as in the existing ETS would obligate directly the many million individual house and car owners and small companies[98]. It would present advantages of citizen empowerment and a direct demand side price signal. However it would increase very significantly the number of regulated entities in comparison to the existing ETS. This increase is not administratively practicable and is not an efficient option due to the high transaction costs that would derive from the large number entities and private persons that would be regulated, both for the regulator and for the participants. For further details see Annex 5 Section 12.

5.3.3.3 The creation of separate systems for road transport and for buildings

This option would assume that two new ETS would be created, one for road transport and one for the buildings sector, in addition to the existing ETS. Despite the fact that some design elements could be shared under both new systems, from an economic perspective this option has been discarded from the beginning due to the reduction of the cost-effectiveness potential in creating two new different and non-integrated markets. Other problems related to the functioning of the market, such as active participation, the market power of some entities, or related to social impacts can be more pronounced in a smaller market[99].

5.3.3.4 A high upstream approach for one ETS covering all fossil fuels

This option would assume that the existing ETS is replaced with a new EU wide-all-fossil-fuels upstream emissions trading system. This would mean a complete overhaul of

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[98] 195 million households in EU-27 (2019, source: Eurostat), 237 million passenger cars in EU 27 (2018, source: Eurostat), 29 million Light duty vehicles and 6 million trucks (2018, source ACEA)

[99] ICF et al. (2020).

the ETS, which has proven to work well. Therefore a very high upstream regulation for all sectors, including those included in the existing ETS, has been discarded from the beginning in the 2030 CTP Impact Assessment.

6 WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1 **Strengthening of the existing ETS (power and industry installations)**

This section assesses the impacts of an increased ambition of the current EU ETS (power and industry installations) in line with the -55% target and goes on to assess the impacts on the related aspects: the Market Stability Reserve, the auction share, the Innovation Fund, and the provisions to address the risk of carbon leakage. For some of the latter analyses, the increased ambition is taken as starting point.

6.1.1 Environmental impacts

6.1.1.1 Strengthening of the EU ETS target/cap

The environmental performance of the ETS in terms of reduced emissions is primarily determined by its cap on the total number of allowances. This determines the limit on emissions allowed, corresponding to allowances, to ensure the emission reduction foreseen is achieved.

As described in Section 5.2.1.1 the cap strengthening options are set proportional to the MIX scenario's cost-effective emission reduction opportunities of ETS sectors (where power sector reduces more and industry less) of -62% in 2030 (compared to 2005). This is in line with the overall -55% target (compared to 1990), and determines the cap figure in 2030 (same 2030 cap in all options). Compared to REF, this implies an additional reduction of 11% over the period 2021 to 2030 (-17% for 2026-30), while emissions between 2013 and 2019 decreased by 16%. The impacts for individual MS are analysed in Annex 13. Comprehensive MS scenario data is presented in a separately published technical note[100].

Cap options that include rebasing of the cap generally lead to a lower total amount of allowances than the options based only on a change of the LRF.

[100] See the "Technical Note on the Results of the "Fit for 55" core scenarios for the EU Member States"

Regarding the strengthening options, each option reflects a different trajectory to reach the 2030 outcome. The environmental impact is assessed by:

1. Cumulative cap - is an indicator of the overall environmental impact and the smoothness of the cap trajectory over the period 2021-30. It allows comparing the environment impact balance over time of the options with different years for LRF change, with or without rebasing and different LRF levels
2. Average relative deviation between the cap and the projected emissions under the MIX scenario (before MSR application) compared to the baseline cap/emission difference – this is an indicator for the alignment of the ETS cap with the projected emissions[101]. The lower the relative deviation the higher the cap/emission alignment (see ection 6.1.1.2 for further details on market surplus)

Table 5: Overview of existing ETS cap options with cumulative budget and average delta to emissions

		Baseline	**AMB1**	**AMB2a**	**AMB2b**	**AMB2c**	**AMB3c**
LRF	2021-23	2,20%	2,20%	2,20%	2,20%	2,20%	2,20%
	2024-25	2,20%	2,20%	5,09%	3,90%	4,22%	2,20%
	2026-30	2,20%	6,24%	5,09%	3,90%	4,22%	4,57%
Rebase	Y/N		no	no	yes	yes	yes
	How big		no	no	163	119	163
1) Total cap (2021-30) - EU27+EEA							
		13781	12596	12201	11712	11845	12270
(2) Average relative deviation difference between the cap and projected emissions per year compared to the baseline difference							
			-30%	-40%	-53%	-50%	-39%

Option AMB1, though the LRF increase is highest, has the highest cumulative cap, i.e. lower overall environmental impact, because the LRF update is applied only in 2026 without rebasing. This is also reflected in a higher value of indicator (2) on the cap to emissions relative deviation.

For options AMB2a and AMB3c the cumulative cap indicator results in a similar 2021-30 total cap, and similar relative deviation of cap to projected emissions.

[101] Projected emissions based on PRIMES-GAINS

Option AMB2b and AMB2c have a similar 2021-30 total cap, and similar delta of cap to projected emissions, i.e. a bigger alignment to projected emissions.

In addition to GHG emissions, many installations covered by the ETS, which remain within the scope of the Industrial Emissions Directive, also emit a significant amount of other air pollutants (e.g. NO_X, SO_X and dust). In general, it is expected that the decarbonisation of industry and power generation will also lead to further emission reductions of those air pollutants,[102] with the corresponding positive effect on air quality, and consequently on health and well-being.

For example, GAINS modelling indicates that 2030 sulfur dioxide (SO_2) emissions compared to 2015 decrease by 57% in REF and 69% in MIX[103]. The modelling also projects in 2030 13% less use of biomass as fuel in MIX compared to REF, and 2% less than in 2020, mitigating conflicts with objectives for sustainable land/forest use and biodiversity. It is thus expected that the strengthened ETS target/cap will overall contribute to the zero pollution ambition of the EU Green Deal. In this respect, the ETS and the Industrial Emissions Directive will reinforce one another to reduce emission of GHGs and other air pollutants.

6.1.1.2 Market Stability Reserve

The environmental effects of the MSR are determined by how it functions in terms of eliminating the historical surplus, and thus making the ETS more resilient in relation to supply-demand imbalances.

In addition to the direct impacts on emission reductions, a more stable and stronger carbon price signal should also allow the ETS to better support the achievement of the EU wide 2030 targets for renewable energy and energy efficiency.

The analysis has shown that, for a given cap pathway, the choice of the MSR option does not influence emissions in a significant manner, since in the model, companies optimise their behaviour in the long term, looking at the cap level in 2030, which is the same for all options (see Figure 4 in Section 6.1.2.1.2 below). Emissions under MSR2 are slightly

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102 Wood, Wider environmental impacts of industry decarbonisation, 2021; Vandyck et al., Air quality co-benefits for human health and agriculture counterbalance costs to meet Paris Agreement pledges, Nature Communications 2018, vol. 9, p. 493 ff.

103 For Member State results see the "Technical Note on the Results of the "Fit for 55" core scenarios for the EU Member States".

lower relative to MSR0+ and MSR1. Under the MSR0+ and MSR1, 2030 emissions reach 1,013 $MtCO2_e$ and 1,003 $MtCO2_e$ respectively. This compares to 2030 emissions of 968 $MtCO2_e$ under MSR2. However, it should be noted that these emissions projections are not directly comparable to those from energy system models which optimise for the entire energy system. The key insight from these numerical projections is that MSR intakes play a minor but positive role in reducing emissions further under the EU ETS.

6.1.1.3 Framework to address the risk of carbon leakage

The environmental outcome of the ETS in terms of GHG emissions in the EU is determined by its overall cap and is in principle independent of the level of free allocation. The risk of carbon leakage occurs when a reduction in domestic production is replaced by more emissions intensive production in other jurisdictions. This is important to consider since it may appear that the carbon price has reduced emissions. However, if production has simply moved to a jurisdiction with less stringent environmental regulation, emissions could fall in the European Economic Area but increase overall.

An effective carbon leakage protection mitigates the risk that more ambitious EU emission reductions are offset by emission increases outside the EU. A strengthened cap in the ETS Directive could affect the protection against the risk of carbon leakage by triggering the cross-sectoral correction factor (CSCF). The impact of the tiered approach (option CL1) and the strengthened benchmarks (option CL2) on the triggering of the CSCF is assessed in Section 6.1.2.2.4. .

Options CL1 and CL2 provide also some incentives to reduce emissions in the EU by exposing some sectors to higher carbon costs.

6.1.1.4 Innovation Fund

The IF was set decided with a clear objective of funding the commercial demonstration of innovative low-carbon technologies, aiming to bring to the market industrial solutions to decarbonise Europe and support its transition to climate neutrality.

The 311 projects submitted under the Innovation Fund's first call for proposals promise to reduce around 1.2 Gt of CO_2 emissions in their lifetime. Option IF1 and even more so IF2 would enable more of the projects which cannot be funded by the current size of the Innovation Fund to receive support and can help materialise a higher share of the GHG emissions that the applicant projects can realise[104].

Further analysis of the applications[105] shows the main technological pathways employed in the eligible sectors are in line with the long-term decarbonisation strategies of the sectors and can contribute significantly to EU transition to climate neutrality. The Innovation Fund is able to support a very wide variety of clean tech solutions, reducing emissions in multiple sectors in a synergistic and cross-cutting manner. More analysis is available in Annex 11.

6.1.2 Economic impacts

The transition to a climate-neutral economy will be transformative. This initiative expects to have a direct impact by steering investment and growth in the ETS sectors towards sustainable products and processes. The Impact Assessment accompanying the 2030 CTP found that by 2030 the investment stimulus and the use of carbon pricing revenue for the reduction of distortionary taxes or green investment can stimulate GDP growth by up to 0.5%, but highlighted the asymmetric challenges and opportunities associated with structural change. For high-emitting activities, the cost of emitting and cost of transformation may be higher[106].

The economic impacts of the cap options cannot be dissociated from the MSR options because it is the combination of both that will determine the market balance and resulting price signal. In the same way, the competitiveness assessment of sectoral impacts on energy intensive sectors are primarily driven by the carbon leakage protection options. Therefore, in this section the economic impacts are divided in two assessments: market balance and competitiveness.

[104] Deployment of innovative technologies for decarbonisation will generally also have a positive direct impact on air emissions, particularly of NOx and SOx. Reduction of atmospheric pollutant emissions limits their deposition in water bodies and soils and in this way reduces risks associated with the contamination of water and soil deriving from conventional technologies. See Wood (2021).

[105] https://ec.europa.eu/clima/sites/clima/files/innovation-fund/large-scale_call_statistics_en.pdf

[106] SWD(2020)176, Section 6.4.2

6.1.2.1 Market balance

In this section we assess the impacts of different MSR options combined with different cap options on the total number of allowances in circulation, the carbon price, price stability and revenues. We explore the performance of alternative MSR options under the central cap option AMB2a (LRF that will take effect in 2024). This cap option was selected because it is central in terms of cumulative cap outcome, but also because the final outcomes with different cap options are quite similar in terms of outcomes in 2030, emissions and modelled price trends. The outcomes were also tested against a range of shocks (see Annex 8, Section 22), for other cap options (AMB1, AMB2b) and for several policy sensitivities, including more extreme cap scenarios (see Annex 8, Section 23).

Details on the modelling approach and assumptions used, as well as guidance on interpreting the modelling results are provided in Annex 4, Section 9.1. It is important to note that the modelling outputs are not intended to be used as forecasts for prices and emissions. However, when combined with qualitative and quantitative insights, they can provide useful indications of the direction and size of impact.

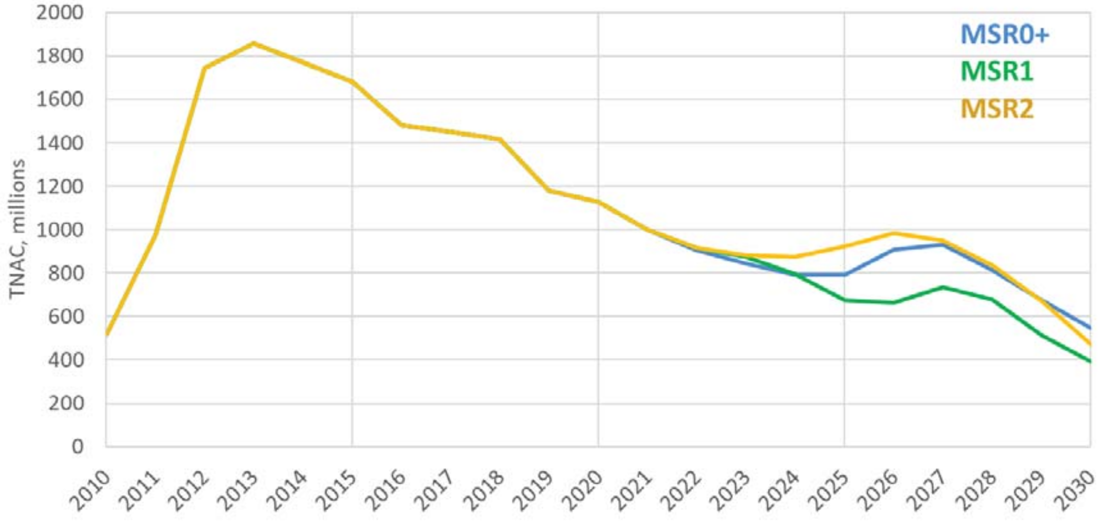
Consistent with recent price developments, modelled behaviour suggests that the expectation of substantially enhanced ambition in the EU ETS increases short term price expectations. These increased prices, alongside the economic shock accompanying COVID-19, contribute to substantial hedging over Phase 4 of the EU ETS.

6.1.2.1.1 *Market surplus (TNAC) and MSR dynamics*

With the central cap scenario, the TNAC diverges across MSR designs in the middle of this decade, before trending towards a level of 450 million in 2030. However, the TNAC trend is uncertain in the near term as the speed of economic recovery and industrial activity following the COVID-19 impact remains unclear. In the modelling analysis, TNAC lies above 800 million before 2025 across all MSR options, resulting in continuous MSR intakes during this period. The evolution of TNAC over time is jointly determined by annual supply of allowances and the emissions pathway. A more stringent MSR removes a larger supply of allowances through intakes (downward effect on TNAC), with a secondary effect of lowering annual emissions by encouraging expectations of future scarcity in the market (upward effect on TNAC). On balance, the first effect dominates the second. The pathway for TNAC under respective MSR options is shown below.

A comparison of the MSR options must also take into account the levels of the thresholds retained, in particular of the upper threshold, and the evolution of the TNAC in relation to that upper threshold. For instance, for similar TNAC outcomes, an option with an upper threshold of 833 million could be more effective than an option with a lower threshold, in particular taking into account the uncertainties in terms of future liquidity needs of the market (including hedging needs, as set out in Annex 8, Section 24)

Figure 3: TNAC under different MSR options with central cap scenario AMB2a



Source: Vivid Economics

Over the period of 2021-30, cumulative MSR intakes under MSR1 and MSR2 are 1.5 and 1.6 billion respectively, compared to 1.2 billion under MSR0+. The volume of intakes under MSR1 is greater than MSR0+ because of the higher intake rate. By contrast, MSR2 results in larger MSR intakes, as the TNAC is higher.

MSR0+ is not able to reduce the TNAC sufficiently, due to its lower intake rate. The TNAC remains above the upper threshold until the end of the period.

The ability of MSR1 to reduce TNAC relatively quickly comes at the expense of a threshold effect, when TNAC dips below the intake threshold. The threshold effect occurs when the volume of MSR intakes drops suddenly, which is the result of calculating intakes as a fixed percentage of the TNAC and of having a fixed upper threshold. The threshold effect is visible as a jump in auction volumes and a kink in the TNAC pathway. In the given scenario for MSR1, this occurs in 2027/28. The presence of such a threshold effect can introduce uncertainty to market participants, who face ambiguity about the short-term auction supply as TNAC approaches the upper threshold. The realisation of TNAC being right above or below the threshold can represent a sizeable shock to annual auction volumes, resulting in sharp changes in prices.

By contrast, MSR2 is able to avoid the threshold effect. This is because intakes under option 2 are calculated as a percentage of the difference between TNAC and the intake threshold, resulting in smaller intakes as TNAC approaches the intake threshold.

MSR3 should result in a similar market surplus to MSR2. MSR3 follows the design of MSR2, with the only difference being the introduction of an auction reserve price. In all cases explored in the modelling analysis, the price under MSR2 does not fall below the auction reserve price.

Invalidation

Across all options, the vast majority of allowances that are placed into the MSR eventually get invalidated:

- MSR0+, as currently legislated, invalidates allowances within the MSR in excess of the prior year auction volume.
- MSR1 follows this invalidation mechanism, resulting in a similar downward trend in the stock of allowances held in the MSR.
- MSR2 and MSR3 however, invalidate allowances in excess of the lower threshold, and do not completely remove the MSR stock. As a result, the residual MSR stock under MSR2 and MSR3 remains at around 400 million allowances, which are available for injections in the case of supply shortages. Across all MSR options, modelling shows releases would only take place in the 2030s with a cumulative size of 400 to 500 million allowances. This is relatively small when compared to the cumulative MSR invalidations that range from 3 billion under MSR0+ to 3.5 billion under MSR2.

The precise design of the invalidation mechanism is not consequential to market outcomes in 2021-30, given that almost all allowances placed in the MSR are invalidated. Given the constrained foresight of market actors assumed in the analysis, as long as there are no significant volumes of release from the MSR in the 2020s or 2030s, the market's forecast of the future supply of allowances is independent of the timing in which allowances get invalidated within the MSR. What matters to market participants is the supply of allowances in the medium term, which is more influenced by MSR intakes rather than releases. The presence of the invalidation mechanism remains important as a guarantee that allowances stored in the MSR will not be released back into future auctions in large volumes.

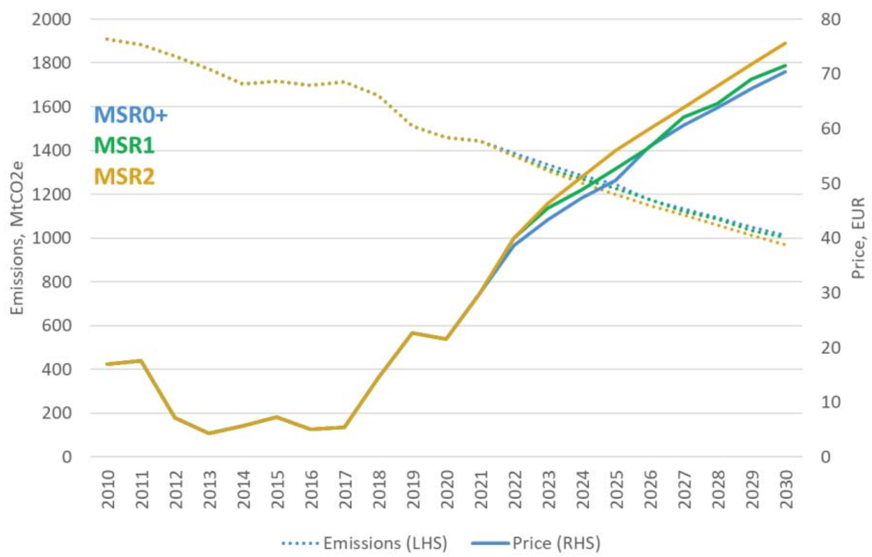
6.1.2.1.2 *Stylised impact on carbon prices from different options*

This section assesses how different MSR options combined with cap scenarios, can impact the carbon prices. As indicated, the modelling outputs are not intended to be used as forecasts for prices and emissions. In particular the modelling focuses on carbon prices as adjustment variable and does not well cover the overall policy mix. Moreover, the expectations of firms on the future supply of allowances (even past the 2030 horizon) plays a big role in the model, in terms of emissions, hedging and carbon prices (see also

Annex 4 Section 9.1). However, when combined with qualitative and quantitative insights, the model can provide useful indications of the direction and size of impact.

Other models discussed in this Impact Assessment (see Sections 5.1 and 8) have provided different carbon price values. The MIX and MIX-CP -55% policy scenarios of the PRIMES energy system model, which both assume a parallel strengthening of renewable energy and energy efficiency policies, albeit less strong in MIX-CP, as well as foresight of market actors on future emission reduction requirements, project for the existing ETS an increase of carbon prices in 2030 from €30 in REF to €48 and €52.5 (in constant 2015 prices), and see stronger increases only after 2030. The characteristics of the Vivid ETS MSR model used here are set out in Annex 4, Section 9.1. A key difference is the way other policies are modelled. The results of both models for 2030 fall within the very broad range of 2030 carbon price projections of carbon market analysts for 2030[107].

Figure 4: Stylised representation of emissions and carbon prices across different MSR scenarios for the central cap option AMB2a.



Note: Prices are presented in constant 2015 prices.

Source: Vivid Economics

[107] Carbon Pulse Daily of 8 April 2021: POLL: Big boost for EU carbon price forecasts as several analysts see EUAs topping €100 this decade; ICIS: European carbon market to shift gear, February 2021.

With the central scenario AMB2a, modelled prices are the highest under MSR2, because MSR2 leads to the highest intakes into the MSR, which then affects the scarcity expectations of market participants. Prices are lowest under MSR0+, i.e. ca 7 % lower than in MSR2 scenario. MSR1 sees higher prices than MSR0+ in the first half of this decade driven by larger intakes and therefore tighter supply. However, as intakes under MSR1 come to an end earlier than under MSR0+, their price paths converge towards 2030.

Modelling outcomes under MSR3 are the same as MSR2, though the inclusion of short-term responses should mitigate short run price volatility. The inclusion of an auction reserve price under MSR3 simply introduces a lower bound to the range of prices in the market. In the assumed policy environment, this lower bound is not breached throughout the time horizon in the absence of large shocks (see sensitivity analysis in Annex 8, Section 22).

Modelling indicates that the increase in EU ETS ambition through changes to the cap is a much more significant driver of the price trajectory than the MSR.

The variation in prices under different cap scenarios is small, as less stringent cap scenarios face higher intakes to the MSR during 2021-2030. For instance, with MSR0+, differences in adjusted supply across cap variations become even smaller, leading to less price variation. Caps which are initially less stringent, such as AMB1, have a higher surplus of allowances in earlier periods due to greater annual supply. This increases the TNAC during 2021-2030, which subsequently increases intakes into the MSR, reducing auctioned allowances and the effective cap. This leads to similar price outcomes across the different caps.

6.1.2.1.3 *Price volatility*

The smooth price paths depicted in the graph above is a result of modelling assumptions and the annual reporting period in the model. In practice, shocks will introduce short term volatility within time spans of weeks or months. These short-term shocks are not captured through the quantitative model deployed for this Impact Assessment. This section examines how the MSR can influence price stability in the short term, while Annex 7, Section 22 discusses the MSR in response to longer term, structural shocks.

In the context of MSR design, clear and predictable intakes will help reduce supply side uncertainty.

As noted in the previous section, both the MSR0+ and MSR1 are prone to a threshold effect[108], depending on the level of TNAC. This represents a major source of uncertainty to market participants as TNAC approaches the upper threshold, a very plausible case for the decade 2021-30. Prices may become volatile as market expectations regarding the level of TNAC swings back and forth depending on forecasted emissions, as the precise number of TNAC will be influential to allowance supply.

Predictability is one of the main advantages for the intake design proposed for MSR2. Intakes under MSR2 are proportional to the difference between TNAC and the upper threshold, resulting in a smooth response function. This will prevent the price volatility associated with the threshold effect as in the case of the baseline and option 1. At the same time, option MSR2 may be more complex and more difficult to understand by market participants, thereby contributing negatively to price volatility.

In order for MSR1 and MSR2 to contribute to price stability, they should not reduce the surplus to an unreasonable extent and thus provide sufficient market liquidity. For the market to operate effectively, the TNAC needs to be high enough to allow for hedging as well as efficient banking to spread out intertemporal abatement costs. Therefore, the MSR thresholds play an important role in ensuring that the TNAC stays at a reasonable range. The analysis showed that the intake threshold analysed in MSR1 and MSR2, starting at 700 million in 2024, sits within the range of the estimated amount of market surplus required for hedging between 2025 and 2030. At the same time, the MSR0+ threshold of 833 million could also be appropriate in the first part of the decade, providing additional liquidity and reassurance to the market, by avoiding short-term situations in which the liquidity would be too tight.

MSR3 may provide additional stability by constraining market expectations regarding potential extreme price outcomes. The introduction of an auction reserve price would create a floor on market price expectations, which would reduce uncertainty in the event of downside shocks, such as a negative demand shock. At the same time, this option could introduce speculation opportunities and volatility in the case the carbon price is close to the price floor.

6.1.2.1.4 *Auction revenues*

Auction revenues for the existing ETS were conservatively estimated using reference carbon prices in line with Section 5.2.1, and the auction volumes after the application of

[108] If TNAC is just above the intake threshold, the MSR will remove over 100 million allowances from subsequent auctions, compared to zero intakes if TNAC is just below the intake threshold

the MSR that resulted from the Vivid EU ETS model (see Annex 13). Under MSR1 and MSR2, the cumulative auction revenues at the end of 2030 are lower than the baseline due to larger reductions in auction volume.

The size of auction revenues is jointly determined by the volume of auctions and the EUA price. Due to larger intakes under MSR1 and MSR2 as compared to MSR0+, cumulative auction volumes are 3% lower with MSR1, and 6% lower with MSR2, relative to MSR0+ between 2021 and 2030. As a result, compared against the baseline, auction revenues are 4% lower in MSR1 and 6% lower in MSR2.

6.1.2.2 Competitiveness

6.1.2.2.1 *Strengthening of the EU ETS target/cap*

Even though all cap options achieve the 2030 target, they each have an impact on the overall amount of allowances and therefore different impacts the risk of carbon leakage. The risk of carbon leakage in turn affects competitiveness of EU firms, with potential impacts on growth and jobs. If international competitors do not need to comply with equally stringent carbon regulation, the carbon price creates a differential in production costs. As a result, domestic firms are competing in markets (through imports or exports) where foreign producers may not face an equivalent carbon price. This potential loss of competitiveness can cause firms to reduce their production or investments into productive capacity, with implications for local growth and employment. The evidence on the existence of carbon leakage in scientific literature is summarised in the CBAM IA.

This section investigates the impact of options on the framework to address the risk of carbon leakage, on the compliance costs at sector level and the possibilities to pass on these compliance costs to consumers. This analysis is supplemented by a qualitative assessment on incentives for innovation which will determine carbon costs in the long-term.

The analysis carried out in the context of the 2030 Climate Target Plan included detailed modelling of economic impacts, including sectoral impacts, which indicated that without increased global action, increasing climate ambition in the EU typically results in a negative impact for the energy-intensive sectors. Impacts are significantly limited with free allocation. Sectoral production can be positively impacted if the climate policy and any associated carbon revenues are seen as boosting investment and economic development[109]. None of the modelling assumed any additional measures to protect against the risk of carbon leakage.

Compliance costs depend on the carbon price, the level of free allocation, and the amount of emissions released during production. The carbon price is not directly impacted by the modalities for the distribution of free allocation, as the total amount of allowances available (the cap) has been fixed in advance (see Section 5.2.3.1 on the strengthening of ETS target) and is not affected by the modalities of allocation (auctioning or free allocation).

The compliance costs borne by sectors are ultimately dependent on their ability to pass through carbon costs to their customers. The ETS Directive already recognises this fact emphasising that the level of carbon leakage risk faced by sectors depends on the extent to which it is possible for these sectors to pass through their costs without losing market share. A general understanding is that carbon-intensive sectors are able to pass through at least a part of the carbon costs, but it remains to date difficult to quantify the exact rate of costs passed through per sectors or products.

At the same time, it is reasonable to assume that climate policies will become more stringent in other countries over time, which could lead to increased, or at least stable, cost pass-through rates for some products. As the number of allowances will decrease over the next decade, it is likely that industries will face increased compliance costs after 2020 but this will ultimately depend on the ability to increase carbon efficiency in production, and the ability to pass on carbon costs, e.g. through more specialised products. Considering that a share of carbon costs is likely to be passed through, it can effectively limit carbon cost increases for industrial sectors. In some cases, additional carbon costs may be more than fully offset by increases in product prices.

For the free allocation element, the more stringent the cap update, i.e. lower total cap for the period 2021-30, the lower the total volume available for free allocation. Table 6 provides the overview of the cap update options with the resulting free allocation budget, where the reference allowance distribution is the current legislative framework with 57% auction share, 3% free allocation buffer and existing fund size framework. The calculation of the year when the CSCF is triggered and of its average value in the period from 2026 to 2030 is described in Annex 4.

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[109] SWD (2020), Section 6.4.2, Table 16 and Annex 9.5.3, Table 49

Table 6: Impacts of the cap trajectory options on free allocation

	Baseline	AMB1	AMB2a	AMB2b	AMB2c	AMB3c
Total cap (2021-30) - EU-27+EEA	13 781	12 596	12 201	11 712	11 845	12 270
Free Allocation (excluding amount earmarked for Innovation Fund)	5601	5091	4921	4711	4768	4951
Free allocation buffer (3%)	413	378	366	351	355	368
Delta to baseline for total free allocation	-	-9%	-12%	-16%	-15%	-11%
Year when CSCF is triggered	-	2030	2029	2028	2028	2029
Average CSCF for the period 2026-30	100%	94%	88%	79%	82%	89%

Option AMB1 (new LRF from 2026, no rebasing) would trigger the application of the cross-sectoral correction factor (CSCF) in 2030 while Option AMB2c (new LRF from 2024, rebasing by 117 million allowances in 2024) will likely do so from 2028 onwards. For the period 2026 to 2030, the average CSCF would be 94% for AMB1 (that means that free allocation amounts would be reduced by 6%) and 82% for AMB2c. The use of the CSCF will reduce the amount of free allocation across all industry sectors, independent of the degree to which they are actually at risk of carbon leakage.

In order to assess the economic impacts of the strengthened emission cap, the estimated free allocation was subsequently compared with the projected emissions for 10 ETS sectors which together receive more than 85% of the total free allocation (i.e. cement, lime, refineries, iron and steel, fertilisers, ceramics, non-ferrous metals, chemicals, pulp and paper, glass). For each of the sectors, a yearly improvement in the greenhouse gas efficiencies ranging from 1% to 2% was assumed. The potential carbon costs were then calculated by multiplying the assumed EU allowance price with the difference between projected emissions and free allocation (see Annex 4). Table 7 shows selected economic impacts of the options for strengthening the EU ETS Target on these 10 ETS sectors. The table only shows carbon costs and does not include investment and operating costs needed to abate emissions.

Potential carbon costs range from EUR 38 to 52 billion, depending on the cap trajectory, as compared to costs of EUR 18 billion in the baseline scenario. This translates into carbon costs in the range of 1.8% to 2.5% per value added for the different cap trajectories, while the carbon costs in the baseline scenario would amount to around 0.9% per value added. The cost increase from the baseline scenario to AMB1 is in the order of

EUR 20 billion and is mostly due to the projected carbon price increase. The cap scenario AMB2b with the highest cumulated cap reduction would increase carbon costs to EUR 34 billion due to increased carbon prices and reduced free allocation. Under the described assumptions, the increase in the EUA price will likely have a bigger influence on the carbon costs than the reduced free allocation.

Table 7: Economic impacts of different cap trajectory options for 10 ETS sectors

Impact	Unit	Cap trajectory option					
		Baseline	**AMB 1**	**AMB 2a**	**AMB 2b**	**AMB 2c**	**AMB 3c**
Cumulated free allocation for the period 2021-30	million EUAs	4892	4757	4598	4401	4455	4626
Cumulated projected emissions for the period 2021-30	million t CO_2 equivalents	5706	5706	5706	5706	5706	5706
Difference between emissions and free allocation	million EUAs	813	948	1108	1305	1251	1080
	% of emissions	14%	17%	19%	23%	22%	19%
Net direct carbon costs	EUR billion NPV 2021-2030 (2015 prices)	18	38	45	53	50	43
	% of value added	0.88%	1.8%	2.1%	2.5%	2.4%	2.1%
	% of production value	0.17%	0.34%	0.40%	0.47%	0.45%	0.39%
	% of EBITDA	1.8%	3.7%	4.3%	5.0%	4.8%	4.2%
NB: The figures only refer to 10 ETS sectors: cement, lime, refineries, iron and steel, fertilisers, ceramics, non-ferrous metals, chemicals, pulp and paper, glass.							

6.1.2.2.2 *Market Stability Reserve*

As regards in particular the MSR, there are two expected channels by which the cap setting and the MSR option chosen, and thereby the total number of allowances in circulation, may affect competitiveness:

• Volatility: by reducing price volatility, which reduces uncertainty for the longer term;

• Carbon prices: by contributing to increasing prices, which increases production cost for emitters.

Direct estimates of the MSR's impact on competitiveness and growth through reducing volatility are currently limited. Venmans (2016) found that allowance price volatility was seen as an incentive for abatement investment by some but a disincentive by others.[110] This means that it is difficult to predict the effect that the MSR will have on competitiveness through the volatility channel without more study on behavioural responses of firms.

Given their largely comparable and limited impact on price levels (see Section 6.1.2.1.2 above), the different MSR options will have minimal differences in terms of carbon leakage and competitiveness. Given the lack of adverse impacts on competitiveness and leakage so far from the EU ETS price in general, the small levels of price rise driven by the various MSR options are unlikely to bring significant negative competitiveness impacts. With regards to the price level, the stringency of cap is much more consequential than the MSR design.

The design of MSR2 and MSR3 may able to improve the predictability of the occurrence of intakes as compared to the baseline and MSR1, representing a minor advantage for competitiveness. As intakes are more predictable and continuous throughout the time horizon, MSR2 and MSR3 can reduce uncertainty on the supply side (see Section 6.1.2.1.1). The exact impact on competitiveness has not been quantified in the literature. However, the magnitude of such an impact is likely much smaller than that of the expected increase in prices and the phasing out of free allocations that may accompany the introduction of a CBAM.

6.1.2.2.3 *Framework to address the risk of carbon leakage*

As shown in Section 6.1.2.2.1, the options for the cap trajectory and the auction share likely mean that the cross-sectoral correction factor (CSCF) will be applied, whereby free allocation is adjusted downwards in a uniform manner across all sectors. To reduce the likelihood or the extent to which the CSCF would need to be applied, the tiered approach (CL1) aims at better targeting free allocation to ensure that the sectors at highest risk of carbon leakage continue to receive free allocation at 100% of the benchmark level. Table 8 shows that the tiered approach avoids the application of the CSCF for most of the cap trajectories (compare with Table 6).

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[110] Venmans, F. (2016) - "The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS", Journal of Cleaner Production

Table 8: Impacts of a tiered approach from 2026 onwards on free allocation for different cap trajectory options

	Baseline (CL0)	AMB1 and CL1	AMB2a and CL1	AMB2b and CL1	AMB2c and CL1	AMB3c and CL1
Year when CSCF is triggered	-	-	-	2029	2030	-
Average CSCF for the period 2026-30	100%	100%	100%	92%	94%	100%

Strengthening the benchmark values by increasing the maximum update rate (CL2) also aims at better targeting free allocation. Table 9 shows that this approach does not avoid the application of the CSCF for most cap trajectories, but that the average CSCF applied is around 7% higher compared to the cap trajectories without strengthened benchmark values (compare with Table 6).

Table 9: Impacts of strengthened benchmarks from 2026 onwards on free allocation for different cap trajectory options

	Baseline (CL0)	AMB1 and CL2	AMB2a and CL2	AMB2b and CL2	AMB2c and CL2	AMB3c and CL2
Year when CSCF is triggered	-	-	2030	2029	2029	2030
Average CSCF for the period 2026-30	100%	100%	95%	86%	88%	96%

Table 10 below provides figures for the projected cumulated emissions and free allocation over the period 2021 to 2030 for the most important industry sectors. The cumulated free allocation was estimated for the two cap trajectory options AMB1 and AMB2b, in combination with the tiered approach (option CL1) or the strengthened benchmarks (option CL2).

As can be seen from the average CSCF, both the tiered approach and the strengthened benchmarks reduce the extent to which the CSCF would need to be applied. In the case of the cap trajectory AMB1, the application of the CSCF could be avoided.

Table 10: Projected cumulated emissions and free allocation over the period 2021 to 2030 per industry sector for cap trajectory options AMB1 and AMB2b in combination with a tiered approach (option CL1) or strengthened benchmarks (option CL2)

	Option						
	All options	**AMB1 and CL0**	**AMB1 and CL1**	**AMB1 and CL2**	**AMB2b and CL0**	**AMB2b and CL1**	**AMB2b and CL2**
Average CSCF for the period 2026–2030	**NA**	**94%**	**100%**	**100%**	**79%**	**92%**	**86%**
Sector	**Projected cumulated emissions in million t**	**Cumulated free allocation in million EUAs from 2021 to 2030**					
Cement	1079	903	929	929	834	891	864
Lime	238	158	131	145	146	127	137
Refineries	1014	764	786	784	708	754	731
Iron and Steel	1609	1440	1481	1457	1332	1420	1358
Fertilizers	286	263	271	261	243	260	244
Ceramics	61	44	36	40	41	35	38
Non-ferrous metals	163	139	114	137	128	111	128
Chemicals	891	703	583	683	651	565	639
Pulp and Paper	209	233	194	209	216	189	197
Glass	156	109	91	110	101	88	103
Other sectors	ND	712	641	661	661	622	624
Total	ND	5469	5259	5417	5062	5062	5062
NB: ND = not determined.							

In terms of total free allocation, two cases can be distinguished. In the case of the cap trajectory AMB1, the total free allocation is reduced both by the tiered approach and the strengthened benchmarks. This is, first, because the total amount available for free allocation determined by the minimum auction share is not exceeded and, second, because the tiered approach reduces free allocation for sectors that are not deemed to be at highest risk (e.g. chemicals, pulp and paper, other sectors) or because the strengthened benchmarks reduce free allocation for sectors where high benchmark update rates were applied for the period of 2021 to 2025 (e.g. pulp and paper, other sectors). However, in the case of cap trajectory AMB2b, the tiered approach and the strengthened benchmarks do not affect the total free allocation, as the total amount available for free allocation is determined by the minimum auction share. Therefore, the overall carbon costs remain unchanged by the application of the CL options, while sectoral impacts differ.

Both the tiered approach and the strengthened benchmarks lead to a redistribution of free allocation between sectors. A sector with less free allocation will face increased carbon costs while a sector with more free allocation will face reduced carbon costs. In the case of the tiered approach, free allocation is more focused on sectors at highest risk of carbon leakage (i.e. cement, refineries, iron and steel, fertilizers) while it decreases for sectors at medium risk (i.e. lime, ceramics, non-ferrous metals, chemicals, glass, other sectors).

In the case of strengthened benchmarks, a similar tendency can be observed, although it is generally less pronounced. Depending on the sector, free allocation increases (i.e. for cement, refineries, iron and steel), remains roughly constant (i.e. for fertilizers, non-ferrous metals, glass) or decreases (i.e. for lime, ceramics, chemicals, pulp and paper, other sectors), reflecting the sectors' emissions efficiency improvements. Free allocation would be reduced most in those sectors where emission intensities from the best installations are furthest below the existing benchmark values, either because benchmark values were historically set at too high values or because of improvements in emissions intensity. The option thus better reflects the actual emission intensity improvements of different sectors and reduces the risk of granting free allocation above the emission levels to sectors in which an important share of the installations is operating below current benchmark levels.

Implementing the tiered approach (option CL1) would imply revising the list of sectors deemed to be at risk of carbon leakage and to implement a more complex methodology in which different levels of risk can be identified. If the analysis is kept at a quantitative level based on the current carbon leakage indicator (based on the trade and emissions intensity of the sector), this additional burden would be limited. The strengthened benchmarks (option CL2) would not imply any additional administrative burden compared to the baseline. Under the current legislation, the benchmark values to be applied during the period from 2026 to 2030 will be based on data for the years 2021 and 2022. Changing the maximum update rate that can be applied to a benchmark will not impact the level of complexity of the exercise, only its possible final result.

To conclude, the likelihood or the extent to which a CSCF would need to be applied would be reduced by option CL1 and, to a lesser, but still significant extent, by option CL2. This is particularly relevant for cap scenarios with rebasing. In cases where there is no shortage of free allowances, options CL1 and CL2 reduce the total amount of free allocation. However, this should not substantially increase the risk of carbon leakage as the most exposed sectors maintain their free allocation in option CL1 or experience a lower reduction under option CL2 as the revised benchmarks better reflect the actual performance of the installations. In addition, some positive economic impacts from additional auctioning revenues could be expected. Both the tiered approach and the strengthened benchmarks lead to a redistribution of free allocation between sectors whereby the available free allocation is better targeted to sectors at highest risk of carbon leakage.

6.1.2.2.4 *Improving support for low-carbon investment and innovation through the existing Innovation Fund*

The Innovation Fund will further incentivise innovation and research in sustainable technology, products and processes and carbon removals solutions, including possibly in new sectors included in the ETS. The ETS Innovation Fund can already now support production, use and storage of zero-emission fuels in buildings and transport as well as other activities relevant for these sectors, such as substitute products (e.g. innovative wood construction instead of bricks and cement).

In the existing ETS, 450 million allowances are used for the Innovation Fund of which 325 million allowances are taken from the total amount available for free allocation. Under option IF1, the latter amount would not change and therefore the application of the CSCF will not be affected in comparison to the baseline. Under option IF2, additional 50 million allowances from the free allocation budget are earmarked for the Innovation Fund. This leads to a small increase of the impact of the CSCF (before applying CL1 or CL2, see Table 13 below in comparison to Table 6 above). Out of the 83% respondents to the OPC in favour of an increase of the Innovation Fund, 45% indicated that it should be increased by using more allowances from the auction share, while 9% indicated that the allowances should come from free allocation.

Table 11: Impacts of a further increase of the Innovation Fund (option IF2) from 2026 onwards on free allocation for different cap trajectory options

	Baseline	AMB1 and IF2	AMB2a and IF2	AMB2b and IF2	AMB2c and IF2	AMB3c and IF2
Delta to baseline for total free allocation	-	-10%	-13%	-17%	-16%	-12%
Year when CSCF is triggered	-	2030	2029	2028	2028	2029
Average CSCF for the period 2026-30	100%	93%	86%	78%	80%	87%

Both options IF1 and IF2 will enable more projects to be funded that will bring emission reductions, improve the competitiveness of the companies behind them, make them global leaders in exporting clean tech solutions and create clusters of low-carbon innovation all across Europe with the associated economic and employment benefits. The negative effects of the increased likelihood of triggering the CSCF in option IF2 may be offset by these positive effects and the increased resilience of companies that invest in clean tech solutions.

6.1.2.2.5 *Carbon Border Adjustment Mechanism (CBAM)*

The assessment of a CBAM as a measure to address the risk of carbon leakage is part of a separate impact assessment accompanying a separate legal proposal. That impact assessment covers the selection of sectors for the CBAM, its design and the modelling of related impacts. The introduction of a CBAM is likely to have an impact on the existing framework to address the risk of carbon leakage and in particular on free allocation. This is because both free allocation and the CBAM share the same objective: to prevent the risk of carbon leakage. They are therefore alternative measures.

Depending on the actual design of the CBAM, two cases can be distinguished.

In the first case, a CBAM option is chosen that does not affect free allocation (e.g. CBAM IA option 6: consumption charge). In this case, no changes to the free allocation mechanism are necessary.

Alternatively, a CBAM is established for selected sectors whereby importers pay for the embedded emissions in the imported products and free allocation is gradually reduced for these sectors (e.g. during a transitional period) until free allocation is completely abandoned (i.e. all options in the CBAM IA based on a notional ETS or import tax). If such an option is chosen and gradually phased in, the reduction of free allocation should mirror the pace of increase of the CBAM charges, in order to ensure that an adequate level of carbon leakage protection is maintained and at the same time no double protection occurs.

As free allocation is reduced, the question arises whether, when and by how much the minimum auction share in the ETS Directive should increase, because the selected sectors will need to buy their allowances on the market. If the auction share in the ETS Directive is kept unchanged, it means that the same amount of free allocation remains available to a smaller number of sectors. An obvious response to the reduced entitlements to free allocation would therefore be to increase the auction share corresponding to the reduction of free allocation of the CBAM sectors. In such a case there should be no impact on the likelihood and the extent of the CSCF.

If, for example, iron and steel, cement and fertilisers were covered by the CBAM, the impact on the quantities of allowances allocated for free would be significant, as these three sectors are expected to receive more than 45% of the total free allocation in the period from 2021 to 2025.

The sectors falling under the CBAM would need to buy additional allowances compared to the current situation. Not allocating these allowances to the auction share could result in increasing scarcity and carbon prices in the short-term, depending on when unused free allocation (if any) would be auctioned. If the auction share were increased to incorporate all the free allowances destined for the three aforementioned sectors (i.e. iron and steel, cement, fertilisers), the auction share is estimated to increase from 57% to 77%.

6.1.3 Social impacts of strengthening the ETS

6.1.3.1 Impacts on employment

The macro-economic analysis conducted as part of the Impact Assessment accompanying the 2030 CTP concluded that the impact of an increase in climate ambition to -55% on aggregate employment would be relatively limited, ranging between -0.26% and +0.45%. The employment impacts are positive if carbon pricing revenues are recycled to lower other taxes or to support green investment[111].

A strengthening of the ETS as in options AMB1 to AMB3 and MSR1 to MSR2 is hence expected to have small effect on the employment as a whole. However significant shifts in the sectoral composition of employment and associated job changes that workers will have to go through are expected over the next decade, which would generate challenges for the labour force and potential mismatches between skills available and the skills requirements. These have been analysed in the Impact Assessment underpinning the 2030 CTP based on scenarios which assumed either global action with mitigation efforts that are compatible with the achievement of the 1.5°C target or “fragmented action” only assuming the implementation of Nationally Determined Contributions under the Paris Agreement as of 2018.

Employment in the coal sector, in particular, is expected to be around 50% below baseline by 2030. While this is not consequential in terms of total employment at the EU level, it has significant implications for some regions and local communities. Employment in the gas sector is expected to fall significantly as well, though less severely than for coal.

[111] SWD(2020)176, Section 6.5.1

Table 12: Impacts of 55% GHG reduction on EU sectoral employment in existing ETS sectors (deviation from baseline in 2030, in percent)

Employment vs. baseline, 2030	**Fragmented action**	**Global action**
Coal	-49.1 | -48.3	-47.1 | -46.3
Gas	-11.2 | -8.5	-7.9 | -5.8
Electricity supply including renewables	2.8 | 3.3	5.7 | 6.6
Ferrous metals	-4.1 | 0.1	2.2 | 7.0
Non-ferrous metals	-2.2 | -0.1	3.6 | 6.3
Chemical products	-0.8 | -0.1	0.6 | 1.4
Paper products	-0.4 | 0.1	0.0 | 0.7
Non-metallic minerals	-2.1 | 0.3	-0.1 | 2.7

Source: SWD(2020)176, JRC-GEM-E3 model

Conversely, electricity supply is likely to gain most significantly from a higher level of climate ambition by 2030, through increased green employment. The electrification of the economy and the switch to renewables, which tend to be relatively labour intensive, are naturally expected to generate higher employment in the sector.

For the industrial sector the direction of the impact depends on the extent of climate action in other parts of the world as well as on the carbon leakage protection framework. Therefore a just transition is an important aspect. The ETS recognises the asymmetric distribution of its impacts on certain regions and MS with lower GDP.

The transformation is likely to affect education and vocational training systems as re-skilling can enable impacted regions to capitalise on all possible new opportunities in sustainable technology development, products and processes through the transformation of their labour forces. For example, through Cohesion Policy and the Just Transition Mechanism, investments in renewable energy technologies are expected to be deployed across the EU, including in coal regions. In addition, investments from the Just Transition Mechanism will compensate the negative impacts of the transition for the territories identified in the Territorial Just Transition plans. ETS auctioning revenues could further contribute to mitigating social impacts.

It can be expected that differences of sectoral employment impacts across different options for strengthening of the ETS target and reviewing the MSR are limited.

The described macroeconomic modelling results assume that industry at risk of carbon leakage receives free allocation. Under a more targeted free allocation (options CL1 and CL2), the carbon costs for the sectors that receive less free allocation will be higher unless they can pass on the costs in the product price (less international competition). If there is no possibility to pass on costs in the product price, market shares could be reduced, which could lead to employment losses. However, since the reason for the lower allocation to some sectors would be the ability to pass on costs, this should limit the employment effects.

Overall, it is expected that the impact of the options to modify the framework to address the risk of carbon leakage are less pronounced than the impacts induced by the strengthened cap.

6.1.3.2 Other social impacts

This initiative also addresses the increasing concern of European citizens, and particularly younger generations, that urgent action is needed on climate change to ensure the wellbeing of future generations.

This initiative is likely to contribute to positive health impacts, reducing avoidable healthcare costs and mortality by reducing air pollution caused by fossil fuels and high-emission industrial processes, such as carcinogens and particulate matter. 2030 health damages in MIX are EUR 17.6 to 35.2 billion per year lower compared to REF.

6.2 **Extension of emissions trading or alternatives for the maritime emissions**

This section considers the four main policy options described in Section 5.2.3.1, which include the extension of the ETS to maritime transport (MAR1), a separate sectoral ETS (MAR2), a levy on ship GHG emissions (MAR3) and the extension of the ETS to maritime in combination with standards (MAR4). A summary of the policy options analysed is included in Annex 6.

For the purpose of this assessment, a comprehensive set of tools has been used ranging from specialised datasets and dedicated modelling tools such as the PRIMES-Maritime module and the GEM-E3 economic model. Details of this assessment are given in Annex 10 and details on the methodology used for the assessment of impacts is explained in Annex 4.

6.2.1 Environmental impacts

This chapter aims to assess how the different policy options can reduce the negative impact of maritime transport on climate change, air quality and marine biodiversity.

6.2.1.1 Changes in emissions of GHG

In the baseline scenario, GHG emissions from international navigation are expected to grow by around 14% between 2015-2030 and by 34% between 2015-2050, wiping out the positive effect of technical and operational energy efficiency measures and practices put in place since 2008. It would also make the increased EU climate objectives harder to achieve as it requires stepping up EU actions in all sectors, as highlighted in the 2030 communication.

In this context, the four policy options considered in this impact assessment have been developed in a way to ensure a reduction of GHG emissions commensurate with the increased climate effort expected in the ETS[112]. Depending on the policy option, the reduction in GHG emissions would either come from mitigation measures implemented in the maritime sector itself, or from the purchase of general ETS allowances (out-of-sector abatement). The impact of policy options in terms of absolute GHG emissions reduction will highly depend on the selected **geographical scope**. In principle, the broader the geographical coverage, the higher the climate impact ought to be. This, however, should be tempered by the fact that the geographical scope can also have an effect on the effective implementation of carbon pricing measures (e.g. risk of evasion).

The table below shows the level of **CO_2 emission reductions** that would be triggered in 2030, assuming different combinations of policy options and geographical scope. The first group of columns provides information about the maritime CO_2 emissions covered by carbon pricing. It includes information about the absolute level of CO_2 emissions projected in 2030 in the baseline scenario and in each option, the emissions cap, the expected in-sector abatements induced by the price signal and other policies and the expected demand for out-of-sector allowances. The second column shows how the maritime emissions not covered by carbon pricing would change in 2030 as a result of other policies. The last column shows the total amount of in-sector and out-of-sector abatements that would originate from the considered maritime policies in 2030.

All the in-sector emission reductions take into account the impact of the FuelEU Maritime initiative, in line with the MIX assumptions. However, reductions related to on-shore power requirements are not quantified in this chapter as well as reductions coming from future IMO short-term measures yet to be adopted.

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[112] In MAR1, MAR2 and MAR4, the emissions cap is subject to the same linear reduction factor as for stationary installations and aviation. In the mid- and long-term, the cap follows a trajectory until 2050 in view to reduce the maritime emissions in a way compatible with the climate neutrality objective. The model assumes a similar level of emission reductions in MAR3.

Table 13. CO_2 emission reductions from maritime policy options and scopes in 2030

	Maritime emissions covered by carbon pricing					Other maritime emissions	Total emission reductions
Policy option	*2030 BAU emissions (REF)* *MtCO2*	*2030 Projected Emissions* *MtCO2*	*2030 Emissions cap* *MtCO2*	In-sector reductions vs baseline *MtCO2*	Demand for out of sector allowances *M EUA*	In-sector emission reductions vs baseline *MtCO2*	In-sector and out of sector emission reductions *MtCO2*
Scope:	**MINTRA** (emissions from at-berth and intra-EEA voyages)						
MAR1	46	*41*	*26*	5	15	11	30
MAR2	46	*26*	*26*	19	0	15	34
MAR3	46	*min 26*	*n/a*	*up to* 19	0	15	34
MAR4	46	*40*	*26*	6	14	13	32
Scope:	**MEXTRA50** (emissions from at-berth, intra-EEA and half of extra-EEA voyages)						
MAR1	*92*	*81*	*53*	11	28	6	45
MAR2	*92*	*53*	*53*	39	0	8	47
MAR3	*92*	*min 60*	*n/a*	*up to* 39	0	8	*up to* 47
MAR4	*92*	*79*	*53*	13	26	7	46
Scope:	**MEXTRA100** (emissions from at-berth, intra-EEA and extra-EEA voyages)						
MAR1	*138*	*120*	*79*	18	41	n/a	59
MAR2	*138*	*79*	*79*	59	0	n/a	59
MAR3	*138*	*min 79*	*n/a*	*up to* 59	0	n/a	*up to* 59
MAR4	*138*	*117*	*79*	21	38	n/a	59

Note: numbers are rounded

Source: PRIMES Maritime module

In **MAR1**, the extension of the ETS to the maritime sector would result in a total reduction of 59 Mt of CO_2 emissions in 2030 for the largest geographical scope (MEXTRA100), 45 Mt for the intermediate one (MEXTRA50), and 30 Mt for intra-EU voyages and at-berth emissions (MINTRA). That would be equivalent to reducing the total maritime emissions from the baseline by 22% to 43%. A significant share of these reductions (up to 69%) is associated with out-of-sector abatements, assuming a carbon price in the range of EUR 45[113]. The demand for general ETS allowances in 2030 is therefore estimated at between 15 and 41 Mt CO_2 depending on the selected geographical

[113] Lower band of the carbon price assumptions from the MIX scenario

scope. The in-sector abatements would primarily come from the increased use of alternative fuels promoted through the FuelEU Maritime initiative[114], with the ETS price signal contributing to this growth. In the short-term, MAR1 applied to MEXTRA100 would roughly trigger one third of the reductions in the sector and the two thirds outside. Higher ETS prices would further accelerate the implementation of mitigation measures in the sector.

In **MAR4**, the combination of carbon pricing with a carbon intensity standard would result in a total of 59 Mt of CO_2 emission reductions in 2030 for MEXTRA100, 46 Mt for MEXTRA50, and 32 Mt for MINTRA when compared to the baseline. Following the same logic as in MAR1, companies would be expected to purchase a significant amount of general ETS allowances in 2030 (between 14 and 38 million EUA depending on the selected geographical scope). The operational carbon intensity standard, as modelled in this impact assessment[115], would modestly increase the level of in-sector abatements expected by 2030.

In **MAR2**, the separate maritime ETS would lead to total emission reductions in 2030 of 59 Mt for MEXTRA100, 47 Mt for MEXTRA50, and 34 Mt for MINTRA. All abatement of emissions would take place in the maritime sector as shipping companies would not be able to purchase allowances from other sectors. In **MAR3**, the emissions levy could result in similar emissions reductions because the price signal is assumed to be comparable to the one observed in the separate maritime ETS. However, the level of projected emission reductions would be much more uncertain compared to the other policy options where maritime emissions would be capped.

As shown by these results, the geographical coverage has a very strong influence on the mitigation impact of each policy option. Extending the geographical coverage beyond intra-EEA emissions to MEXTRA50 would increase the total amount of emission reductions by 50% while covering all maritime emissions would increase it by around 97%.

The geographical scope would also have a strong effect on the type of covered shipping activities. As shown in the figure below, a measure focusing on MINTRA would cover

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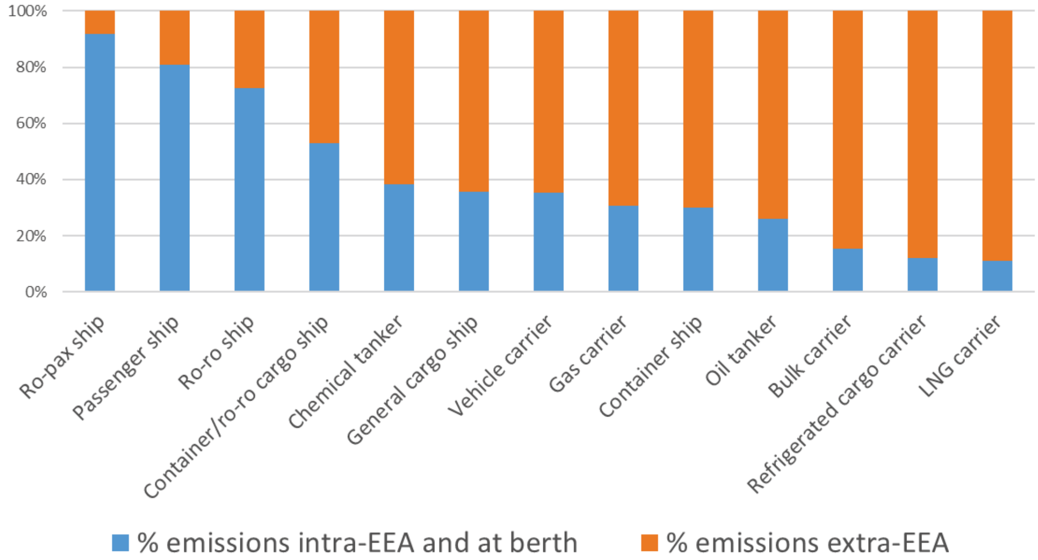
[114] The MIX scenario assumes that renewable and low-carbon fuels would represent around 8-9% of the maritime energy mix in 2030. The impacts of the FuelEU Maritime initiative are described in a separate impact assessment.

[115] The model obliges the modelled fleet to improve its operational carbon intensity by at least 40% in 2030 compared to 2008 levels and to follow a linear trajectory over the period 2030-2050 to reach the operational carbon intensity improvements observed in 2050 in MIX.

most of the short-sea shipping emissions, whereas addressing extra-EEA emissions would significantly increase the proportion of emissions coming from deep-sea shipping.

Figure 5: Distribution of intra-EEA and at-berth emissions vs extra-EEA emissions per ship type



Source: THETIS-MRV data 2018 and 2019, based on EEA (including EU28)

Changes in GHG emissions also depend on the **type of GHG emissions covered**. While CO_2 emissions represent around 98% of all maritime GHG emissions, non-CO_2 emissions have been growing over the past years. The model shows that in all policy options (MINTRA scope), the share of non-CO_2 emissions would represent around 3.5% to 4% of all GHG emissions by 2050. This projection is mostly related to higher levels of methane slippage, as a result of a larger uptake of decarbonised gaseous fuels. However, this high share of non-CO_2 emissions would be reduced substantially if significant progress were achieved on methane slip control.

Changes in emissions of **black carbon** are also important as the fuel burned in shipping engines can result in atmospheric black carbon and surface deposition that can accelerate the melting of ice and snow, in particular in the arctic region. According to the model, all policy options would result in a reduction of black carbon emissions of at least 7% in 2030 compared to the baseline.

6.2.1.2 Impacts on air pollution

Shipping emissions can impact air quality in coastal areas but also on land, as emissions from ships are transported in the atmosphere over hundreds of kilometres. All policy options are expected to have a positive impact on public health compared to the baseline as ships would emit less **air pollutants**. These decreases are driven by the uptake of fuels with lower emission factors, the use of cleaner energy sources at berth and energy efficiency improvements. The table below shows the level of maritime air pollutant emissions reduction that would be achieved in 2030 compared to the baseline, assuming different policy option applied to the intermediary geographical scope (MEXTRA50).

Table 14: Reduction of air pollutant emissions by 2030 for different maritime policies (scope MEXTRA50)

	Air emission reduction by 2030 compared to REF (%) – Scope MEXTRA50				
	NOx	*CO*	NMVOC	PM10	SOX
MAR1	-7%	-6%	-7%	-7%	-8%
MAR2	-10%	-6%	-9%	-10%	-10%
MAR3	-10%	-6%	-9%	-10%	-10%
MAR4	-8%	-7%	-8%	-9%	-10%

Source: PRIMES Maritime module

6.2.1.3 Use of energy

In terms of **energy efficiency**, all policy options are expected to boost the uptake of energy efficiency measures as the cheapest available in-sector abatement measures. The analysis carried out in the fourth IMO Greenhouse Gas Study confirms that energy efficiency measures such as speed reduction, hull coating, wind power, propeller improvements, improved auxiliary systems or main engines have much lower abatement costs than other options such as the use of alternative fuels. As an example, it estimates the cost to reduce one tonne of CO_2 based on speed reduction at around 14 EUR/t-CO_2 while a reduction of one tonne of CO_2 based on the use of alternative fuel at between 213 to 343 EUR/t-CO_2 in 2030.

The following table illustrates the energy efficiency improvements expected in the model from the different policy options, assuming a MINTRA geographical scope.

All scenarios show that energy efficiency improvements are expected to take place compared to the baseline. By 2030, the model indicates that MAR1 applied to all intra-EEA emissions would increase the average energy efficiency of freight vessels by 6.9% compared to 2020 (8% when applied to MEXTRA50). In MAR4, the combination of carbon pricing policies with an operational standard would make freight vessels 8.1% more energy efficient in 2030 compared to 2020 considering a MINTRA scope (9.2% if applied to MEXTRA50). In MAR2, the requirement to achieve in-sector emission reductions would lead to slightly higher energy efficiency improvements estimated at 8.8% for MINTRA (similar trends could possibly observed in MAR3).

Table 15: Average energy efficiency (energy consumption per tonne-km) improvements of freight vessels

	Average energy efficiency improvements (energy consumption per tonne-km) of freight vessels – index 100= 2020 levels – MINTRA scope	
	2020	2030
Baseline	100	97
MAR1	100	93
MAR2	100	91
MAR3	100	up to 91
MAR4	100	92

Source: PRIMES Maritime module

These levels of energy efficiency improvement come in particular from the purchase of more energy efficient vessels. In the next decade, new ships are expected to be at least 15%-25% more energy efficient through improved machinery and electricity systems (including hybridisation) and the use of waste heat recovery[116]. However, the relatively slow replacement rate of vessels and their long lifetimes explain why the average energy efficiency improvement of the entire fleet is not so pronounced until 2030. In addition, the model also considers operational energy efficiency improvement such as speed reduction. In the feedback received from stakeholders, most market actors confirmed the potential to further improve the energy efficiency of the sector, which varies for different ship sizes and types and which are not all captured in the model.

In terms of the **use of renewables and low-carbon fuels**, all policy options are expected to reinforce the aims of the FuelEU Maritime initiative. In particular, carbon pricing would make the switch to sustainable alternative fuels more affordable by supporting energy efficiency improvements, resulting in less fuel to be purchased by shipping companies. It would also help bridge the price gap between conventional and alternative fuels (to an extent which would depend on the level of the carbon price). By 2030, MAR1 would have limited contribution to achieving the goals of the FuelEU maritime initiative in terms of uptake of alternative fuels as an ETS price in the range EUR 45/tCO_2 would improve the cost competitiveness of alternative fuels compared to fossil fuels but it would not be sufficient to bridge the whole price gap. However, in the long-term, MAR1 would further accelerate the demand for alternative fuels. MAR4 would have a positive effect on the short-term as companies would be able to fulfil their

[116] UNEP Emissions Gap Report 2020

operational carbon intensity requirement by notably purchasing more alternative fuels. MAR2 and possibly MAR3 would lead to a more rapid uptake of alternative fuels (representing more than 19% of the fuel mix by 2030) as a result of higher carbon prices.

6.2.1.4 Risk of evasion

As for other sectors, it is necessary to assess the risk of evasion linked to each maritime policy option. In practice, market actors could decide to reduce their exposure to carbon price by:

a) adding a new port call outside the EEA in a journey to minimise the amount of emissions in the ETS scope (Evasive port calls);
b) unloading goods in a non-EEA port and loading it into another ship to reach the final destination (Transhipment);
c) shifting demand to other transport modes, although there would be no leakage if these other modes are covered by the ETS;
d) using ships below the threshold defined in the EU maritime MRV regulation (smaller vessels);
e) assigning their best performing vessels to EU related voyages while keeping the less performing ones for non-EEA trade routes (fleet optimisation).

This would reduce the effectiveness of the policy options in reducing GHG emissions and would shift carbon emissions to other geographical areas or other transport modes. The risk of carbon leakage depends on practical feasibility, the carbon price level and the geographical scope.

(a) Evasive port calls

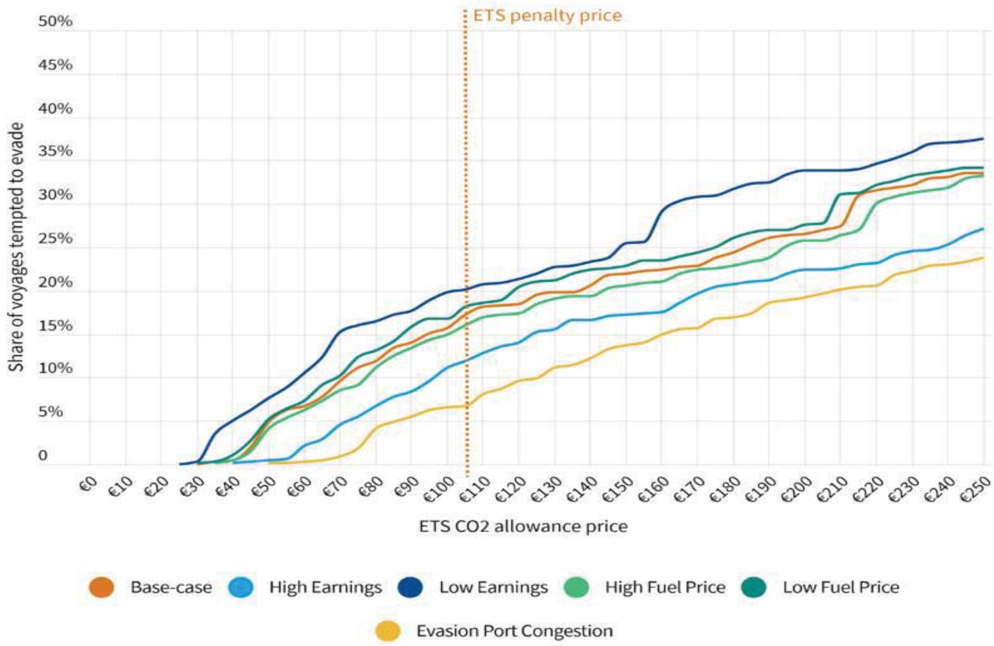
Evasion becomes lucrative when the cost of compliance exceeds the costs associated with the evasive port call (i.e. additional port, fuel, operational, administrative and opportunity[117] costs). As compliance costs increase proportionally to the carbon price, the risk of evasion can be characterized by a ‘turning point price’ that represents the carbon price above which the evasion could become profitable from an economic point of view. The decision to add an evasive port call also depends on other aspects such as its practical feasibility (e.g. additional time to the incoming/outgoing leg particularly in relation to certain commodities, e.g. perishable goods).

Figure 6 below estimates that with a carbon price of EUR 60 per tCO_2, the share of voyages tempted to evade is between 0.1% and 10%.

[117] revenue lost from the evaded journeys

The EU maritime transport MRV regulation already requires ships to load or unload cargo in order for the stop to fall under the port call definition. This stringent definition represents an important additional barrier to evasion and could be strengthened to further mitigate the risk.

Figure 6: Share of voyages tempted to evade for different ETS price (considering that all intra-EEA and half of extra-EEA voyages are covered by the carbon price)[118]



Source: T&E, 2020

Case studies building on a recent T&E (2020) study[119] (Annex 10) analysed the risk of evasion for three major EU seaports in close proximity to a non-EEA port: Greece (Piraeus), Spain (Algeciras) and the Netherlands (Rotterdam). They considered three types of ships: container ships, bulk carriers and oil tankers, due to their high level of activity in extra-EEA shipping relative to other vessel types. For container ships, opportunity costs increase more significantly in relation to their size than for bulk carriers and oil tankers. Large containers are thus less likely to evade. For bulk carriers and oil tankers, the larger vessels have lower turning point prices and therefore have higher risk

[118] ETS penalties are paid by the operators who fail to comply with their obligation to surrender allowances under the ETS

[119] https://www.transportenvironment.org/sites/te/files/publications/ETS_shipping_study.pdf

of evasion. Longer routes present a higher risk of evasion due to higher fuel and operational costs making the additional costs of evasion lower in comparison.

The options with the highest carbon price (MAR2 and MAR3) present the highest risk of evasion. In the mid- to long-term, higher ETS prices are likely to increase the risk as shown in the figure below (considering option MAR1 with MEXTRA50 scope). At an ETS price of around EUR 100/tCO_2, the risk of evasion would concern 20% of the voyages that could be tempted to evade if third country climate policies stay the same.

In terms of geographical scope, the risk of evasion would be the highest in case extra-EEA voyages are covered. Under the MEXTRA50 scope, the risk of evasion is zero at EUR 30/tCO_2, but at EUR 50/tCO_2 it concerns 4.8% of all voyages, representing 8.2% of the emissions covered. Under the MEXTRA100 scope, 6.7% of all voyages would be tempted to evade at EUR 30/tCO_2.

In addition, the risk of evasion could increase if the cost of compliance from other EU initiatives would add to carbon costs.

The risk of evasion would be cancelled if the main departure or arrival countries outside the EEA would apply similar carbon pricing policies.

Additional measures to limit the risk of evasion might be considered after the proposed measures enter into force, based on the monitoring for evasive port calls practices. Such a monitoring could rely on vessel tracking information (AIS data) and maritime freight statistics.

(b) Transhipment

To evade EU measures, transhipment activities could be relocated to nearby ports outside the EEA. Transhipment is a competitive sector where hubs compete for the traffic related to a specific region or market. Shipping companies already use nearby alternative competing transhipment hubs and could be tempted to increase transhipment activities in those ports, should these appear more competitive.

Delocalisation of transhipment activities could particularly impact voyages from container vessels. For other types of vessels, transhipment is uncommon and setting up a transhipment for the sole purpose of evasion is unlikely. Adding an additional port call with transhipment will significantly increase the cost of the voyage (e.g. cargo handling, delays in deliveries, additional charter, logistic and administrative costs, etc.) and increase the voyage length.

The practical feasibility of changing transhipment hub depends on a range of important factors, including port location, proximity to primary routes, cities and ports, berth availability, draft constraints, transit time, cost, frequency and service quality. The financial attractiveness of changing transhipment port is at present largely linked to the port fees, and to a much smaller extent to fuel, operating and opportunity costs (as very minimal deviation from the original route would be required). For the two ports analysed in the case study (Annex 10), Algeciras and Tanger Med, a significant difference in transhipment costs already exists. Competition for transhipment activities is currently strong between the two ports. However, the risk of changing transhipment port in favour of Tanger Med as an evasive behaviour might increase if the gap between the costs of transhipment between the two ports is exacerbated due to the carbon price, in particular for MAR2 and MAR3.

None of the geographical options would exclude the risk of transhipment relocation. The longer the voyages, the higher the risk is in terms of delocalisation of transhipment activities, MEXTRA100 therefore being more at risk of evasion than MEXTRA50. Impact on the amount of emissions evading the scope will be smaller for MINTRA.

The risk of transhipment has been highlighted by ports (e.g. port of Algeciras), port associations and World Shipping Council in the OPC, as well as for North Sea ports in relation to competition from UK ports. This risk would be strongly limited if equivalent measures were to be adopted in neighbouring countries. The UK has adopted legal requirements for ships that call at UK ports to report their greenhouse gas emissions[120] and the UK's sixth Carbon Budget will incorporate the UK's share of international aviation and shipping emissions. However, at the time of this analysis, the UK has not yet decided to include shipping emissions in its national Emissions Trading System[121].

(c) Modal shift

The increased cost of shipping resulting from carbon pricing could cause a shift from maritime transport to other modes of transport such as road or rail. However, modal shift would only occur if there is no similar carbon pricing applied to road transport as the majority of railway activities are already covered by the ETS. Road transport under the MIX scenario will be subject to a number of decarbonisation policies fostering the use of more sustainable modes of transport. Risk of modal shift under MAR1 is therefore considered inexistent. Options for initiatives are detailed in the Smart and Sustainable Mobility Strategy[122]. In addition, modal shift would only concern intra-EEA maritime

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120 https://www.legislation.gov.uk/uksi/2018/1388

121 https://www.legislation.gov.uk/uksi/2020/1265/made

122 Accompanying document to the Smart and Sustainable Mobility Strategy: COM(2020) 789

transport activities as deep-sea shipping is less likely to compete with other modes of transport. Annex 10 provides a detailed analysis of the risk of modal shift.

(d) Smaller vessels

For all policy options, market operators could decide to operate ships below 5.000 gross tonnage to evade carbon pricing. This risk may occur in specific shipping sectors where the use of smaller vessels is common and where the gain in efficiency related to the use of larger vessels would be less than the compliance costs. This aspect is further developed in the next chapter about economic impacts. The risk would be higher, in relative terms, for MINTRA than for MEXTRA scopes and the options MAR2 and MAR3 with a higher carbon price will create a higher incentive to use ships under the threshold. It should be noted that, if there were deliberate evasion of this type, the Council and European Parliament could lower the relevant thresholds.

(e) Fleet optimisation

The risk of seeing companies optimising their fleet by assigning their best performing vessels to EEA related voyages and keeping the less performant ones for other trade routes may occur for deep-sea ships having no fixed routing, such as trampers. The risk is considered to be limited as companies would not directly evade carbon pricing. In addition, the implementation of such a strategy might be more difficult to put in place when ships are chartered, which characterises the tramp shipping industry. However, the risk would still be higher for MAR2 and MAR3 (higher carbon prices) as well as for MAR4 as it includes mandatory carbon intensity requirements. Fleet optimisation would decrease the total emissions emitted in the geographical scope and increase emissions outside the scope. The adoption of global measures such as the technical and operational carbon intensity foreseen to be adopted at IMO or equivalent carbon pricing measures outside the EEA would reduce this risk.

6.2.1.5 Impacts on ecosystems and biodiversity

The impacts of ship emissions on ecosystems and biodiversity are highly site-specific but can cause damage through acidification and eutrophication. Ship movements can also negatively affect natural habitats and certain species. In addition, climate change can produce changes in water temperature, increasing CO_2 levels and decreasing pH, changes in nutrients and dissolved oxygen due to changes in circulation and stratification, extreme weather events and sea level rise.

By reducing GHG emissions and the release of air pollutants, all the proposed policy options are expected to contribute to reducing the negative impacts of shipping activities on ecosystems and biodiversity. Carbon pricing would also encourage the further deployment of slow steaming practices that can reduce underwater noise and reduce negative impacts on habitats. The positive impact of each policy option on maritime ecosystems and biodiversity is expected to be proportional to the level of in-sector abatement triggered, meaning that more benefits would come from MAR2 and MAR3 where the purchase of EUA from other sectors is not an option.

6.2.2 Economic impacts

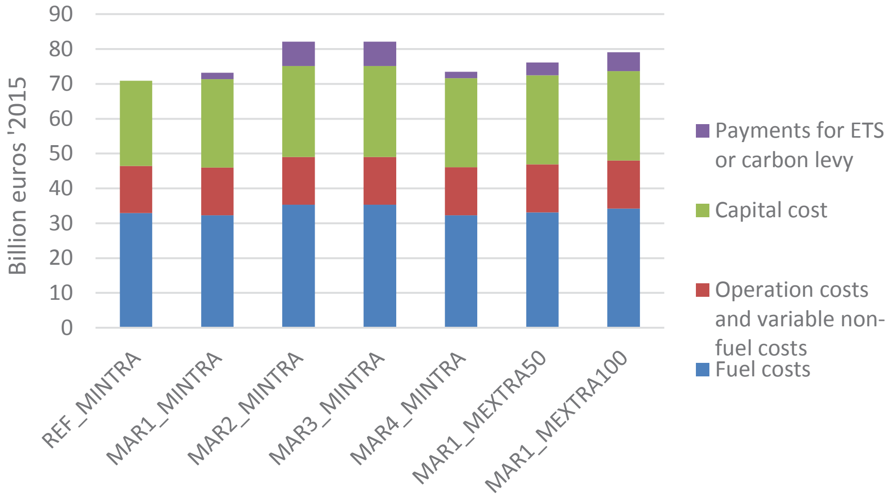
6.2.2.1 Direct economic impacts

In all policy scenarios, **maritime transport activity** is expected to grow in the long-term although not as much as in the reference scenario, which does not reflect the transformation of the EU economy towards climate neutrality and the lower dependence on oil imports. By 2030, the policy options are projected to have a minor impact on total shipping activities in comparison to the baseline (e.g. from -0.8% for MAR1 to around -1.2% for MAR2 and MAR3 in 2030 when applied to intra-EEA emissions). A broader geographical scope would also lead to higher impacts (e.g. -0.9% for MAR1 with MEXTRA50 and -1.1% for MAR1 with MEXTRA100). In addition, short sea shipping is expected to be slightly more affected than deep-sea shipping as carbon pricing would result in higher relative costs.

In terms of direct costs, all policy options would incur some additional direct costs for regulated entities in the form of ETS/carbon levy payments, as well as additional capital, fuel, operational and administrative costs, partially compensated by fuels saving. However, from a society perspective the ETS/carbon levy payments do not represent a net cost, as there are corresponding auctioning or tax revenues (see Section 6.3.2.3). When looking at the additional costs, it is important to keep in mind that the sector currently benefits from a wide range of tax exemptions and reductions that are de facto forms of fossil fuel support. A detailed analysis is carried out in the impact assessment accompanying the revision of the Energy Taxation Directive.

The graph below shows how costs are likely to vary considering different policy options and different geographical scope.

Figure 7: Costs breakdown in 2030 for different maritime policy options and scope (billion EUR 2015)



Source: PRIMES Maritime module

MAR1 would increase the total direct costs for users by 3% in 2030 if applied to intra-EEA emissions. This cost increase can be explained by the estimated ETS payment that would represent an amount of around EUR 1.9 billion[123]. The slightly higher fuel costs coming from the use of more expensive renewable and low-carbon fuels (as induced by the FuelEU Maritime initiative) would be compensated by the fuel savings expected in 2030. In this scenario, the short-sea shipping industry would be more impacted than the deep-sea shipping sector as they mostly perform intra-EEA voyages. If applied to MEXTRA50, MAR1 would become 7% more expensive than the baseline, mainly due to increased ETS payments amounting to around EUR 3.7 billion. It would also mean a bigger contribution from the deep-sea shipping sector. Finally, if all emissions were covered under MAR1, the measure would be 12% more expensive compared to a business as usual scenario and the ETS payment would peak to around EUR 5.5 billion. **MAR4** would result in similar outcomes. Fuel costs would be comparable as more energy efficiency improvements would be implemented together with a slight increased use of alternative fuels.

When applied to intra-EEA emissions in 2030, **MAR2** would substantially increase the total costs by around 16%. This increase is mainly due to higher operational costs linked to the closed ETS. Regulated entities would pay high carbon prices estimated at around EUR 268 per tonne of CO_2, which would represent an overall amount of EUR 7 billion in

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[123] For MAR1 and MAR4 assumption based on the lower band of EU ETS carbon price ranges in the policy scenarios represented by MIX (Section 5.2.1). For MAR2 and MAR3, result of the modelling.

2030 reflecting the abatement costs of the various measures that would have to be implemented in the sector to stay below the emissions cap (same cap as in MAR1 and MAR4 but with no flexibility). The increase in total costs would also come from the use of more expensive alternative fuels. Similar impacts are assumed for **MAR3** as the levy option would have to apply comparable carbon prices to generate sufficient emission reductions, although without any guarantee.

In terms of **compliance costs predictability**, MAR3 stands out for having the highest certainty because the costs per unit of emissions would be specified in the regulation, unlike the costs of the ETS allowances which would be subject to market fluctuations. However, the certainty linked to MAR3 would depend on whether the levy is adjusted regularly or not. In contrast, MAR2 could have fluctuating ETS prices. MAR1 and MAR4 would be less exposed to such a risk as the Market Stability Reserve has the ability to reduce price volatility and because maritime emissions would only represent a small share of the overall ETS market.

In the **long-term**, all policy options are expected to lead to an increase in total costs of approximatively 16-20% by 2050 as a result of the high penetration of renewable and low-carbon fuels, which implies higher fuels costs and higher capital costs. At the same time, carbon pricing in the maritime sector would lead to progressive energy efficiency improvements, in particular, in the time horizon after 2030, which would contribute to reducing the fuel costs.

In terms of **external costs**, all policy options would generate important economic savings as they would lead to substantial air pollutant reduction. Depending on the selected policy option and scope, external costs savings are estimated at around EUR 345 to 540 million in 2030 relative to the baseline and at over EUR 13.7 billion over the period 2020-2050 in terms of Net Present Value (e.g. up to EUR 18.1 billion for MAR1 when applied to MEXTRA100). These estimates aggregate health effects, crop loss, biodiversity loss and material damage.

6.2.2.2 Impacts on Administrative Burden

All policy options will create administrative tasks for the regulated entities, the national public authorities involved and the European Commission (see also costs estimations in Annex 3).

Administrative burden on regulated entities

For regulated entities, administrative burden will be very limited as a monitoring, reporting and verification system for CO_2 emissions is already in place. All policy options would rely on data coming from this MRV system, therefore MRV activities would not generate any substantial additional administrative burden. Regulated entities have already incurred one-off costs for the preparation of monitoring plans, the development of IT systems and the establishment of MRV procedures. Since 2019, companies submit every year to the Commission and to the relevant Flag State authority an emissions report, which has been verified by an independent accredited verifier. The costs of MRV compliance were estimated at about 6.700 EUR per ship per year (Faber & Schep, 2016). The only additional MRV costs that would be induced by the policy options would relate to the preparation of emissions reports at company level but this task could be supported by the IT system behind the EU maritime MRV system (THETIS-MRV). It could automatically aggregate all relevant data at company level.

For the ETS based policy options, there would also be a one off costs to open a registry account or become familiarised with the requirements of the system. Annual costs would include costs linked to the purchase and surrender of allowances, keeping records or supporting requests from competent authorities. Experience from the ETS shows that these activities generate much less administrative burden than the monitoring, reporting and verification of emissions. Non-MRV costs are estimated to represent around 10%[124] of the MRV costs.

In MAR3, the carbon levy would imply some set-up costs but the annual levy payment would be part of the overall tax management system of companies and is likely to represent marginal costs.

Option MAR4 would require additional verification activities to validate the attainment of the carbon intensity reduction target, but these could be part of the verification process under the EU maritime transport MRV system.

- The case of SMEs

Unlike other sectors already covered by the ETS, SMEs represent the significant majority of enterprises in the shipping sector, with 76% of freight companies and 86% of passenger transport companies having fewer than 10 employees. By limiting the scope of the measure to ships above 5.000 gross tonnage, it would reduce the number of ships covered by at least 44% and exclude around 95% of maritime transport SMEs. For the remaining covered SMEs, impacts will be proportionally higher than for bigger

[124] This share is consistent with a survey in the UK (BEIS, 2016), which indicates that non-MRV administrative costs represent around 5% of total ongoing administrative costs for stationary installations and 10% for small emitters. Moreover, non-MRV costs for aviation represent around 7% of ongoing administrative costs (European Commission, 2014).

companies due to a lack of economies of scale and SMEs are likely to rely on intermediaries to help them fulfil their obligations.

Responses to the targeted stakeholder consultation suggest that SMEs might be more exposed to unfair competition on a global scale, in particular under ETS options, due to SME's limited administrative capacity and know-how to deal with an ETS.

Administrative burden on public authorities

MRV related costs will be the same under all options. Public authorities will have to ensure that regulated entities are capable of monitoring and reporting emissions, they will also have to review the amount of emissions reported by regulated entities, based on information verified by independent accredited verifiers. This is estimated to entail relatively limited additional costs. The European Maritime Safety Agency (EMSA) could potentially assist MS competent authorities in this task with their expertise on MRV data and related IT tools (e.g. by facilitating the exchange of information, developing guidelines and criteria). This would increase costs to EMSA, but reduce costs and improve efficiency for MS. Since 2018, EMSA is successfully running the IT tool (THETIS-MRV) that supports the implementation of the EU Maritime MRV regulation.

Under the ETS options (MAR1, MAR2 and MAR4), the main additional administrative costs will stem from the administration of the registry, compliance and enforcement. Such processes can build on the ones existing under the ETS and thus the incurred administrative costs will be very limited. The establishment of a fully separate ETS (MAR2) would however lead to some additional costs if not build upon existing tools. In terms of enforcement, the surrendering of required allowances will be registered electronically in the registry and the system will allow for a rapid identification of non-compliant companies. In case of non-compliance, public authorities will have to recover non-surrendered allowances and ensure that non-compliant regulated entities are held liable for the payment of an excess emissions penalty.

An estimation of the cumulated ETS costs for national authorities is provided in the table below based on previous ETS experience.

Table 16: Estimated administrative costs for all competent national authorities

ETS administrative costs for all competent authorities	
One-off costs (costs per period) (million euros)	0.5 – 1.5
Annual costs (million euros)	0.5 – 6.4

Source: Ricardo, 2021

MAR3 would also require the setting up of a new mechanism but which would be simpler compared to an ETS registry. The carbon levy could for instance be implemented as an annual single transaction based on EU maritime transport MRV data and collected based on existing tax systems at national level. However, depending on how the levy is redistributed, there might be a need to set up and manage a new tax registration system for those shipping companies whose business is registered in one MS but have ships registered in another MS. This could result in additional set up and monitoring costs.

Costs for compliance checks and enforcement will impact national authorities of the 22 Port States, but these will be very limited. For MAR4, Port State Control officers will check the availability of Documents of Compliance certifying that carbon intensity requirements are met. Verifying the availability of certificates is a routine activity for Port State Control officers. There is an opportunity to use of electronic certificates that could remove the need for a physical check in its entirety, a possibility already being discussed for the revision of the Port State Control and Flag State Directives.

The various EMSA tools in support of enforcement activities (THETIS, THETIS-EU, RuleCheck and the EMSA Academy) and EMSA's expertise in this field, could support the correct implementation and enforcement at national and EU level. During visits to MS, EMSA could also provide assistance to monitor the implementation of the carbon pricing policy, organise workshops to share experience and lessons learnt.

For the European Commission, the main additional administrative costs would come from the update of the IT system behind the EU maritime transport MRV Regulation, the transposition and conformity checks of national legislation, the administering of the EU registry (MAR1 and MAR4) or the creation of a separate registry for the maritime system (MAR2). It could also include the development of delegated or implementing acts (e.g. operational carbon intensity thresholds per ship type and size in MAR4).

6.2.2.3 Impact on revenues for Member States/Union

The level of revenues varies across the policy options and according to the geographical scope. An ETS which covers 50% extra-EEA emissions generates a higher level of revenues than one that covers only intra-EEA voyages as it covers more emissions.

The table below presents the additional revenues that could be generated at EU level in 2030 (as estimated in the PRIMES Maritime module). It considers different policy options and geographical scope as well as the fact that purchasing ETS allowances from other sectors does not generate additional revenues.

In the case of a levy, revenues are expected to be distributed at MS level, which will decide on the revenue use.

The discussion on use of ETS maritime revenues is linked with the discussions on using ETS auction revenues as an EU own resource.

Table 17: Additional revenues generated by policy options (billion Euro 2015)

	ETS or levy additional revenues in 2030 (billion EUR 2015)	**Assumptions in terms of ETS or levy price in 2030 (EUR/tCO_2)**[125]
MAR1 –MINTRA	1.2 b EUR	*45,5*
MAR1 _MEXTRA50	2.4 b EUR	*45,5*
MAR1 –MEXTRA100	3.6 b EUR	*45,5*
MAR2 and MAR3_MINTRA	7 b EUR	*268*
MAR4 –MINTRA	1.2 b EUR	*45,5*

Source: PRIMES Maritime module

6.2.2.4 Impacts on the European internal market and trade

As detailed in Annex 10, no significant impacts are expected as regards the level playing field. Due to the flag neutrality imbedded in all options, EU shipping operators would not be put in a disadvantaged position compared to non-EU shipping operators. However, threshold effects may occur between ships right below and above the 5.000 GT threshold, particularly for general cargo ships and chemical tankers. By retaining the 5.000 GT threshold, the competition effects between shipping and other transport modes, in particular road, is being limited, as smaller ships are typically more exposed to such modal shift.

As also recognised in the impact assessment accompanying the revision of the Energy Taxation Directive, the current exemption of the maritime sector from the energy taxation represents de facto fossil fuel support, which is not in line with the objectives of the European Green Deal. This creates a fragmentation of the transport internal market and distorts the level playing field across the different transport modes and the involved sectors of the economy. A carbon price on the maritime sector will aim at ensuring a level playing field among various transport sectors and improve the functioning of the internal market by addressing unfair competition.

[125] For MAR1 and MAR4, based on the lower band of carbon price ranges in the policy scenarios represented by MIX.

Table 18: Description of possible economic impacts from a maritime carbon pricing policy

Impacts	Description
1) Transport costs	Maritime carbon pricing would lead to increased running costs for shippers in the form of increased voyage costs (e.g. purchase of ETS allowances, use of more expensive fuels) or capital costs (e.g. investments in new vessels or technologies). At the same time, the adoption of GHG mitigation measures and the possible use of revenues can contribute to reduce these costs. In the mid- to long-term, higher ship running costs are expected to lead to higher freight rates.
2) Transport choices	Higher transport costs may change shippers' modal, route, and port selection (detailed in the carbon evasion section 6.2.1.4).
3) Import prices	An increase in transport costs, if substantial, may increase import prices of goods, since transport costs are a component of commodities' market price. However, this increase in import prices is generally not proportional to increase in transport costs given that import prices depend on several other factors, such as the share of maritime transport costs in product prices and the ability of importers to transfer costs to the consumers.
4) International trade	If substantial, the changes in import prices of goods may trigger changes in trade flows. States may trade more with geographically closer producing/consuming States and trade less with more remotely located trade partners. Another possible impact is the increase in consumption of domestic products in place of imports. Moreover, fossil fuels reduction as a result of implementing the policy options will positively impact the trade balance.

Impact on trade

Due to its central role in enabling economic activity, applying a carbon price to shipping would affect the whole spectrum of economic agents: raw material suppliers, manufacturers and service providers, the shipping industry, retailers and eventually consumers. The ultimate impact on these agents will depend on the relative levels of costs, the savings generated by the policy measures in the long-term and investment choices. The direct change in ship running costs resulting from the selected policy would be expected in turn to impact on freight rates, depending on the ability to pass these additional costs or savings through the maritime supply chain, as described in the table below. Final consumers will only bear the portion of any cost variation that is passed-through by manufacturers and retailers.

An analysis of ten relevant commodities for European trade (detailed methodology in Annex 10) suggests that an open ETS covering 50% of extra-EEA emissions (option

MAR1 with MEXTRA50 scope) would have relatively small impacts on prices, even by 2050.

Even in the case of full cost pass-through, prices of commodities such as iron ore and cereals would rise by less than 2% by 2050. Goods such as crude oil, organic chemicals or perishable goods would largely be unaffected by an increase in shipping costs. Furthermore, the change in price is not expected to be noticeable by consumers to the extent to drive significant changes in their behaviour. Effects on demand is therefore projected to be very limited, with some of the largest likely potential long-term effects being shown for iron and steel and organic chemicals.

The table below presents a summary of the impacts on price and demand for each selected commodity by 2030 and 2050.

Table 19: Summary table of impacts on commodity price and demand from open ETS (MAR1)

Commodity	Change in price (%)		Change in demand (%)	
	2030	2050	2030	2050
Crude oil	0.2%	0.6%	0.0%	-0.1%
Refined petroleum products	0.5%	0.1 to 1.3%	0.0 to -0.4%	-0.1 to -1.0%
Natural gas	0.4 to 0.5%	0.5 to 1.3%	0.0%	-0.1%
Iron ore	0.3 to 0.7%	0.8 to 1.8%	-0.1 to -0.2%	-0.2 to -0.4%
Iron and steel	0.3 to 0.4%	0.6 to 1.1%	-0.1 to -0.6%	-0.4 to -1.5%
Cereals	0.3 to 0.6%	0.8 to 1.6%	0.0 to -0.2%	0.0 to -0.5%
Perishable goods	0.0 to 0.4%	0.0 to 1.0%	0.0 to -0.3%	0.0 to -0.8%
Office and IT equipment	0.2 to 0.4%	0.4 to 1.0%	-0.1 to -0.4%	-0.3 to -1.0%
Motor vehicles	0.0 to 0.4%	0.0 to 0.9%	0.0 to -0.1%	0.0 to -0.3%
Organic chemicals	0.0 to 0.3%	0.0 to 0.6%	0.0 to -1.0%	0.0 to -2.4%

Source: Ricardo analysis, GEM-E3, 2021

Note: A number of factors, including complex supply-chain relationships as well as supply and demand factors influence the price of commodities. Political and economic uncertainties arising from the withdrawal of the UK and the COVID-19 pandemic may also have strong implications for the assumptions underlying this analysis, including consumption levels, the market share of producers, and ability of producers to pass through costs onto consumers or the next step in the supply chain.

- **Global perspective**

The majority of the main global trade partners have a significant share of their export and import trade flows with the EU, but only those where the main export products have a low economic value to weight ratio (i.e. Russia, China, India) may be significantly affected by the measures (see Annex 10 for figures). Some third countries are more vulnerable to increases in maritime transport costs, as the Small Islands Developing Countries and Least Developed Countries, and could be relatively more impacted by increased transport costs with the EU. Their already lower connectivity makes them already pay comparatively higher premiums in terms of shipping costs. Moreover, they are more likely to export lower value products to the EU. Furthermore, some goods imported to or exported from these countries could be transhipped in EU ports on their route, leading to a price increase for non-EU voyages[126] if those are covered under the measure. The more costly the measures (MAR2, MAR3) and the broader the scope (MEXTRA50 and MEXTRA100), the more likely the impacts will be on trade flows.

In contrast, third countries could benefit from the energy efficiency improvements induced by carbon pricing, should these vessels operate globally and not only in the EEA. The global shipping sector would also benefit from an EU context supporting innovation, in particular if part of the revenues are used for that purpose. Some neighbouring countries could also benefit from the EU initiative if evasion is taking place (e.g. Morocco, Russia).

When it comes to global measures, a political economic analysis (see in Annex 10) suggests that countries are more likely to agree on a global Market Based Measure once a regional measure is implemented. Some countries could however see benefits for their competitiveness if carbon pricing is only impacting the EU economy, but this is less likely to happen in a context where major economies are committing to long term net zero GHG emissions goals (e.g. Japan, China, Korea, the US, Canada, New Zealand).

The compatibility of an EU measure with a potential global measure is difficult to assess at this stage as no decision on such a global measure will be taken before 2023[127]. Divergences may come from the different regulated entities, policy objectives and levels of stringencies. Once an IMO measure is adopted, the EU measure should be reassessed.

It should also be mentioned that some international partners and stakeholders criticised the intention of the EU to implement a regional market based mechanism claiming that it would cause a negative impact on the global maritime decarbonisation discussion.

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[126] World Shipping Council communicated in the OPC that in a 2015 study, it was estimated that 12% of the containers passing in EU ports were in transit.

[127] as per the IMO Initial GHG Reduction Strategy

6.2.3 *Social impacts*

6.2.3.1 Impacts on employment

It is estimated that the EU shipping industry supported a total of 2 million jobs in 2018, both through its supply chain and through expenditure of workers (ECSA, 2020). In terms of direct jobs, the shipping sector employed 685,000 people in 2018 in various sub-sectors across the EU. This includes 365,000 jobs (53%) in freight transport (including towing and dredging), 255,000 jobs (37%) in passenger transport, plus a small number of jobs in service and offshore support vessels; renting and leasing. The split of land to sea is 17% - 83%.

Two types of impacts can be distinguished on jobs: the direct impact on employment and the indirect impact, related to changes of skills and knowledge of employees.

It is expected that all options could lead to an increase in employment in the wider shipping sector associated with the development of **abatement technologies, new sources of energy, digitalization and increased energy efficiency of shipping**. A closed ETS (MAR2) has the potential to increase jobs particularly in the shipping sector as this option focuses on in-sector emissions reductions and therefore could result in greater or more rapid innovation in the sector. MAR 4 requires carbon intensity reductions and is therefore likely to further encourage innovation in the sector. Revenues generated by the different options will support this tendency as long as revenues are spent in maritime decarbonisation. An extra-EEA scope will have more actors incentivised to innovate thus making it more likely to generate a larger impact on the jobs market.

Employment in European **ports and distribution hubs** is expected to rise along with an expected growth in trading activities[128]. However, if carbon evasion occurs, it could lead to a decreased level of shipping activities in certain ports and distribution hubs and lead to a potential reduction in employment. This could potentially have wider reaching impacts on the whole supply chain and the local community in which the port is located.

All policy options have little or no effect on the employment in the **commodity sectors** which rely on shipping for trade. The impact on employment largely follows the pattern of production in these sectors. The impact on jobs takes into account the direct effects

[128] UNCTAD Review of Maritime Transport 2020

from increasing transportation costs (i.e. higher prices for the goods transported) but also the indirect effects (higher production costs for industries which face higher costs of intermediate inputs) and induced effects (changes in final demand due to changes in income). The net impact of MAR1 applied on MEXTRA50 (including the FuelEU Maritime initiative) is negative but very small (2,500 fewer jobs in 2030 and 10,000 fewer jobs in 2050 at the EU level). Sectors will be impacted differently, with e.g. negative impacts on fossil fuel companies in 2050 and positive impacts for others (see Annex 10). However, the small negative effects on certain commodity sectors will be compensated by the overall positive impacts on employment in the broader maritime sector associated with the increase in innovation and more energy efficient technologies.

In the longer term, as new technologies and alternative (low/zero carbon) fuels become more prevalent, some **job requirements** will change and seafarers noticeably will require adequate trainings (this was also highlighted in the public consultation). Such changes will be linked to an increased digitalisation of the sector (e. g. smart routing) which will increase the demand for information systems jobs in the shipping sector. However, impacts on job requirements due to fuel changes would be primarily driven by the FuelEU Maritime initiative.

6.2.3.2 Impact on vulnerable households

Certain goods that rely on sea transport, for example fuels used for road transport, can make up a considerable proportion of household expenditure and variations in the price of these commodities can therefore have direct impacts on the disposable income of households. Changes in transportation costs could potentially affect household disposable incomes both through the supply (commodity prices) and the demand channels (employment and wages). The impact is differentiated by household income class depending on the consumption pattern and sources of income of each class. The estimated overall impact on welfare[129] is negative but small (EUR 77 million at the EU level in 2030, see detailed figures in Annex 10). When the effect is normalised to the income of each household class then the lowest income households seem to have a higher welfare loss than the average by 2050. However, the welfare loss for the low income decile is still marginal (around 0.015% of their income in 2050). This impact is based on MAR1 MEXTRA50, which also include the effect of the FuelEU Maritime initiative.

[129] Measured using hicksian equivalent variation which is a monetised welfare indicator and shows how much money must be given to the consumer to reach the new state of welfare. A positive number indicates a welfare improving effect.

While the impact on vulnerable households is estimated to be minimal, they could also potentially benefit from the generated revenues.

6.3 Extension of emissions trading to buildings and road transport/ all fossil fuels

This section analyses the environmental, economic and social impacts of the policy options for a further extension of the scope of the EU emissions trading beyond maritime transport as set out in Section 5.2.4 with a view to achieving the overall increase of ambition of GHG emission reductions for 2030. This includes administrative feasibility and related costs and synergies and coherence with related policies.

6.3.1 Environmental impacts

6.3.1.1 Impacts of option EXT1: Extension to buildings and road transport

Buildings and transport represent the bulk of fossil fuel CO_2 emissions covered by the ESR, with emissions of around 1.2 Gton[130]. To achieve EU-wide -55% GHG emission reductions compared to 1990, the two sectors are projected to achieve with the inclusion in an emissions trading system and in the context of a policy mix a reduction of -43% by 2030 compared to the 2005 level[131]. This compares to a reduction of -34% in the baseline scenario which is without changes to the legislative framework, and would thus ensure a further emission reduction by almost 10 percentage points. All MS would see additional emission reductions (see Annex 13 Section 47 for an overview table of projected emission reductions for all MS).

For comparison, under an extended ETS that would include current stationary sectors, intra-EU aviation and road transport and buildings, these sectors would need to reduce by 55% compared to 2005 by 2030. In the context of the modelled policy mix, the two new sectors would contribute one third of the absolute emission reductions between 2020 and 2030 of all sectors subject to EU carbon pricing to achieve the EU's 2030 GHG target, with the other two thirds of the reduction falling upon the sectors in the existing ETS.

Covering the new sectors under an emissions trading system would provide for increased certainty in delivering these GHG emissions reductions, since the cap sets a limit on the emissions that economic operators can account for by surrendering allowances, with any

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[130] Average 2016-18 emissions; See also Annex 5 Section 10.
[131] Results of the MIX scenario. In MIX-CP emission reductions are with -42% similar.

excess rendering them liable to high fines. Such certainty is not possible through other types of measures such as taxation. With buildings and road transport CO_2 emissions included in an ETS, around three quarters of the current total GHG emissions would be covered by EU-wide caps. Considering the evolution of emissions, the share of total emissions covered by emissions trading would be more than two thirds by 2030, twice as much as the existing ETS alone[132].

In an upstream system, it is important that the CO_2 price signal is passed on to the end-consumers of the fuels to create the right incentives for them to reduce emissions. As further analysed in Annex 5, Section 12.2, it seems very likely that this will be the case. End-consumers would thus have an additional economic incentive to reduce their direct emissions. This incentive is likely to counter possible rebound effects on emissions from efficiency improvements and the resulting cost reductions. It is likely to rise the lower the emission reductions through other measures are. It would also help in diffusing decarbonisation technologies more quickly, because the carbon price would reduce the payback time for energy efficiency or renewable energy investments in proportion to the increase in the fuel price resulting from adding the carbon price.

The environmental impact in MS also depends on the additionality to national measures under the ESR and to national carbon pricing measures, i.e. whether those MS that have carbon taxation will reduce/abolish them with the introduction of an EU wide carbon pricing system. In this context, the introduction of carbon pricing could foster additional supportive measures[133]. In 2020, only seven MS had explicit national carbon pricing instruments for buildings and transportation fuels in place: Denmark, Finland, France, Ireland, Portugal, Slovenia and Sweden. Prices range from 19 EUR/tCO_2 in Slovenia to around 115 EUR/tCO_2 in Sweden. The German national emissions trading system started in January 2021, with fixed increasing carbon prices initially starting from 25 EUR/tCO_2. The relative price impact, and therefore environmental impact will moreover be higher in MS where the existing level of other taxes on fossil fuels is low. Germany has indicated its interest to have its system replaced by an EU-wide system.

6.3.1.1.1 *Specific considerations for the buildings/ heating sector*

Examples of building technologies, which could be implemented profitably at carbon prices in the range of the PRIMES modelling results[134] are early replacement of boiler

[132] The exact percentage depends on if and how maritime transport would be also included.
[133] CERRE, Feasibility and impacts of EU ETS scope extension, December 2020.
[134] 2030 carbon price of EUR_{2015} 48 in MIX and EUR 80 in MIX-CP. Both scenarios include a mix of policies.

and other heating or cooling technical building systems, integrated heating and domestic hot water, insulation solutions, water heater replacements, ground source electric heat pumps for the commercial sector, biomass heating or electric heat pumps in the residential sector.

Even though demand for heating fuel is very inelastic to fuel prices in the short term, in the longer term household energy demand has been more price elastic, meaning that demand responds to a carbon price with elasticity values ranging from 0.23 to 0.5 in the EU and its MS[135].

Tackling other market barriers and failures in this sector, for instance due to split incentives, lack of access to finance, and lack of information, e.g. through the EED and EPBD revision, as well as the measures that would be encouraged by the Renovation Wave initiative (see also Section 6.3.5.2), could lead to a greater responsiveness to pricing but are not reflected in the elasticities. The IA accompanying the 2030 CTP has shown that adding carbon pricing for emissions from buildings to an unchanged current policy mix would deliver a ten percentage points higher reduction in emissions by 2030[136].

6.3.1.1.2 *Specific considerations for the road transport sector*

For the transport sector as well, it is important to emphasise that an emissions trading system should be considered only as a complementary measure to other transport policies: given the prevalence of a variety of market failures in the transport system, a mix of instruments will be required to help transform the sector. The most important instrument for tackling these issues are CO_2 emission standards for vehicles, for which the revision is the object of a parallel IA, which indicates that strengthened standards as of 2030 could deliver alone around 40 to 50% of the additional emission reductions in road transport in 2030[137]. The remaining reduction is delivered by all the other policies in the MIX scenario, including carbon pricing and regulatory measures to increase the market uptake of renewable and low carbon fuels. The CO_2 standards could usefully be complemented by pricing incentives which impact the fuel use in the entire vehicle stock (existing and new vehicles) and could increase the demand for more fuel-efficient vehicles (see also Section 6.3.5.2). Increasing the level of the CO_2 standards will contribute to increasing emission reductions and thus lower the carbon price required to

[135] ICF et al. (2020).

[136] Comparing the carbon pricing focused scenario CPRICE, with 2030 carbon prices of EUR_{2015} 60, with the baseline scenario used in that IA.

[137] Amendment of the Regulation setting CO2 emission standards for cars and vans.

achieve the emission cap for the new ETS sectors set as described in Section 5.2.4.3. And lower CO_2 standard levels will contribute to increase the carbon price to achieve that cap.

Such pricing incentives could in addition support fuel shift towards low-carbon fuels, modal shift, as well as operational efficiency improvements, for all road transport. The carbon price would shorten the payback time on investments in more efficient vehicles and thus increase the incentive to switch to zero-emissions vehicles. Such changes and the removal of market barriers cannot be incentivised by either carbon pricing alone or standards alone.

Based on historical data, price elasticities (or how demand responds to a carbon price) in transport have been estimated to lie between 0.17 on average in the short term and 0.34 in the long term[138]. This would lead to reductions of around 1-3% of the fuel demand for the estimated carbon prices predicted up to 2030. The long-term elasticity of freight transport is higher than for passenger transport.

However, if policies tackling market failures and barriers are in place and transport decarbonisation is tackled in a holistic approach, emissions could be more responsive to pricing than predicted, implying that elasticity based estimates of emission reductions are on the conservative side. Furthermore, the elasticity based impact estimates could be too low in a situation where the system is close to a transition to electrification, where, if price expectations help convince a segment of the market to move to zero emission vehicles, the market introduction of these vehicles could be sped up. In this medium to long term, electrification of the road transport system would lead to inclusion of part of the sector into the existing ETS by default.

Examples of transport technologies which could be implemented profitably at carbon prices in the range of the modelling results are improved aerodynamics, engine efficiency, tyre resistance, reducing the weight of vehicles, more blending of biofuels as well as to a certain extent the switch to electric vehicles[139].

6.3.1.2 Impacts of option EXT2: Extension to all fossil fuel combustion

For an emission scope of all fossil fuels outside of the existing ETS (except maritime transport), current CO_2 emissions are around 1.4 Gton and the modelled level of reduction of emissions by 2030 compared to 2005 is in MIX also -43%. Two main sectors would be added to the scope of emissions under option EXT1: small emitters

[138] ICF et al (2020).

[139] Results from bottom-up modelling by ICF et al. (2020), using carbon prices between €30 and €90.

from the industry sector (around 60% of the emissions added to the scope compared to EXT1[140]) and off-road vehicles and machinery in agriculture, forestry and construction. Fugitive emissions[141] would remain in the scope of the ESR.

Reductions compared to modelled emissions in 2025 would be over 24% in 2030, making the speed of reduction in the second half of the decade roughly comparable to that expected from the road transport and buildings sector put together.

In the agricultural and forestry sector mitigation options such as biofuels are available, however with qualifications: for instance, in the case of agriculture and forestry tractors electrification has not yet achieved any significant market penetration due to the high investment costs and a limited offer. In the non-ETS industry, most emissions are caused by gas-generated heat generation for which electric heat is not always a possible alternative for these companies[142]. PRIMES results might overestimate the reductions, as the separation of small emitters in the modelling is difficult. Other analyses[143] find mitigation costs quickly exceeding €100/tCO_2, and higher than for EXT1.

6.3.1.3 Linking options

Neither ELINK1 nor ELINK2 would change the overall environmental outcome if existing and new ETS are looked at together. Abatement potentials analysis[144] indicates that if the current EU ETS and the new ETS for road transport and buildings were to be linked from the start as in ELINK2, and if cost-effective mitigation potentials turned out to be more difficult to realise in new ETS sectors, allowances would flow from the former to the latter.

6.3.2 Economic impacts

The general economic impacts of increased ETS and ESR ambition and various scenarios were assessed in Section 6.4 of the IA accompanying the 2030 CTP. The extension of emissions trading to the new sectors can assist in incentivising the cheapest reductions across MS, improving cost-effectiveness in these sectors[145].

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[140] Sources : PRIMES. ICF et. al. (2020).

[141] Fugitive emissions are emissions of gases or vapors from pressurized equipment due to leaks and other unintended or irregular releases of gases, mostly from industrial activities.

[142] ICF et.al. (2020).

[143] ICIS: Carbon Market Spotlight. Discussing sector extension options for the EU ETS. March 2021

[144] ICF et. al. (2020).

[145] The Effort Sharing Regulation Impact Assessment includes an analysis of sectoral energy system costs of the whole Fit for 55 package per Member State group including also the transport and building sector.

Introducing carbon pricing of fossil fuel use can contribute to significant savings of fossil fuel imports (of around €83 billion over the period 2021 to 2030) notably in transport but also buildings[146]. It also contributes to improvements of energy security by reducing the energy dependency ratio (e.g. for 2030 from 54.5% in REF to 52.9% in MIX-CP). Strengthening other policies in the mix improves this further (2030 in MIX: 52.5%).

6.3.2.1 Option EXT1: Extension to buildings and road transport

6.3.2.1.1 *Impact on investment*

Carbon pricing increases energy costs for consumers but at the same time raises revenues which can be used for reinvestments, for stimulating climate action and to address social or distributional impacts of carbon pricing. The annual revenues could be large, and, once the new ETS is operational, significantly higher than in the existing ETS (see Annex 13), as all the allowances in the new ETS would be auctioned.

The IA for the 2030 CTP[147] recognised that there is an investment challenge linked to the higher climate ambition in particular in the residential and tertiary buildings sectors irrespective of the scenario concerned. It found that the additional investments needed in the MIX scenario to meet the higher ambition targets compared to baseline would remain skewed towards the demand side, dominated by residential investment. In order to achieve the additional level of private and public investment, EU wide around EUR 40bn for residential and around EUR 15bn for tertiary would need to be mobilised annually. The bulk of the increase is required to improve thermal efficiency of buildings and to reduce share of fossil fuels in heating, with substantial additional investment also in office buildings in the tertiary sector for similar purposes.

Concerning the residential sector specifically, additional investment will be required so that total investment expenditures as a percentage of household consumption are likely to rise. Table 20 below gives an estimate of rises in annual capital cost as a percentage of consumption between Reference, and the MIX and MIX-CP policy scenarios. These estimates cover cumulative impacts of ETS extension and other policies, e.g. strengthened energy efficiency and renewable energy policies. The expenditure rises are provided as an average characterising different groups of MS: those with a GDP per capita below 60% of the EU average, those with a GDP per capita between 60% and 100% of the EU average, and those with a GDP per capita above the EU average.

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[146] See SWD(2020)376, Section 6.4.1.4, comparing results of the carbon price driven CPRICE scenario, with similar 2030 carbon prices as MIX-CP, with BSL.
[147] See Sections 6.4.1.3 and 9.5.2.2.

The table shows that residential investment expenditures are expected to increase in 2030 in the EU by 0.4 to 0.7 percentage points of household income compared to baseline. In a more carbon price driven policy setting, investment expenditures increase less strongly than in a more balanced policy mix[148], while fuel expenditures show the opposite picture (see below Section 6.3.3.1.1). Investment increases in MIX are well above EU average in MS with a GDP per capita below 60% of the EU average. However, large fuel expenditure reductions would be realised as well, if such investment expenditures, in housing stock renovation and energy efficient equipment, would take place.

Table 20: Annual residential sector capital costs as a percentage of household consumption in 2030, percentage point difference compared to Reference

Annual residential sector capital costs		**All households**	**Lower income Households**
EU	**MIX**	0.71%	1.43%
	MIX-CP	0.38%	0.70%
MS < 60% GDP/Capita	**MIX**	0.97%	1.99%
	MIX-CP	0.81%	1.62%
MS between 60-100% GDP/Capita	**MIX**	0.81%	1.92%
	MIX-CP	0.25%	0.48%
MS > 100% GDP/Capita	**MIX**	0.62%	1.14%
	MIX-CP	0.36%	0.62%

Source: PRIMES.

With regards to road transport, the Sustainable and Smart Mobility Strategy (SSMS) and the IA accompanying the 2030 CTP have recognised the central importance which investments aimed at boosting demand for zero- and low-emission vehicles and at accelerating the rollout of recharging and refueling infrastructure for these vehicles will play in achieving the goal of decarbonising significantly road transport by 2030.

For example, the SSMS estimated that by 2030, 30 million zero-emission vehicles could be on the road in the EU and require 3 million publicly accessible charging points (of which 2 million to be added between 2025 and 2030) together with the development of

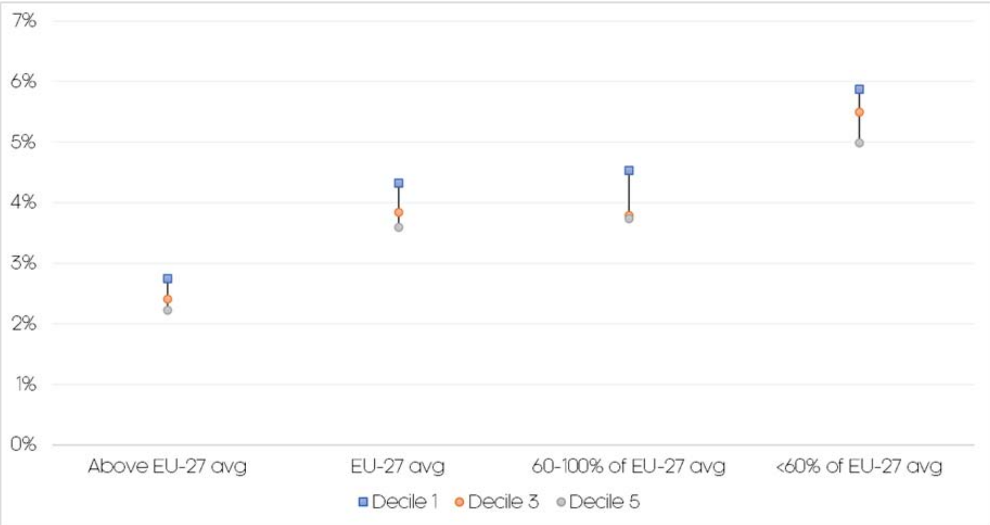
[148] As the Impact Assessment accompanying the 2030 CTP has shown, investment expenditures increase most strongly in a -55% policy scenario without extended carbon pricing.

home charging. The investment required for the installation of this number of public charging points, a (which should include equipment, installation and grid upgrades), also tackled by the revision of Directive 2014/94/EU on the deployment of alternative fuels infrastructure, and for home charging should be significant[149].

6.3.2.1.2 *Impact on fuel costs, consumers and economic actors*

The introduction of a carbon price would increase end-consumer prices for fossil fuels (household heating and cooling expenditure and gasoline for vehicles) to a different degree depending on the carbon price levels and on the underlying relative level of existing other taxes on fossil fuels.

Figure 8: Share of Household fossil fuel energy expenditure in total final consumption expenditure in EU-27 countries grouped by GDP per capita (above EU-27 avg, 60-100% of EU-27 avg, <60% of EU-27 avg), and country group averages, in Decile 1, 3 and 5, %



Source: ICF et al. (2020) (forthcoming) assessment for the European Commission – Potential extension of the EU ETS. Data is for the latest available year for all the countries (oldest year: 2010, latest year: 2015). Split into country groups by GDP/capita, within group ordered by share of expenditure in total final consumption expenditure in Middle class households (Decile 5), largest to smallest. Fossil fuel expenditure is without carbon pricing.

The impact of this increase in fuel prices on fuel costs is projected to be mitigated by an overall decrease in the demand for fossil fuels. In addition, the relative increase in fuel costs has also to be considered in relation to the current share of fossil fuel costs in

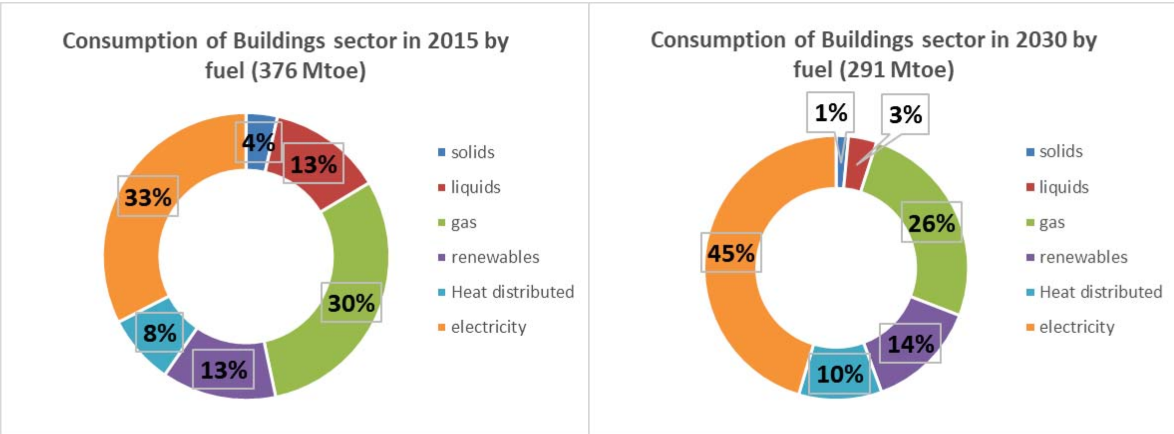
[149] See also T&E RechargeEU, Jan. 2020. ICCT working paper 2019-14. The SSMS also targets 1000 public hydrogen refuelling stations by 2025.

household expenditure which differs between MS and household groups, as shown in Figure 8.

In the buildings sector, the impact will be larger for households that use coal for heating, and even more so in lower income MS that have relatively cheap and low taxed coal available.

With the introduction of a carbon price, coal end user prices would increase significantly (see Section 6.3.3.2) in the low income MS concerned. However, at EU level the share of coal in the overall mix of fuels used for heating is relatively small even though the share of relative emissions are higher (see Figure 11) so that targeted measures could be taken to ease the transition for the consumers concerned and support cleaner systems such as (geothermal) heat pumps.

Figure 9: Energy consumption of the residential sector by fuel (EU-27)



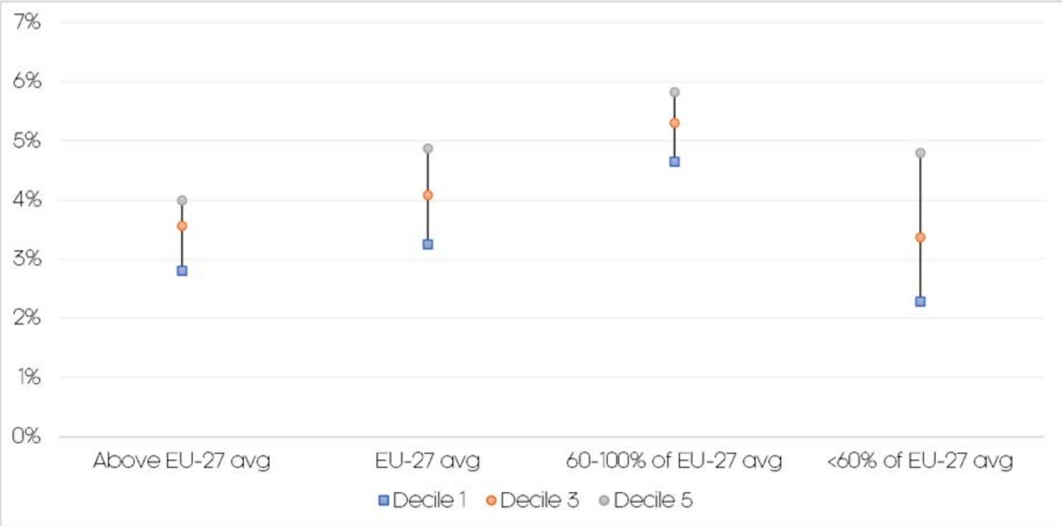
Source: PRIMES, MIX scenario

By contrast, at a similar level of carbon price the impacts on consumer prices for natural gas and for heating oil are much lower than for coal, because end user prices are generally higher also in lower income MS (see Figure 13 and Figure 14 in Section 6.2.3.1 for the impacts on end consumer prices).

In the road transport sector, the impact on consumer prices (see Section 6.3.3.1 for more detail) and therefore on fuel costs will be largest in those MS which currently apply the lowest excise duties on diesel and on petrol, but the situation is more contrasted than for the buildings sector as several lower income MS apply high taxes on petrol and diesel. Clearly, the cost efficiency of the ETS at achieving additional emissions abatements might be limited by the current heterogeneity of the national fuel tax landscape (see also Annex 5, Section 16.4).

In addition, the initial share of transport fuel costs within total final consumption expenditure tend to be the higher at least for medium income households, and clearly lowest for the poorer households (Decile 1)[150]. Largely explained by this, an increase in transport fuel costs would have the relatively largest impact for medium income households, while the relative increase in transport fuel expenditure (at the expense of other types of expenditure) is also notable for most countries' lower-middle class households (see Figure 11).

Figure 10: Share of Household transport fuel expenditure in total final consumption expenditure in EU-27 countries grouped by GDP per capita (above EU-27 avg, 60-100% of EU-27 avg, <60% of EU-27 avg), and country group averages, in Decile 1, 3 and 5, %)



Source: ICF et al. (2020). Fossil fuel expenditure is without carbon pricing.

Another impact for consumer choice is that covering building emissions with a new ETS would correct to some degree the current absence of a level playing field in terms of carbon pricing of domestic fossil-fuelled heating systems with district heating and electric heating already now covered by the ETS. The latter amount to around 30% of EU direct and indirect heating emissions, with significantly higher shares in a number of MS. Covering road transport emissions with the new ETS would also correct the absence of a level playing field between fossil-fuelled road transport and electric vehicles and electrified rail, which is already covered by the existing ETS.

[150] ICF et. al.

A carbon price of around 48€ as in MIX for 2030[151] would increase fuel prices by 11 ct/l (petrol) to 13 ct/l (diesel) which seems unlikely to drive much refuelling and tank tourism out of the EU. It can be safely assumed that transport companies already exploit existing fuel price differentials with countries neighbouring the EU, and that the fuel price increase from the carbon price would not change the situation in any significant way[152].

6.3.2.1.3 *Impact on the business of regulated entities*

As described in Section 5.2.4.3, the extension of emissions trading to the new sectors would be an upstream system, whereby the compliance obligation concerns the act of releasing on the market fossil fuels for combustion in the sectors concerned. Therefore the regulated entities would not be the emitters and would pass on the carbon cost to the individual emitters, but would also bear the compliance costs.

In order to acquire the correct number of allowances, the regulated entities must estimate the fuel volumes they will supply. They will need to manage their carbon allowance needs and may need to trade allowances if they have a surplus or shortage. They may need to call upon advisors such as corporate banks to provide them with advice and services to manage their carbon needs and to hedge against the risk of rising prices. This would come at a cost.[153] There are also costs for regulated entities associated with the monitoring and reporting of fuel quantities (see Section 6.3.4). The question arises whether there is a need to provide some kind of exemptions for small entities. This question is especially pertinent with respect to the regulation of coal, as there are many, sometimes very small coal suppliers which until now are hardly regulated.

Excluding small entities from the new ETS may seem advantageous in terms of limiting burden and impact for the entities concerned; however, this advantage would have to be weighed against the resulting environmental impact. Also, a system with de minimis thresholds such as the one used for the ETS does not seem appropriate in the case of the fuel-supply based new ETS. In the case of the new ETS, there is a risk that such de minimis approach would trigger avoidance of the rules by organising businesses such that they remain under the thresholds. Alternative mechanisms to reduce the burden can be considered, such as facilitating the access by small entities to auctions for example by allowing them to form business groups that can bid on their behalf in auctions.

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[151] In MIX-CP with less stringent complementary policies the 2030 carbon price for new ETS sectors is EUR_{2015} 80.

[152] ICF et. al. (2020).

[153] See in relation to the German domestic emissions trading system: IW-Gutachten, Nationaler Emissionshandel für Verkehr und Wärme.

6.3.2.2 Option EXT2: Extension of emissions trading to all fossil fuel combustion

The economic impacts of EXT1 apply also for EXT2. Annual ETS revenues for the period 2026 to 2030 could also be significant (see Annex 13) and higher than under EXT1, depending on the extent of provisions against the risk of carbon leakage for small industry. As mentioned in Section 6.3.1.2, in this option around 60% of the emissions added to the scope of EXT1 would come from small industry.

Small emitters from the industry which fall under the scope of the ETS Directive could and have largely been opted out subject to measures that should achieve an equivalent contribution to emission reductions as if they would have under the EU ETS. The reason for such exclusion was that administrative costs for full MRV[154] were found to be too high for these emitters compared to the carbon price for the emissions. Another reason for these SMEs was that for some sectors international competitiveness is of high concern, and the additional administrative complexity and costs which would arise at all levels (local, national and EU) if carbon leakage measures are required could make equivalent policy approaches more efficient[155].

A reason for including the small industry as in EXT2 could be if the equivalent measures were to deliver insufficient reduction in emissions. However, the monitoring under the ETS Directive for the opted-out installations subject to equivalent measures under Art. 27 suggests that these measures deliver emission reductions as intended[156]. In addition, where there is a risk of carbon leakage for SMEs, a framework for compensation would need to be considered (see Section 6.3.4) which is likely to generate additional administrative complexity and costs in view of the large number of these small or very small emitters.

6.3.2.3 Linking options

According to the abovementioned considerations on the differences in emission abatement potentials between sectors, and if complementary policies were not as effective as assumed in MIX, prices in the new ETS could be quite different and potentially higher than in the existing ETS. This is illustrated by MIX-CP where the 2030 carbon prices are EUR_{2015} 52.5 in the current ETS and 80 in the new ETS sectors.

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[154] Articles 27 and 27a of the ETS Directive allow for simplified MRV.

[155] Umweltbundesamt et al.; Evaluation of the EU ETS Directive, 09/2015.

[156] An estimate gives emissions reduction between the average of 2008-2010 and 2018 of around 18%.

Allowing for allowances to flow from the new ETS to the existing ETS as in ELINK2 could contain the abatement costs, but it could put pressure on industrial sectors.

A full linking of the two systems as in option ELINK1, , could allow limiting the risk of high prices in the new ETS and the same GHG reductions could be achieved at lower cost as without linking[157]. However, conversely, linking the systems could increase the risks for the current EU ETS. Linking the systems gradually, once the price in the new system has stabilised, could mitigate these risks.

6.3.3 Social impacts

6.3.3.1 Impact on employment

The macro-economic analysis conducted as part of the Impact Assessment accompanying the 2030 CTP concluded that the impact of an increas if climate ambition to -55% on aggregate employment would be relatively limited. The employment impacts is positive if carbon pricing revenues are recycled to either lower other taxes or to support energy efficiency investment[158].

An extension of emissions trading in both EXT1 and EXT2 options is hence expected to have small effect on the employment as a whole. However significant shifts in the sectoral composition of employment and associated job changes that workers will have to go through are expected over the next decade, which would generate challenges for the labour force and potential mismatches between skills available and the skills requirements. These have been analysed in the Impact Assessment underpinning the 2030 CTP. Oil and gas supply belong to the sectors with significant projected employment decreases.

Table 21: Impacts of 55% reduction on EU sectoral employment related to buildings, transport and other fossil fuel use (deviation from baseline across scenarios, in percent)

Employment vs. baseline, 2030	**Fragmented action**	**Global action**
Oil	-5.2 | -3.1	-7.9 | -5.7
Gas	-11.2 | -8.5	-7.9 | -5.8
Construction	0.3 | 0.6	-0.1 | 0.4

[157] ICF et al. (2020).
[158] SWD(2020)176, Section 6.4.2

Other equipment goods	-0.3 | 0.4	2.0 | 2.8
Transport (land)	-0.5 | 0.0	-0.7 | 0.1
Market services	-0.3 | 0.1	-1.4 | -0.7

Source: SWD(2020)176, JRC-GEM-E3 model (see scenario explanation in Section 6.1.3.1)

Sectors that are likely to gain most significantly include construction, notably through more green employment. The need for measures to increase the energy efficiency and decarbonise heating of buildings triggers higher employment in construction and often also in the equipment goods industry. Employment in land transport is either stable or could slightly decrease. Market services, by far the largest provider of jobs in the EU, would be affected relatively little.

6.3.3.2 Impact on lower-income and vulnerable households

6.3.3.2.1 *Option EXT1: Extension of emissions trading to buildings and road transport*

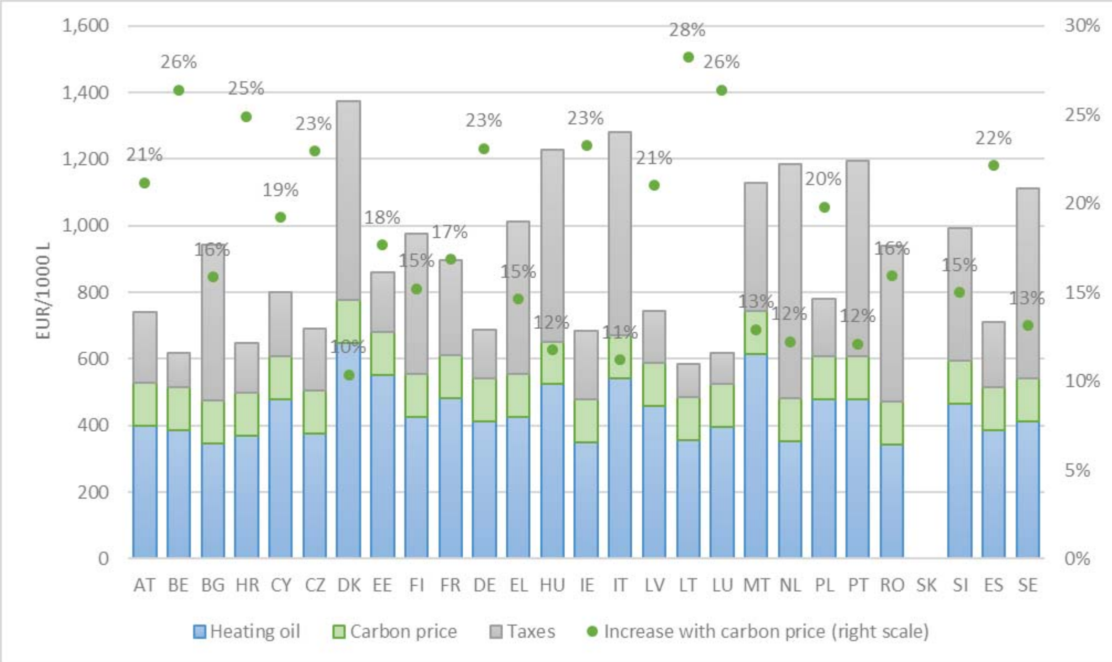
Energy costs and expenditure on transports represents an important share of total final expenditure of lower to middle-class households, even in rich countries. The introduction of emissions trading in road transport and buildings will increase the price of energy and therefore the energy costs for households, independently from their income. According to Eurostat data on consumption expenditure[159], energy expenditures rise with income, but as a share of disposable income, energy expenditures decline with higher incomes.

This means that an emissions trading system for buildings will not affect households equally, but would likely have a regressive impact on disposable income, as low income households tend to spend a greater proportion of their income on heating[160]. In addition, the introduction of a harmonised carbon price will have a very different impact on consumer prices in MS depending on the existing level of taxes on the fuels concerned, as pre-tax prices of fossil fuels are comparable across MS.

[159] ICF et al. (2020); Eurostat Structure of consumption expenditure by income quintile and COICOP consumption purpose. https://ec.europa.eu/eurostat/web/products-datasets/product?code=hbs_str_t223

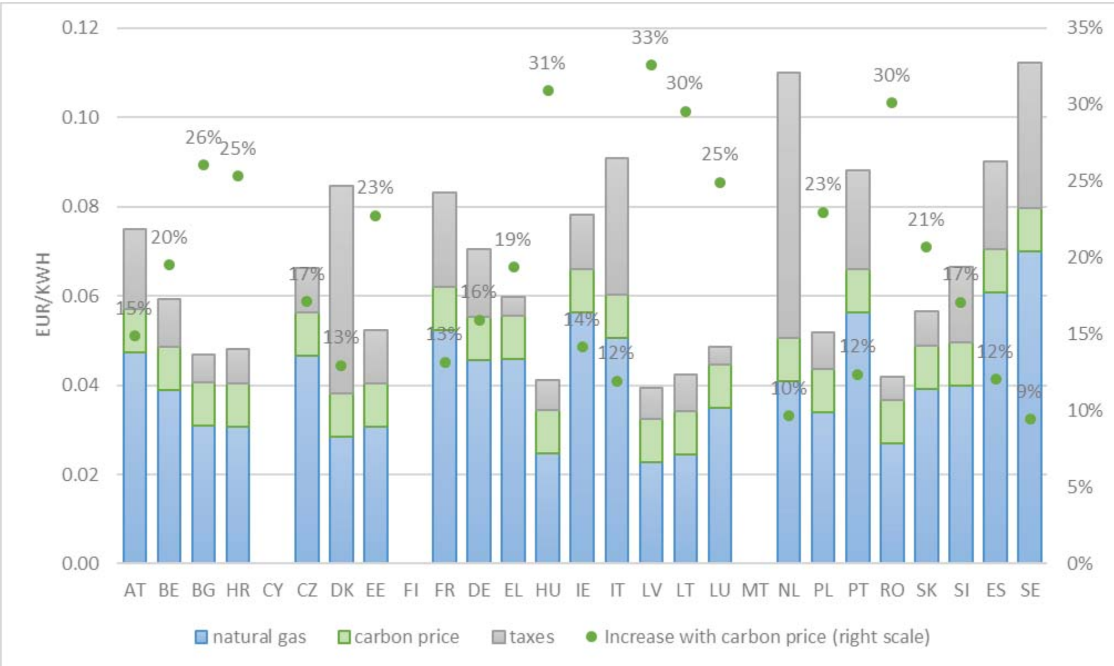
[160] ICF et al. (2020).

Figure 11: Impact of carbon price on consumer prices per Member State – heating oil)



Source: Oil Price Bulletin, EU Commission. Average June 2020 –May 2021 pre-tax prices and taxes and assuming a carbon price of EUR 48 /tonne CO_2. Percentages mentioned in Figures 11 and 12 represent the increase in consumers prices due to the extended emissions trading

Figure 12: Impact of carbon price on consumer prices per Member State – natural gas)



Source: Eurostat, Note: CY, MT and FI do not report natural gas prices in the household sector. 2020 prices assuming a carbon price of EUR 48 /tonne CO_2.

With regards to coal, as it is very little taxed the impact on consumer prices of a EUR 48 carbon price would be comparatively much larger than for natural gas or heating oil with an EU average impact estimated at 52% and up to nearly 100% in few Member States.

For the residential sector specifically, energy poverty issues are of special importance to investigate. For this it is important to see how the described fuel price increases translate into increased fuel expenditures for different household groups, which depends on the investments made to reduce fuel use. Figure 8 in Section 6.3.2.1.2 has shown based on statistical data that the impact on the lowest income decile is more significant than on the third decile and fifth decile. Table 24 below gives an estimate of rises in fuel expenditures as a percentage of household consumption expenditures between Reference and the MIX and MIX-CP policy scenarios. These estimates cover cumulative impacts of emissions trading and other policies, e.g. the revision of the energy taxation directive. The expenditure changes are estimated for low, medium and high income groups as defined according to modelling, and provided for three GDP groups of MS: those with a GDP per capita below 60% of the EU average, those with a GDP per capita between 60% and 100% of the EU average, and those with a GDP per capita above the EU average. The figures between the income groups are not necessarily comparable, as the high, medium and low income groups are defined relative to the average income of a MS. Note that there are therefore uncertainties involved in the aggregation within the groups.

Table 22: Fuel expenditure only as a percentage of household overall consumption expenditure in 2030 compared to Reference

Fuel Expenditures only		Lower income Households	Medium income households	High income households	All households
EU	MIX	-0.27%	-0.11%	-0.04%	-0.12%
	MIX-CP	0.07%	0.05%	0.07%	0.06%
MS < 60% GDP/Capita	MIX	0.15%	0.08%	0.15%	0.12%
	MIX-CP	0.62%	0.30%	0.28%	0.36%
MS between 60-100% GDP/Capita	MIX	-0.42%	-0.14%	-0.07%	-0.18%
	MIX-CP	-0.09%	-0.02%	0.01%	-0.02%
MS > 100% GDP/Capita	MIX	-0.29%	-0.13%	-0.07%	-0.14%
	MIX-CP	0.04%	0.04%	0.04%	0.04%

Source: PRIMES.

Overall fuel expenditures as percentage of income remain near stable. In the more ETS driven policy scenario (MIX-CP), they are projected to increase EU-wide on average by 0.06 percentage point. In the more balanced policy scenario (MIX), fuel expenditures as percentage of income are likely to drop by 0.12 percentage point. This means that there can be fuel expenditure savings despite the price increases, under the condition that the cost-effective investments to achieve -55% emission reductions (see above Section 6.3.2.1.1) are realised and hence less fossil fuels are used.

As Table 20 in that section also shows that in a cost-effective policy mix the investment expenditure increases for lower income households would be across all MS income groups over double of the average household. If these investments are realised, then on average for lower income households (drop of 0.27 percentage points in MIX) the picture looks better than for the average household. For the low-income Member State group the share of fuel expenditures in household consumption expenditures rises across all income groups, by around 0.12 to 0.36 percentage points on average and by 0.15 to 0.62 percentage points for low-income households.

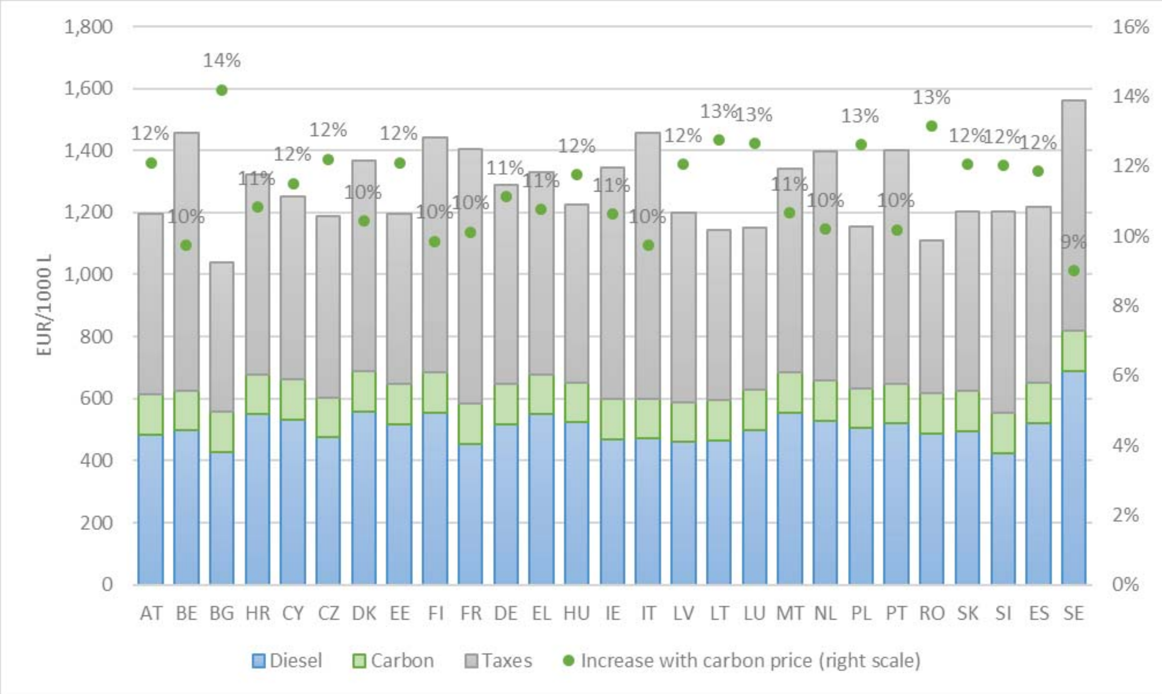
According to the modelling results, the general key challenge in the residential sector is hence to ensure that the necessary energy efficiency, refurbishment and renewable energy investments (see Table 20 in Section 6.3.2.1.1 above) take place including in lower-income households. Taking this into account, the challenge of fuel price increases remains limited and focused on lower-income households in low-income MS.

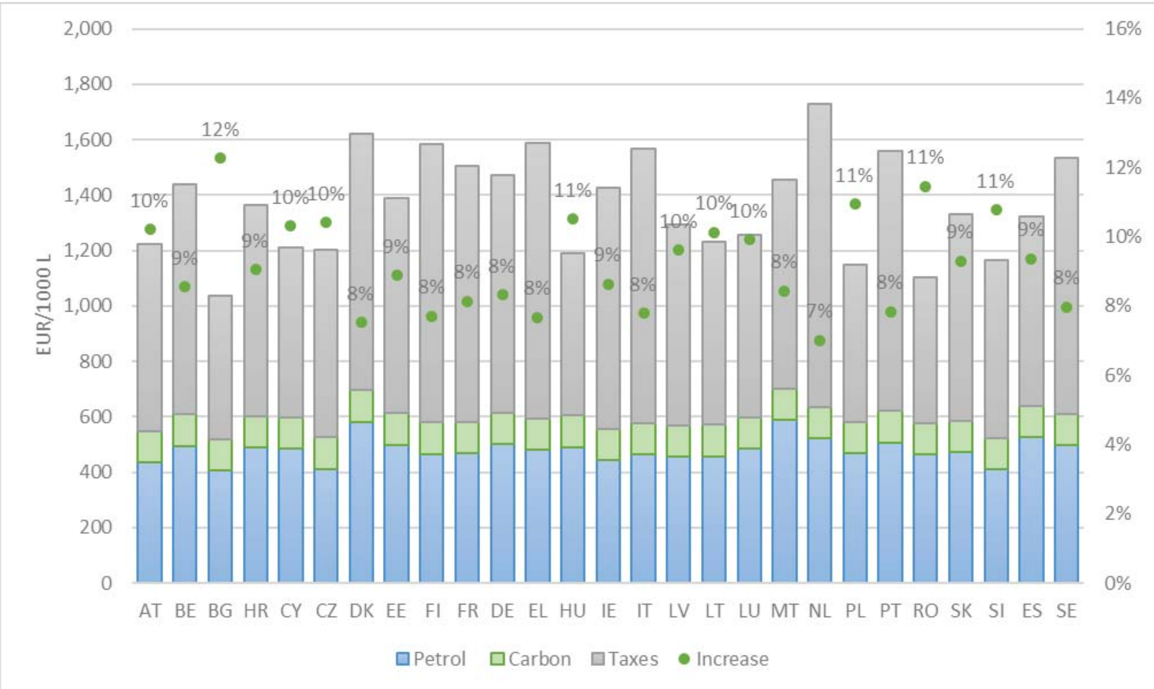
In the case of house heating energy expenses, there is a large variance across countries due to the initial share of natural gas in households' energy mix.

Road transport impacts are mixed – typically it is the 'lower-middle' and 'middle' parts of the household income classes where the proportion of spending on transport is highest (because the lowest income households do not have access to a private vehicle)[161].

[161] ICF et al. (2020).

Figure 13: Impact of carbon price on consumer prices per Member State – (diesel and petrol for road transport)





Source: Oil Price Bulletin, EU Commission. Average June 2020 –May 2021 pre-tax prices and taxes and assuming a carbon price of EUR 48 /tonne CO_2

Revenues from the auctioning of allowances can be used through different redistributive mechanisms as compensation to the regulated entities and the consumers (reduction in income tax, employer's social security contributions and VAT), invest in energy efficiency or in renewables, or other options. Also rules mitigating excessive short term price increases could be considered (see Annex 5, Section 11).

The social impacts could be mitigated with a multi-faceted policy approach at EU and national levels. At EU level, the initiatives include the Energy Poverty Observatory[162] which supports MS' efforts in alleviating and monitoring energy poverty; the Recovery and Resilience Facility[163] has earmarked significant expenditure for climate investment and the green transition; and the European Pillar of Social Rights action plan aims for a socially fair and just green transition for all Europeans. At national level, the NECPs submitted by the MS pursuant to the Governance Regulation[164] give a detailed overview of existing policies tackling energy poverty. Mitigation policies and measures at national level can be of the following types: aim at improving the energy situation of households by financing improvements in energy efficiency; provide financial assistance to reduce energy bills; provide advice view energy audits; introduce measures such as protection against disconnection for vulnerable households.

The Impact Assessment for the Revision of the Energy Taxation Directive can provide further insight, as it has considered the impacts on households per income decile in selected countries. While initial impacts can be mildly regressive, the impact assessment shows that revenue recycling can, in theory, fully resolve the distributional issues which arise, confirming a similar result obtained in the IA accompanying the 2030 CTP.

6.3.3.2.2 *Option EXT2:* Extension of emissions trading to all fossil fuel:

In addition to the impacts explained above under EXT1, EXT2 would cover more sectors, such as agriculture. It can therefore have a larger impact on rural areas.

6.3.3.3 Other social impacts

In the EU heating of buildings is a main sectoral source of fine particles with a diameter of 2.5 µg or less (PM2.5), while road transport is the main sector producing NO_x emissions[165]. These pollutants have significant adverse effects on human health and can cause respiratory and cardio-vascular diseases, among others. They are also at the root of premature deaths. An ETS extension as under EXT1 and EXT2 likely contributes to

[162] C(2020)9600 Commission recommendation on energy poverty, October 2020.
[163] Regulation (EU) 2021/241.
[164] Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action.
[165] European Environment Agency: Air quality in Europe – 2020 Report. EEA Report No.9/2020.

positive health impacts due to overall reduced air pollution from fossil fuel use. For example, in 2030 premature deaths and life years lost due to PM2.5 emissions are around 8% lower in MIX than in REF[166]. This typically benefits lower-income and vulnerable households more as they are more affected by air pollution[167].

6.3.4 Administrative impacts

Extending emissions trading to the road transport and building sectors or to all fossil fuels, implies setting up a completely new system alongside the existing ETS, with another type of compliance companies (fuel suppliers rather than final emitters). This brings challenges from a regulatory and administrative point of view, as well as costs for the public sector and for the regulated entities. For both options EXT1 and EXT2, one-time administrative costs, regularly occurring administrative costs and cost for disclosure and sanctioning can be identified due to the establishments of a new ETS system. Lessons learnt form the experience of existing ETS can be taken into account and existing infrastructure (such as the Registry) can be used. Additionally, at least for oil and gas, entities that could be regulated under the new ETS are already regulated for other policy purposes, and therefore there could be room to use the already existing corresponding infrastructure also for the purposes of meeting their obligations under the new ETS.

Extension of emissions trading to the road transport and building sectors or to all fossil fuels will require to put in place and design a robust and feasible system for Monitoring, Reporting and Verification (MRV) of emissions. The monitoring and reporting rules that would be adopted for the upstream regulated entities would in principle not be more complex as compared to the existing ETS system. This is because in the new sectors, only sales of largely standardised fuels for combustion purposes would be monitored. As the Impact Assessment accompanying the 2030 CTP articulates, the calculation of emissions will continue to rely on emission factors. To the extent possible and subject to further analysis, the existing ETS system of standardised fuel emission factors per energy content would be applied.

Provisions related to auctioning, to the use of the Union Registry and to enforcement and compliance measures will also need to be put in place. The infrastructure of the existing

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[166] Annex 3 of the Effort Sharing Regulation impact assessment (SWD(2021)611) analyses benefits per Member State groups.

[167] EEA: Unequal exposure and unequal impacts: social vulnerability to air pollution, noise and extreme temperatures in Europe, EEA Report No 22/2018.

ETS, even if used to a certain extent, will need adaptations and reinforcement. Because the ETS regulatory framework has proven to work well and in light of the fact that a future linking and/or merging of the two systems is a possibility, it is appropriate to design the regulatory framework for the new ETS along the same lines and make it as compatible as possible with that of the existing ETS (Registry, MRV rules, auctioning rules, compliance cycle).

In the case of option EXT2, a framework on free allocation or alternative compensatory measures would need to be considered in addition, because of the risk of carbon leakage at the level of the end-consumers of the fuel.

Secondly, an extension to new sectors will create cost related to the setting in place and the operating of the system for regulated entities and for the competent authorities, including in terms of human resources and IT infrastructure. For regulated entities, participation in the system will at least trigger costs related to obtaining the GHG permit, open and maintain registry account(s), comply with the MRV rules (preparing and updating the monitoring plan, implementing its procedures, monitoring and reporting, verification fees charged by the independent verifier), and purchasing and surrendering allowances. Administrative costs include fees for the use of the registry, which are different across MS[168].

Public competent authorities will have at least costs related to the preparation, implementation and running of the system, and the establishment of a compliance system. Non-recurring costs to implement the system can also be foreseen as setup registry accounts and processes. It can also be foreseen recurrent costs as the helpdesk function, approval of permits, monitoring plans, review verification statement, registry handling and other costs as preparing guidance documents, translations, meetings, website updates. The number of regulated entities administered by each MS, the administrative structure and the allocation of responsibilities among the different levels of administration can also entail different costs among MS.

Both under option EXT1 and EXT2, as the system would be based on volumes of fuel supplied, the new MRV system would share more similarities with the MRV applicable to aviation both in terms of costs and obligations. Under option EXT2, free allocation for small industry would increase administrative costs for public authorities as well as for small industry.

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[168] https://ec.europa.eu/clima/policies/ets/registry_en#tab-0-1

Both for EXT 1 and EXT2, it is expected that administrative burden will be moderate in the case of oil and gas, and high in the case of coal, due to the specificities of the supply chains. Further details, together with an illustrative cost estimate for coal under EXT1 are presented in Annex 5, Section 12.3.

As mentioned in Section 5.2.2.3, the point of regulation needs to fit the different EU MS. In particular with respect to gas and coal where there is no EU harmonised excise duty system, it could be considered to propose in EU legislation a default point of regulation while allowing MS to deviate from this if there are justified reasons. Where relevant, this could allow the MS to limit the administrative impacts, both on the side of the public authorities and/or the regulated entities.

In setting an upstream system, complexities related to the tracking of fuel over the supply chain and boundaries issues can arise, together with the risk of double burden and loopholes. Double burden may occur when an ETS operator surrenders allowances to comply with ETS obligations and pays a carbon price on fuel used as a result of obligations under the new ETS. For instance, an industrial installation covered by the existing ETS that pays a carbon price for the reported emissions downstream and also pays a carbon price for the fuel purchased at the point of sale. There is therefore a double coverage of fuel being supplied to installations already covered by the ETS. This may require compensation regimes as *ex-ante* exemptions to the fuels suppliers or *ex-post* compensation of the downstream regulated entity when double burden occurs and carbon price is payed twice.

Loopholes would lead to evasion of the carbon price (for example non-ETS gas consumers in a large industrial zone connected to the TSO that do not purchase their gas from a supplier). Loopholes and double burden requires the fuel supplier to differentiate on the intended use and destination of the fuel, and in particular if, when combusted, the fuel will incur with a compliance obligation. This is also linked with the monitoring, reporting and verification design for these sectors.

As regards the different linking options there would be little differences as regards administrative impacts.

Finally, difficulties related to implementation can also be identified in the interactions between the energy efficiency obligation schemes[169] under the Energy Efficiency Directive (EED) and the possible extension of emissions trading to buildings as in option EXT1. Both instruments would to some extent rely on the same regulated entities, the energy suppliers. Indeed, not only energy suppliers might be regulated under both schemes, but also the obligated entities under the energy savings obligation schemes might be defined differently among the different MS[170]. Article 7a of the EED establishes that MS shall designate obligated parties among energy distributors, retail energy sales companies and transport fuel distributors or transport fuel retailers operating in their territory. Annex 5 provides for more details on regulated entities.

6.3.5 Coherence with other elements of the regulatory framework

The vast majority of respondents to the OPC, from a broad range of stakeholder groups, endorsed the maintenance of the Effort Sharing Regulation and the deployment of other sector-specific policies when extending the use of emissions trading to emissions from buildings, road transport or all fossil fuel combustion. CO_2 standards for cars and vans, transport policies, policies addressing energy efficiency of buildings and renewable energy policies as well as, to a lesser degree, energy taxation.

6.3.5.1 Interactions with the Effort Sharing Regulation

Emissions from road transport, buildings and other fossil fuel combustion are already covered by the Effort Sharing Regulation (ESR). If the ESR continues to cover these sectors, European carbon pricing via the ETS could possibly be seen as a double regulation. However, while EU-wide carbon pricing has shown to provide important incentives for cost-effective emissions reductions, it has been deemed that a continued accountability and action by MS for national emission reductions in these sectors incentivised by national targets under the ESR would not lead to inefficiencies, but rather lead to important synergies (for a detailed analysis of double coverage, see Section 6.1.6 of the impact assessment for the ESR review). This view has also been voiced by a large number of stakeholders in the public consultation on the ESR.

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[169] Under articles 7 and 7a of the Energy Efficiency Directive, amended by Directive 2018/2002, MS must set up an energy efficiency obligation scheme, which requires energy companies to achieve yearly energy savings of 1.5% of annual sales to final consumers.

[170] Most MS have chosen to obligate energy suppliers. However, in Denmark and Italy distribution companies are obligated, in Portugal the obligation is held by a non-profit private entity with a public function.

Different sectors covered by the ESR are already affected by a range of regulatory EU measures covering one or several sectors (see also following subsections). EU-wide carbon pricing through extended emissions trading can be seen as additional measure in the policy mix, contributing to achieving the enhanced ESR targets in a subset of the ESR sectors in a consistent way. The additional economic emission reduction incentives would cover around 50% (EXT1) or around 60% (EXT2) of ESR emissions, with a cap consistent with the cost-effective contributions of those sectors. Thus there is no distortion of the contributions of ESR sectors not covered by EU-wide carbon pricing.

Moreover, national measures that address non-price barriers or make alternative solutions available can make carbon pricing work better. Together with other measures discussed in the following subsections, this increases the credibility that a new ETS starting by the middle of the decade can deliver meaningful reductions in line with -55%.

The interactions between the ETS extension and ESR are assessed in more detail in the Impact Assessment of the ESR review. On the administrative implications of a possible parallel coverage of emissions see also Annex 5, Section 16.1.

6.3.5.2 Interaction between EXT1 and the other regulatory framework

There are clear complementarities between option EXT1 and the existing regulatory framework applying to **buildings**, notably the Energy Performance of Buildings Directive, the Energy Efficiency Directive, the Renewable Energy Directive, the Ecodesign Directive and the Energy Labelling Regulation (for a detailed analysis see Annex 5, Section 16.2). In line with a net 55% emission reduction target, the 2030 CTP anticipated that the actions in the Renovation Wave Communication and its goal of doubling the renovation rate will contribute to reduce buildings' greenhouse gas emissions by 60% as compared to 2015. Specifically, the EED, EPBD and RED II, which are all being reviewed and strengthened to contribute to increased GHG reduction ambition by 2030 will help to overcome market failures that impede emissions abatement that cannot be overcome by a price signal alone.

A higher price signal for heating or cooling of buildings will in principle support the objectives of the analysed Directives. Carbon prices at an adequate level can be effective in incentivising the switch towards low-carbon heating, achieving increased renewables ambition and in ensuring a level playing field between energy carriers.

An ETS extension and its higher costs for fossil building heating would result in an additional economic incentive for increased EE ambition and the energy efficiency measures promoted by the EPBD and the EED, provided that the carbon price signal is sufficiently high. The measures would likely become more cost-effective and have a shorter payback period, while the ETS would address potential rebound effects of energy efficiency improvements. Combined with sector specific EE policies and financing tools, an ETS would support achieving higher renovation rates and deeper renovations, notably concerning the improvement in heating installations and their replacements and the market diffusion of minimum energy performance requirements for buildings.

The ETS cap setting outlined in Section 5.2.4.3 reflects these complementarities, with an ambition level reflecting the combination of current legislation with such a strengthened policy mix. It would hence provide the additional carbon price incentive necessary to achieve the GHG objective while fostering the energy related objectives.

The new MFF, the Recovery and Resilience Facility, Cohesion Policy and in eligible regions also the Just Transition Fund may help to fund structural investments to mitigate the analysed negative social impacts of the ETS in terms of higher energy prices on vulnerable groups, by promoting energy efficiency investments that help these groups who may lack the capital to reduce their energy demand[171]. In the Renovation Wave the need for financial assistance for energy efficiency investments specifically addressing low-income citizens is recognized as essential to achieve the targeted level of renovations.

One element in which there are some more complex interactions is between EED Art. 7 and the new ETS. For the period 2021-2030, MS are currently required to achieve cumulative end-use energy savings equivalent to new annual savings of at least 0,8 % of final energy consumption, with an increase consistent with -55% GHG reductions envisaged in the EED review. MS must achieve the required cumulative end-use energy savings by establishing an energy efficiency obligation scheme, adopting alternative policy measures, or a combination of both. Details on measures adopted by MS under this scheme and interactions or overlaps that might occur regarding energy efficiency obligation schemes (including White Certificates) or other policy measures under Art. 7 is provided in Annex 5, Section 16.2.

There are clear complementarities between option EXT1 and the existing regulatory framework applying to **road transport**, mainly the CO_2 performance standards, the Eurovignette Directive, Renewable Energy Directive and the Energy Taxation Directive. Some of those complementarities have already been highlighted in Section 6.3.1.1. The individual measures are analysed in Annex 5, Section 16.3.

As the CO_2 performance standards have generally been effective at lowering emissions in the transport sector, and the responsiveness of the sector to price changes is limited, the

[171] ICF et al. (2020).

ETS inclusion of road transport would not (and could not) replace the existing policies which have been and will be key to drive the development of zero carbon technologies for cars and vans. The two policy instruments are complementary. The CO_2 performance standards address the supply on the market of more fuel efficient vehicles and set requirements on vehicle manufacturers with regards to their fleets of new vehicles. The proposed future standards will ensure a significant increase in the supply of new zero emission vehicles over time[172]. The Alternative Fuel Infrastructure Directive has and will be instrumental to drive the deployment of recharging infrastructure.

The ETS coverage concerns the fuel use in the entire vehicle stock (existing and new vehicles) and captures real-life emissions. It could increase the demand for more fuel-efficient vehicles, facilitating the achievement of increased ambition under the CO_2 standards for cars and vans. It could address possible rebound effects, whereby customers drive more as their vehicles become more efficient due to lower usage costs[173].

In the OPC, CO_2-standards for cars and vans were mentioned most frequently as ‘very important’ by 64% of respondents (and as ‘important’ by another 23% of respondents) as regards to other policies that should be deployed when extending emissions trading to emissions from buildings, road transport or all fossil fuel combustion.

The Eurovignette Directive, predominantly concerned with charging for use of road infrastructure, implements the user pays principle in addition to the polluter pays principle. The proposal for a revised Eurovignette Directive (including differentiated infrastructure charges based on CO_2 emissions for heavy-duty vehicles) and the upstream ETS would not overlap since the objective of the variation of the infrastructure charge is not to capture the external costs of CO_2 emissions. It cannot be linked to a CO_2 price or the cost of emissions. An ETS would be a more targeted tool as it imposes a carbon price per actual ton emitted and on all roads, whereas a CO_2-adjusted road charge would provide an additional incentive to the deployment of low- and zero-emission heavy-duty vehicles.

As regards to the review of the Renewable Energy Directive 2018/2001 (RED II), an increase in supply of renewable energy for transport could lead to a lower carbon price. The ETS would set economic incentives that can contribute to the development of renewable and low-carbon fuels, contributing to the achievement of the renewable energy

172 Impact Assessment on the cars & vans CO2 standards.

173 ICCT, op. cit, p. 5; CE Delft, Analysis of the options to include transport and the built environment in the EU ETS (2014), p. 60.

transport targets and of the hydrogen strategy. The reporting and monitoring methodology for the energy content of transport fuels established under RED II for the fuel suppliers are potentially complementary to the ETS inclusion.

The Energy Taxation Directive lays down minimal tax rates for motor fuels, heating fuels and electricity. These minimum tax rates, above which MS can establish their respective rates, have remained unchanged since 2003. Extending the use of emissions trading is complementary to the revised ETD with its focus on the energy content and improved coherence between energy carriers and sectors. Removing many exemptions as envisaged could help in improving a level playing field between fossil fuels versus electricity in heating enabling further renewable uptake and electrification. The new ETS would address the carbon content and give a carbon price signal on top of the ETD levels.

6.3.5.3 Interaction between EXT2 and the other regulatory framework.

Many interactions of EXT2 with the other regulatory framework are similar of those of EXT1 analysed in the prior section. Several additional particularities can be identified, with the individual measures being analysed in Annex 5, Section 16.5.

One issue is that, if small industrial installations currently excluded from being subject to the ETS, would be subject to a carbon price, they would pay a different and possibly higher carbon price than larger competitors in the same sector which are subject to the ETS having access to free allowances. There would therefore be the need for a mechanism to tackle risk of carbon leakage for those small industrial installations.

Regarding the Renewable Energy Directive, in case all fossil fuels were included in an ETS, all sectors would have an incentive to use more biofuels to avoid the carbon price, driving up the demand for biofuels in all sectors outside the scope of the existing ETS plus transport and housing.

In the case of all fossil fuel covered under an ETS, the increase of the fuel price would be more palpable for the uses specified in Article 8 of the Energy Taxation Directive, which establishes derogations in the form of significantly reduced tax rates for motor fuels in certain uses, as they start from a much lower base. Regarding the EU Agricultural Policy, the partial exemption specified in Article 8 of the Energy Taxation Directive for diesel and kerosene might need to be revised.

7 HOW DO THE OPTIONS COMPARE?

7.1 Strengthening of the existing ETS (power and industry installations)

7.1.1 Summary comparison of effectiveness and efficiency/key impacts of individual options

Key differences between the individual options to strengthen the existing ETS are summarised in the following tables. The baseline option sets the comparison reference for the different options, noting that its ambition is not in line with the cost-effective 2030 ambition.

7.1.1.1 Strengthening of the ETS target/cap

Table 23: Comparing key impacts of the ETS ambition strengthening options[174]

Key impacts	AMB1	AMB2a	AMB2c	AMB3c
Environmental impacts				
Cumulative cap - Trajectory smoothness over 2021-30 period – balance of environment impact over time	+ Steeper LRF change	++ Earlier trajectory change	++ Balanced between LRF change and rebase	+ Smaller rebase with steeper LRF
Difference between the cap and projected emissions– indicator to balance between environment impact and flexibility for emission variations[175]	+ 50% below baseline, risking to create big allowances surplus	++ 70% below baseline, though still ensuring some flexibility	+ 90% below baseline, allowing for limited variations to projected emissions	++ similar to AMB2a
Economic impacts				
Market balance – implications to market liquidity	(assessed below in the MSR table)			
Competitiveness - Risk of triggering CSCF with CL0	0 Limited risk of triggering CSCF	- CSCF risk in 2029	-- CSCF risk in 2028	- CSCF risk in 2029

[174] The baseline option while not being in line with the cost-effective 2030 ambition sets the comparison reference

[175] Comparison to 2013-19 average emission delta to cap of 163 million allowances per year, where Baseline delta is significantly above the 2013-19 reference.

7.1.1.2 Market Stability Reserve

Table 24: Comparing key impacts of the MSR options

Key impacts compared to MSR0+		MSR1 *Update current parameter values*	MSR2 *More dynamic parameters*	MSR3 *MSR2 with addition of short term response mechanism*
Environmental impacts				
Impact on emissions		0/+	0/+ Emissions under MSR2 are slightly lower than in MSR0+ and MSR1, however the differences are not significant	0/+
Economic impacts				
Market balance across cap scenarios[176]	AMB1	+	--	--
	AMB2a	+	-	-
	AMB2b	--	0	0
	AMB2c	0/-	0/+	0/+
Reduction of the market surplus over a reasonable time horizon		+/- Reduces TNAC the fastest in the near term due to larger intakes between 2024-2026, maintaining the downward pressure on annual allowance supply However, TNAC reduction may be too steep with the tighter cap scenarios	- TNAC is above the upper threshold throughout the period for all cap scenario	- May be able to reduce the TNAC slightly more than MSR2, but this reduction is uncertain, because it only occurs if the carbon price is below the set threshold.
Ensuring market resilience		+ Strong reduction of any surplus due to demand shocks	++ Avoids the threshold effect, because intakes are smaller as the TNAC approaches the intake threshold. Better adapted to	+ Avoids the threshold effect like MSR2, however challenges in finding an appropriate threshold for a carbon price

[176] The impact of cap scenarios AMB1 and AMB2b in conjunction with the MSR options is assessed in Annex 8, Section 23.1, and the impact of cap scenario AMB2c in Annex 8, Section 23.2,

		decreasing cap over the medium term	floor risk destabilising the market Opportunities for speculation if carbon price were to approach price floor
Carbon price signal	+ Positive impact in terms of signalling future scarcity to the market; prices are marginally higher under MSR1 and MSR2, driven by larger intakes	+ Also positive impact in terms of signalling. Prices are marginally higher under MSR1 and MSR2, driven by larger intakes in the reserve	+ Option provides a threshold in the unlikely event the carbon price would drop significantly May act as an insurance for low-carbon investments
Price volatility	-- Threshold effect may still induce price volatility.	++ Reduces price volatility that is due to the threshold effect	0/+ Could reduce uncertainty in the event of downside shocks, but potential of volatility when the carbon price is just above the threshold
Competitiveness, growth and jobs	0	+ May improve the predictability of the occurrence of intakes as compared MSR1.	0/+ Slight advantage as ensuring a stable carbon price in the unlikely event the carbon price drops to the threshold
Auction revenues	-	-	Uncertain impact, since when in operation it would reduce auction volumes but also ensure a price level
Predictability, complexity and transparency	+ Simple formula that has proven its worth	+ No threshold effect when the TNAC is close to the upper threshold, but formula is more complex	-- Even more complex mechanism; it cannot be predicted when the price threshold would operate

7.1.1.3 Framework to address the risk of carbon leakage

Table 25: Comparison of options to address the risk of carbon leakage

Key impacts	Options	
	Option CL1: Tiered approach	Option CL2: Strengthened benchmarks
Environmental impacts		
Provide protection against the risk of carbon leakage	++ Better targets free allocation to sectors at highest risk Long-term protection against risk of carbon leakage by incentivising emission reductions	++ Better targets free allocation based on actual GHG emission intensities Long-term protection against risk of carbon leakage by incentivising emission reductions
Incentives for low-carbon technologies	+ Provides incentives for the deployment of technologies with a relatively short payback time	+ Provides incentives for the deployment of technologies with a relatively short payback time
Economic impacts		
Costs for ETS installations	0 Reduces carbon costs for sectors at highest risk of carbon leakage Increases carbon costs for sectors at medium risk of carbon leakage	0 Reduces carbon costs for sectors where the GHG efficiency of the best performing installations is above the benchmark levels Increases carbon costs for sectors where the GHG efficiency of the best performing installations is below the benchmark levels
Administrative burden	- Tiered approach needs a revision of the list of the sectors deemed to be at risk of carbon leakage	0 Strengthened benchmarks use the established mechanism for free allocation

7.1.1.4 Improving support for low-carbon investment and innovation through the existing Innovation Fund

Table 26: Comparison of options to increase the Innovation Fund

Key impacts		
	Option IF 1: Increase to 550 million allowances	Option IF 2: Increase to 700 million allowances
More innovative clean tech projects financed	+ A moderate increase of the funding available (around EUR 5 billion) allows funding around 50 additional projects (assuming 100 million average grant size)	++ A strong increase of the funding available (around EUR 12.5 billion) allows funding around 125 additional projects (assuming 100 million average grant size)
More effective support to innovative clean tech projects	++ The circa EUR 5 billion added to the initial remaining IF resources: - can be effectively absorbed in 4 or 5 calls to be run as of 2026 - can finance complementary mechanism (CCfDs) but only as pilot	+ The circa EUR 12.5 billion added to the initial remaining IF resources: - cannot be effectively absorbed in 4 or 5 calls to be run as of 2026 as these calls need to be very big - can further finance more comprehensive CCfDs

Administrative burden	++ The additional administrative burden of running slightly bigger calls as of 2026 can be manageable or easy to address.	- Risk of administrative challenges due to significantly bigger calls
Improve the competitiveness of EU industry	+ More companies can get funding and become global clean tech leaders	+ Even more companies can get funding and become global clean tech leaders Slightly decreases the amount of free allowances, thereby increasing the possible need to apply the CSCF

7.1.2 Comparing packages of options

The different options assessed individually in the previous section interact with each other. To get a better idea of possible combinations, four policy packages are developed and compared in this section.

Table 27: Consistent policy packages to strengthen the existing ETS

Component	**Package**			
	1	**2**	**3**	**4**
Strengthening of the ETS Target/Cap	**AMB1** [new LRF from 2026, no rebasing]	**AMB2a** [new LRF from 2024, no rebasing]	**AMB2c** [new LRF from 2024, rebasing]	**AMB3c** [new LRF from 2026, rebasing]
Market Stability Reserve	**MSR1**	**MSR1**	**Combination of MSR parameters**	**Combination of MSR parameters**
Framework to address the risk of carbon leakage	**CL1** [tiered approach]	**CL1** [tiered approach]	**CL2** [strengthened benchmarks]	**CL2** [strengthened benchmarks]
Improving support for low-carbon investment and innovation through the Innovation Fund	**IF 2** [increase to 700 million EUAs]	**IF 2** [increase to 700 million EUAs]	**IF 1** [increase to 550 million EUAs]	**IF 1** [increase to 550 million EUAs]

The packages are internally consistent. Logical pairings were sought, while filtering out some combinations that cannot realistically be combined. For instance, an increased auction share combined with the environmentally most stringent cap scenario leads to a very high carbon leakage risk; conversely, a less stringent cap such as AMB1 should not be combined with the MSR2 option because the surplus would increase instead of decrease. On the other hand, the presented packages are not the only ones possible: there is room to compile different combinations.

All four packages reach the cost-effective environmental ambition of -62% in 2030, but the cap trajectories differ in two ways: is there a rebasing and how early is the current cap trajectory amended. The answers to these two questions inform the available policy choices for the other four elements of the package: MSR, auctioning share, carbon leakage framework and Innovation Fund. As a general rule, the more rebasing and the earlier the action, the lower the total amount of free allowances available and the higher the positive environmental impact over the period to 2030. By contrast, action by 2026 only and without rebasing means that more allowances can be used to address carbon leakage risks and distributional concerns.

In **Package 1,** the AMB1 scenario is based on an LRF-only approach starting in 2026 only. The resulting underlying cumulative cap over the period 2021 to 2030 is 1185 million ton (8.6%) lower than the current ETS cap, but higher than for the other scenarios (up to 750 million ton if compared to AMB2c). This means more allowances are, in principle, available for auctioning and for free allocation compared to other cap strengthening options. No cross-sectoral correction factor (CSCF) will be triggered, and combining AMB1 with option CL1 (the tiered approach to free allocation) means that space is freed up to increase the amount of allowances for auctioning and to transfer extra free allowances to the Innovation Fund (IF2). In terms of market stability, a less ambitious cap scenario increases the risk of a surplus building up, making the case for a stronger 24% intake rate (MSR1).

In **Package 2** the AMB2a scenario combines an LRF-only scenario with early action: there is no rebasing and an LRF of 5.09% applies as of 2024. This leads to a cumulative cap that is about 400 million allowances lower than under Package 1. In terms of carbon leakage risks, the combination of AMB2a with CL1 avoids triggering the CSCF. In terms of the MSR, there is no strong need for fundamental changes to its design. The increase of the intake rate as per MSR1 is sufficient to address a possible increase of the surplus. At the same time, in order to allow for gradual changes with the aim of protecting the EU industry, using the smoother MSR2 option and allowing an initially higher TNAC is not excluded as a possibility. The size of the cumulative cap and the more focused carbon leakage protection measure should also provide space to increase the Innovation Fund contribution of the current ETS.

Package 3 contains the more stringent cap option: AMB2c combines rebasing with early action, leading to a cumulative cap that is around 750 million allowances smaller than in Package 1 and 350 million allowances lower than in Package 2. In such a scenario, where the cap is very close to actual emissions, there is no space to increase the Innovation Fund contribution of the existing ETS. Even without these options, the triggering of the CSCF cannot be avoided. Option CL2 would however partly balance the rebasing of around 119 million allowances and manage to keep the impact of the CSCF modest, triggering it only as of 2029 and with an average value of 0.88 for the period 2026-2030.

There is a likelihood of the surplus dropping very rapidly. Hence, a conservative intake rate, and additional protection against the threshold effect is needed. Sufficient market liquidity must be ensured, possibly by keeping the current upper threshold of 833 million, but combined with more frequent MSR reviews assessing this threshold. A combination of the parameters[177] presented in MSR options MSR0+, MSR1 and MSR2 could provide the best mix of controlling the TNAC, avoiding price volatility and ensuring sufficient market liquidity. Such a combination could behave better than both MSR1 and MSR2 in terms of TNAC reduction, all the while keeping the benefits of MSR2 in terms of avoiding threshold effects and price volatility.

Package 4 is based on a cap option that combines rebasing in 2026 with a relatively high LRF after that (AMB3c). In terms of cumulative cap, this option is comparable to Package 2 (i.e. 425 million allowances more than in Package 3 or 1,5 billion lower than the current ETS), but with stronger efforts post 2026 to compensate for the later start. Option CL2 is sufficient to maintain an adequate level of leakage protection (small CSCF in 2030, with an average value of 0.96 for the period 2026–2030), in case the IF contribution of the current ETS is not increased. Again, MSR options can be combined.[197] With a cap that is only adapted in 2026, it is important to adjust the MSR intake rate to 24%. At the same time, a smoother intake rate like in MSR2 could be applied when the TNAC is lower, in order to avoid threshold effects. Again, keeping the current upper threshold of 833 million could provide sufficient market liquidity, especially in conjunction with more frequent MSR reviews.

7.1.3 Coherence

The ETS is a well-established cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. With its focus on markets and economic emission reduction incentives, it is coherent with other EU policies which primarily address non-price barriers. Increasing the environmental contribution of the ETS does not change its technology-neutral character, allowing it to continue to run alongside sector-specific policies. The Market Stability Reserve will continue to enhance policy synergies by mitigating supply/demand imbalances regardless of their origin, for instance by reducing the impact that complementary and overlapping policies in the area of renewables or energy efficiency can have on the carbon market.

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[177] Such a combination, with an upper threshold of 833 million allowances, and a more aggressive variable intake rate that is a mix of MSR1 and MSR2, was assessed in Annex 8, Section 23.3.

As ambition increases and the carbon price signal is reinforced, the ETS's funding instruments become more relevant to address the impacts and needs of those impacted. The strengthened Innovation Fund remains coherent with other EU-wide funding mechanisms as well as with State aid rules, preventing overcompensation on the one hand, but providing higher, and more targeted, support to address the innovation challenge.

In terms of carbon leakage, coherence with the parallel proposal for a CBAM is ensured through the principle that an effective level of protection against the risk of carbon leakage is safeguarded. In practice, if a CBAM is proposed for selected sectors and the proposal determines that the installations in these sectors lose their right to free allocation, then the relevant ETS legislation would enable such a decision.

7.1.4 Proportionality

All options analysed for the strengthening of the existing ETS are based on the already existing instrument, the ETS Directive. The initiative is limited to ETS adjustment needs that are triggered by the increased emissions reduction target of at least 55%.

The instrument of emissions trading ensures that additional costs for industry due to the increased level of ambition of the EU's climate policies are expected to be kept to a minimum, given that the ETS incentivises emissions reduction by operators with the lowest abatement costs. Moreover, the use of the existing instruments minimises any additional administrative costs.

To conclude, all options analysed for the strengthening of the existing ETS are considered proportional as they do not go beyond what is necessary to achieve the objectives.

7.2 **Extension of emissions trading or alternatives for maritime emissions**

7.2.1 Effectiveness and efficiency

All maritime policy options would ensure that the maritime transport sector contributes to the emission reductions needed to achieve the 55% ambition. The main differences among the different options is summarised in the table below.

Table 28: Comparison of maritime policy options

Key impacts	MAR1	MAR2	MAR3	MAR4
Environmental impacts				
Absolute GHG abatements vs BSL by 2030	All policy options would result in similar total CO_2 emission reduction, in line with the common level of ambition in the ETS (same linear reduction factor). MINTRA: 30-34 $MtCO_2$ MEXTRA50: 45-47 $MtCO_2$ MEXTRA100: 59 $MtCO_2$			
Emission reductions certainty	High certainty (emissions cap)	High certainty (emissions cap)	Lower certainty (no emissions cap)	High certainty (emissions cap)
Origin of GHG emission reductions	Mostly out-of-sector reductions	In-sector abatements only	In-sector abatements only	Mostly out-of-sector reductions
Risk of carbon evasion by 2030	MINTRA: low MEXTRA50: low MEXTRA100: medium	MINTRA: high MEXTRA50: high MEXTRA100: very high	MINTRA: high MEXTRA50: high MEXTRA100: very high	MINTRA: low MEXTRA50: low MEXTRA100: medium
Economic impacts				
Social Net Present Value[178] compared to BSL for the period 2020-2050	MINTRA: EUR 113 billion MEXTRA50: EUR101 billion MEXTRA100: EUR78 billion	MINTRA:EUR 94 billion	MINTRA: EUR 94 billion	MINTRA: EUR119 billion

[178] Assumptions: NPV estimations based on annualised capital costs; a social discount rate of 4%; GHG and air quality external costs based on Handbook of external costs 2019; carbon value from the Handbook of external costs 2019, ETS or tax payments are excluded as they are a transfer between agents (i.e. from industry to authorities) from the societal perspective, administrative costs are not included.

Increased costs vs BSL by 2030 & **CO_2 price**	MINTRA: +3% MEXTRA50: +7% MEXTRA100: +12% 45.5EUR/tCO_2	MINTRA: +16% 268EUR/tCO_2	MINTRA:+16 % 268EUR/tCO2	MINTRA: +4% 45.5EUR/tCO2
Additional Auction revenues in 2030	MINTRA:EUR 1.2 billion MEXTRA50: EUR 2.4 billion MEXTRA100: EUR 3.6 billion	MINTRA: EUR 7 billion	MINTRA: EUR 7 billion	MINTRA50: EUR 1.2 billion
Proportionality				
Admin costs compared to BSL	Regulated entities: low Public authorities: moderate	Regulated entities: low Public authorities: moderate	Regulated entities: low Public authorities: low to moderate	Regulated entities: low Public authorities: moderately high

7.2.1.1 Environmental effectiveness and impacts

When applied to the same geographical scope, the four policy options are expected to result in **comparable environmental impacts** as they were designed to ensure CO_2 emission reductions in line with what is projected under the revised ETS cap (similar linear reduction factor). However, the levy on CO_2 emissions (MAR3) provides less **certainty** as regards the achievement of these reductions as it does not cap emissions contrary to the other policy options (MAR1, MAR2 and MAR4).

The policy options would lead to **emission reductions in different sectors and activities**. An open ETS (MAR1 and MAR4) would lead to the implementation of mitigation measures in the maritime transport sector, as well as in other ETS sectors when abatement costs are cheaper through the purchase of ETS allowances. The separate ETS (MAR2) and the levy option (MAR3) would only drive emission reductions in the maritime sector itself.

The single most important factor influencing GHG emission reductions is the **geographical scope**. The absolute level of CO_2 emission reductions compared to the baseline by 2030 would vary from around 30 MtCO_2 to 59 MtCO_2 depending on the voyages covered. This, of course, needs to be read in conjunction with the analysis on the possible risk of evasion, which show that a broader geographical coverage tend to amplify that risk. In addition, the risk of evasion is higher in the policy options where carbon prices are the highest, such as the separate ETS (MAR2) or the levy (MAR3).

7.2.1.2 Economic effectiveness and efficiency

For all policy options, the social Net Present Value calculated as the difference between the societal costs and the benefits of each option over the period 2020-2050 is positive. This means that they would bring added value to the society and that their benefits in the form of e.g. GHG emission reduction, better air quality, energy savings and external costs savings would outweigh their costs in the long term.

In terms of cost-effectiveness, the separate ETS option (MAR2) and the levy (MAR3) would result in close to six times more expensive CO_2 abatement costs in 2030 than the two other options based on the ETS extension (MAR1 and MAR4). This is because they would only target mitigation measures in the maritime sector that are estimated to be more expensive than in other ETS sectors.

In terms of compliance costs, the policy options would incur additional direct costs for regulated entities in the form of ETS/carbon levy payments, additional capital costs, additional fuel and operational costs, partially compensated by fuels saving. These direct costs are estimated to be significantly higher in MAR2 and MAR3 compared to MAR1 and MAR4. However, from a society perspective, the ETS/carbon levy payments do not represent a net cost, as they are offset by the corresponding auctioning or tax revenues. Moreover, these additional costs would only have a very limited impact on the prices of commodities in the long-term, which are expected to increase by less than 0.2 to 0.7% by 2030. In terms of macroeconomic impacts, policy options produce non-sizeable impacts on GDP. Sector-wise, only the supply chain of fossil fuels is likely to be somewhat impacted. These will be partially offset by an increase in production of alternative fuels by 2050.

All policy options would also raise additional revenues. MAR2 and MAR3 would lead to the highest additional revenues in 2030 as they induce a much higher carbon price and don’t allow the purchase of general ETS allowances.

7.2.2 Coherence

All policy options are coherent with the objectives of the European Green Deal, which aims to ensure effective carbon pricing throughout the economy, including in transport where price must reflects the impact it has on the environment and on health. They are also coherent with the assessment underpinning the 2030 Climate Target Plan and the Sustainable and Smart Mobility Strategy.

The four options would fit well with the basket of measures on maritime transport announced in the European Green Deal. All policy options can work in full synergy with the FuelEU maritime initiative as carbon pricing will reduce the price gap between sustainable low carbon alternative fuels and traditional fossil fuels, and it will trigger energy efficiency improvements that will make the switch to alternative fuels more affordable by reducing the overall fuel consumption. In addition, revenues could be used to progress innovation and accelerate the deployment of zero-emission vessels, as shown by proposals submitted under the existing Innovation Fund. However, while carbon pricing has the ability to greatly facilitate the uptake of renewable and low-carbon fuels depending on the carbon price and the use of revenues, there is also a need to address all the non-pricing problems that hamper the deployment of renewable and low-carbon fuels. This is the ambition of the FuelEU Maritime initiative, which aims at creating a predictable demand for these fuels in order to stimulate the process of their selection and deployment, as well as the gradual technological improvement of yet immature solutions. In this context, the two measures would complement each other and carbon prices (e.g. in MAR2 and MAR3) would contribute to further accelerate the uptake of renewable and low-carbon fuels by making them more economically viable.

The taxation of maritime bunker fuel as considered in the impact assessment of the ETD revision could also complement a carbon pricing policy applied to maritime transport. Taken together, these two policies would reinforce the carbon price signal and the economic attractiveness of mitigation measures such as the implementation of energy efficiency measures or the switch to renewable and low-carbon fuels. In addition, the fuel tax could help change the behaviour of market actors not directly targeted by the proposed policy options such as fuel suppliers, ports or companies operating ships below 5.000 gross tonnage. It is also worth noting that the envisaged tax on maritime bunker fuel would not apply to bunker fuel sold for extra-EU voyages and that in itself it would lead to a much smaller carbon price signal in comparison to the four policy options considered in this impact assessment.

All policy options are also fully consistent with existing EU legislation such as the EU maritime transport MRV framework. As regards the interaction with the Effort Sharing Regulation (ESR), it would be beneficial if MS would continue implementing national measures under the ESR to reduce emissions from domestic navigation as a substantial part of these emissions would not be covered under the considered policy options. These national measures have the potential to play a key role in supporting the uptake of zero-emission vessels and innovative technologies, which are likely to be first implemented and demonstrated on small vessels involved in domestic navigation.

In terms of coherence with action at global level, notably at the International Maritime Organization (IMO), it is estimated that all policy options have the ability to positively contribute to the objectives of the initial IMO GHG reduction strategy to be revised by 2023.

While discussions around a possible global carbon pricing mechanism started in 2006 at IMO, there is still no consensus on the nature of such a measure and if there would be an agreement to implement such a mechanism, it would likely take place in the period from 2023 to 2030. Since all policy options considered in this assessment have already been reflected at IMO through different submissions, in theory, any of them could be further considered and implemented by the IMO in the future. Would a similar measure be adopted, then it will be necessary to ensure that no regulatory conflict is happening between the EU and the IMO measure. Divergences may come from the different regulated entities, policy objectives and levels of stringencies. Would the IMO adopt a different instrument then the compatibility would need to be assessed. It should also be noted that there are precedents of IMO following the EU action with global measures. The adoption of an EU measure may therefore increase the likelihood of a decision at the IMO. As regards MAR4, there is a possible risk of double regulation with the IMO framework, depending on what would be agreed at IMO in terms of operational carbon intensity measure and depending on how the measure is designed at EU level.

As regards the geographical scope, all options are legally feasible and coherent with EU law. Results from the OPC show that 76% of respondents support a broad scope including both intra-EEA and extra-EEA voyages as opposed to intra-EEA only (MINTRA). If extra-EU voyages are included, 65% prefer to cover 100% of all incoming and outgoing voyages (MEXTRA100). However, according to some stakeholders, the coverage of emissions from extra-EEA voyages could pose some political challenges at international level.

7.2.3 Proportionality

Based on the analysis carried out in this impact assessment, all policy options would result in low administrative costs for regulated entities as they already monitor, report and verify their CO_2 emissions in line with the EU maritime transport MRV regulation, which has been designed from the start as a first step to carbon pricing. In addition, all policy options would continue excluding the maritime transport SMEs operating ships below the size threshold of 5.000 gross tonnage.

Other compliance activities such as the purchase and surrendering of allowances would only add limited administrative costs.

As regards public authorities, all policy options are considered proportional as the additional administrative costs on public authorities to implement and enforce the policy measure would depend to a strong extent on the number of regulated entities, which would be limited to a maximum of 1.600 entities in total. For public authorities, MAR1 and MAR2 would result in moderate additional administrative burden to e.g. check aggregated MRV data, manage registries or implement enforcement actions. More costs would be associated with MAR4 as it would also require public authorities to develop standards and check compliance. On the contrary, MAR3 would lead to lower costs, in particular if authorities can rely on existing tax collection systems.

7.3 Extension of emissions trading to buildings and road transport or all fuels

7.3.1 Effectiveness and efficiency

7.3.1.1 Environmental impacts

Both options **EXT1** (extension to the buildings and transport sectors) and **EXT2** (extension to all fossil fuel combustion not yet covered by the ETS) ensure that the sectors concerned contribute to the emission reductions needed in line with EU targets and Paris Agreement commitments while ensuring synergies with complementary other policies targeting these sectors. They both imply that a significantly increased share of total GHG emissions would be covered by an EU-wide cap and trading system. As a result, both options provide for an increased certainty in delivering the overall GHG emission reductions.

Under option **EXT2**, the share of current total GHG emissions that would be covered by an EU-wide cap would be slightly higher than in option EXT1 (about 6 percentage points).

Options **EXT1** and **EXT2** are expected to deliver a similar reduction in emissions of GHG in the sectors concerned by 2030 compared to 2005, which would be almost 10 percentage points higher than the projected reduction of -34% in the baseline.

7.3.1.2 Economic impacts

For both options **EXT1** and **EXT2**, extending emissions trading to the new sectors would assist in incentivising cost-effective emission reductions in the sectors concerned, even though the incentive may differ according to MS due to the current heterogeneity of the fuel tax landscape.

Under option **EXT1**, considering relatively low price elasticities in these sectors, carbon pricing would work in concert with other policies such as EE and RES policies and CO_2 standards for vehicles, with the carbon price and the reallocation of resources stemming therefrom helping to realise the significant investments needed for a quicker diffusion of decarbonisation technologies.

This could be complemented under options **EXT1** and **EXT2** with a contribution of the new ETS sectors to the Innovation Fund as in option IF1 (using 100 million allowances from the new ETS cap) to foster the availability of such technologies on the market. Already under the current Innovation Fund there is significant interest from projects related to clean transport, from projects providing clean tech solutions in renewable heating and cooling of buildings and the call for small-scale projects is putting further emphasis on projects providing carbon neutrality solutions for buildings or construction products substituting carbon intensive ones. IF1 allows to make more resources available for such projects without a need to explicitly change its current scope, Option IF2 (using among others 200 million allowances from the new ETS) would allow for a broader coverage and bigger amounts, which would then not be available for other purposes.

Under option **EXT2,** for small emitters in the industry, the costs of inclusion in an emissions trading, as opposed to applying equivalent measures in some cases as under EXT0 and EXT1, may outweigh the benefits. SMEs with similar activities but of a different size may be covered by a different regime (the ETS or the new ETS) with potentially a different carbon price.

Both options **EXT1** and **EXT2** would affect individual spending on transport and heating fuels in the short or medium term, until the investments to reduce fossil fuel use have taken effect. Hence social acceptability for the measure, in particular by households who have difficulties to afford those investments, will be challenging. However, the revenue raised should be enough to address the social and distributional concerns alongside other revenue allocation (see Annex 13).

Table 29: Comparison of key impacts of ETS extension options EXT1 and EXT2

Key impacts	EXT1	EXT2
Environmental impacts		
Emission reductions	++ -43% by 2030 in MIX compared to -34% in REF	++ -43% by 2030 in MIX compared to -34% REF
Contribution to the -55% ambition by 2030	+/++ Higher certainty in delivering target: emissions covered by cap and trade would be two thirds by 2030, twice as much as the existing ETS alone	++ Higher certainty in delivering 2030 target: higher coverage vs EXT1 (about 6 percentage points)
Economic impacts		
Incentivise cost-effective emission reductions	++ Carbon price reduces payback time for energy efficiency investments The building sector responds better to the carbon price than road transport.	+ Limited mitigation options in agriculture/forestry vs EXT1 Equivalent measures work for small industry opted-out from ETS
Auction revenue	++ Revenue can help mitigate social impacts and accelerate the decarbonisation of the sectors concerned	++ Revenue can help mitigate social impacts and accelerate the decarbonisation of the sectors concerned
Competitiveness/ SME impact	0 Almost zero risk of carbon leakage in buildings and transport	0/- Some firms in small industry and agriculture might be negatively impacted

Other impacts		
Social impacts	- Impact of carbon price on poorer households can be mitigated by redistribution	- Impact of carbon price on poorer households can be mitigated by redistribution
Complementarity with other existing measures	+ Clear complementarities between EXT1 and existing regulatory framework	+ Complementarities in EXT2 comparable to EXT1
Additional administrative burden	- Regulated entities: moderate Administrative authorities: moderate	- - Regulated entities: moderate to high, depends how free allocation for small industry is organised Administrative authorities: high, because of the complexity involved with the free allocation for small industry

With regard to the two linking options analysis of current abatement potentials indicates that if the existing ETS and the new ETS for road transport and buildings are linked, and if cost-effective mitigation potentials turn out to be more difficult to realise in new ETS sectors, allowances would flow from the former to the latter. This could limit prices in the new ETS, but also increase the price in the existing ETS.

7.3.2 Coherence

The new emissions trading regime would work in parallel with existing policies applying to the sectors concerned (see analysis in Section 6.2.5 and in Annex 5). This is coherent due to the above described complementarities, as both under option **EXT1** and **EXT2**, the additional economic incentives provided by the extension of emissions trading to new sectors will, on their own, not be sufficient to reduce emissions in these sectors to the required levels. The more effective the regulatory measures on energy efficiency, vehicle emission performance and the enabling investments are, and the faster the sector decarbonises, the lower the carbon price generated by the new ETS will be.

The new regime under option **EXT2** would also capture the combustion of fossil fuels in certain cases where a significantly reduced tax rate currently applies under the Energy Taxation Directive (for example motor fuels in agriculture). The relative increase of the fuel price by the carbon price would be felt more in these cases.

An extended use of emissions trading would improve the overall policy mix. It would allow targeted strengthening of regulatory measures needed to achieve the enhanced climate ambition but would not replace other policies. Conversely a decision not to apply emissions trading to buildings and transport would require a further strengthening of regulatory measures, notably in the field of renewable energy and energy efficiency.

7.3.3 *Proportionality*

In all options, the new emissions trading system would be organised as an upstream system, thus avoiding that regulation falls upon the numerous end-users of fuel. The number of regulated entities can be expected to be broadly the same in **EXT1** and **EXT2**. They lead to similar impacts in terms of monitoring, reporting and verification. Both in **EXT1** and **EXT2**, regulated entities would to a considerable extent be able to build their monitoring system required for the new emissions trading system on the monitoring mechanisms that are in place for taxation purposes. In both **EXT1** and **EXT2**, regulated entities would need to distinguish fuels that go to entities already covered by the ETS (e.g. gas to industry) to avoid a double coverage by a carbon price which would otherwise require compensation mechanism.

In the case of **EXT1,** the regulated entities will need to know the end-use of the fuel (i.e. is it used in the buildings and road transport sector) which they normally know for taxation purposes or because they are in contact with the end customer. MS would be able to identify relatively easily the entities to be regulated since these would be known for taxation purposes, at least in the case of oil and often gas and to a varying degree for coal, depending on the MS's national taxation regime. MS would need to prepare, implement and run the system, manage the registry, verify compliance by the regulated entities with their obligations under the new system and enforce compliance where necessary.

In the case of **EXT2**, considerable additional burden can be expected stemming from the fact that free allocation measures would need to be foreseen for small industry for reasons of level playing field and to avoid carbon leakage. Any such compensation mechanisms for small industry risk being complex.

8 PREFERRED OPTION

When proposing its updated 2030 greenhouse gas emissions reduction target of at least 55%[179], the European Commission also described the actions across all sectors of the economy that would complement national efforts to achieve the increased ambition. A number of impact assessments have been prepared to support the envisaged revisions of key legislative instruments.

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[179] Communication on Stepping up Europe's 2030 climate ambition - Com(2020)562

Against this background, this Impact Assessment has analysed the various options through which a revision of the EU Emissions Trading System could effectively and efficiently contribute to the delivery of the updated target as part of a wider "Fit for 55" policy package.

Methodological Approach

Drawing conclusions about preferred options from this analysis requires tackling two methodological issues.

First, as often the case in impact assessment analysis, ranking options may not be straightforward as it may not be possible to compare options through a single metric and no option may clearly dominate the others across relevant criteria. Ranking then requires an implicit weighting of the different criteria that can only be justifiably established at the political level. In such cases, an impact assessment should wean out as many inferior options as possible while transparently provide the information required for political decision-making.

Secondly, the "Fit for 55" package involves a high number of initiatives underpinned by individual impact assessments. Therefore, there is a need to ensure coherence between the preferred options of various impact assessments.

Policy interactions

Given the complex interdependence across policy tools and the interplay with the previous methodological issue outlined above, no simultaneous determination of a preferred policy package is thus possible. A sequential approach was therefore necessary.

First, the common economic assessment[180,181] underpinning the "Communication on Stepping up Europe's 2030 climate ambition" looked at the feasibility of achieving a higher climate target and provided insights into the efforts that individual sectors would have to make. It could not, however, discuss precise sectoral ambitions or detailed policy tools. Rather, it looked at a range of possible pathways/scenarios to explore the delivery of the increased climate ambition. It noted particular benefits in deploying a broad mix of policy instruments, including strengthened carbon pricing and increased regulatory policy ambition.

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180 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176
181 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331

An update of the pathway/scenario focusing on a combination of extended use of carbon pricing and medium intensification of regulatory measures in the economy, while also reflecting the COVID-19 pandemic and the National Energy and Climate Plans, confirmed these findings.

Taking this pathway and the Communication on Stepping up Europe's 2030 climate ambition as central reference, individual impact assessments for all "Fit for 55" initiatives were then developed with a view to provide the required evidence base for the final step of detailing an effective, efficient and coherent "Fit for 55" package.

At the aggregate level, these impact assessments provide considerable reassurances about the policy indications adopted by the Commission in the Communication on Stepping up Europe's 2030 climate ambition. This concerns notably a stronger and more comprehensive role of carbon pricing, energy efficiency and renewable energy policies, the land sector, and the instruments supporting sustainable mobility and transport. These would be complemented by a carbon border adjustment mechanism and phasing out of free allowances. This would allow to continue to address the risk of carbon leakage in an efficient manner. It would also preserve the full scope of the Effort Sharing Regulation for achieving the increased climate target.

Various elements of the analyses also suggest that parts of the revenues of a strengthened and extended ETS should be used to counter any undesirable distributional impacts such a package would entail (between and within MS). While the best way to do this is still to be determined, this would seem a superior alternative to foregoing the relevant measures altogether or simply disregarding the uneven nature of their distributional impacts. Under both these alternatives, the eventual success of any package proposed would be at risk.

Preferred policy options

Preliminarily assuming this fact and the analysis above as the framework for the aggregate "Fit for 55" package, the specific analysis carried out in this impact assessment comes to the main following conclusions and would suggest the following preferred policy options for the revision of the EU Emissions Trading System:

1. **Increased ambition of the existing ETS and MSR**

In line with a coherent approach across policies, the 2030 ambition should reflect the cost-effective contribution of the sectors as part of a policy mix. Based on the updated MIX -55% policy scenario for current ETS sectors this contribution is calculated as -62% in 2030 compared to 2005. Power and industry would continue to provide their cost-effective higher emission reduction contribution compared to other sectors. Many stakeholders support the strengthening of the existing ETS to increase its ambition in line with the new 2030 target and based on cost-efficiency considerations. The separately assessed amendments of the ETS Directive concerning the aviation sector would ensure a proportionate aviation contribution.

Each of the four **ambition (sub-)options** retained to achieve this -62% reduction involves either a change of the annual Linear Reduction Factor or a combination with a possible one-off change in the cap. Any of these options would be effective and efficient to achieve the 2030 objective, but differ e.g. in terms of impacts on emission reductions over the period and free allocation volumes. Stakeholders generally recognised the importance of adjusting the linear reduction factor, while some stakeholders also highlighted the importance of a combination with a one-off reduction of the cap. The choice between the different ETS ambition strengthening options and related packages with other options, e.g. how the Market Stability Reserve is further developed in this context, remains therefore a political one. The MSR operation has wide support across stakeholder groups, while there is no consensus about the necessary changes to its parameters.

2. Auction share and addressing the risk of carbon leakage

A tightened ETS cap reduces the available allowances to be auctioned or allocated for free. In this context, an increase of the auction share and corresponding further reduction of the free allowances share seems only conceivable if the Carbon Border Adjustment Mechanism would effectively protect the industry sectors concerned so that free allocation for these sectors could be gradually phased out.

In addition, a more targeted approach to free allocation, where it still applies, is needed in the form of strengthened benchmarks (and conditionality elements) which provides a fairer and more transparent distribution of free allocation than a higher cut for all sectors by the cross-sectoral correction factor. This was also supported by a wide range of stakeholders, even if not by all parts of the private sector.

3. Increased Innovation Fund

An increase of the Innovation Fund has clear advantages in terms of strengthening competitiveness, innovation and environmental effectiveness to provide the low carbon solutions needed for further decarbonisation post-2030 and would generally be welcomed by stakeholders. However, the selected amount and its sourcing is ultimately a political choice, which is linked with the decisions on existing ETS ambition and/or with the decision on whether or not to extend emissions trading to new sectors.

4. ETS extension to maritime transport

In line with the Climate Target Plan, the preferred option of extending the ETS to maritime transport emissions (MAR1) has clear advantages as it would ensure that the sector contributes cost-effectively to the EU climate efforts. In addition, it would ensure that the price of maritime transport reflects the impact it has on climate. It would also correspond to stakeholders' preferred policy option out of the proposed options. The ETS extension to maritime transport could cover emissions from all intra-EEA voyages (MINTRA) or, depending on political choices, could also extend further, to include half of the emissions from extra-EEA voyages (MEXTRA50). This includes emissions from at-berth operations. This **extension** would build on data coming from the EU maritime transport MRV system which would be accounted in both the ETS cap reference emissions and trajectory/LRF design (see Annex 6, Section 18.1). All new emissions allowances would be auctioned in line with the default method for allocating allowances in the ETS and would take the form of general ETS allowances. To ensure a smooth transition, a phase-in period could be introduced where companies would only have to purchase allowances for a portion of their emissions, gradually rising to 100% over 3 years. As only around 45 or 90 million tons of CO_2 would be added to the existing ETS depending on the selected geographical scope, the impact on the other sectors covered would remain limited. MAR1 would also result in limited administrative costs.

In terms of **coherence**, this approach and the FuelEU maritime initiative are complementary as carbon pricing facilitates the uptake of renewable and low-carbon fuels as well as other emission reductions. It would also be compatible with the future operational and technical standards being developed at the International Maritime Organization (IMO) for existing ships, without a risk of double regulation. The need for further operational and technical standards at EU level would need to be considered in the future taking into account the effectiveness of these global measures.

5. **New ETS for buildings and transport**

Emissions trading could be **extended to buildings and road transport,** as additional economic incentives and a more level playing field are needed to ensure achieving the cost-effective reductions of these sectors to the -55% target. A majority of academic stakeholders and EU citizens support an ETS extension, while the majority of private sector actors, trade unions and NGOs are sceptical.

The main benefit of this extension scope compared to an extension to all fossil fuel combustion is economic efficiency, notably as buildings and road transport are not or at very low risk of carbon leakage. For including small industry and agriculture fuels, creating a new carbon leakage risk protection regime would be administratively complex due to the numerous SME's concerned. Both extension scopes score high on environmental effectiveness, with slight additional advantages for an extension to all fossil fuel combustion as the share of emissions covered by an EU-wide cap would be higher. At least for a transitional period, the extension should take the form of a separate ETS to make the required new upstream MRV system work and avoid an uncertain price risk for existing ETS sectors, as also preferred by the majority of stakeholders and notably private sector actors.

The ambition level, emissions cap and trajectory for the new ETS would be set **coherently** in line with the cost-effective emission reductions of buildings and road transport, which amount to approximately 43% emission reductions compared to 2005, using a combination of carbon pricing and by strengthening the existing regulatory framework. This is notably consistent with the preferred option for the ambition level of energy efficiency targets under the Energy Efficiency Directive. An increase in buildings renovation rate to be driven by the EPBD revision is also taken into account. Full auctioning of allowances would be justified as there is no or very limited risk of carbon leakage for these sectors, and would generate significant revenues to help financing investment needs or to address social and distributional impacts, which might arise due to an increase in fuel prices having an impact on low-income households. Support measures to promote energy efficiency, such as the strengthening of Article 7 by obliging MS to address vulnerable, energy poor, or low-income households, would be necessary to avoid excessive distributional effects, via inter alia directing part of the revenues from carbon pricing on buildings to energy efficiency improvements for energy poor households. A market stabilisation mechanism similar to the one in the existing ETS would be established.

By providing the additional economic incentives (through carbon pricing) necessary to achieving the cost-effective emission reductions in buildings and transport, the new ETS would **complement** the Effort Sharing Regulation in the current scope, which maintains incentives for national action. The strengthening of other sectoral legislative initiatives that contribute to reducing emissions in those sectors, in particular CO_2 standards for cars, the Energy Efficiency Directive, the Energy Performance in Buildings Directive the Renewable Energy Directive will also take into account the ETS extension. Additional administrative costs could be limited by using, where possible, existing structures used for the Directive laying down the general arrangements for excise duty and the Energy Taxation Directive. In turn, additional energy savings would be enhanced by the new ETS, with its potential link to energy savings under Article 7 of the EED.

6. Solidarity mechanisms

Existing mechanisms in the ETS help in addressing distributional impacts between and within MS. These include the 10% solidarity share of auctioning revenues redistributed to lower income MS and the use of some allowances to feed an investment and solidarity fund (the Modernisation Fund) for the lowest-income MS. These mechanisms could be further developed, without prejudice to an ETS contribution to Own Resources. Mechanisms using revenues from auctioning could also help compensate the social impacts of the extended application of emissions trading.

Well-designed energy efficiency programmes funded by some of the ETS revenues could help addressing these social issues. Thus, MS could be required to systematically spend revenues (or a specific share of revenues) from EU ETS auctioning for energy efficiency improvement measures.

Action to address skills, financing mechanisms, consumer empowerment, split incentives and the alleviation of energy poverty under the Energy Efficiency Directive could complement the approach to distributional impacts of the EU ETS.

8.1 **REFIT (simplification and improved efficiency)**

The ETS legislation has consistently favoured approaches to minimise the regulatory burden for both economic operators and administrations. In particular, installations with low emissions benefit from the possibility for MS to exclude them from the ETS if they are subject to national measures leading to an equivalent contribution to emission reductions.

9 HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

The Commission will continue to monitor and evaluate the functioning of the ETS in its annual Carbon Market Report, as foreseen under Article 10(5) of the ETS Directive. This covers also the impacts of the current revision of the ETS.

Furthermore, evaluation of progress on the application of the ETS Directive is regulated in the current Article 21, which requires MS to submit to the Commission an annual report paying particular attention to issues including the allocation of allowances, operation of the Registry, application of monitoring and reporting, verification and accreditation and issues relating to compliance.

The measures above (namely the Commission's annual Carbon Market Report and Member States annual report) shall also apply to the sectors to which emissions trading is extended. The MRV data obtained through the regulation of the new sectors will be a key source for information for the Commission to evaluate progress in the sectors concerned.

With respect to maritime transport, the Commission will notably rely on data collected through the EU maritime transport MRV system and analysis from the annual report on CO_2 emissions from maritime transport, which provides aggregated and explained results. With respect to the possible extension to buildings and transport, the Commission will rely on data collected through the new MRV system for these sectors, while comparing them also with the corresponding GHG inventory data for these sectors.

The integrated governance and monitoring process under the Regulation on the Governance of the Energy Union and Climate action is also expected to make sure that climate and energy-related actions at European, as well as regional, national and local level, including the ETS, contribute to the EU climate neutrality and Energy Union's objectives.

Additionally, the Commission regularly carries out studies on various pertinent aspects of EU climate policy. Such examples in the past years are the studies on evidence or lack of evidence for the occurrence of carbon leakage and studies evaluating the application and effectiveness of free allocation[182]. This approach will also continue throughout phase 4.

Several market analysts regularly closely follow various aspects of the carbon market and its functioning and the Commission will continue to monitor this work. Also, through regular contacts with stakeholders, the Commission is alert to their views and concerns about the functioning of the ETS. ETS-related matters are discussed in a dedicated forum, the Climate Change Expert Group (CCEG) which brings together MS Competent Authorities, stakeholders (industry associations and NGOs) and the Commission. In its different formations, the CCEG discusses the implementation of free allocation, auctioning and issues related to the functioning of the union registry.

In addition, the ETS Compliance forum provides the Competent Authorities of all ETS countries (the 27 MS, Norway, Iceland and Liechtenstein) with a platform for sharing information, learning and experience, leading to effective implementation of the ETS. The forum executes targeted events, such as the Compliance Forum Conference, organized annually and aimed at sharing experiences and facilitating dialogue amongst MS Competent Authorities, as well as Task Forces dedicated to specific topics and training events. National Accreditation Bodies and verifiers are sometimes invited to participate to the activities of the ETS Compliance forum, where relevant.

Furthermore, the Technical Working Group on ETS Monitoring, Reporting, Verification and Accreditation (MRVA) brings together representatives of MS Competent Authorities to share experiences and suggestions concerning effective and efficient implementation of Commission Implementing Regulation (EU) No 2018/2066[183] and Commission

182 https://ec.europa.eu/clima/policies/ets/allowances/leakage_en#tab-0-2

183 Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012. OJ L 334, 31.12.2018, p. 1.

Implementing Regulation (EU) No. 2018/2067[184] and to discuss potential updates and improvements of the ETS MRVA Regulations.

[184] Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council. OJ L 334, 31.12.2018, p. 94.

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EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 601 final

PART 2/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

{COM(2021) 551 final} - {SEC(2021) 551 final} - {SWD(2021) 557 final} - {SWD(2021) 602 final}

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Annex 1: Procedural information

1 Lead DG, Decide Planning/CWP references

The Directorate-General (DG) for Climate Action has led the preparation of this initiative and the work on the Impact Assessment in the European Commission. The planning entry was approved in Decide Planning under the reference PLAN/2020/8684. It is included in the 2021 Commission Work Programme[1] under the headline ambition 'European Green Deal' and the policy objective 'Fit for 55 package'.

2 Organisation and timing

The planned adoption date (Q2 2021) was included in the Commission Work Programme. The Inception Impact Assessment was open for feedback between 29 October 2020 and 26 November 2020. The Open Public Consultation was online between 13 November 2020 and 05 February 2021.

An inter-service steering group (ISSG) for preparing the climate-related "Fit for 55 Package" initiatives to implement the 2030 climate target plan was established in October 2020 to prepare this initiative. Its members were: SG, LS, AGRI, BUDG, COMM, COMP, CNECT, DGT, DIGIT, EAC, ECFIN, ECHO, EMPL, ENER, ENV, ESTAT, FISMA, FPI, GROW, HOME, HR, IAS, INTPA, JRC, JUST, MARE, MOVE, NEAR, OLAF, REFORM, REGIO, RTD, SANTE, TAXUD, and TRADE. The ISSG met four times in the period from September 2020 until adoption. On 13 October it discussed the draft Inception Impact Assessments and the questionnaires for the Open Public Consultations, on 14 December IA sections 1 to 4 and the policy options, on 3 March the complete IA draft before submission to the Regulatory Scrutiny Board, and on 8 June the legal draft and the revised impact assessment.

3 Consultation of the RSB

Two upstream orientation meetings on the Fit for 55 package in general and on ETS and ESR were held in November. A draft Impact Assessment was submitted to the Regulatory Scrutiny Board (RSB) on 10 March 2021. A framing note on policy coherence in "Fit for 55" climate and energy initiatives was submitted to the RSB on 7 April 2021. Following the RSB meeting on 14 April 2021, it issued a positive opinion with reservations on 19 April 2021.

The RSB's recommendations for improvement have been addressed as presented below.

[1] COM(2020) 690 final

1) The report should be more accessible to inform the key policy choices. The narrative should be less technical, shorter and be readable without an extensive prior knowledge of European climate policies. The report should make particular effort to improve the presentation of the preferred option(s), making the various trade-offs and open choices clear for policy-makers.

- We have improved the readability throughout the document and added explanations to make the content better accessible.
- Although both elements, as well as the required more detailed inclusion of stakeholder feedback (see item 4) tend to make the text longer, we still managed to shorten the main part of the impact assessment significantly.
- As the assessment covers four distinct but interrelated elements which are all worth an assessment on its own (strengthening of the existing ETS, review of the Market Stability Reserve, extension of the ETS to maritime transport, extension of emissions trading to buildings and transport or all fossil fuel combustion emissions), the document still exceeds the length of a typical impact assessment.
- We have improved the presentation of the preferred options in Section 8, linked them back to stakeholder feedback and making trade-offs clearer where relevant.

2) While the report should be self-standing, it should highlight the significant interlinkages with other 'Fit-for-55' initiatives. It should be clear on what the Climate Target Plan has decided and which 'sectoral' choices are still left open. It should elaborate on the consequences of deviating from the 'optimal balance' between regulatory and pricing instruments. The report should further clarify coherence with the possible Carbon Border Adjustment Mechanism (CBAM), in particular the auctioning share for trade exposed and energy-intensive sectors. It should explain to what extent the ETS revision depends on the CBAM initiative. It should also clarify to what extent it takes into account CO_2 reductions generated by a possible revision of the Energy Taxation Directive. Moreover, it should explain why aviation is dealt with in another initiative.

- We have further strengthened the interlinkages with other 'Fit-for-55' initiatives, notably in Sections 2.4.1, 2.4.2, 6.2.1, 6.3.1 and 6.3.5.
- We have clarified in Section 1.1 what the Climate Target Plan has decided and what it left still open. In the same section we also explain why aviation is dealt with in another impact assessment.
- The consequences of deviations from a balance between regulatory and pricing instruments are e.g. reflected by the MIX-CP scenario. The interpretation of differences between the MIX-CP and MIX scenarios has been strengthened, e.g. in Sections 5.2.1 and Section 6.3.
- We have further clarified the coherence with the possible Carbon Border Adjustment Mechanism (CBAM) in Sections 5.2.2.4 and 6.1.2.2.5, including how CBAM could impact the auctioning share and related parts of the ETS revision. A CBAM sensitivity is part of the MSR sensitivity analysis in Annex 8, Section 23.4.

- CO_2 reductions by the preferred option of a possible revision of the Energy Taxation Directive are covered in the MIX scenario, the core modelling scenario used in this impact assessment. This is clarified in Section 5.2.1 and Annex 4, Section 8.5.2.

3) The report should strengthen the rationale why the ETS should be extended to the maritime sectors and (part of) the ESR sectors. It should reinforce the analysis of the related problems and clarify what and how much these individual extensions would add to other existing or planned regulatory initiatives, such as the CO_2 emissions for cars and vans and the FuelEU maritime initiative. The report should better argue the choice of ETS coverage in the current ESR sectors. It should discuss whether a selective coverage of ESR sectors in the ETS might lead to increased complexity or distortions, as sectors would fall under different climate policy regimes.

- The rationale why the ETS should be extended to the maritime sectors, the analysis of related problems has been strengthened, notably in Section 2.4.1, and the complementarity with the contribution of the FuelEU maritime initiative has also been further clarified in Section 6.2.1.1.
- The rationale why emissions trading could be extended to buildings and transport and the analysis of related problems has been strengthened, notably in Section 2.4. The complementarity with the initiative on CO_2 emission standards for cars and vans (see Section 6.3.5.2) has also been further clarified in Section 6.3.1.1.2.
- Analysis of interactions with the ESR in Section 6.3.5.1 has been strengthened.

4) The report should systematically take into account the comments made by the different stakeholder groups and confront them with the findings of the analysis throughout the report.

- The main text and Annex 2 were amended to expand the discussion on stakeholder views. In particular, where relevant, the provided description has been complemented with the results of the undertaken correlation analysis by stakeholder group.
- Stakeholder views have also been integrated in the preferred option section.

5) The methodological section (in the annex), including methods, key assumptions, and baseline, should be harmonised as much as possible across all 'Fit for 55' initiatives. Key methodological elements and assumptions should be included concisely in the main report under the baseline section and the introduction to the options. The report should refer explicitly to uncertainties linked to the modelling. Where relevant, the methodological presentation should be adapted to this specific initiative.

- A common methodological section across the seven CLIMA and ENER 'Fit for 55' initiatives including models used, key assumptions, baseline and policy scenarios has been included in Annex 4, before the specific additional methods used in this impact assessment are presented.

- The concise presentation of key methodological elements and assumptions in the main report has been improved in Sections 5.1 and 5.2.1, also referring explicitly to uncertainties related to the modelling.

6) Annex 3 should follow the standard format and present a summary of costs and benefits with all key information, including quantified estimates.

- A summary of costs and benefits in table format with all key information, including quantified estimates, where available, has been added to Annex 3.

4 EVIDENCE, SOURCES AND QUALITY

This initiative builds upon evidence gathered in the Impact Assessment for the previous ETS revision[2] concluded in 2018, the Impact Assessment accompanying the 2030 Climate Target Plan[3], analysis conducted in support of the Commission's Long-Term Strategy[4] and any relevant evidence compiled in other concurrent Green Deal initiatives. It builds on emissions data and experiences from the implementation of the EU monitoring, reporting and verification systems. It makes use of updated EU Reference Scenario 2020, which includes COVID-19 impacts, and updated policy scenarios, building upon the scenarios developed for the 2030 CTP (see Annex 4, Section 8). In addition it makes uses of several support contracts. Vivid Economics conducted a study to support the European Commission in the review of the MSR[5]. Concerning carbon leakage provisions, support work was carried out by Öko-Institut, Trinomics, Ricardo and Adelphi. Furthermore, a study team led by Ricardo conducted a study on "EU ETS for maritime transport and possible alternative options or combinations to reduce greenhouse gas emissions"[6]. Further information on evidence, scenarios and sources is provided in Annexes 2 and 4.

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[2] SWD (2015) 135.
[3] SWD(2020)176.
[4] European Commission: In-depth analysis in support of the Commission Communication COM(2018) 773 A Clean Planet for all, A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy, Brussels 28 November 2018.
[5] Vivid Economics, (2021) – "Review of the EU ETS' Market Stability Reserve", report prepared for DG CLIMA, publication upcoming.
[6] Ricardo, E3 Modelling and Trinomics, (2021) – "Study on EU ETS for maritime transport and possible alternative options or combinations to reduce greenhouse gas emissions", publication upcoming.

Annex 2: Stakeholder consultation

The revision of the ETS builds upon the feedback on the 2030 CTP and interlinkages of the ETS with parallel policies and the broader objectives of the European Green Deal. The scope of the ETS consultation was limited to potential amendments to the ETS. In particular, the main objective of the consultation was to gather stakeholder views on the strengthening of the existing ETS, the extension of the ETS to new sectors (maritime transport as well as buildings, road transport or all fossil fuel combustion) and the review of the Market Stability Reserve (MSR). The consultation also looked for inputs on how to address the risk of carbon leakage, the use of revenues and low-carbon support mechanisms.

The Commission first invited feedback on the Inception Impact Assessment (IIA), outlining the initial considerations and policy options of the revision. The consultation on the IIA was open for feedback from 29 October 2020 to 26 November 2020.

The Commission then organised an online public consultation (OPC) with a questionnaire. The OPC was open for 12 weeks, in line with the Better Regulation Guidelines, from 13 November 2020 to 5 February 2021. The online questionnaire contained 29 questions, mainly multiple choice questions but with the possibility to elaborate on the given response.

Respondents could also submit position papers both in response to the IIA and the OPC.

The Commission asked a contractor[7] to produce a report analysing the results of the IIA and the OPC, including the submitted position papers. The results of the public consultation are summarised below based on the report provided by the contractor.

To support the maritime initiative, a targeted stakeholder survey was carried out between December 2020 and February 2021, accompanied by a targeted interview programme launched in January 2021 and concluded in February 2021. The results are reflected in the analysis of impacts.

In addition, the Commission held (virtual) bilateral and multilateral stakeholder meetings to discuss the revision of the ETS. In total, the Commission participated in more than 50 (virtual) stakeholder meetings, including with companies and business associations across different sectors, trade unions, non-governmental organisations (NGOs) and

[7] Technopolis Group in association with COWI, SQ Consult and Exergia.

public authorities of MS.[8] The Commission also participated in several virtual conferences in order to present the upcoming revision of the ETS and to invite stakeholders to participate in the public consultation. Finally, the Commission instructed a contractor to organise two expert workshops on the review of the MSR.[9] The outcome of these meetings and workshops will not be further analysed in this report as concerned stakeholders' views are also reflected in their responses to public consultation and hence no additional analysis is required.

5 FEEDBACK RECEIVED ON THE INCEPTION IMPACT ASSESSMENT

The Commission received 258 unique responses, including 128 from business associations and 59 from companies/business organisations (together private sector stakeholders), 34 from NGOs, 15 from EU citizens and 6 from public authorities. 90% of respondents came from 20 EU MS and 10% from outside EU (Japan, Norway, Palestine[10], South Korea, Switzerland, UK, Ukraine and the US, mostly private sector stakeholders). 163 position papers were received as attachments from these stakeholders. As contributions did not necessarily touch upon all aspects of the revision, the results presented below refer to those respondents that expressed their views on a certain topic.

The majority of respondents agreed with the context of the revision of the ETS presented in the IIA roadmap, meaning that there is an overall support for the need to revise the ETS legislation to align it with the higher climate target set in the European Green Deal.

With regards to achieving an increased ETS ambition, the majority of respondents favoured increasing the linear reduction factor (LRF) and/or rebasing the cap. NGOs and clean energy/technology/service providers tended to opt for the combined LRF/rebased cap approach to maximise the increase in ambition, whereas industry stakeholders preferred an increased LRF over a rebased cap to avoid big step changes that impact predictability. Respondents agreed that climate objectives should not be met through a one-off MSR review.

However, about half of respondents were in favour of strengthening the MSR to meet its objective of ensuring market stability (largely NGOs, 'green' businesses, but also some 'traditional' business stakeholders). Only few respondents commented on a carbon price

[8] As notable example, on 1 June 2021, the Commission, represented at the highest level, met with social partners from both the employer and employee side to discuss the Fit for 55 package, including the ETS revision.

[9] https://ec.europa.eu/clima/events/expert-workshop-market-stability-reserve_en,, https://ec.europa.eu/clima/events/2nd-expert-workshop-market-stability-reserve_en.

[10] This designation shall not be construed as recognition of a State of Palestine and is without prejudice to the individual positions of the Member States on this issue.

floor with a slight majority of those being in favour (mostly environmental NGOs and clean-energy companies).

Stakeholders were generally in agreement with the proposed inclusion in the current ETS of the maritime sector. In contrast, just over half of respondents were in disagreement with the inclusion of emissions from buildings or road transport in the current ETS. Those opposing it had concerns relating to impacts on the competitiveness of the current ETS sectors by including sectors with high abatement costs and/or different price elasticities. More generally with regard to the extension of emissions trading to road transport and buildings, some stakeholders raised concerns regarding the increased administrative burden from overlapping policies as well as the impact of rising heating or transport prices on consumers, especially for low-income households. Some respondents, mainly from the private sector, mentioned their support for a separate ETS for buildings and road transport emissions.

6 RESULTS OF THE OPEN PUBLIC CONSULTATION

6.1 Overview of respondents

493 stakeholders responded to the OPC on the revision of the ETS. The largest group was private sector stakeholders (70%; 342), followed by NGOs (10%; 49 responses), EU citizens (7%; 35), public authorities (5%; 26) and academia (2%; 8). Five trade unions also responded to the OPC. Respondents came from 25 EU Members States with no respondents from Bulgaria and Croatia. The largest number of replies came from Belgium[11] (23%; 114), followed by Germany (13%; 63), France and Italy (both at 6%). Respondents from outside the EU were from Canada, Japan, Norway, Russia, Switzerland, UK, Ukraine and the US.[12]

No campaigns were identified.

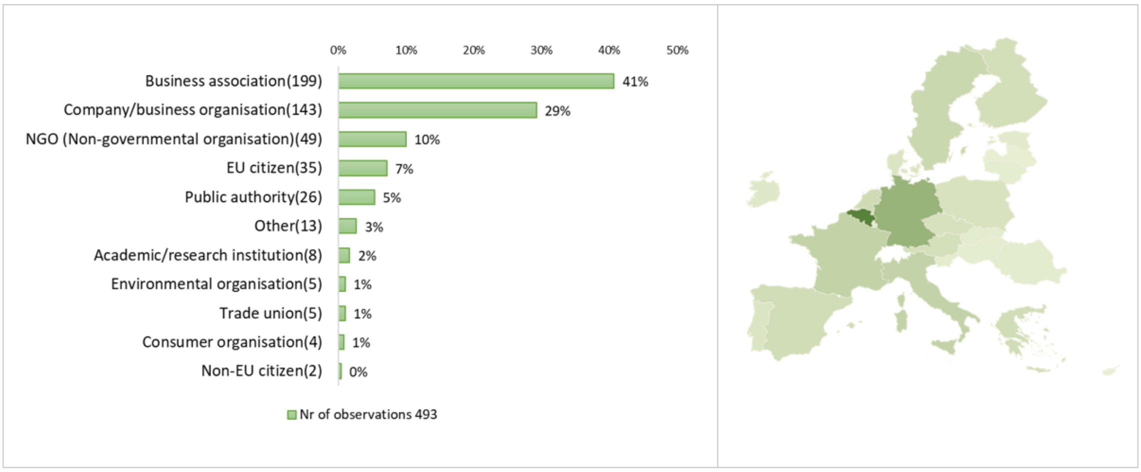
Additional position papers could be provided in response to the OPC. In total, 145 papers were received. Based on a preliminary review and a selection (e.g., exclusion of duplicates), 129 papers were thoroughly analysed. About half of the papers originated from business associations, 27% from companies from various sectors (notably 13 from

[11]This result is influenced by the fact that many business associations and NGOs that responded are based in Belgium.

[12]In the remainder of the analysis, the differentiation between stakeholder groups focusses on the private sector and NGOs given the large number of respondents. Results for other stakeholder groups will also be mentioned, however, results have to be interpreted with caution. For instance, the number of replies from EU citizens is too low to give a representative picture, while the group of public authorities encompasses a very diverse spectrum from different policy fields and levels, including local, regional and federal authorities.

the energy sector), 9% from NGOs and 8% from public authorities. Remaining papers included positions from academia, environmental organisation, trade unions and others.

Figure 14: Distribution of respondents by type and country



Source: Technopolis Group

6.2 Methodology for data processing

The responses from the online survey were processed statistically and thematically, with a correlation analysis for each question.[13] As questions in the online survey were optional, the percentages presented below refer to the total respondents that answered the concerned questions. Some questions allowed respondents to 'rate' options (1-5). On these ratings, the report provides figures for the "highest rating" category, as this is indicative of most support.

Position papers were processed via cataloguing, meaning data from each paper was logged in a database to provide key themes and information from paper and author.

6.3 Questionnaire

6.3.1 Contribution of ETS to the overall climate ambition for 2030

37% of respondents (145) from a wide range of stakeholder groups indicated that the current ETS sectors should increase their contribution (compared to 2005) in line with

[13] The data set resulting from the public consultation was fine-tuned based on data triangulation with regard to a few questions, which allowed multiple replies to questions originally meant to receive a single reply only. To avoid contradicting replies and make the statistics easier to interpret, the reply was reduced to one option based on all available information from the respondent, including replies to previous questions, open text replies and submitted position papers. This data manipulation did not significantly change the results compared to the original dataset. In particular, the relative ranking of options has not been altered.

the new target and based on cost-efficiency considerations. Only about 10% of respondents each argued for either a higher (mainly NGOs, environmental organisations and EU citizens) or lower (mainly private sector respondents) contribution of the ETS compared to the cost-efficiency principle. The remaining 39% of respondents (151), mainly from the private sector, selected "other" and commented that alternative contributions could be set, stressing the need for a thorough impact assessment of each sector to determine what level of cost-effective emissions reduction can be achieved by 2030 and the need to ensure business predictability and competitiveness of the carbon market.

A majority of respondents (67%; 220) from all stakeholder groups indicated the increase of the LRF to be the most relevant factor to strengthen the ETS ambition. Respondents were more divided on the importance of a one-off cap reduction in combination with increasing the LRF as well as the early application of a strengthened cap. While these options were found important by a wide range of stakeholder groups (including NGOs, environmental organisations, academic/research institutions, EU citizens and public authorities), this was not the case for the private sector, notably not for the manufacturing sector. Similarly, a divide was registered in respondents' views on the importance of changes in the MSR parameters as means to achieve the increased ambition.

There was also no agreement on how a strengthened ETS cap should be divided between auctioning and free allocation. Between the two proposed options of the survey, increasing the auction share while decreasing free allocation was, by a small margin, the preferred option (24%, including the majority of EU citizens and academic/research institutes and some NGOs) over the continuation of the current auction share of 57% (19%, including some private sector respondents and the majority of public authorities). However, a significant share of respondents (57%), including the majority of NGOs and the private sector, indicated "other" providing various replies. While some NGOs asked to abolish free allocation all together, many respondents from the private sector pointed to the risk of carbon leakage and the need to avoid the application of the cross-sectoral correction factor.

6.3.2 Addressing the risk of carbon leakage

Most responses expressed[14] (80%; 540) from a wide range of stakeholder groups argued in favour of amending or replacing the current carbon leakage framework, including most of NGOs and public authorities, either introducing other measures to further incentivise GHG reductions (31%), replacing it with a CBAM for selected sectors (18%), targeting the support even more to the sectors most at risk (17%), or making free

[14] This was a multiple choice questions and respondents could select several options.

allocations conditional on beneficiaries carrying out investments for reducing their GHG emissions (14%).

Regarding possible changes to benchmark-based allocation, the most preferred option was to increase transparency regarding benchmark values and process via mandatory publication of the underlying data by industry (55% of respondents found this to be important or very important). Otherwise, respondents' opinions were very much divided with about one half of respondents finding the following proposals important, and the other half, in particular the majority of respondents from the private sector, not: the introduction of a modified method to determine benchmark values to ensure faster incorporation of innovation and technological progress, additional product benchmarks or revised definitions of product benchmarks to incentivise innovation. 84% of respondents also referred to other important aspects and provided many different ideas, such as the use of benchmarks to reward first-movers, support for other measures such as carbon contracts for difference as well as general claims for a higher or lower level of carbon leakage protection.

The responses to the question on indirect cost compensation are summarised in Annex 9.

6.3.3 An increasing role for emissions trading

The vast majority of respondents from a wide range of stakeholder groups argued that, in addition to carbon pricing, other policies should be deployed when extending the use of emissions trading to emissions from buildings, road transport or all fossil fuel combustion, including CO_2 standards for cars and vans (87%), transport policies (79%), policies addressing energy efficiency of buildings (79%) and renewable energy policies (76%) as well as, to a lesser degree, energy taxation (56%).

A narrow majority of responses[15] (52%; 636), including from NGO, private sector respondents and trade unions, had a negative view on the integration of the building and transport sectors into the ETS because of the large differences between new sectors and the current ones so that abatement efforts would mainly materialise in the current ETS sectors, because it would give an insufficient price signal for the transport and building sector to decarbonise, and/or because the integration of the new sectors in the current ETS might disrupt and undermine its stability. Only less than one-third of responses, including the majority of EU citizen and academic/research institutions, saw an integration favourable, arguing that it would provide for cost-effectiveness, a level-playing field and a uniform carbon signal. 18% of responses referred to "other" (positive or negative) effects, with half of them arguing against the introduction of emission trading for new sectors and the other half being open to consider an extension as an

[15]This was a multiple choice questions and respondents could select several options.

option, generally either after a careful assessment of the impacts and a trial period or in a separate temporary or permanent ETS.

Most of respondents (46%; 164), including the majority of NGOs, private sector respondents and trade unions, felt that a separate EU-wide emissions trading system for road transport and buildings or all fossil fuel use as a parallel system to the current ETS should stay independent and no relationship between the current and new separate system should be established. 19% of respondents, including the majority of EU citizens, argued for 'two-way flexibilities' between the systems, while only 2% argued for one-way flexibilities. Further 33%, including the majority of academic/research institutions, indicated "other" giving various replies, in particular stressing the need for a thorough impact assessment before integrating the two systems.

Views were divided on whether the ETS revision should already determine when and how emissions trading for road transport and buildings or all fossil fuel use could be gradually integrated into the existing ETS. 45% (174) of respondents, including the vast majority of NGOs, environmental organisations and trade unions as well as almost half of the private sector respondents (in particular from the manufacturing sector), claimed that the risks associated with an integration are too high and that the legislation should not pursue such a step. 43% (165) of respondents, including the majority of academic/research institutions, public authorities and EU citizens as well as the slight majority of private sector respondents (in particular from the energy sector), were open to having the revised ETS Directive determine when and how emissions trading for road transport and buildings or all fossil fuels could be gradually integrated into it. These respondents preferred a review clause (26%) to a fixed integration date (17%).

6.3.4 Extension to maritime GHG emissions

Most respondents who expressed a view on the proposed policy options (35%; 117), including the majority of NGOs, environmental organisations, academic/research institutions and public authorities, argued that extending the ETS to cover maritime transport would be the most appropriate measure to put a price on GHG emissions from EU maritime transport activities. This option was followed by a specific ETS just for maritime transport (14%) and a tax at EU level (8%). However, 43% of respondents indicated "other" giving various replies, including more than half of private sector respondents. The majority of respondents from the maritime industry argued against the extension of the ETS to cover maritime transport, preferring a global approach at IMO level instead.

A clear majority of respondents (54%; 144) from a broad range of stakeholder groups stated that EU carbon pricing measures in the maritime sector should be combined with EU emission standards for ships (notably technical or operational carbon intensity standards). However, only 25% of respondents from the maritime sector selected this option, while most of them indicated that emissions standards would be sufficient.

In terms of design elements, a large majority of respondents (71%; 155) from different stakeholder groups felt that a carbon price should be paid by ship commercial operators. Regarding exemptions to a carbon pricing policy for maritime transport, 37% of respondents (75) indicated that only ships below 400 GT should be excluded, in line with the IMO's existing measures in place for those ships. A slightly smaller number (28%; 57) stated that ships below 5000 GT should be excluded, while this was the preferred option of respondents from the maritime industry. Concerning the geographical scope of carbon pricing for the maritime sector, 76% of total respondents (171) (and 57% of respondents from the maritime industry) supported addressing emissions from intra-EU and extra-EU voyages. Regarding the type of emissions covered, there was a nearly even split between respondents preferring an inclusion of only CO_2 emission and those in favour that also methane, nitrous oxide and black carbon emissions should be accounted for in view of their important increase over the period 2012 to 2018. The majority of respondents from the maritime industry preferred to only include CO_2 emissions in line with the EU MRV system for shipping.

If the EU were to apply carbon pricing to emissions from extra-EU voyages, a majority (65%; 123) favoured as a basis criterion the application of 100% of both the incoming and the outgoing journeys. 48% of respondents from the maritime industry supported this option, while 33% indicated a preference for 50% of both the incoming and outgoing journeys.

6.3.5 Market Stability Reserve

The prevailing view (71%; 232) across a wide range of stakeholder groups was that the MSR has delivered on its main objective and should be continued (only 4% indicated that the approach did not work, 25% indicated "other" with various replies). Among these respondents, for 54%, the MSR would benefit from improvements, either in its parameters (30%), through the addition of a carbon price floor (13%), or in its reactivity to address unexpected demand or supply shocks (11%), while the other 17% of respondents indicated that the approach has worked well and should not be changed. The carbon price floor option (12%) was mostly supported by private sector stakeholders, arguing that a carbon price would strengthen the current framework, ensure a clear price signal for low-carbon investments and improve the predictability of the ETS.

For 46% of respondents (108), the current MSR thresholds, used to determine whether allowances are placed in the MSR or released, should be kept as they are. This option was the most preferred by private sector stakeholders, public authorities and trade unions. 37% of respondents argued that the thresholds should be decreased, i.e. making a release less likely and a placement in the MSR more likely, including the majority of NGOs, environmental organisations and parts of the private sector (in particular the energy sector). A minority of respondents (18%) from different stakeholder groups indicated that the thresholds should be increased.

As regards the options for the MSR intake rate, respondents were almost evenly split between those in favour of keeping it as per current regulation[16] (23%; 65) and those opting for the MSR intake rate to be kept at 24% beyond 2023 (21%; 58). These are the options most preferred by private sector respondents and trade unions. Another 18% (51) argued that the intake rate should be higher than 24% to reduce the surplus faster, including the majority of NGOs and environmental organisations. 12% (34) indicated that the intake rate should be decreased to lower than 12% from 2024 onwards, including parts of the private sector (in particular the manufacturing sector).

A clear majority of respondents (63%) from a wide range of stakeholder groups expressed a preference to maintain the invalidation rule, according to which allowances in the MSR above the level of auction volumes of the previous year are invalidated as of 2023, either unreservedly (38%) or with an amendment (25%). 27% of respondents were instead in favour of abolishing the invalidation rule, including parts of the private sector (in particular the manufacturing sector).

Furthermore, a clear majority of respondents (62%; 173) from a wide range of stakeholder groups supported the option to include aviation allowances and emissions in the calculation of the surplus. A minority of respondents (38%) from different stakeholder groups was against the inclusion.

With regards to the cancellation of allowances for MS that implement national measures to close fossil fuels power plants or other measures that substantially reduce demand for allowances, the most preferred option (44%; 139) was that it should not be made mandatory. This was the preferred option for the majority of private sector respondents. However, one third of the respondents (35%; 111), including the majority of NGOs and environmental organisations, was in favour of cancelling them proportionally.

6.3.6 Revenues

The most preferred option[17] for using the ETS revenues, was “Support for clean investment in ETS sectors” (22%; 299), followed closely by “More support to innovation” (20%; 279).

The vast majority of respondents (87%; 307) from a wide range of stakeholder groups indicated that stricter rules are necessary to ensure MS spend their ETS auction revenues in line with climate objectives. 64% of this group of respondents opted for MS to spend

[16]Meaning at 24% and fall back to the level of 12% beyond 2023.
[17]This was a multiple choice questions and respondents could select several options.

more revenues on climate-related purposes, while 23% of them indicated that MS should spend ETS revenues in a way compatible with the climate neutrality objective (‘do no harm’).

6.3.7 Low-carbon support mechanisms

An increase of the Innovation Fund in some form was supported by an overwhelming majority of respondents (83%; 280) from a wide range of stakeholder groups. The most preferred option was an increase by using more allowances from the auction share (45%; 151), followed by a significant increase regardless of the source of allowances (29%; 98), and by an increase by using more allowances from the free allocation share (9%; 31). The first option (allowances from auction share) was the private sector’s preferred option, while NGOs expressed more support for the latter two options. A minority of respondents (17%) from different stakeholder groups indicated that the size of the Innovation Fund should remain unchanged.

A large majority of respondents (74%; 251) agreed that the maximum funding rate for projects financed by the Innovation Fund should be increased from the current 60% of the relevant costs. This was supported by both NGOs and the private sector, albeit not the majority of academic/research institutes and environmental organisations. Among the supporters of such a change, more than half (55%; 188) favoured an unconditional increase allowing better risk-sharing for risky and complex projects, whereas about one-fifth (19%; 63), including the majority of NGOs, were in favour of an increase but only in case of competitive bidding.

88% of respondents (288), coming from all stakeholder groups, were also in favour of additional supporting instruments be introduced to support full market deployment of low-carbon products through the Innovation Fund.

53% of respondents (130) argued favourably for an increase in the Modernisation Fund with a further 4% of respondents (9) arguing that the size of the Modernisation Fund should remain unchanged in terms of the absolute amount. An increase in the Modernisation Fund was supported by the vast majority of NGOs and environmental organisation and about half of private sector respondents. According to 36% of respondents (87), the Modernisation Fund should remain at a 2% cap.

A clear majority of replies[18] (74%) from a wide range of stakeholder groups supports the streamlining of the Modernisation Fund and an enhancement of the coherence with the Green Deal. The most favoured option was that the Modernisation Fund be allowed to finance only non-fossil fuel based heating and cooling systems (33%; 132), closely

[18]This was a multiple choice questions and respondents could select several options

followed by the exception for financing coal-fired district heating in certain MS be removed (32%; 129 responses). Only weak support had the notion that the Modernisation Fund should be allowed to finance only priority projects to simplify the administration (8%).

6.4 Position papers

Three quarters of the analysed position papers originated from companies and business organisations and many focussed on specific topics of the revision. The majority opinion put forward in the group of stakeholders that submitted position papers on certain topics is not necessarily aligned with the majority opinion put forward by all stakeholders in response to the questionnaire.

6.4.1 Contribution of ETS to the overall climate ambition for 2030 and main challenges

Thirty-eight respondents commented specifically on the contribution of the current ETS sectors to increased targets. Eight business associations representing a wide range of industries and two companies (mining and aluminium/hydropower), felt that there was a strong argument for other sectors to contribute more to increased targets. Ten respondents largely from the energy and power industry supported an increase in ambition from the ETS sector. The remaining respondents either expressed support in an increase in ambition without specifying details or called for the targets to be based on cost-effectiveness analysis.

Most of the papers referred to challenges in achieving the higher 2030 ambition in some from or other. There were differing views on the main challenges – the ones mentioned include costs and technology readiness levels of decarbonisation technologies in general or in certain industries, the need to avoid carbon leakage and provide investment certainty as well as the need to ensure changes in the ETS and the wider policy landscape are mutually reinforcing. The mentioned means to address these challenges included providing financial support through EU funds and maintaining or strengthening the role of free allocation as well as other carbon leakage provisions (including indirect cost compensation).

6.4.2 Addressing the risk of carbon leakage

Which level of free allocation is appropriate was generally not stated as it was recognised that it would also depend on other elements of the carbon leakage framework. Respondents who commented on this aspect (48) generally supported maintaining the carbon leakage framework or increasing the protection against the risk of carbon leakage. Free allocation and indirect cost compensation were elements that were frequently mentioned. Opinions were mixed on whether a CBAM should replace other measures or should be additional.

The issue of benchmarks attracted few comments (26) which were varied with no clear preference on how to update the benchmarks.

Most respondents who commented on indirect cost compensation (27) were supportive of it continuation.

6.4.3 Market Stability Reserve

Respondents commenting on the MSR (47) raised several points. Several respondents commented that the MSR revision should be seen in the larger context of the ETS revision. Various respondents (from the energy sector, general business sector and NGOs) supported maintaining the intake rate of 24% after 2023 or support strengthening of the MSR in more general terms. Others felt that strengthening the MSR would lead to an undesirable increase in the carbon price and that the MSR should be used to avoid application of the cross-sectoral correction factor, to fund innovation or clean technology or to top up the New Entrants Reserve (mainly energy intensive industry). Several respondents from industry emphasised that the MSR should be viewed primarily as a stability instrument (i.e. addressing volatility), and should not be used as an instrument to drive up the carbon price. There was opposition as well as (more limited) support for using price-based triggers for the MSR or inclusion of a carbon price floor.

6.4.4 Extensions of emissions trading to other sectors

Forty-eight stakeholders commented on the extension of emissions trading to buildings and transport. The overwhelming majority were against inclusion of the sectors in the current ETS, with 27 preferring to strengthen existing legislation rather than using emissions trading and 16 responding that it should be through a separate scheme. Notably, the option of a separate ETS was mentioned as a testing ground and as a possible preparatory step towards inclusion in the current ETS. If these sectors were to be integrated in the current ETS, such integration should be done carefully to avoid disruption in the current ETS. The only support for integrating new sectors into the current ETS came from four energy related companies and a public authority.

There was a clear preference from the maritime industry respondents for regulation to occur at IMO level. These respondents argued that if developments are to occur at EU level the clear preference is for it to cover intra EU voyages only and be based on free allocation. The same stakeholders also stressed that any formal maritime ETS should be separate from the current ETS.

6.4.5 Revenues and low-carbon support mechanisms

Most of the thirty-two stakeholders who responded on the use of ETS auction revenues supported them going to decarbonisation technologies, often those technologies to be supported related to the sector of the respondent. A trade union supported investment in decarbonisation technologies with a requirement that it also brought jobs to Europe.

Most of the respondents agreed with using an EU mechanism such as the Innovation Fund or the Modernisation Fund for supporting clean technologies. Almost all respondents who mentioned carbon contracts for difference were supportive of their use.

Most respondents from the maritime industry argued that, in case allowance were auctioned or a levy used, all revenues should flow back in full to the R&D needed by to decarbonize the maritime industry.

Annex 3: Who is affected and how?

7 WHO IS AFFECTED AND HOW

7.1 Practical implications of the initiative

The ETS has been in force since 2005 and its scope has remained largely intact, covering around 9.200 to 9.500 large, stationary installations (11.000 before UK's withdrawal from the EU) and, since 2012, approximately 500 airlines. Small installations do not take part in the ETS or can be opted out. The covered entities, have become very familiar with the ETS's annual compliance cycle based on obligations related monitoring, reporting and verification of emissions. Compliance with these rules is almost 100%. This also holds for the national authorities responsible for various implementing tasks, such as the issuing of emission permits, the assessment of monitoring plans and emission data, as well as the allocation of free allowances.

For the regulated entities under the existing ETS in the **power and industry sector**, a strengthening of the ETS does not affect these regular activities. However, as ambition increases and free allocation starts to decrease, industrial players may choose to become more active participants on the carbon market, increasing their hedging behaviour to better manage their compliance costs.

The situation is different for the new sectors to which emissions trading may be extended.

With regard to the **maritime sector**, the regulated entities, i.e. the companies, whose role is described in more detail in Annex 6, will already be familiar with the dedicated MRV-rules for their sector, but these activities will have to be complemented by allowance management to ensure a sufficient number of allowances is acquired and surrendered in time.

The regulated entities[19] in the **road transport and buildings sector** have no experience with emissions trading or its practical implications. However, putting the obligation upstream on the tax warehouses and on fuel suppliers implies that those entities usually have experience in dealing with fuel taxation and related administrative procedures. Additional administrative tasks will be related to the particularities of an emissions trading system, such as obtaining a GHG emissions permit, opening and maintaining registry account(s), including paying the registry fees, complying with the specific ETS MRV rules (preparing and updating the monitoring plan, implementing its procedures, monitoring and reporting, verification fees charged by the independent verifier), and the

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[19] See Annex 18 for more information on these regulated entities

timely purchasing and surrendering of allowances (see Annex 5 for further details). The monitoring and reporting rules would be simpler than those applying to the current sectors: only sales of largely standardised fuels for combustion purposes would be monitored and the calculation of associated emissions would rely on emission factors. As such, the new MRV system would be more similar to the system applicable to aviation, both in terms of costs and obligations. In addition, no free allocation is envisaged under EXT1, hence the implementing of corresponding rules does not apply.

Insofar as **public authorities** are concerned, MS could decide to establish as the competent authority for the new sectors the same as the one actually responsible for the current ETS, reducing the administrative burden and benefitting from synergies.

7.2 Summary of costs and benefits

The following tables haves been prepared on the basis of the preferred policy options presented in Section 8. With regard to the strengthening of the existing ETS (and related policies), no preferred package has been identified among the coherent policy packages identified in Section 7. Therefore, where relevant, this annex refers to all four coherent policy packages.

Some cost and benefits have been quantified in the context of the 2030 Climate Target Plan and refer to the overall effects of an EU-wide, economy-wide net greenhouse gas emissions reduction target by 2030 compared to 1990 of at least 55% based on the MIX policy mix of carbon pricing, renewables, energy efficiency and transport decarbonisation policies with either one extended ETS or two separate ETS with caps set reflecting cost-effective contributions for each of the two ETS segments. Such estimates have been marked in *italic* in the below tables.

Table 30: Overview of benefits

I. Overview of Benefits (total for all provisions) – Preferred options		
Description	***Amount***	***Comments***
Direct benefits		
Strengthening of the existing ETS (Packages 1-4)		
Reduction in greenhouse gas emissions	All four packages reach the cost-effective environmental ambition of -62% in 2030. Compared to the baseline, this implies an additional reduction of 11% over the period 2021 to 2030 (-17% for 2026-30). **Package 1 (AMB1):** cumulative cap over the period 2021 to 2030 is 1185 million ton (8.6%) lower than the current ETS cumulative cap	Direct benefits to society at large from higher projected emission reductions in 2021-2030 in close to all MS. See Sections 6.1.1.1 and 7.1.2 as well as Annex 13

	Package 2 (AMB2a): cumulative cap that is about 400 million allowances lower than under Package 1 **Package 3 (AMB2c):** cumulative cap that is around 750 million allowances smaller than in Package 1 and 350 million allowances lower than in Package 2 **Package 4 (AMB3c):** in terms of cumulative cap, this option is comparable to Package 2	
Reduced air pollution emissions	**Packages 1-4:** Many installations covered by the ETS also emit a significant amount of other air pollutants (e.g. NOX, SOX and dust), which are also expected to decrease with a decarbonisation of industry and power generation. Air pollutant emissions in 2030 reduce compared to the baseline, for example SO_2 emissions by 12 % points.	Direct benefits to society at large in close to all MS. Main beneficiaries are citizens, typically benefitting those living in urban areas and lower-income and vulnerable households, who are most affected by air pollution. See Section 6.1.1.1
Improvements with regard to market resilience, carbon price signal and price volatility (market stability)	**Packages 1+2 (MSR1):** Improved market resilience, stronger carbon price signal, however, threshold effect may still induce some price volatility **Packages 3+4 (combination of MSR parameters):** Improved market resilience, stronger carbon price signal, lower price volatility	Direct beneficiaries are ETS installations, as a stable ETS has a positive effect on competitiveness. A stable ETS also benefits society at large, as it provides a clear price signal for long-term investment in decarbonisation. See Sections 6.1.2.1 and 7.1.1.2
Higher low-carbon financing	**Packages 1-4**: with an increase in the average carbon price from EUR 29 under current policies to EUR 50 for the period 2021 to 2030 under the strengthened ETS, the size of the IF would increase by at least EUR 14.5 billion.	Direct benefits to ETS installations who receive funding and improve their competitiveness. The higher financing for low-carbon technologies will also benefit society at large in all MS, as it will

	(The higher carbon price also increases the value of the other auctioning revenues, i.e. the revenues allocated to the Modernisation Fund and to MS. However, as these are defined as a share of the cap, the increase in the carbon price must be balanced against the lower number of allowances.) **Packages 1-2 (IF2):** + 150 million allowances or EUR 7.5 billion (with an average carbon price of EUR 50)	eventually bring about higher emission reductions. See Sections 5.2.1 and 5.2.2.4
Extension to maritime transport		
Reduction in greenhouse gas emissions	**MAR1**, the extension of the ETS to the maritime sector would result in a total reduction of 30 Mt of CO_2 emissions in 2030 if we only cover intra-EEA voyages and at-berth emissions (MINTRA). That would be equivalent to reducing the total maritime emissions from the baseline by around 22%. With a broader geographical coverage, MEXTRA50, the total emissions reduction would result in 45 Mt of CO_2 emissions by 2030 compared to the baseline.	Direct benefits to society due to the reduction in GHG emissions coming either from mitigation measures implemented in the maritime sector itself (in-sector abatement), or from the purchase of general ETS allowances (EUA) leading to abatement actions in other ETS sectors (out-of-sector abatement). See Section 6.2.1
Reduced air pollution emissions	Positive impact on public health compared to the baseline as ships would emit less air pollutants, due to improvement in energy efficiency, the uptake of fuels with lower emission factors and the use of cleaner energy sources at berth.	Direct benefits to society, in particular port areas. See Section 6.2.1.2
Generation of auction revenues	Additional revenues generated in 2030 are estimated at EUR 1.2 billion for MAR1 with MINTRA scope (EUR 2.4 billion for MAR1 with MEXTRA50).	
Extension of emissions trading to road transport and buildings (EXT1)		
Reduction in greenhouse gas emissions	The two sectors' cost-effective emission reduction is 43% in 2030 (compared to 2005). Compared to the baseline (-34%), this implies an additional reduction of almost 10%.	Direct benefits to society at large from higher projected emission reductions in 2021-2030 in close to all MS

	Covering the new sectors under an emissions trading system provides for increased certainty in delivering the greenhouse gas emissions reductions.	See Section 6.3.1.1
Reduced air pollution emissions	The road transport and buildings sectors also emit a significant amount of other air pollutants (e.g. PM2.5 and NO_X,), which are also projected to decrease with a decarbonisation of these sectors.	Direct benefits to society at large in close to all MS. Main beneficiaries are citizens, typically benefitting those living in urban areas and lower-income and vulnerable households, who are most affected by air pollution. See Section 6.3.3.3
Generation of auction revenues and higher low-carbon financing	Average annual revenue of EUR 47 billion in period 2026-2030 of which the following revenues would be used for the Innovation Fund: **Package 1-2 (IF2):** +200 million allowances or +EUR 10 billion (with an average carbon price of EUR 50) **Package 3-4 (IF1):** +100 million allowances or +EUR 5 billion (with an average carbon price of EUR 50)	ETS auctioning revenues are expected to benefit to the society at large, as MS increase their government expenditure, in particular for green investment, or reduce taxes. The revenue could also be used to address social and distributional concerns. Direct benefits to ETS installations who receive funding and improve their competitiveness. The higher financing for low-carbon technologies will also benefit society at large in all MS, as it will eventually bring about higher emission reductions. See Section 7.3.1.2 and Annex 13
Indirect benefits of strengthening and extending the ETS		
Improved energy security	The savings of fossil fuel imports contribute to improvements of energy security by reducing the energy dependency ratio in 2030 from 54.5% in the baseline to 52.9% (MIX-CP) and 52.5% (MIX).	Indirect benefits to society at large See Section 6.3.2.

Employment	*Limited effects. The employment impact is positive if carbon pricing revenues are recycled to lower other taxes or to support green investment.*	Possible indirect benefits to society at large, but significant shifts in sectoral composition expected. See Sections 6.1.3.1 and 6.3.3.2
Reduction in healthcare costs	Health damages in 2030 reduce by EUR 17.6 to 35.2 billion compared to the baseline due to reduced air pollution. Annex 3 of the Effort Sharing Regulation impact assessment analyses benefits per Member State groups.	Indirect benefits to society at large See Sections 6.1.3.2 and 6.3.3.3

Table 31: Overview of costs

II. Overview of costs – Preferred options						
		Citizens/Consumers	Businesses		Administrations	
		Recurrent	One-off	Recurrent	One-off	Recurrent
Strengthening of the ETS target/cap (incl. MSR)	Direct and indirect costs	Indirect costs Average carbon price for period 2021-2030 increases from EUR 29 to EUR 50 with partial cost pass-through to consumers		Compliances costs for regulated entities Average carbon price for period 2021-2030 increases from EUR 29 to EUR 50 with partial cost pass-through to consumers Reduced free allocation **Package 1 (AMB1+CL1):** no triggering of CSCF		

				Package 2 (AMB2a + CL1): no triggering of CSCF **Package 3 (AMB2c+CL2)**: CSCF applied as of 2029, on average 0.88 for period 2026-2030 **Package 4 (AMB3c+CL2):** CSCF applied in 2030, on average 0.96 for period 2026-2030 See Section 6.1.2.2.1		
Higher low-carbon financing	Direct and indirect costs					<u>Admin costs for the European Commission</u> **Packages 1-2 (IF2):** Risk of administrative challenges due to significantly bigger calls **Packages 3-4 (IF1):** Additional administrative burden of running slightly

						bigger calls can be manageable or easy to address See Section 7.1.1.4
Extension to road transport and buildings	Direct and indirect costs	Indirect costs Household annual investment expenditures: + 0.38 to 0.71 percentage point in 2030 compared to the baseline Household fuel expenditures: - 0.12 to +0.06 percentage point (as a consequence of investments) However, there are differences between low- and high-income households and MS. See Sections 6.3.2.1.1 and 6.3.3.1.1	Admin costs for regulated entities Initial setting up to comply with MRV system (human resources, IT) See Annex 5 showing a (high-end) estimated one-off cost of 6085 to 8590 EUR per entity	Compliances costs for regulated entities Negligible (cost-pass through to end-consumers) Admin costs for regulated entities Continued compliance with MRV system (human resources, IT) See Annex 5, showing estimated (high end) recurring administrative costs of 4900 EUR to 6350 EUR per entity	Admin costs for national public authorities Initial setting up of the MRV system (human resources, IT) etc See Annex 5 showing one-off costs of 9.6 million on aggregate basis for all MS Admin costs for the European Commission Initial setting up of the MRV rules, registry, auctioning provisions (largely following framework of existing ETS) See Section 6.3.4	Admin costs for national public authorities Continued operation of the MRV system (human resources, IT) See Annex 5 showing estimated recurring costs for MS of 1000-1400 EUR per entity Admin costs for the European Commission Continued operation of the registry and organisation of auctioning (largely following framework of existing ETS) See section 6.3.4
Extension to maritime transport	Direct and indirect costs		Admin costs for regulated entities (estimated at around	Admin costs for regulated entities • Management of the	Admin costs for national public authorities (estimated	Admin costs for national public authorities (estimated

			EUR 8 000-20 000)[20] per entity: • Familiarisation with the ETS, communication with public authorities, setting up carbon management functions (ten man-days per ten-year period) • Application fee in the Union Registry (300 – 870 €)[21] See Section 6.2.2	registry account, purchase and surrender allowances (estimated at 1100-5600€ per entity)[22] • Account annual fees (EUR 300 – 3 700 per entity) • Supporting regulator requests Compliances costs for regulated entities If the ETS extension is applied to intra-EEA emissions, the estimated ETS payment would represent an amount of	at EUR 0.5 to 1.5 million per period for all national competent authorities): • Preparation and implementation of national legislation and guidelines, • Information and communication tasks. • ETS specific communication Admin costs for the European Commission • Updating the IT system behind the EU maritime transport MRV	at EUR 0.5 to 6.4 million per year for all national competent authorities): • Approval of monitoring plans and review of verified emission reports • Registry operations • Monitor compliance and enforcement actions Admin costs for the European Commission • Administer the EU registry (create new allowances)

[20] estimation by Ricardo AEA, 2021

[21] The registry fees to the Union Registry depend on the Member State and the type of operator but expected ranges have been estimated based on available information from relevant authorities.

[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799575/Cost_of_Compliance_Report.pdf

				around EUR 1.9 billion in 2030. See Section 6.2.2 However, from a society perspective the ETS payments do not represent a net cost, as there are corresponding auctioning revenues (see section 6.3.2.3 and table on benefits above).	Regulation • Transposition and conformity checks of national legislation See Section 6.2.2	See Section 6.2.2

Annex 4: Analytical methods

8 Common analytical framework for the Impact Assessments of the revision of ESR, ETS, CO_2 standards, LULUCF, RED and EED

8.1 Introduction

Aiming at covering the entire GHG emissions from the EU economy, and combining horizontal and sectoral instruments, the various pieces of legislation under the "Fit for 55" package strongly interlink, either because they cover common economic sectors (e.g. buildings sector is currently addressed by energy efficiency and renewables polices but would be also falling in the scope of extended ETS) or by the direct and indirect interactions between these sectors (e.g. electricity supply sector and final demand sectors using electricity).

As a consequence, it is crucial to ensure consistency of the analysis across all initiatives. For this purpose, the impact assessments underpinning the "Fit for 55" policy package are using a collection of integrated modelling tools covering the entire GHG emissions of the EU economy.

These tools are used to produce a common Baseline and a set of core scenarios reflecting internally coherent policy packages aligned with the revised 2030 climate target, key policy findings of the CTP (see annex 1) and building on the Reference Scenario 2020, a projection of the evolution of EU and national energy systems and GHG emissions under the current policy framework[23]. These core scenarios serve as a common analytical basis for use across different "Fit for 55" policy initiatives, and are complemented by specific variants as well as additional tools and analyses relevant for the different initiatives.

This Annex describes the tools used to produce the common baseline (the Reference Scenario 2020) and the core policy scenarios, the key assumptions underpinning the analysis, and the policy packages reflected in the core policy scenarios.

[23] The "current policy framework" includes EU initiatives adopted as of end of 2019 and the national objectives and policies and measures as set out in the final National Energy and Climate Plans – see the EU Reference Scenario 2020 publication.

8.2 **Modelling tools for assessments of policies**

8.2.1 Main modelling suite

The main model suite used to produce the scenarios presented in this impact assessment has a successful record of use in the Commission's energy, transport and climate policy assessments. In particular, it has been used for the Commission's proposals for the Climate Target Plan[24] to analyse the increased 2030 mitigation target, the Sustainable and Smart Mobility Strategy[25], the Long Term Strategy[26] as well as for the 2020 and 2030 EU's climate and energy policy framework.

The PRIMES and PRIMES-TREMOVE models are the core elements of the modelling framework for energy, transport and CO_2 emission projections. The GAINS model is used for non-CO_2 greenhouse gas emission projections, the GLOBIOM-G4M models for projections of LULUCF emissions and removals and the CAPRI model is used for agricultural activity projections.

The model suite thus covers:

- **The entire energy system** (energy demand, supply, prices and investments to the future) and **all GHG emissions and removals** from the EU economy.
- **Time horizon:** 1990 to 2070 (5-year time steps).
- **Geography:** individually all EU Member States, EU candidate countries and, where relevant the United Kingdom, Norway, Switzerland and Bosnia and Herzegovina.
- **Impacts:** energy system (PRIMES and its satellite model on biomass), transport (PRIMES-TREMOVE), agriculture, waste and other non-CO_2 emissions (GAINS), forestry and land use (GLOBIOM-G4M), atmospheric dispersion, health and ecosystems (acidification, eutrophication) (GAINS).

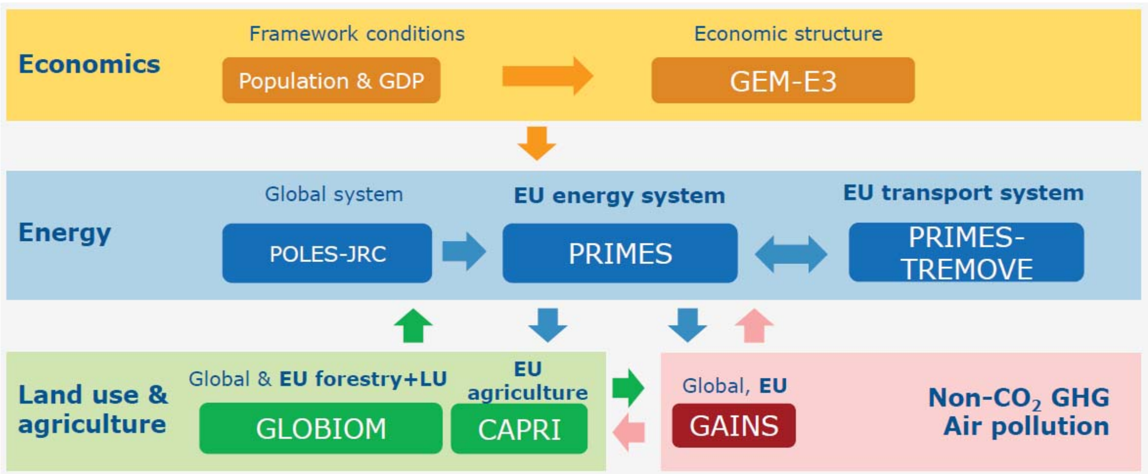
The modelling suite has been continuously updated over the past decade. Updates include the addition of a new buildings module in PRIMES, improved representation of the electricity sector, more granular representation of hydrogen (including cross-border trade[27]) and other innovative fuels, improved representation of the maritime transport sector, as well updated interlinkages of the models to improve land use and non-CO_2 modelling. Most recently a major update was done of the policy assumptions, technology

[24] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176
[25] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331
[26] https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf
[27] While cross-border trade is possible, the assumption is that there are no imports from outside EU as the opposite would require global modelling of hydrogen trade.

costs and macro-economic assumptions in the context of the Reference scenario 2020 update.

The models are linked with each other in such a way to ensure consistency in the building of scenarios (Figure 15). These inter-linkages are necessary to provide the core of the analysis, which are interdependent energy, transport and GHG emissions trends.

Figure 15: Interlinkages between models



8.2.2 *Energy: the PRIMES model*

The PRIMES model (Price-Induced Market Equilibrium System)[28] is a large scale applied energy system model that provides detailed projections of energy demand, supply, prices and investment to the future, covering the entire energy system including emissions. The distinctive feature of PRIMES is the combination of behavioural modelling (following a micro-economic foundation) with engineering aspects, covering all energy sectors and markets.

The model has a detailed representation of policy instruments related to energy markets and climate, including market drivers, standards, and targets by sector or overall. It simulates the EU Emissions Trading System. It handles multiple policy objectives, such as GHG emissions reductions, energy efficiency, and renewable energy targets, and provides pan-European simulation of internal markets for electricity and gas.

[28] More information and model documentation: https://e3modelling.com/modelling-tools/primes/

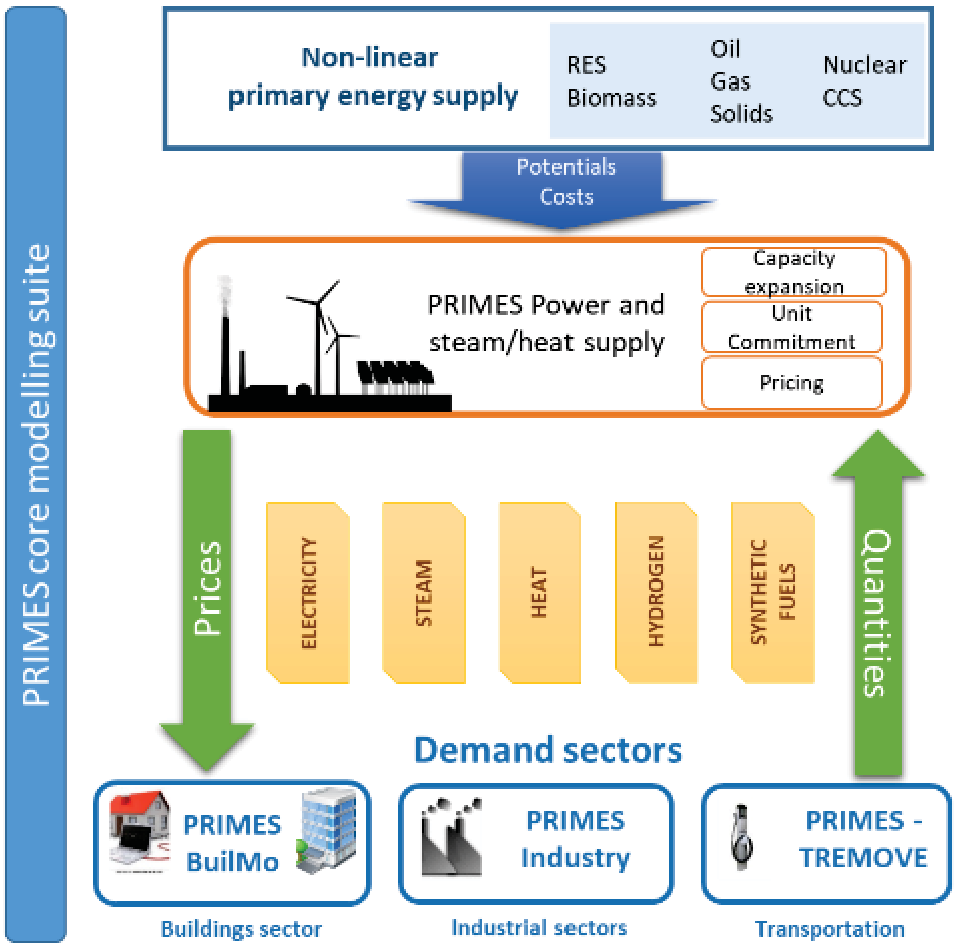
The model covers the horizon up to 2070 in 5-year interval periods and includes all Member States of the EU individually, as well as neighbouring and candidate countries.

PRIMES offer the possibility of handling market distortions, barriers to rational decisions, behaviours and market coordination issues and it has full accounting of costs (CAPEX and OPEX) and investment on infrastructure needs.

PRIMES is designed to analyse complex interactions within the energy system in a multiple agent – multiple markets framework. Decisions by agents are formulated based on microeconomic foundation (utility maximization, cost minimization and market equilibrium) embedding engineering constraints and explicit representation of technologies and vintages, thus allowing for foresight for the modelling of investment in all sectors.

PRIMES allows simulating long-term transformations/transitions and includes non-linear formulation of potentials by type (resources, sites, acceptability etc.) and technology learning. Figure 2 shows a schematic representation of the PRIMES model.

Figure 16: Schematic representation of the PRIMES model



It includes a detailed numerical model on biomass supply, namely PRIMES-Biomass, which simulates the economics of current and future supply of biomass and waste for energy purposes. The model calculates the inputs in terms of primary feedstock of biomass and waste to satisfy a given demand for bio-energy and provides quantification of the required capacity to transform feedstock into bioenergy commodities. The resulting production costs and prices are quantified. The PRIMES-Biomass model is a key link of communication between the energy system projections obtained by the core PRIMES energy system model and the projections on agriculture, forestry and non-CO_2 emissions provided by other modelling tools participating in the scenario modelling suite (CAPRI, GLOBIOM/G4M, GAINS).

It also includes a simple module which projects industrial process GHG emissions.

PRIMES is a private model maintained by E3Modelling[29], originally developed in the context of a series of research programmes co-financed by the European Commission. The model has been successfully peer-reviewed, last in 2011[30]; team members regularly participate in international conferences and publish in scientific peer-reviewed journals.

Sources for data inputs

A summary of database sources, in the current version of PRIMES, is provided below:

- Eurostat and EEA: Energy Balance sheets, Energy prices (complemented by other sources, such IEA), macroeconomic and sectoral activity data (PRIMES sectors correspond to NACE 3-digit classification), population data and projections, physical activity data (complemented by other sources), CHP surveys, CO_2 emission factors (sectoral and reference approaches) and EU ETS registry for allocating emissions between ETS and non ETS
- Technology databases: ODYSSEE-MURE[31], ICARUS, Eco-design, VGB (power technology costs), TECHPOL – supply sector technologies, NEMS model database[32], IPPC BAT Technologies[33]
- Power Plant Inventory: ESAP SA and PLATTS
- RES capacities, potential and availability: JRC ENSPRESO[34], JRC EMHIRES[35], RES ninja[36], ECN, DLR and Observer, IRENA

[29] E3Modelling (https://e3modelling.com/) is a private consulting, established as a spin-off inheriting staff, knowledge and software-modelling innovation of the laboratory E3MLab from the National Technical University of Athens (NTUA).
[30] SEC(2011)1569 : https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1569_2.pdf
[31] https://www.odyssee-mure.eu/
[32] Source: https://www.eia.gov/outlooks/aeo/info_nems_archive.php
[33] Source: https://eippcb.jrc.ec.europa.eu/reference/

- Network infrastructure: ENTSOE, GIE, other operators
- Other databases: EU GHG inventories, district heating surveys (e.g. from COGEN), buildings and houses statistics and surveys (various sources, including ENTRANZE project[37], INSPIRE archive, BPIE[38]), JRC-IDEES[39], update to the EU Building stock Observatory[40]

8.2.3 Transport: the PRIMES-TREMOVE model

The PRIMES-TREMOVE transport model projects the evolution of demand for passengers and freight transport, by transport mode, and transport vehicle/technology, following a formulation based on microeconomic foundation of decisions of multiple actors. Operation, investment and emission costs, various policy measures, utility factors and congestion are among the drivers that influence the projections of the model. The projections of activity, equipment (fleet), usage of equipment, energy consumption and emissions (and other externalities) constitute the set of model outputs.

The PRIMES-TREMOVE transport model can therefore provide the quantitative analysis for the transport sector in the EU, candidate and neighbouring countries covering activity, equipment, energy and emissions. The model accounts for each country separately which means that the detailed long-term outlooks are available both for each country and in aggregate forms (e.g. EU level).

In the transport field, PRIMES-TREMOVE is suitable for modelling *soft measures* (e.g. eco-driving, labelling); *economic measures* (e.g. subsidies and taxes on fuels, vehicles, emissions; ETS for transport when linked with PRIMES; pricing of congestion and other externalities such as air pollution, accidents and noise; measures supporting R&D); *regulatory measures* (e.g. CO_2 emission performance standards for new light duty vehicles and heavy duty vehicles; EURO standards on road transport vehicles; technology standards for non-road transport technologies, deployment of Intelligent Transport Systems) and *infrastructure policies for alternative fuels* (e.g. deployment of refuelling/recharging infrastructure for electricity, hydrogen, LNG, CNG). Used as a module that contributes to the PRIMES model energy system model, PRIMES-

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[34] Source: https://data.jrc.ec.europa.eu/collection/id-00138
[35] Source: https://data.jrc.ec.europa.eu/dataset/jrc-emhires-wind-generation-time-series
[36] Source: https://www.renewables.ninja/
[37] Source: https://www.entranze.eu/
[38] Source: http://bpie.eu/
[39] Source: https://ec.europa.eu/jrc/en/potencia/jrc-idees
[40] Source: https://ec.europa.eu/energy/en/eubuildings

TREMOVE can show how policies and trends in the field of transport contribute to economy-wide trends in energy use and emissions. Using data disaggregated per Member State, the model can show differentiated trends across Member States.

The PRIMES-TREMOVE has been developed and is maintained by E3Modelling, based on, but extending features of, the open source TREMOVE model developed by the TREMOVE[41] modelling community. Part of the model (e.g. the utility nested tree) was built following the TREMOVE model.[42] Other parts, like the component on fuel consumption and emissions, follow the COPERT model.

Data inputs

The main data sources for inputs to the PRIMES-TREMOVE model, such as for activity and energy consumption, comes from EUROSTAT database and from the Statistical Pocketbook "EU transport in figures[43]. Excise taxes are derived from DG TAXUD excise duty tables. Other data comes from different sources such as research projects (e.g. TRACCS project) and reports.

In the context of this exercise, the PRIMES-TREMOVE transport model is calibrated to 2005, 2010 and 2015 historical data. Available data on 2020 market shares of different powertrain types have also been taken into account.

8.2.4 Maritime transport: PRIMES-maritime model

The maritime transport model is a specific sub-module of the PRIMES and PRIMES-TREMOVE models aiming to enhance the representation of the maritime sector within the energy-economy-environment modelling nexus. The model, which can run in stand-alone and/or linked mode with PRIMES and PRIMES-TREMOVE, produces long-term energy and emission projections, until 2070, separately for each EU Member-State.

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[41] Source: https://www.tmleuven.be/en/navigation/TREMOVE

[42] Several model enhancements were made compared to the standard TREMOVE model, as for example: for the number of vintages (allowing representation of the choice of second-hand cars); for the technology categories which include vehicle types using electricity from the grid and fuel cells. The model also incorporates additional fuel types, such as biofuels (when they differ from standard fossil fuel technologies), LPG, LNG, hydrogen and e-fuels. In addition, representation of infrastructure for refuelling and recharging are among the model refinements, influencing fuel choices. A major model enhancement concerns the inclusion of heterogeneity in the distance of stylised trips; the model considers that the trip distances follow a distribution function with different distances and frequencies. The inclusion of heterogeneity was found to be of significant influence in the choice of vehicle-fuels especially for vehicles-fuels with range limitations.

[43] Source: https://ec.europa.eu/transport/facts-fundings/statistics_en

The coverage of the model includes the European intra-EU maritime sector as well as the extra-EU maritime shipping. The model covers both freight and passenger international maritime. PRIMES-maritime focuses only on the EU Member State, therefore trade activity between non-EU countries is outside the scope of the model. The model considers the transactions (bilateral trade by product type) of the EU-Member States with non-EU countries and aggregates these countries in regions. Several types and sizes of vessels are considered.

PRIMES-maritime features a modular approach based on the demand and the supply modules. The demand module projects maritime activity for each EU Member State by type of cargo and by corresponding partner. Econometric functions correlate demand for maritime transport services with economic indicators considered as demand drivers, including GDP, trade of energy commodities (oil, coal, LNG), trade of non-energy commodities, international fuel prices, etc. The supply module simulates a representative operator controlling the EU fleet, who offers the requested maritime transport services. The operator of the fleet decides the allocation of the vessels activity to the various markets (representing the different EU MS) where different regulatory regimes may apply (e.g. environmental zones). The fleet of vessels disaggregated into several categories is specific to cargo types. PRIMES maritime utilises a stock-flow relationship to simulate the evolution of the fleet of vessels throughout the projection period and the purchasing of new vessels.

PRIMES-maritime solves a virtual market equilibrium problem, where demand and supply interact dynamically in each consecutive time period, influenced by a variety of exogenous policy variables, notably fuel standards, pricing signals (e.g. ETS), environmental and efficiency/operational regulations and others. The PRIMES maritime model projects energy consumption by fuel type and purpose as well as CO_2, methane and N_2O and other pollutant emissions. The model includes projections of costs, such as capital, fuel, operation costs, projections of investment expenditures in new vessels and negative externalities from air pollution.

The model serves to quantify policy scenarios supporting the transition towards carbon neutrality. It considers the handling of a variety of fuels such as fossil fuels, biofuels (bioheavy[44], biodiesel, bio-LNG), synthetic fuels (synthetic diesel, fuel oil and gas, e-ammonia and e-methanol) produced from renewable electricity, hydrogen produced from renewable electricity (for direct use and for use in fuel cell vessels) and electricity for electric vessels. Well-to-Wake emissions are calculated thanks to the linkage with the PRIMES energy systems model which derives ways of producing such fuels. The model also allows to explore synergies with Onshore Power Supply systems. Environmental regulation, fuel blending mandates, GHG emission reduction targets, pricing signals and

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[44] Bioheavy refers to bio heavy fuel oil.

policies increasing the availability of fuel supply and supporting the alternative fuel infrastructure are identified as drivers, along fuel costs, for the penetration of new fuels. As the model is dynamic and handles vessel vintages, capital turnover is explicit in the model influencing the pace of fuel and vessel substitution.

Data inputs

The main data sources for inputs to the PRIMES-maritime model, such as for activity and energy consumption, comes from EUROSTAT database and from the Statistical Pocketbook "EU transport in figures[45]. Other data comes from different sources such as research projects (e.g. TRACCS project) and reports. PRIMES-maritime being part of the overall PRIMES model is it calibrated to the EUROSTAT energy balances and transport activity; hence the associated CO_2 emissions are assumed to derive from the combustion of these fuel quantities. The model has been adapted to reflect allocation of CO_2 emissions into intra-EU, extra-EU and berth, in line with data from the MRV database.[46] For air pollutants, the model draws on the EEA database.

In the context of this exercise, the PRIMES-maritime model is calibrated to 2005, 2010 and 2015 historical data.

8.2.5 Non-CO_2 GHG emissions and air pollution: GAINS

The GAINS (Greenhouse gas and Air Pollution Information and Simulation) model is an integrated assessment model of air pollutant and greenhouse gas emissions and their interactions. GAINS brings together data on economic development, the structure, control potential and costs of emission sources and the formation and dispersion of pollutants in the atmosphere.

In addition to the projection and mitigation of non-CO_2 greenhouse gas emissions at detailed sub-sectorial level, GAINS assesses air pollution impacts on human health from fine particulate matter and ground-level ozone, vegetation damage caused by ground-level ozone, the acidification of terrestrial and aquatic ecosystems and excess nitrogen deposition of soils.

Model uses include the projection of non-CO_2 GHG emissions and air pollutant emissions for the EU Reference Scenario and policy scenarios, calibrated to UNFCCC emission data as historical data source. This allows for an assessment, per Member State, of the (technical) options and emission potential for non-CO_2 emissions. Health and

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[45] Source: https://ec.europa.eu/transport/facts-fundings/statistics_en
[46] https://mrv.emsa.europa.eu/#public/eumrv

environmental co-benefits of climate and energy policies such as energy efficiency can also be assessed.

The GAINS model is accessible for expert users through a model interface[47] and has been developed and is maintained by the International Institute of Applied Systems Analysis[48]. The underlying algorithms are described in publicly available literature. GAINS and its predecessor RAINS have been peer reviewed multiple times, in 2004, 2009 and 2011.

Sources for data inputs

The GAINS model assesses emissions to air for given externally produced activity data scenarios. For Europe, GAINS uses macroeconomic and energy sector scenarios from the PRIMES model, for agricultural sector activity data GAINS adopts historical data from EUROSTAT and aligns these with future projections from the CAPRI model. Projections for waste generation, organic content of wastewater and consumption of F-gases are projected in GAINS in consistency with macroeconomic and population scenarios from PRIMES. For global scenarios, GAINS uses macroeconomic and energy sector projections from IEA World Energy Outlook scenarios and agricultural sector projections from FAO. All other input data to GAINS, i.e., sector- and technology- specific emission factors and cost parameters, are taken from literature and referenced in the documentation.

8.2.6 Forestry and land-use: GLOBIOM-G4M

The Global Biosphere Management Model (GLOBIOM) is a global recursive dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to provide policy analysis on global issues concerning land use competition between the major land-based production sectors. Agricultural and forestry production as well as bioenergy production are modelled in a detailed way accounting for about 20 globally most important crops, a range of livestock production activities, forestry commodities as well as different energy transformation pathways.

GLOBIOM covers 50 world regions / countries, including the EU27 Member States.

Model uses include the projection of emissions from land use, land use change and forestry (LULUCF) for EU Reference Scenario and policy scenarios. For the forestry sector, emissions and removals are projected by the Global Forestry Model (G4M), a

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[47] Source: http://gains.iiasa.ac.at/models/
[48] Source: http://www.iiasa.ac.at/

geographically explicit agent-based model that assesses afforestation, deforestation and forest management decisions. GLOBIOM-G4M is also used in the LULUCF impact assessment to assess the options (afforestation, deforestation, forest management, and cropland and grassland management) and costs of enhancing the LULUCF sink for each Member State.

The GLOBIOM-G4M has been developed and is maintained by the International Institute of Applied Systems Analysis[49].

Sources for data inputs

The main market data sources for GLOBIOM-EU are EUROSTAT and FAOSTAT, which provide data at the national level and which are spatially allocated using data from the SPAM model[50]. Crop management systems are parameterised based on simulations from the biophysical process-based crop model EPIC. The livestock production system parameterization relies on the dataset by Herrero et al[51]. Further datasets are incorporated, coming from the scientific literature and other research projects.

GLOBIOM is calibrated to FAOSTAT data for the year 2000 (average 1998 - 2002) and runs recursively dynamic in 10-year time-steps. In the context of this exercise, baseline trends of agricultural commodities are aligned with FAOSTAT data for 2010/2020 and broadly with AGLINK-COSIMO trends for main agricultural commodities in the EU until 2030.

The main data sources for G4M are CORINE, Forest Europe (MCPFE, 2015)[52], countries' submissions to UNFCCC and KP, FAO Forest Resource Assessments, and national forest inventory reports. Afforestation and deforestation trends in G4M are calibrated to historical data for the period 2000-2013.

8.2.7 Agriculture: CAPRI

CAPRI is a global multi-country agricultural sector model, supporting decision making related to the Common Agricultural Policy and environmental policy and therefore with far greater detail for Europe than for other world regions. It is maintained and developed

[49] Source : http://www.iiasa.ac.at/

[50] See You, L., Wood, S. (2006). An Entropy Approach to Spatial Disaggregation of Agricultural Production, Agricultural Systems 90, 329–47 and http://mapspam.info/ .

[51] Herrero, M., Havlík, P., et al. (2013). Biomass Use, Production, Feed Efficiencies, and Greenhouse Gas Emissions from Global Livestock Systems, Proceedings of the National Academy of Sciences 110, 20888–93.

[52] MCPFE (2015). Forest Europe, 2015: State of Europe's Forests 2015. Madrid, Ministerial Conference on the Protection of Forests in Europe: 314.

in a network of public and private agencies including the European Commission (JRC), Universities (Bonn University, Swedish University of Agricultural Sciences, Universidad Politécnica de Madrid), research agencies (Thünen Institute), and private agencies (EuroCARE), in charge for use in this modelling cluster). The model takes inputs from GEM-E3, PRIMES and PRIMES Biomass model, provides outputs to GAINS, and exchanges information with GLOBIOM on livestock, crops, and forestry as well as LULUCF effects.

The CAPRI model provides the agricultural outlook for the Reference Scenario, in particular on livestock and fertilisers use, further it provides the impacts on the agricultural sector from changed biofuel demand. It takes into account recent data and builds on the 2020 EU Agricultural Outlook[53]. Depending on the need it may also be used to run climate mitigation scenarios, diet shift scenarios or CAP scenarios.

Cross checks are undertaken ex-ante and ex-post to ensure consistency with GLOBIOM on overlapping variables, in particular for the crop sector.

Sources for data inputs

The main data source for CAPRI is EUROSTAT. This concerns data on production, market balances, land use, animal herds, prices, and sectoral income. EUROSTAT data are complemented with sources for specific topics (like CAP payments or biofuel production). For Western Balkan regions a database matching with the EUROSTAT inputs for CAPRI has been compiled based on national data. For non-European regions the key data source is FAOSTAT, which also serves as a fall back option in case of missing EUROSTAT data. The database compilation is a modelling exercise on its own because usually several sources are available for the same or related items and their reconciliation involves the optimisation to reproduce the hard data as good as possible while maintaining all technical constraints like adding up conditions.

In the context of this exercise, the CAPRI model uses historical data series at least up to 2017, and the first simulation years (2010 and 2015) are calibrated on historical data.

[53] EU Agricultural Outlook for markets, income and environment 2020-2030, https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/agricultural-outlook-2020-report_en.pdf

8.3 Assumptions on technology, economics and energy prices

In order to reflect the fundamental socio-economic, technological and policy developments, the Commission prepares periodically an EU Reference Scenario on energy, transport and GHG emissions. The scenarios assessment used for the "Fit for 55" policy package builds on the latest "EU Reference Scenario 2020" (REF2020)[54].

The main assumptions related to economic development, international energy prices and technologies are described below.

8.3.1 Economic assumptions

The modelling work is based on socio-economic assumptions describing the expected evolution of the European society. Long-term projections on population dynamics and economic activity form part of the input to the energy model and are used to estimate final energy demand.

Population projections from Eurostat[55] are used to estimate the evolution of the European population, which is expected to change little in total number in the coming decades. The GDP growth projections are from the Ageing Report 2021[56] by the Directorate General for Economic and Financial Affairs, which are based on the same population growth assumptions.

Table 32: Projected population and GDP growth per Member State

	Population			GDP growth	
	2020	2025	2030	2020-'25	2026-'30
EU27	447.7	449.3	449.1	0.9%	1.1%
Austria	8.90	9.03	9.15	0.9%	1.2%
Belgium	11.51	11.66	11.76	0.8%	0.8%
Bulgaria	6.95	6.69	6.45	0.7%	1.3%

[54] See EU Reference Scenario 2020 publication.
[55] EUROPOP2019 population projections https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data
[56] The 2021 Ageing Report : Underlying assumptions and projection methodologies https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en

Croatia	4.06	3.94	3.83	0.2%	0.6%
Cyprus	0.89	0.93	0.96	0.7%	1.7%
Czechia	10.69	10.79	10.76	1.6%	2.0%
Denmark	5.81	5.88	5.96	2.0%	1.7%
Estonia	1.33	1.32	1.31	2.2%	2.6%
Finland	5.53	5.54	5.52	0.6%	1.2%
France	67.20	68.04	68.75	0.7%	1.0%
Germany	83.14	83.48	83.45	0.8%	0.7%
Greece	10.70	10.51	10.30	0.7%	0.6%
Hungary	9.77	9.70	9.62	1.8%	2.6%
Ireland	4.97	5.27	5.50	2.0%	1.7%
Italy	60.29	60.09	59.94	0.3%	0.3%
Latvia	1.91	1.82	1.71	1.4%	1.9%
Lithuania	2.79	2.71	2.58	1.7%	1.5%
Luxembourg	0.63	0.66	0.69	1.7%	2.0%
Malta	0.51	0.56	0.59	2.7%	4.1%
Netherlands	17.40	17.75	17.97	0.7%	0.7%
Poland	37.94	37.57	37.02	2.1%	2.4%
Portugal	10.29	10.22	10.09	0.8%	0.8%
Romania	19.28	18.51	17.81	2.7%	3.0%
Slovakia	5.46	5.47	5.44	1.1%	1.7%
Slovenia	2.10	2.11	2.11	2.1%	2.4%
Spain	47.32	48.31	48.75	0.9%	1.6%
Sweden	10.32	10.75	11.10	1.4%	2.2%

Beyond the update of the population and growth assumptions, an update of the projections on the sectoral composition of GDP was also carried out using the GEM-E3 computable general equilibrium model. These projections take into account the potential medium- to long-term impacts of the COVID-19 crisis on the structure of the economy, even though there are inherent uncertainties related to its eventual impacts. Overall, conservative assumptions were made regarding the medium-term impacts of the pandemic on the re-localisation of global value chains, teleworking and teleconferencing and global tourism.

8.3.2 International energy prices assumptions

Alongside socio-economic projections, EU energy modelling requires projections of international fuel prices. The 2020 values are estimated from information available by mid-2020. The projections of the POLES-JRC model – elaborated by the Joint Research Centre and derived from the Global Energy and Climate Outlook (GECO[57]) – are used to obtain long-term estimates of the international fuel prices.

Table 33 shows the international fuel prices assumptions of the REF2020 and of the different scenarios and variants used in the "Fit for 55" policy package impact assessments.

Table 33: International fuel prices assumptions

in $'15 per boe	2000	'05	'10	'15	'20	'25	'30	'35	'40	'45	'50
Oil	38.4	65.4	86.7	52.3	39.8	59.9	80.1	90.4	97.4	105.6	117.9
Gas (NCV)	26.5	35.8	45.8	43.7	20.1	30.5	40.9	44.9	52.6	57.0	57.8
Coal	11.2	16.9	23.2	13.1	9.5	13.6	17.6	19.1	20.3	21.3	22.3
in €'15 per boe	2000	2005	'10	'15	'20	'25	'30	'35	'40	'45	'50
Oil	34.6	58.9	78.2	47.2	35.8	54.0	72.2	81.5	87.8	95.2	106.3
Gas (NCV)	23.4	31.7	40.6	38.7	17.8	27.0	36.2	39.7	46.6	50.5	51.2
Coal	9.9	15.0	20.6	11.6	8.4	12.0	15.6	16.9	18.0	18.9	19.7

Source: Derived from JRC, POLES-JRC model, Global Energy and Climate Outlook (GECO)

[57] https://ec.europa.eu/jrc/en/geco

The COVID crisis has had a major impact on international fuel prices[58]. The lost demand cause an oversupply leading to decreasing prices. The effect on prices compared to pre-COVID estimates is expected to be still felt up to 2030. Actual development will depend on the recovery of global oil demand as well as supply side policies[59].

8.3.3 Technology assumptions

Modelling scenarios on the evolution of the energy system is highly dependent on the assumptions on the development of technologies - both in terms of performance and costs. For the purpose of the impact assessments related to the "Climate Target Plan" and the "Fit for 55" policy package, these assumptions have been updated based on a rigorous literature review carried out by external consultants in collaboration with the JRC[60].

Continuing the approach adopted in the long-term strategy in 2018, the Commission consulted on the technology assumption with stakeholders in 2019. In particular, the technology database of the main model suite (PRIMES, PRIMES-TREMOVE, GAINS, GLOBIOM, and CAPRI) benefited from a dedicated consultation workshop held on 11th November 2019. EU Member States representatives also had the opportunity to comment on the costs elements during a workshop held on 25th November 2019. The updated technology assumptions are published together with the EU Reference Scenario 2020.

8.4 **The existing 2030 framework: the EU Reference Scenario 2020**

8.4.1 The EU Reference Scenario 2020 as the common baseline

The EU Reference Scenario 2020 (REF2020) provides projections for energy demand and supply, as well as greenhouse gas emissions in all sectors of the European economy under the current EU and national policy framework. It embeds in particular the EU legislation in place to reach the 2030 climate target of at least 40% compared to 1990, as well as national contributions to reaching the EU 2030 energy targets on Energy efficiency and Renewables under the Governance of the Energy Union. It thus gives a detailed picture of where the EU economy and energy system in particular would stand in terms of GHG emission if the policy framework were not updated to enable reaching the

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[58] IEA, Global Energy Review 2020, June 2020
[59] IEA, Oil Market Report, June 2020 and US EIA, July 2020.
[60] JRC118275

revised 2030 climate target to at least -55% compared to 1990 proposed under the Climate Target Plan[61].

The Reference Scenario serves as the common baseline shared by all the initiatives of the "Fit for 55" policy package to assess options in their impact assessments:

- updating the Effort Sharing Regulation,
- updating the Emission Trading System,
- revision of the Renewables Energy Directive,
- revision of the Energy Efficiency Directive,
- revision of the Regulation setting CO_2 emission performance standards for cars and light commercial vehicles,
- review of the LULUCF EU rules.

8.4.2 Difference with the CTP "BSL" scenario

The REF2020 embeds some differences compared to the baseline used for the CTP impact assessment. While the technology assumptions (consulted in a workshop held on 11th November 2019) were not changed, the time between CTP publication and the publication of the "Fit for 55" package allowed updating some other important assumptions:

- GDP projections, population projections and fossil fuel prices were updated, in particular to take into account the impact of the COVID crisis through an alignment with the 2021 Ageing Report[62] and an update of international fossil fuel prices notably on the short run.
- While the CTP baseline aimed at reaching the current EU 2030 energy targets (on energy efficiency and renewable energy), the Reference Scenario 2020, used as the baseline for the "Fit for 55" package, further improved the representation of the National Energy Climate Plans (NECP). In particular it aims at reaching the national contributions to the EU energy targets, and not at respecting these EU targets themselves.

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[61] COM/2020/562 final

[62] The 2021 Ageing Report : Underlying assumptions and projection methodologies https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en

8.4.3 Reference scenario process

The REF2020 scenario has been prepared by the European Commission services and consultants from E3Modelling, IIASA and EuroCare, in coordination with Member States experts through the Reference Scenario Experts Group.

It benefitted from a stakeholders consultation (on technologies) and is aligned with other outlooks from Commission services, notably DG ECFIN's Ageing Report 2021 (see Section 8.3.1), as well as, to the extent possible, the 2020 edition of the EU Agricultural Outlook 2020-2030 published by DG AGRI in December 2020[63].

8.4.4 Policies in the Reference scenario

The REF2020 also takes into account the still-unfolding effects of the COVID-19 pandemic, to the extent possible at the time of the analysis. According to the GDP assumptions of the Ageing Report 2021, the pandemic is followed by an economic recovery resulting in moderately lower economic output in 2030 than pre-COVID estimates.

The scenario is based on existing policies adopted at national and EU level at the beginning of 2020. In particular, at EU level, the REF2020 takes into account the legislation adopted in the Clean Energy for All European Package[64]. At national level, the scenario takes into account the policies and specific targets, in particular in relation with renewable energy and energy efficiency, described in the final National Energy and Climate Plans (NECPs) submitted by Member States at the end of 2019/beginning of 2020.

The REF2020 models the policies already adopted, but not the target of net-zero emissions by 2050. As a result, there are no additional policies introduced driving decarbonisation after 2030. However, climate and energy policies are not rolled back after 2030 and several of the measures in place today continue to deliver emissions reduction in the long term. This is the case, for example, for products standards and building codes and the ETS Directive (progressive reduction of ETS allowances is set to continue after 2030).

Details on policies and measures represented in the REF2020 can be found in the dedicated "EU Reference Scenario 2020" publication.

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63 https://ec.europa.eu/info/news/eu-agricultural-outlook-2020-30-agri-food-sector-shown-resilience-still-covid-19-recovery-have-long-term-impacts-2020-dec-16_en

64 COM(2016) 860 final.

8.4.5 Reference Scenario 2020 key outputs

For 2030, the REF2020 scenario mirrors the main targets and projections submitted by Member States in their final NECPs. In particular, aggregated at the EU level, the REF2020 projects a 33.2% share of renewable energy in Gross Final Energy Consumption. Final energy consumption is 823 Mtoe, which is 29.6% below the 2007 PRIMES Baseline.

In the REF2020, GHG emissions from the EU in 2030 (including all domestic emissions & intra EU aviation and maritime) are 43.8% below the 1990 level. A carbon price of 30 EUR/tCO_2eq. in 2030 drives emissions reduction in the ETS sector. Table 4 shows a summary of the projections for 2030. A detailed description of the REF2020 can be found in a separate report published by the Commission[65].

Table 34: REF2020 summary energy and climate indicators

EU 2030	REF2020
GHG reductions (incl. Domestic emissions & intra EU aviation and maritime) vs 1990	-43.8%
RES share	33.2%
PEC energy savings	-32.7%
FEC energy savings	-29.6%
Environmental impacts	
GHG emissions reduction in current ETS sectors vs 2005	-48.2%
GHG emissions reduction in current non-ETS sectors vs 2005	-30.7%
Energy system impacts	
GIC (Mtoe)	1224.2
- Solid fossil fuels	9.3%
- Oil	31.9%
- Natural gas	22%
- Nuclear	11%

[65] See “EU Reference Scenario 2020” publication.

- Renewables	25.8%
Final Energy Demand (Mtoe)	822.6
RES share in heating & cooling	32.8%
RES share in electricity	58.5%
RES share in transport	21.2%
Economic and social impacts	
System costs (excl. auction payment) (average 2021-30) as % of GDP	10.9%
Investment expenditures (incl. transport) average annual (2021-30) vs (2011-20) (bn€)	285
EU ETS carbon price (€/ton, 2030)	30
Energy- expenditures (excl. transport) of households as % of total consumption	7.0%

Source: PRIMES model

The system costs (excluding ETS carbon-related payments) reaches close to 11% of the EU's GDP on average over 2021-2030. This cost[66] is calculated ex-post with a private sector perspective applying a flat 10% discount rate[67] over the simulation period up to 2050 to compute investment-related annualized expenditures.

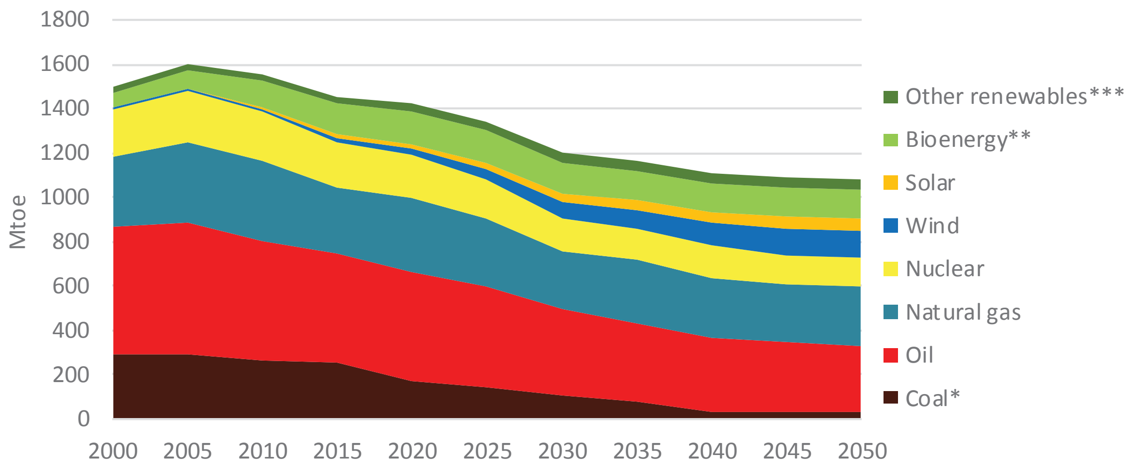
By 2050, final energy consumption is projected at around 790 Mtoe and approximately 74% of the European electricity is generated by renewable energy sources. GHG emissions in the EU are projected to be about 60% lower than in 1990: the REF2020 thus falls short of the European goal of climate neutrality by 2050.

[66] Energy system costs for the entire energy system include capital costs (for energy installations such as power plants and energy infrastructure, energy using equipment, appliances and energy related costs of transport), energy purchase costs (fuels + electricity + steam) and direct efficiency investment costs, the latter being also expenditures of capital nature. For transport, only the additional capital costs for energy purposes (additional capital costs for improving energy efficiency or for using alternative fuels, including alternative fuels infrastructure) are covered, but not other costs including the significant transport related infrastructure costs e.g. related to railways and roads. Direct efficiency investment costs include additional costs for house insulation, double/triple glazing, control systems, energy management and for efficiency enhancing changes in production processes not accounted for under energy capital and fuel/electricity purchase costs. Energy system costs are calculated ex-post after the model is solved.

[67] See the EU Reference Scenario 2020 publication for a further discussion on the roles and levels of discount rates in the modelling, which also represent risk and opportunity costs associated with investments.

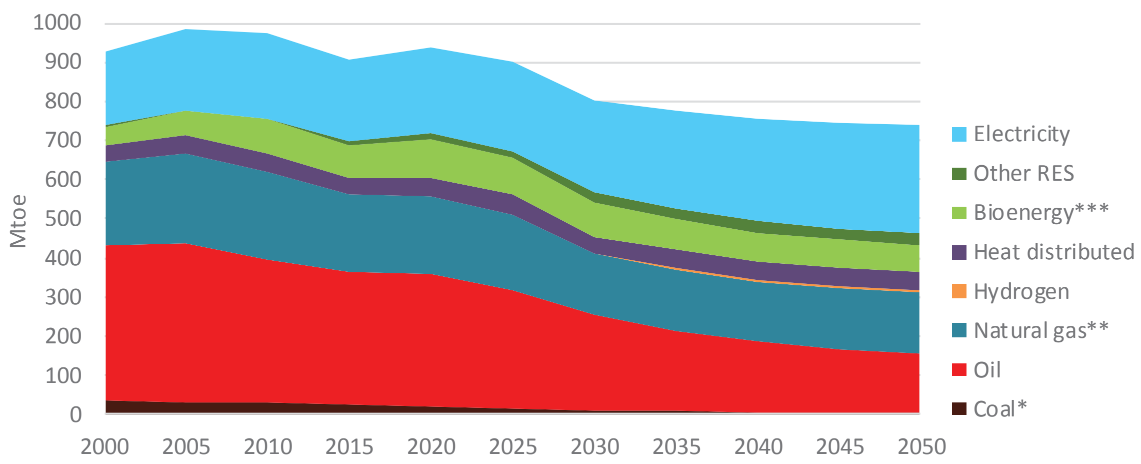
Focusing on the energy system, REF2020 shows that in 2030 fuel mix would still be dominated by fossil fuels. While the renewables grow and fossil fuels decline by 2050, the substitution is not sufficient for carbon neutrality. It also has to be noted that there is no deployment of e-fuels that are crucial for achievement of carbon neutrality as analysed in the Long Term Strategy[68] and in the CTP.

Figure 17: Fuel mix evolution of the Reference Scenario 2020



Source: Eurostat, PRIMES model

Figure 18: Share of energy carriers in final energy consumption in the Reference Scenario 2020



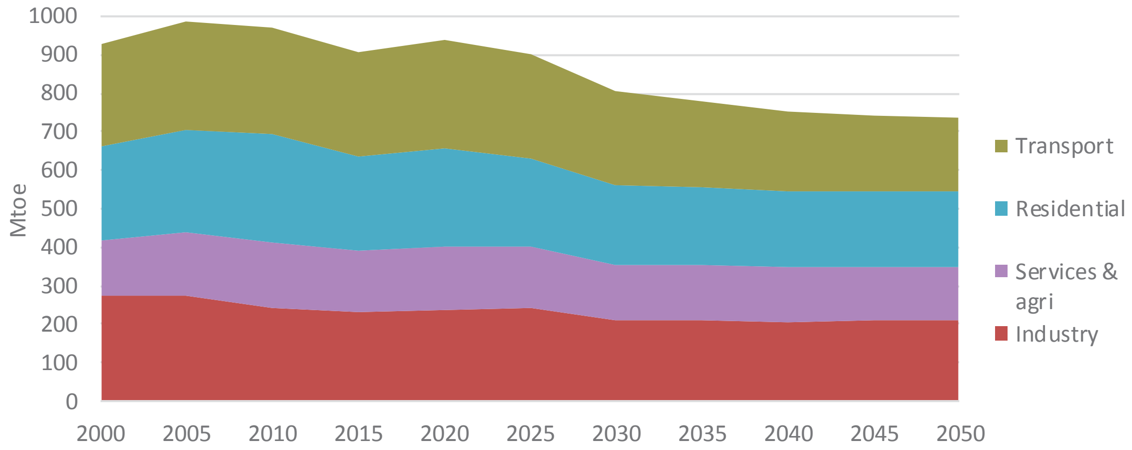
*Note: * includes peat and oil shale; ** includes manufactured gases, *** includes waste*

Source: Eurostat, PRIMES model

[68] COM(2018) 773

Coal use in power generation decrease by 62% by 2030 and almost completely disappear by 2050. Also demand for oil sees a significant decrease of 54% over the entire period – the most important in absolute terms. Electricity generation grows by 24% by 2050.

Figure 19: Final energy demand by sector in the Reference Scenario 2020



Source: Eurostat, PRIMES model

Despite continued economic growth, final energy demand decreases by 18% between 2015 and 2050 (already by 2030 it decreases by more than 8%).

8.5 Scenarios for the “Fit for 55” policy analysis

8.5.1 From the Climate Target Plan scenarios to “Fit for 55” core scenarios

In the Climate Target Plan (CTP) impact assessment, the increase of efforts needed for the GHG 55% target was illustrated by policy scenarios (developed with the same modelling suite as the scenarios done for the “Fit for 55” package) showing increased ambition (or stringency) of climate, energy and transport policies and, consequently, leading to a significant investment challenge.

The first key lesson from the CTP exercise was that while the tools are numerous and have a number of interactions (or even sometimes trade-offs) a **complete toolbox of climate, energy and transport policies is needed** for the increased climate target as all sectors would need to contribute effectively towards the GHG 55% target.

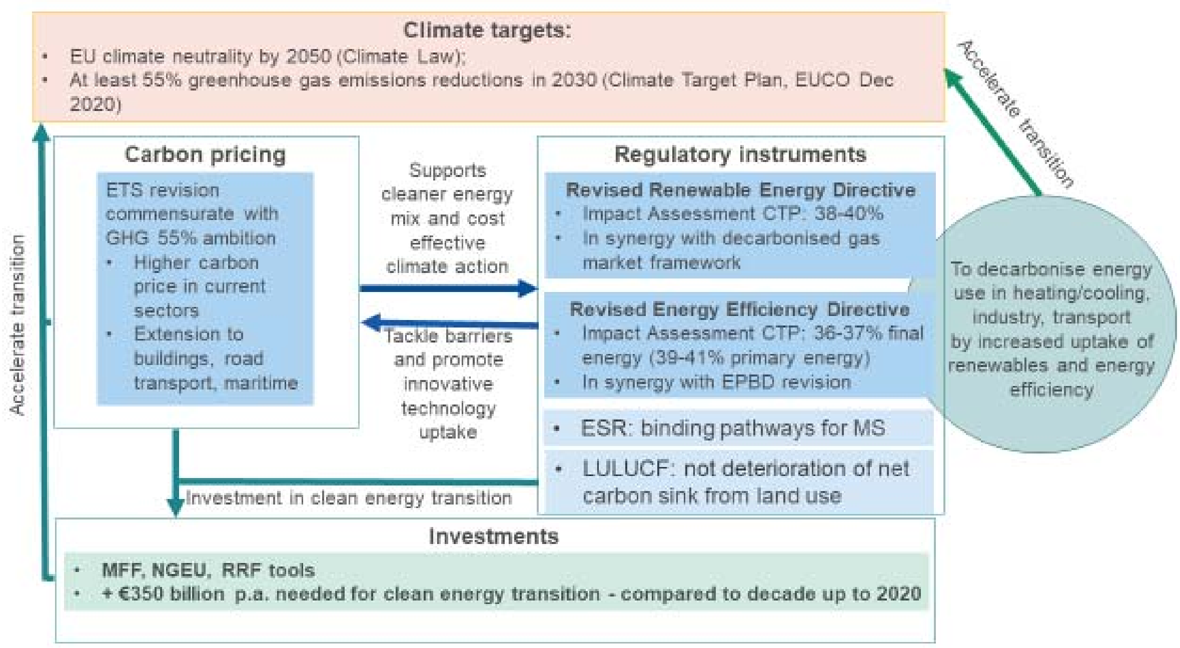
The second key lesson was that even though policy tools chosen in the CTP scenarios were different - illustrating in particular the fundamental interplay between the strength of the carbon pricing and intensity of regulatory measures - **the results achieved were convergent**. All CTP policy scenarios that achieved a 55% GHG target[69] showed very similar levels of ambition for energy efficiency, renewables (overall and on sectoral level) and GHG reductions across the sectors indicating also the cost-effective pathways.

The third lesson was that carbon pricing working hand in hand with regulatory measures helps avoid “extreme” scenarios of either:

- a very high carbon price (in absence of regulatory measures) that will translate into increased energy prices for all consumers,
- very ambitious policies that might be difficult to be implemented (e.g. very high energy savings or renewables obligations) because they would be costly for economic operators or represent very significant investment challenge.

The Figure 20 below illustrates the interactions between different policy tools relevant to reach the EU’s climate objectives.

Figure 20: Interactions between different policy tools



[69] A 50% GHG target was also analysed

With the 55% GHG target confirmed by EU leaders in the December 2020 EUCO Conclusions[70] and the 2021 Commission Work Programme[71] (CWP 2021) that puts forward the complete toolbox to achieve the increased climate target (so-called "Fit for 55" proposals), the fundamental set-up of the CTP analysis was confirmed. This set-up is still about the interplay between carbon pricing and regulatory measures as illustrated above, and the extension of the ETS is the central policy question.

As described above, the policy scenarios of the CTP assessment are cost-effective pathways that capture all policies needed to achieve the increased climate target of 55% GHG reductions. This fundamental design remains robust and the CTP scenarios were thus used as the basis to define the "Fit for 55" policy scenarios.

In the context of the agreed increased climate target of a net reduction of 55% GHG compared to 1990, the 50% GHG scenario (CTP MIX-50) explored in the CTP has been discarded since no longer relevant. The contribution of extra EU aviation and maritime emissions in the CTP ALLBNK scenario was assessed in the respective sector specific impact assessments and was not retained as a core scenario. This leaves the following CTP scenarios in need of further revisions and updates in the context of preparing input in a coherent manner for the set of IAs supporting the "Fit for 55" package, ensuring the achievement of the overall net 55% GHG reduction ambition with similar levels of renewable energy and energy efficiency deployment as in CTP:

- CTP REG (relying only on intensification of energy and transport policies in absence of carbon pricing beyond the current ETS sectors);
- CTP MIX (relying on both carbon price signal extension to road transport and buildings and intensification of energy and transport policies);
- CTP CPRICE (relying chiefly on carbon price signal extension, and more limited additional sectoral policies).

8.5.2 Scenarios for the "Fit for 55"package

Based on the Climate Target Plan analysis, some **updates were needed** though for the purpose of the "Fit for 55" assessment, in terms of:

- **Baseline**:
  - to reflect the most recent statistical data available, notably in terms of COVID impacts,

70 https://www.consilium.europa.eu/media/47328/1011-12-20-euco-conclusions-fr.pdf
71 COM(2020) 690 final

- to capture the objectives and policies put forward by Member States in the NECPs, which were not all available at the time of the CTP analysis,

The baseline used in the Fit for 55 package is thus the “Reference Scenario 2020”, as described in Section 8.4.

- **Scenario design** in order to align better with policy options as put forward in the CWP 2021 and respective Inception Impact Assessments[72].

As a consequence, the three following core policy scenarios were defined to serve as common policy package analysis across the various initiatives of the “Fit for 55” policy assessments:

- **REG**: an update of the CTP REG case (relying only on very strong intensification of energy and transport policies in absence of carbon pricing beyond the current ETS sectors).
- **MIX**: reflecting an update of the CTP MIX case (relying on both carbon price signal extension to road transport and buildings and strong intensification of energy and transport policies). With its uniform carbon price (as of 2025), it reflects either an extended and fully integrated EU ETS or an existing EU ETS and new ETS established for road transport and buildings with emission caps set in line with cost-effective contributions of the respective sectors.
- **MIX-CP**: representing a more carbon price driven policy mix, combining thus the general philosophy of the CTP CPRICE scenario with key drivers of the MIX scenario albeit at a lower intensity. It illustrates a revision of the EED and RED but limited to a lower intensification of current policies in addition to the carbon price signal applied to new sectors.
  Unlike MIX, this scenario allows to separate carbon price signals of “current” and “new” ETS. The relative split of ambition in GHG reductions between “current” ETS and “new ETS” remains, however, close in MIX-CP to the MIX scenario leading to differentiated carbon prices between “current” ETS and “new” ETS[73].

[72] Importantly, all “Fit for 55” core scenarios reflect the Commission Work Programme (CWP) 2021 in terms of elements foreseen. This is why assumptions are made about legislative proposals to be made later on - by Quarter 4 2021. On the energy side, the subsequent proposals are: the revision of the EPBD, the proposal for Decarbonised Gas Markets and the proposal for reducing methane emissions in the energy sector. For transport they refer to the revision of the TEN-T Regulation and the revision of the ITS Directive. In addition, other policies that are planned for 2022 are also represented in a stylised way in these scenarios, similar to the CTP scenarios. In this way, core scenarios represent all key policies needed to deliver the increased climate target.

[73] This is a feature not implemented in the CTP CPRICE scenario.

These three “Fit for 55” core policy scenarios have been produced starting from the Reference Scenario 2020 and thus use the same updated assumptions on post-COVID economics and international fuel prices.

Table 5 provides an overview of the policy assumptions retained in the three core policy scenarios. It refers in particular to different scopes of emissions trading system (“ETS”):

- “current+”: refers to the current ETS extended to cover also national and international intra-EU maritime emissions[74]: this scope applies to all scenarios,
- “new”: refers to the new ETS for buildings and road transport emissions: this scope applies in MIX and MIX-CP up to 2030,
- “large”: refers to the use of emissions trading systems covering the “current” scope ETS, intra-EU maritime, buildings and road transport (equivalent to “current+” + “new”): this scope applies in MIX and MIX-CP after 2030.

The scenarios included focus on emissions within the EU, including intra-EU navigation and intra-EU aviation emissions. The inclusion or not of extra-EU navigation and extra-EU maritime emissions is assessed in the relevant sector specific Impact Assessments..

[74] For modelling purposes “national maritime” is considered as equal to “domestic navigation”, i.e. also including inland navigation.

Table 35: Scenario assumptions description (scenarios produced with the PRIMES-GAINS-GLOBIOM modelling suite)

<table>
<tr><th>Scenario</th><th>REG</th><th>MIX</th><th>MIX-CP</th></tr>
<tr><td rowspan="3">Brief description: ETS</td><td rowspan="3">Extension of “current” ETS to also cover intra-EU maritime navigation[75]
Strengthening of “current+” ETS in line with -55% ambition</td><td colspan="2"><u>By 2030</u>: 2 ETS systems:
- one “current+” ETS (current extended to intra-EU maritime)
- one “new” ETS applied to buildings and road transport

<u>After 2030</u>: both systems are integrated into one “large” ETS</td></tr>
<tr><td rowspan="2">Relevant up to 2030: the 2 ETSs are designed so that they have the same carbon price, in line with -55% ambition</td><td>Relevant up to 2030: “current+” ETS reduces emissions comparably to MIX</td></tr>
<tr><td>Lower regulatory intervention resulting in higher carbon price than in MIX, notably in the “new” ETS</td></tr>
</table>

[75] “Intra-EU navigation” in this table includes both international intra-EU and national maritime. Due to modelling limitations, energy consumption by “national maritime” is assumed to be the same as “domestic navigation”, although the latter also includes inland navigation.

Scenario	REG	MIX	MIX-CP
Brief description: sectoral policies	High intensity increase of EE, RES, transport policies versus Reference	Medium intensity increase of EE, RES and transport policies versus Reference	Lower intensity increase of EE and RES policies versus Reference. Transport policies as in MIX (except related to CO_2 standards)
Target scope	EU27		
Aviation	Intra-EU aviation included, extra-EU excluded		
Maritime navigation	Intra-EU maritime included, extra-EU excluded		
Achieved GHG reduction of the target scope			
Including LULUCF	Around 55% reductions		
Excluding LULUCF	Around 53% reductions		
Assumed Policies			
Carbon pricing (stylised, for small industry, international aviation and maritime navigation may represent also other instruments than EU ETS such as taxation or CORSIA for aviation)			
Stationary ETS	Yes		
Aviation-Intra EU ETS	Yes		
Aviation - Extra EU ETS	Yes: mixture 50/50 carbon pricing (reflecting inclusion in the "current+" / "large" ETS, or taxation, or CORSIA) and carbon value (reflecting operational and technical measures); total equal to the carbon price of the "current+" (up to 2030) / "large" ETS		
Maritime-Intra EU ETS	Yes, carbon pricing equal to the price of the "current+" (up to 2030) / "large" EU ETS		

Scenario	REG	MIX	MIX-CP
Maritime-Extra EU ETS	As in MIX (but applied to the "current+" ETS)	Up to 2030: no carbon pricing. After 2030: 50% of extra-EU MRV[76] sees the "large" ETS price, while the remaining 50% sees a carbon value equal to the "large" ETS carbon price.	
Buildings and road transport ETS	No	Yes (in the "new" ETS up to 2030, and in the "large" ETS after 2030)	
CO_2 standards for LDVs and HDVs	CO_2 standards for LDVs and HDVs + Charging and refuelling infrastructure development (review of the Directive on alternative fuels infrastructure and TEN-T Regulation & funding), including strengthened role of buildings		
	High ambition increase	Medium ambition increase	Lower ambition increase
EE policies overall ambition	High ambition increase	Medium ambition increase	Lower ambition increase
EE policies in buildings	High intensity increase (more than doubling of renovation rates assumed)	Medium intensity increase (at least doubling of renovation rates assumed)	Lower intensity increase, no assumptions on renovation rates increases
EE policies in transport	High ambition increase	Medium intensity increase	As in MIX
RES policies overall ambition	High ambition increase	Medium intensity increase	Lower ambition increase except for transport (see below)

[76] 50% of all incoming and all outgoing extra-EU voyages

Scenario	REG	MIX	MIX-CP
RES policies in buildings + industry	Incentives for uptake of RES in heating and cooling	Incentives for uptake of RES in heating and cooling	No increase of intensity of policy (compared to Reference)
RES policies in transport and policies impacting transport fuels	Increase of intensity of policies to decarbonise the fuel mix (reflecting ReFuelEU aviation and FuelEU maritime initiatives). Origin of electricity for "e-fuels" under the aviation and shipping mandates: up to 2035 (inclusive) "e-fuels" (e-liquids, e-gas, hydrogen) are produced from renewable electricity, applying additionality principle. from 2040 onwards "e-fuels" are produced from "low carbon" electricity (i.e. nuclear and renewable origin). No application of additionality principle. CO_2 from biogenic sources or air capture.		
Taxation policies	Central option on energy content taxation of the ETD revision		
Additional non-CO_2 policies (represented by a carbon value)	Medium ambition increase		

8.5.3 Quantitative elements and key modelling drivers

Policies and measures are captured in the modelling analysis in different manners. Some are explicitely represented such as for instance improved product energy performance standards, fuel mandates or carbon pricing in an emission trading system. Others are represented by modelling drivers ("shadow values") used to achieve policy objectives.

The overall need for investment in new or retrofitted equipment depends on expected future demand and expected scrapping of installed equipment. The economic modelling of the competition among available investment options is based on:

- the investment cost, to which a "private" discount rate is applied to represent risk adverseness of the economic agents in the various sectors[77],
- fuel prices (including their carbon price component),
- maintenance costs as well as performance of installations over the potential lifetime of the installation,
- the relevant shadow values representing energy efficiency or renewable energy policies.

In particular, carbon pricing instruments impact economic decisions related to operation of existing equipment and to investment, in the different sectors where they apply. Table 36 shows the evolution of the ETS prices by 2030 in the Reference and core scenarios.

Table 36: ETS prices by 2030 in the difference scenarios (€2015/tCO_2)

Scenarios	Carbon price "current" ETS sectors		Carbon price "new" ETS sectors	
	2025	2030	2025	2030
REF2020	27	30	0	0
REG	31	42	0	0
MIX	35	48	35	48
MIX-CP	35	52	53	80

The investment decisions are also taken considering foresight of the future development of fuel prices, including future carbon values[78] post 2030. Investment decisions take into account expectations about climate and energy policy developments, and this carbon

[77] For more information on the roles and levels of discount rates applied per sector, see the EU Reference Scenario 2020 publication.

[78] Post 2030, carbon values should not be seen as a projected carbon price in emissions trading, but as a shadow value representing a range of policies to achieve climate neutrality that are as yet to be defined.

value achieves in 2050 levels between €360/tCO_2 (in REG, where energy policy drivers play comparatively a larger role) and €430/tCO_2 (MIX-CP)[79].

In complement to carbon pricing drivers, the modelling uses "shadow values" as drivers to reach energy policy objectives of policies and measures that represent yet to be defined policies in the respective fields: the so-called "energy efficiency value" and "renewable energy value", which impact investment decision-making in the model. These values are thus introduced to achieve a certain ambition on energy efficiency, for instance related to national energy efficiency targets and renewable energy targets in the NECPs as represented in the Reference Scenario 2020, or increased renovation rates in buildings and increased sector specific renewable energy ambition related to heating and cooling in the policy scenarios.

Table 37 shows average 2025-2035 values for the different scenarios. The values in REF2020 reflect the existing policy framework, to meet notably the national energy targets (both energy efficiency and renewable energy) as per the NECPs. They are typically higher in policy scenarios that are based on regulatory approaches than in scenarios that are more based on carbon pricing. The "energy efficiency value" and "renewable energy value" also interact with each other through incentivising investment in options which are both reducing energy demand and increasing the contribution of renewables, like heat pumps. This is for instance the case in the REG scenario, where the comparatively higher "energy efficiency value" complements the "renewable energy value" in contributing to the renewable energy performance of the scenario, notably through the highest heat pump penetration of all scenarios.

Table 37: Energy efficiency value and renewable energy value (averaged 2025-2035)

Scenarios	**Average renewables shadow value**	**Average energy efficiency shadow value**
	(€'15/ MWh)	(€'15/ toe)
REF2020	62	330
REG	121	1449
MIX	61	1052
MIX-CP	26	350

[79] The foresight and the discounting both influence the investment decisions. While in the modelling the discounting is actually applied to the investment to compute annualised fixed costs for the investment decision, its effect can be illustrated if applied to the future prices instead: for example, the average discounted carbon price in 2030 for the period 2030-2050 for renovation of houses and for heating equipment, applying a 12% discount rate, is €65 in the MIX scenario and €81 in the MIX CP scenario.

Specific measures for the transport system

Policies that aim at improving the efficiency of the transport system (corresponding to row "EE in Transport" in the Table 5), and thus reduce energy consumption and CO_2 emissions, are phased-in in scenarios that are differentiated in terms of level of ambition (low, medium, high ambition increase). All scenarios assume an intensification of such policies relative to the baseline. Among these policies, the CO_2 emission standards for vehicles are of particular importance. The existing standards[80], applicable from 2025 and from 2030, set binding targets for automotive manufacturers to reduce emissions and thus fuel consumption and are included in the Reference Scenario.

Medium ambition increase

In this case, the following policy measures are considered that drive improvements in transport system efficiency and support a shift towards more sustainable transport modes, and lead to energy savings and emissions reductions:

- Initiatives to increase and better manage the capacity of railways, inland waterways and short sea shipping, supported by the TEN-T infrastructure and CEF funding;
- Gradual internalisation of external costs ("smart" pricing);
- Incentives to improve the performance of air navigation service providers in terms of efficiency and to improve the utilisation of air traffic management capacity;
- Incentives to improve the functioning of the transport system: support to multimodal mobility and intermodal freight transport by rail, inland waterways and short sea shipping;
- Deployment of the necessary infrastructure, smart traffic management systems, transport digitalisation and fostering connected and automated mobility;
- Further actions on clean airports and ports to drive reductions in energy use and emissions;
- Measures to reduce emissions and air pollution in urban areas;
- Pricing measures such as in relation to energy taxation and infrastructure charging;
- Revision of roadworthiness checks;

[80] The existing legislation sets for newly registered passengers cars, an EU fleet-wide average emission target of 95 gCO_2/km from 2021, phased in from 2020. For newly registered vans, the EU fleet-wide average emission target is 147 gCO_2 /km from 2020 onward. Stricter EU fleet-wide CO_2 emission targets, start to apply from 2025 and from 2030. In particular emissions will have to reduce by 15% from 2025 for both cars and vans, and by 37.5% and 31% for cars and vans respectively from 2030, as compared to 2021. From 2025 on, also trucks manufacturers will have to meet CO_2 emission targets. In particular, the EU fleet-wide average CO_2 emissions of newly registered trucks will have to reduce by 15% by 2025 and 30% by 2030, compared to the average emissions in the reference period (1 July 2019–30 June 2020). For cars, vans and trucks, specific incentive systems are also set to incentivise the uptake of zero and low-emission vehicles.

- Other measures incentivising behavioural change;
- Medium intensification of the CO_2 emission standards for cars, vans, trucks and buses (as of 2030), supported by large scale roll-out of recharging and refuelling infrastructure. This corresponds to a reduction in 2030 compared to the 2021 target of around 50% for cars and around 40% for vans.

Low ambition increase

In this case, the same policy measures as in the *Medium ambition increase* are included. However, limited increase in ambition for CO_2 emission standards for vehicles (passenger cars, vans, trucks and buses) as of 2030 is assumed, supported by the roll-out of recharging and refuelling infrastructure. This corresponds to a reduction in 2030 compared to the 2021 target of around 40% for cars and around 35% for vans.

High ambition increase

Beyond measures foreseen in the medium ambition increase case, the high ambition increase case includes:

- Further measures related to intelligent transport systems, digitalisation, connectivity and automation of transport - supported by the TEN-T infrastructure;
- Additional measures to improve the efficiency of road freight transport;
- Incentives for low and zero emissions vehicles in vehicle taxation;
- Increasing the accepted load/length for road in case of zero-emission High Capacity Vehicles;
- Additional measures in urban areas to address climate change and air pollution;
- Higher intensification of the CO_2 emission standards for cars, vans, trucks and buses (as of 2030) as compared to the medium ambition increase case, leading to lower CO_2 emissions and fuel consumption and further incentivising the deployment of zero- and low-emission vehicles, supported by the large scale roll-out of recharging and refuelling infrastructure. This corresponds to a reduction in 2030 compared to the 2021 target of around 60% for cars and around 50% for vans.

Drivers of reduction in non-CO_2 GHG emissions

Non-CO_2 GHG emission reductions are driven by both the changes taking place in the energy system due to the energy and carbon pricing instruments, and further by the application of a carbon value that triggers further cost-effective mitigation potential (based on the GAINS modelling tool) in specific sectors such as waste, agriculture or industry.

Table 38: Carbon value applied to non-CO_2 emissions in the GAINS model (€2015/tCO_2)

Scenarios	**Non-CO_2 carbon values**	
	2025	2030
REF2020	0	0
REG	4	4
MIX	4	4
MIX-CP	5	10

8.5.4 Key results and comparison with Climate Target Plan scenarios

Table 39: Key results of the "Fit for 55" core scenarios analysis for the EU

2030 unless otherwise stated		REF	REG	MIX	MIX-CP
Key results					
GHG emissions* reductions (incl. intra EU aviation and maritime, incl. LULUCF)	% reduction from 1990	45%	55%	55%	55%
GHG emissions* reductions (incl. intra EU aviation and maritime, excl. LULUCF)	% reduction from 1990	43.4%	53.0%	52.9%	52.9%
Overall RES share	%	33%	40%	38%	38%
RES-E share	%	59%	65%	65%	65%
RES-H&C share	%	33%	41%	38%	36%
RES-T share	%	21%	29%	28%	27%
PEC energy savings	% reduction from 2007 Baseline	33%	39%	39%	38%
FEC energy savings	% reduction from 2007 Baseline	30%	37%	36%	35%
Environmental impacts					
CO_2 emissions reductions (intra-EU scope, excl. LULUCF), of which	(% change from 2015)	-30%	-43%	-42%	-42%
Supply side (incl. power generation, energy branch, refineries and district heating)	(% change from 2015)	-49%	-62%	-63%	-64%
Power generation	(% change from 2015)	-51%	-64%	-65%	-67%
Industry (incl. process emissions)	(% change from 2015)	-10%	-23%	-23%	-23%
Residential	(% change from 2015)	-32%	-56%	-54%	-50%
Services	(% change from 2015)	-36%	-53%	-52%	-48%
Agriculture (energy)	(% change from 2015)	-23%	-36%	-36%	-35%
Transport (incl. domestic and intra EU aviation and navigation)	(% change from 2015)	-17%	-22%	-21%	-21%
Non-CO_2 GHG emissions reductions (excl. LULUCF)	(% change from 2015)	-22%	-32%	-32%	-33%
Reduced air pollution vs. REF	(% change)			-10%	

Reduced health damages and air pollution control cost vs. REF - Low estimate	(€ billion/year)			24.8	
Reduced health damages and air pollution control cost vs. REF - High estimate	(€ billion/year)			42.7	
Energy system impacts					
Primary Energy Intensity	toe/M€'13	83	75	76	76
Gross Available Energy (GAE)	Mtoe	1,289	1,194	1,198	1,205
- Solids share	%	9%	6%	5%	5%
- Oil share	%	34%	33%	33%	33%
- Natural gas share	%	21%	20%	20%	21%
- Nuclear share	%	10%	11%	11%	11%
- Renewables share	%	26%	31%	30%	30%
- Bioenergy share	%	13%	13%	12%	12%
- Other Renewables share	%	13%	18%	18%	18%
Gross Electricity Generation	TWh	2,996	3,152	3,154	3,151
- Gas share	%	14%	12%	13%	14%
- Nuclear share	%	17%	16%	16%	16%
- Renewables share	%	59%	65%	65%	65%
Economic impacts					
Investment expenditures (excl. transport) (2021-30)	bn €'15/year	297	417	402	379
Investment expenditures (excl. transport) (2021-30)	% GDP	2.1%	3.0%	2.9%	2.7%
Additional investments to REF	*bn €'15/year*		*120*	*105*	*83*
Investment expenditures (incl. transport) (2021-30)	bn €'15/year	944	1068	1051	1028
Investment expenditures (incl. transport) (2021-30)	% GDP	6.8%	7.7%	7.6%	7.4%
Additional investments to REF	*bn €'15/year*		*124*	*107*	*84*
Additional investments to 2011-20	*bn €'15/year*	*285*	*408*	*392*	*368*
Energy system costs excl. carbon pricing and disutility (2021-30)	bn €'15/year	1518	1555	1550	1541
Energy system costs excl. carbon pricing and disutility (2021-30)	% GDP	10.9%	11.2%	11.15%	11.1%
Energy system costs incl. carbon pricing and disutility (2021-30)	bn €'15/year	1535	1598	1630	1647
Energy system costs incl. carbon pricing and disutility (2021-30)	% GDP	11.0%	11.5%	11.7%	11.8%
ETS price in current sectors (and maritime)	€/tCO_2	30	42	48	52
ETS price in new sectors (buildings and road transport)	€/tCO_2	0	0	48	80
Average Price of Electricity	€/MWh	158	156	156	157
Import dependency	%	54%	52%	53%	53%
Fossil fuels imports bill savings compared to REF (2021-30)	bn €'15		136	115	99

Energy-related expenditures in buildings (excl. disutility)	% of private consumption	6.9%	7.5%	7.5%	7.4%
Energy-related expenditures in transport (excl. disutility)	% of private consumption	18.1%	18.1%	18.3%	18.5%

*Note: *All scenarios achieve 55% net reductions in 2030 compared to 1990 for domestic EU emissions, assuming net LULUCF contributions of 255 Mt CO_2-eq. in 1990 and 225 Mt CO_2-eq. in 2030 and including national, intra-EU maritime and intra-EU aviation emissions[81].*

Source: PRIMES model, GAINS model

Table 40: Comparison with the CTP analysis

Results for 2030	CTP 55% GHG reductions scenarios range (REG, MIX, CPRICE, ALLBNK)	"Fit for 55" core scenarios range (REG, MIX, MIX-CP)
Overall net GHG reduction (w.r.t. 1990)*	55%	55%
Overall RES share	38-40%	38-40%
RES-E	64-67%	65%
RES-H&C	39-42%	36-41%
RES-T	22-26%	27-29%
FEC EE	36-37%	35-37%
PEC EE	39-41%	38-39%
CO_2 reduction on the supply side (w.r.t. 2015)	67-73%	62-64%
CO_2 reduction in residential sector (w.r.t. 2015)	61-65%	50-56%
CO_2 reduction in services sector (w.r.t. 2015)	54-61%	48-53%
CO_2 reduction in industry (w.r.t. 2015)	21-25%	23%

[81] Emissions estimates for 1990 are based on EU UNFCCC inventory data 2020, converted to IPCC AR5 Global Warming Potentials for notably methane and nitrous oxide. However, international intra-EU aviation and international intra-EU navigation are not separated in the UNFCCC data from the overall international bunker fuels emissions. Therefore, 1990 estimates for the intra-EU emissions of these sectors are based on (a combination of) data analysis for PRIMES modelling and 2018-2019 MRV data for the maritime sector.

CO_2 reduction in intra-EU transport (w.r.t. 2015)	16-18%	21-22%
CO_2 reduction in road transport (w.r.t. 2015)	19-21%	24-26%
Non-CO_2 GHG reductions (w.r.t. 2015, excl. LULUCF)	31-35%	32-33%
Investments magnitude, excluding transport (in bn€/per year)	401-438 bn/year	379-417 bn/per year
Energy system costs (excl. auction payments and disutility) as share of GDP (%, 2021-2030)	10.9-11.1%	11.1-11.2%

*Note: *All scenarios achieve 55% net reductions in 2030 compared to 1990 for domestic EU emissions, assuming net LULUCF contributions of 255 Mt CO_2-eq. in 1990 and 225 Mt CO_2-eq. in 2030 and including national, intra-EU maritime and intra-EU aviation emissions[60] (except the CTP ALLBNK that achieves 55% net reductions including also emissions from extra-EU maritime and aviation).*

Source: PRIMES model, GAINS model

8.6 Results per Member State

This analysis is completed by detailed modelling results at EU and MS level for the different core policy scenarios[82]:

- Energy, transport and overall GHG (PRIMES model)
- Details on non-CO_2 GHG emissions (GAINS model)
- LULUCF emissions (GLOBIOM model)
- Air pollution (GAINS model)

[82] See the "Technical Note on the Results of the "Fit for 55" core scenarios for the EU Member States".

9 SPECIFIC ANALYTICAL ELEMENTS FOR THIS IMPACT ASSESSMENT

9.1 Model used for MSR analysis

9.1.1 MSR model

The Vivid study[83] uses the Vivid EU ETS model, which builds on the modelling approach from Quemin and Trotignon (2019) that is calibrated to represent the average EU ETS compliance entity. The model considers the EU ETS as a competitive market where firms can bank emissions allowances. The model is dynamic as the number of banked allowances from a given year will affect the total supply of allowances in the subsequent year. Firms are required to surrender allowances for compliance each year that match their emissions and bank any remaining allowances that they hold across years. Since a decentralized competitive market equilibrium can be characterized indirectly as the solution to joint cost minimization among all firms (e.g. Montgomery, 1972; Rubin, 1996), the model uses a representative firm approach which is well-documented and widely employed in the literature (e.g. Fell et al., 2012; Kollenberg & Taschini, 2019). Solving the model would return a series of equilibrium prices, banking, and emissions within the EU ETS scope on an annual basis.

The representative firm in the model minimises its abatement cost with rolling horizons and limited foresight. In the model, the firm faces the problem of choosing emissions and abatement over a given time horizon. The firm takes into account its baseline emissions forecast and supply of allowances for the next 10 years.[84] Baseline emissions in this model is a theorical construct to represent the emissions in absence of a carbon price. The supply of allowances is determined by the EU ETS cap and augmented by MSR dynamics. The difference between the baseline emissions and the supply of allowances over this time horizon determines the total abatement required from the firm, thus entering its optimisation problem as a budget constraint. The firm minimises the net present value of abatement costs over these X years given this budget constraint and a given interest rate.[85] Limited foresight of the firm means that its forecast of baseline emissions may deviate from the actual baseline emissions. Shocks to the system will affect the firm's expectations and therefore its optimal choice of emissions and

[83] Vivid Economics (2021) – « Review of the EU ETS Market Stability Reserve », study commissioned by the European Commission, unpublished.

[84] More precisely, the firm decides on emissions in year t after making forecasts of up to year t+9.

[85] In addition, there is a borrowing constraint in which the firm can only borrow allowances up to the number of free allocations in the subsequent year. However, this constraint is not binding over the time period in 2020-2030.

abatement. Finally, equilibrium prices are calculated by mapping the firm's abatement to a marginal abatement cost curve.

More specifically, the firm solves for the following constrained optimisation problem in each year. Given a forward-looking horizon h, the firm in year-t selects year-t emissions e_t and bank the remaining allowances b_t by solving:

$$\min_{\{e_\tau\}_{\tau=t}^{t+h}} \sum_{\tau=t}^{t+h} \beta^{\tau-t} C_\tau(\hat{u}_\tau^t - e_\tau)$$

$$\text{subject to} \quad 0 \leq e_\tau \leq \hat{u}_\tau^t, \quad \text{and} \quad b_\tau = b_{\tau-1} + \hat{f}_\tau^t + \hat{a}_\tau^t + \hat{o}_\tau^t - e_\tau \geq -\hat{f}_{\tau+1}^t$$

Where $\hat{f}_\tau^t, \hat{a}_\tau^t, \hat{o}_\tau^t, \hat{u}_\tau^t$ denotes the firm's year-t forecast of free allocations, auctions, offsets, and baseline emissions for year $\tau \geq t$. The objective function specifies that the firm seeks to minimise the net present value of its abatement costs over the time horizon from year τ to year $\tau + h$. Annual abatement cost $C_\tau(u_\tau^t - e_\tau)$ is a function of abatement, defined as the difference between baseline emissions u_τ^t and actual emissions e_τ. In the model, marginal abatement costs are assumed to be linear in the level of abatement. The discount factor β is derived from the interest rate, $\beta = \frac{1}{1+r}$. The firm faces two constraints in its optimisation problem. First, it must choose an emissions level that is less than or equal to its baseline emissions. Second, the number of banked allowances in a given year b_τ equals the number of unused allowances from the annual supply facing the firm $(b_{\tau-1} + \hat{f}_\tau^t + \hat{a}_\tau^t + \hat{o}_\tau^t - e_\tau)$. Borrowing (i.e. negative banking) is limited to the number of free allocations in the subsequent year, $\hat{f}_{\tau+1}^t$. This mimics the fact that firms within the EU ETS can tap into free allocations distributed in the first quarter in a given year to meet liabilities for the previous year.

The model is the best-in-class representation of the MSR available in the literature. This includes explicit representation of MSR intakes, releases, corresponding thresholds, the invalidation mechanism, and the calculation of TNAC on an annual basis. In particular, the model captures the fact that the TNAC for a given year is reported in May in the subsequent year, then affecting auction volumes from September to August. Given the rules-based nature of the MSR, some other models in the literature estimate the TNAC simply by taking an exogenous emissions pathway as given. However, the advantage of optimisation models such as the one used in this assessment is that the emissions pathway is endogenous to the given policy design. In other words, changes in policy parameters will affect the perceived scarcity of emissions allowances and therefore the firm's behaviour on emissions and abatement. For instance, a higher MSR intake rate should represent a tightening of future allowance supply and therefore reduce emissions today and increase TNAC. The model used in this assessment, adapted from Quemin and Trotignon (2019), is able to model this while capturing realistic aspects of firm behaviour – limited foresight and rolling horizons, as noted above. These aspects of firm behaviour are taken from the latest academic literature and provides an additional perspective to explore the impact of the MSR.

Despite its advantages, there are limitations to the model as it abstracts from some important characteristics of the EU ETS. The modelling outputs are not intended to be used as forecasts for prices and emissions. However, when combined with qualitative and quantitative insights, it can provide useful indications of the direction and size of impact. The key limitations of the model in the context of this study are as follows:

- It draws on a simplified Marginal Abatement Cost Curve (MACC**).** In the model, the firm chooses emissions and abatement by optimising intertemporal abatement cost. Crucial to this optimisation problem is the shape of the MACC, including its steepness and concavity. While this is calibrated to yield plausible modelling results, the MACC parameters used for the optimisation are not flexible enough to mirror MACCs from bottom-up industry research. This also means that the equilibrium price as described by the model may be inaccurate, particularly when the slope of the actual MACC may increase at higher levels of abatement.
- The level of abatement and emissions depend critically on the assumed baseline emissions. Baseline emissions represent the level of emissions without a carbon price, but incorporating announced policies within covered sectors, such as energy efficiency measures and regulated coal phase out. Modelling results are sensitive to both the level and shape of baseline emissions over time because it determines the total level of abatement required from the firm.
- Calibration of model parameters for the future EU ETS scope is imperfect. The calibration of the model involves estimating the appropriate interest rate, length of forward-looking horizon, MACC, and baseline emissions. However, the UK exit from the EU ETS in 2021, the fungibility of aviation allowances in Phase IV, and the likely extension to maritime navigation all meant that parameters calibrated from historical data are not necessarily accurate for the future scope of the EU ETS. Furthermore, firm behaviour might change going forward with reductions in free allowances, forcing industrial companies to hedge more.
- It does not model endogenous demand for allowances from non-compliance entities. The model is designed to investigate the behaviour of a representative firm that faces the costly behaviour of abatement under a limited supply of emissions allowances. Other holders of allowances, such as financial entities or national governments, are not modelled endogenously. The model is therefore unable to analyse how policy choices may induce speculative demand for allowances.
- There is no endogenous technological progress. Investments in abatement technology will generally lower future emissions and abatement costs. However, conditional on the level of banked allowances brought over from the previous year, modelling outputs in a given year is independent of emissions or abatement in previous years.

It should be noted that this model is fundamentally different from energy system models and their results are not directly comparable. As opposed to optimising energy system costs, this model abstracts from the different technological conditions for various sectors and focus on the interaction between MSR dynamics and market equilibrium within the EU ETS. From a policy perspective, increases in climate ambition within the EU is represented as either a tightening of the EU ETS cap or changes in the baseline emissions. This allows the analysis to be more tractable, enabling a clear channel for MSR options to interact with and affect market outcomes in terms of emissions, banking, and prices.

9.1.2 Reparameterisation of model

To better handle the requirements of this review, process the parameters have been updated from the model in Quemin and Trotignon (2019). This is both to reflect the change of scope of the EU ETS and to include more granular emissions projections in constructing the baseline emissions pathway. The updated parameters reflect more realistic firm behaviour and abatement cost functions to give a better sense of the magnitude of effect on price and emissions from the policy scenarios we analyse. Below is a summary of the main adjustments to the model.

9.1.2.1 Baseline emissions

Baseline emissions has been adjusted to account for COVID-19, the coal phase-out as well as more granular emissions trends from the EU commission's 'with existing measures' scenario. As baseline emissions are to represent the emissions of entities covered by EU ETS in absence of EU ETS, the parameterisation has been updated to according with the premise that changes to the baseline that already has been planned or that are already realised should be included. Some changes that are of a more uncertain nature will be modelled as shocks (discussed further below). The adjustments to baseline emissions include:

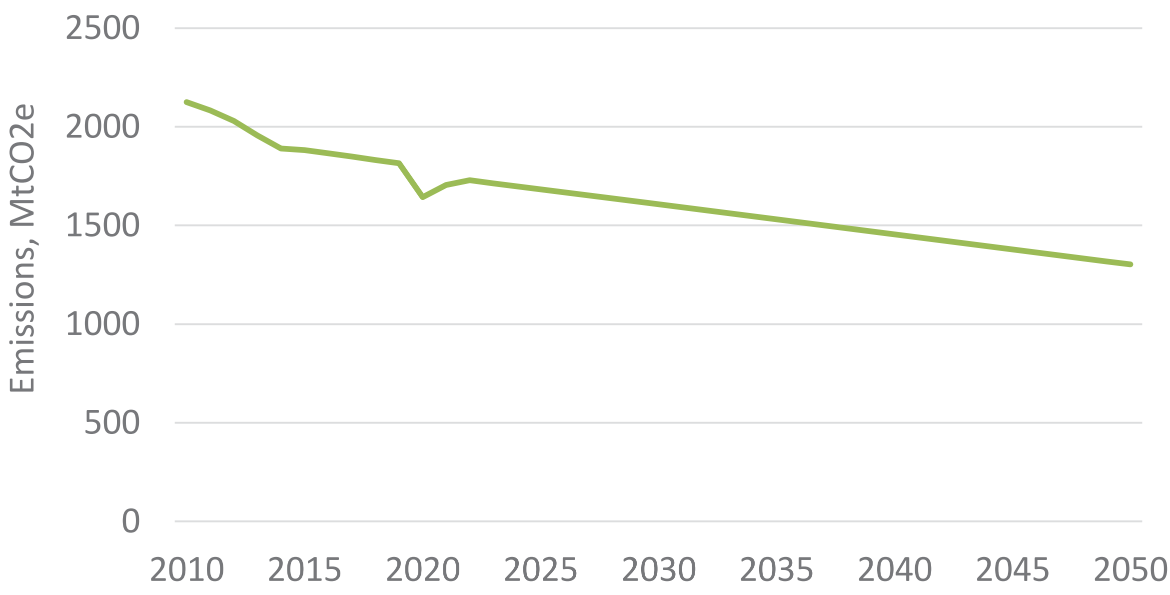
- The COVID-19 pandemic has already had a significant impact on the realised emissions in 2020, so these estimated impacts are included in the baseline. To model the magnitude of the effect on baseline emissions the updated model draws on data from the Price-Induced Market Equilibrium System (PRIMES) energy model. The gives the size of the effect in 2020 (a reduction of about 155 $MtCO_2e$), to include the potentially lasting effect of the pandemic the model assumes that the effect of the pandemic will half in 2021, further half in 2022 and then remain at this level through at the modelled period.
- The baseline is adapted for the already planned phasing-out coal-fired power-plants. This will shift the demand for allowances downwards – estimates from Carbon Market Watch gives estimates of the size of this downwards shift. However, for these estimates, Carbon Market Watch assumes that all the coal-fired plants that are closed will be replaced with renewable energy sources. As at

least some of the phased-out coal is likely to be replaced with gas or other fossil fuels. Thus, the baseline scenario assumes that only half of the effect of the coal phase out will make its way to baseline emissions.

- Baseline emissions are adjusted to reflect the effects of policies other than EU ETS. The baseline has been updated with more granular emissions projections. For this the year-on-year trend from the EU Commission's 'with existing measures scenario' was used.

The baseline emissions trajectory is shown in Figure 16 below.

Figure 21: Baseline emissions estimates for covered sectors under the central policy scenario



Source: Vivid Economics

9.1.2.2 MACC

To reflect the changing cost of abatement more accurately the constant MACC parameter has been replaced with a time-variant one. In the specification of the original model, the abatement of 1 tonne of carbon is assumed to have uniform cost regardless of the level of baseline emissions, this is a simplifying assumption that was made to facilitate the computation of the firm's optimization and the male interpretation of the results more straight-forward. However, an assessment of the literature and of existing MACCs shows that marginal costs tend to increase over time as low-cost abatement options are used up. This means that in later periods the abatement in absolute terms should be more expensive. As a starting point, a plausible assumption is that the in-percentage terms abatement cost is constant (this would mean that abating x% of your baseline emissions would always have the same cost). But in addition to the marginal cost increase it is likely that abatement technology will gradually improve as time goes by, thus the updated model uses a parametrisation that constitutes a compromise between the two extremes (one being that abatement cost is exactly proportional the other one being that it is constant).

9.1.2.3 Interest rate and anticipation period

The model includes an increased interest rate and shortened the planning horizons for the firm. As opposed to the assumed interest rate of 3% in the original model, there as evidence that real firms use interest rate much higher than this. Because of this, the model uses an increased interest rate or 8%. This is also aligned with the assumptions in the PRIMES energy model. Further to this, the firms planning horizon has been slightly shortened from 12 to 10 years. This is because the firm displayed unrealistically forward-looking behaviour. In particulars in terms of high levels of banking.

9.1.2.4 **Growth rates**

The firm's growth rate projections have been lowered to better align with the growth rate of the industries covered by the EU ETS. The original model assumes a 2% real GDP growth rate, while this might be a plausible forecast for the economy, the sectors covered by EU ETS have historically displayed a lower growth rate, as such this is adjusted to 1%.

9.1.2.5 **Adjustments to EU ETS scope**

The model has been further adapted to examine the sectoral and country coverage most relevant to the EU ETS in the near term. This represents three main departures from the original calibration from Quemin and Trotignon (2019).

1. UK exit of the EU ETS
2. Domestic and intra-EEA aviation participating in the EU ETS
3. Domestic and intra-EEA maritime navigation assumed to participate in the EU ETS

Due to the nature of the model, it cannot accommodate scope changes in the EU ETS that occur in the *middle* of the time horizon. This is because the exit or entry of market participants represent a fundamental change to the size and behaviour of the representative firm, complicating the firm’s intertemporal optimisation process.

Throughout this impact assessment, we implement the model by treating all three scope changes as present from the beginning of time. In other words, the model simulates EU ETS emissions, banking and price paths as if the UK has never been part of the system, and that domestic and intra-EEA aviation and maritime navigation has always been part of the system, which begins in 2008 in the model. As a result, the modelling results presented for 2008-2020 are *not directly comparable* with historical figures.

The three scope changes imply adjustments to the level of the cap (and the absolute reduction represented by the LRF) as well as baseline emissions. First in terms of the cap, the historical EU ETS cap for stationary installations and aviation serves as an anchor from 2008 to 2020, in which the aviation cap was extended backwards from 2012 to 2008. Then, the UK share of the cap was removed. A hypothetical cap was constructed for maritime navigation (for the specified MRV scope) using 2005 historical emissions from the PRIMES model and assumed constant throughout 2008 to 2020. The model sums up the cap for stationary installations, aviation and maritime without distinguishing them further. From 2021 onwards, a common LRF is applied across the sectors. As for the baseline emissions, the original baseline emissions series for EU ETS stationary installations from Quemin and Trotignon were augmented by removing the UK component. Next, baseline emissions for aviation and maritime navigation for 2005 and 2010 were obtained from the reference case in PRIMES and then extrapolated into the future using IEA's reference technology scenario. The sum of baseline emissions for stationary installations, aviation and maritime navigation then results in the baseline emissions for the representative firm in this model.

9.1.3 Quantification of magnitude and direction of shocks

The shocks analysed have been quantified using readily available data and analyst judgement of plausible risks to the EU ETS. To ensure shock analysis is representative of risks faced by the EU ETS, we have quantified the shocks within each identified potential stress test based on the largest likely risk. Determining likelihood of different shocks has been informed through literature review and interviews with industry and market experts, while quantification has been informed by estimates from published analysis and internal calculations.

9.1.4 Guidance on interpreting modelling results

Key assumptions to keep in mind while interpreting the modelling results include:

- Imperfect foresight with a 10-year forward looking horizon: the market is assumed to forecast the (MSR-adjusted) supply of allowances and baseline emissions for the next 10 years. This means, for instance, that an anticipated tightening of the cap between 2024-2030 can influence emissions and banking patterns in 2021. If post-2030 cap trajectories differ, the model would show different pre-2030 emissions, banking, and prices. Therefore, the comparisons of different 2024-2030 cap trajectories have been aligned post-2030 to a common LRF of 5.04% like in AMB2a.

- The model should not be used directly to estimate future carbon prices. The modelling outputs are not intended to be used as forecasts for prices and emissions. However, when combined with qualitative and quantitative insights, it can provide useful indications of the direction and size of impact.

- Price acts as an indicator of the scarcity of future supply of allowances: with the forward looking behaviour described above, prices respond more to the tightness of supply relative to demand in the medium/long term instead of the short term. As such, temporary shocks limited to a given year has limited impact on modelling results. Meanwhile, changes in overall EU ETS policy ambition can significantly affect the price path.

- The presence of an MSR tightens future auction supply, increasing abatement and prices: while different MSR designs vary in the timing and size of intakes, they all significantly reduce the supply of allowances as given from the cap.

- Modelling at an annual resolution does not examine short term volatility: the model is not designed to investigate short term shocks or changes to the system.

- Results are not comparable to energy system models due to fundamentally different approaches to modelling.

9.1.4.1 **The regulated phase out of coal power**

The regulated phase out of coal power represents a significant potential source of excess EUAs and reduction in EUA demand. We have used estimates from Carbon Market Watch to estimate the size of this downwards shift. However, we have estimated that around half of the emissions reduction associated with the coal phase will make its way into baseline emissions, with the additional reduction included as potential shocks.

The estimated magnitude of the EU coal phase out is used to inform**:**

- The anticipated reduction in EUA demand. The coal phase out is expected to reduce EUA demand by up to 277 m by 2030. As half of this reduction is built into baseline emissions, the shock size used for an anticipated reduction in EUA demand increases from 27 m in 2021 to reach 138.5 m by 2030. This is expected to be larger than other sources of anticipated reduction in EUA demand seemed likely, such as other policy measures or significant progress in industrial abatement technologies.

- The induced holdings shock**.** The coal phase out is expected to be the largest source of potential induced holdings. The shock used assumes that the EUAs associated with Germany’s coal phase out commitments between 2021 and 2025 are held, without cancellation. This leads to around 630 m allowances being held by non-compliance entities from 2025, driving up TNAC and prices in the ETS. However, there are various potential sources of induced holdings, for instance long term investors may benefit from holding a large share of available allowances or environmental NGOs may choose to hold allowances as a means of driving additional climate action.

9.1.4.2 **The impact of COVID-19 on emissions**

The COVID-19 shock represented the largest shock to economic and environmental outcomes in recent years. To estimate the magnitude of the shock, we have analysed 2020 estimates of emissions in covered sectors under scenarios with and without the COVID impact, taken from the EU's Price-Induced Market Equilibrium System (PRIMES) energy modelling. The gives an estimate of the size of the effect of about 155 $MtCO_2e$ in 2020.

The estimate magnitude of the COVID-19 shock is used to inform:

Baseline emissions trajectory. COVID-19 has resulted in a significant downturn in economic activity and emissions since the start of the pandemic in 2020. It is unclear whether this shock is temporary or will have a long-lasting impact on emissions. We assume that the shock reduces baseline emissions by 155 $MtCO_2e$ in 2020, 78 $MtCO_2e$ in 2021 and 39 $MtCO_2e$ from 2022 onwards, signifying some level of persistence in the emissions reductions associated with the shock.

Unexpected increases or decreases in EU allowance demand. As a historically unprecedented shock, this represents a large tail risk to EUA demand. This is expected to be larger than other short-term impacts on emissions, such as changes in abatement costs due to technological progress or a shift in nuclear usage. The 155 Mt emissions impact is used to estimate both an increase and a decrease in EUA demand, before returning to previous emissions levels to analyse the performance of the MSR under a temporary shock.

9.1.4.3 Limitations of the approach

Modelling the MSR is a challenging exercise, and there is limited literature pertaining to its operation that is of sufficient detail to provide confidence in projecting its operation under different policies designs and market circumstances. The model utilized is the best available for considering the parameterisation of the MSR, based on an extensive review of the literature available. Nonetheless it has several limitations that mean that its results must be interpreted with care. For instance, the model uses a relatively simple representation of abatement costs, results are contingent on assumptions around emissions in a counterfactual scenario without a carbon price, and it is unable to depict heterogeneous firm behaviour. While these are standard assumptions in modelling secondary markets, it is still important to focus on relative results rather than absolute values when interpreting results.

The appropriate parameters for the MSR remain a function of the behaviour of participants in the EU allowance market, which may change over this period. To support the robust functioning of the MSR in the case of unexpected events or changes in the policy context, the IA also considers a range of scenarios for future exogenous market shocks, induced imbalances that could be exacerbated by the MSR design, and policy changes that could affect its operation. However, the sensitivity of the MSR's operation to these changing circumstances may mean that future reviews of its operation are needed to ensure it remains fit for purpose.

There remains uncertainty regarding several aspects of market response that would are relevant for MSR design. For instance, the likely hedging behaviour of market participants, and its implications for the setting of thresholds remains uncertain. Hedging behaviour has changed over time in response to the decarbonisation of the electricity sector, the recent increase in prices in the EU ETS, and the evolution of net holding positions of industrial installations. Significant uncertainty also remains regarding potential policy changes that could change the composition of participants in the EU ETS and their responses to market signals. For instance, the expansion of the EU ETS to new sectors will bring new participants into the market and while educated assumptions regarding their likely hedging demand is possible, they remain uncertain. Similarly, the potential removal of free allocations from certain industrial sectors is also likely to change the behaviour of facilities and companies operating in these sectors, with likely increased hedging, the scale of which is difficult to predict.

9.2 **Models used for carbon leakage analysis**

9.2.1 Calculation of free allocation

To model the availability of free allowances in Phase 4 of the EU ETS, the following two-step approach was used:

1) Calculation of preliminary free allocation: The allocation of free allowances to individual installations was estimated based on the free allocation formula that takes into account the benchmark, the historic activity level and the carbon leakage exposure factor (CLEF) (see Annex 9).
2) Calculation of final free allocation: The preliminary free allocation was then compared with the total amount available for free allocation. This amount is determined by the ETS cap trajectory, the mandatory auction share and the amount earmarked for the innovation fund. If the preliminary free allocation exceeded the total amount available for free allocation in a given year, then a cross-sectoral correction factor (CSCF) was applied (see Annex 9).

The scope of the estimation of free allocation in phase 4 includes all ETS countries (i.e. EU-27 and EEA, excluding the United Kingdom).

The free allocation of allowances for phase 4 was modelled based on a 'bottom-up' approach using data from the preliminary national implementation measures (NIMs) at sub-installation level. These data had been submitted to the Commission by the competent authorities in the ETS countries by 30 September 2019.

Furthermore, a number of assumptions were made for the modelling:

- For the period from 2021 to 2025, the updated benchmark values from Commission Implementing Regulation (EU) 2021/447 were used.
  For the period from 2026 to 2030, the benchmark values were estimated using the same annual update rates that were used to determine the revised benchmark values for the period from 2021 to 2025. For example, annual update rates of 0.2%, 0.9% and 1.6% thus meant that the benchmark values for the period from 2026 to 2030 would decrease by 4%, 18% and 32%, respectively, compared to the benchmark values used in phase 3. The latter values reflect the 20-year period between 2007/2008, the reference year for the benchmarks used in phase 3, and 2027/2028. Therefore, the model assumed a continued improvement in the performance of the best installations.

- The free allocation for process emissions not covered by product benchmarks was set at 0.97 EUAs/t CO_2 equivalents.

- The activity levels were estimated based on the reported average levels for 2017 and 2018 which were then extrapolated year by year using annual average growth rates at NACE 4-digit sector. The annual average growth rates were calculated from activity level data given in thousand tonnes obtained from PRIMES modelling (MIX scenario with -55% overall ambition level). PRIMES data for the years 2015, 2020, 2025 were used to calculate a weighted average growth rate for the period from 2019 to 2025. The calculated rates took into consideration the 2020 drop in activity levels due to the COVID-19 crisis. PRIMES data for 2026 and 2030 were used to calculate an average annual growth rate for the period from 2026 to 2030. As a consequence of the averaging, activity levels for the year 2020 are largely overestimated while the activity levels of all other year are slightly underestimated. These two effects compensate each other.
  For district heating, the projected changes in emissions calculated from PRIMES data were taken as a proxy for the yearly changes in activity levels. For refineries, no activity level data were obtained from PRIMES modelling. For this sector, a constant production was assumed. Finally, PRIMES activity categories were matched to NACE categories. The assumed annual growth rates are given in Table 36.

Table 41: Assumed annual average growth rates for the modelling of free allocation

Sector	Subsector	NACE codes	Assumed annual average growth rates	
			2019 – 2025	**2026 – 2030**
Cement	—	23.51	0.44%	1.04%
Lime	—	23.52	0.36%	1.09%
Refineries	—	19.20	0.00%	0.00%
Iron and steel	—	24.10	-0.35%	0.37%
Fertilisers	—	20.15	0.13%	1.50%
Ceramics	—	23.31	0.73%	1.54%
Non-ferrous metals	Precious metals and others	24.41, 24.45	0.80%	0.51%
	Aluminium	24.42	1.00%	0.55%
	Lead, zinc and tin	24.43	0.47%	0.21%
	Copper	24.44	0.09%	0.35%
Chemicals	Industrial gases, other inorganic basic chemicals, other organic basic chemicals	20.11, 20.13, 20.14	0.13%	1.50%
	Dyes and pigments, plastics in primary forms, synthetic rubber in primary form	20.12, 20.16, 20.17	2.08%	0.86%
Pulp and paper	Pulp	17.11	-0.15%	1.26%
	Paper	17.12	0.41%	1.18%
Glass	—	23.11, 23.12, 23.13, 23.14, 23.19	-0.11%	0.83%
Other industry	—	Various	1.10%	1.51%
District heating	—	35.30	-2.99%	-12.7%

Source: Calculations based on PRIMES activity data.

- Following Regulation (EU) 2019/1842, the historic activity level of an installation for the purposes of free allocation was adjusted when the rolling average of the activity levels of two consecutive years differed by more than 15% compared to the historical activity level of the period 2014 to 2018. The implementation of this rule adjusted the preliminary allocation within the modelling for some installations in the period from 2021 to 2025 allocation. This resulted in an overall increase in preliminary allocation to reflect an increase in production over the time period compared to the historical activity level in the period from 2014 to 2018. However, there was no adjustment of the preliminary allocation in the period from 2026 to 2030 for any installation, as the updated historical activity level for the period from 2019 to 2023 was estimated based on the annual growth rates from PRIMES that did not exceed 2%.

- For product benchmarks that include an adjustment for the exchangeability of fuels and electricity, a factor was derived from the NIMs dataset for the period 2014 to 2018. This factor represents the weighted average ratio of direct to total emissions (weighting by activity level) (Table 33).

Table 42: Factors used for the adjustment of the exchangeability of fuel and electricity for the modelling of free allocation

Product benchmark	Factors for the adjustment of the exchangeability of fuel and electricity
Refinery products	0.897
EAF carbon steel	0.248
EAF high alloy steel	0.303
Iron casting	0.881
Mineral wool	0.726
Plasterboard	0.98
Carbon black	0.971
Ammonia	0.963
Steam cracking	0.933
Aromatics	0.878
Styrene	0.935
Ethylene oxide / ethylene glycol	0.821
Hydrogen	0.957
Synthesis gas (syngas)	0.844

Source: Calculations based on NIMs data.

9.2.2 Calculation of projected emissions

The amounts of preliminary and final free allocation of the different sectors were then compared to the projected emissions.

Some corrections to the assignment of verified emissions to sectors were made so that free allocation and emissions were comparable with one another. This was necessary as emissions may be underestimated when related GHGs are emitted in other ETS sectors. The corrections concerned the following:

- All sectors: Electricity and heat transfers
  Free allocation based on product benchmark refers to the product produced. No free allocation is granted to electricity generation. Therefore, emissions related to electricity produced within the installation were deducted.

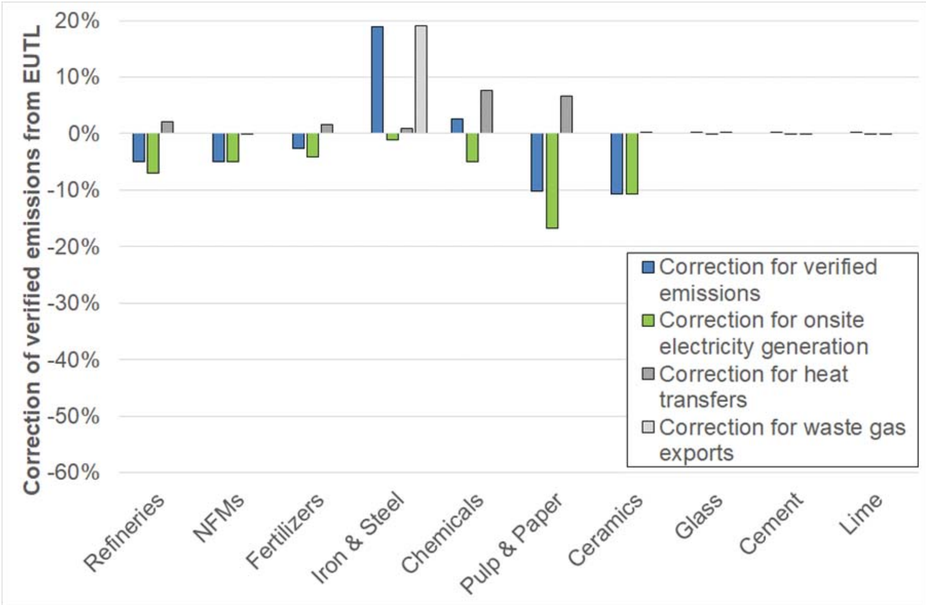
As opposed to the rule for electricity, installations do receive free allocation for heat produced within the same installation but also if imported from other ETS installations and/or exported for district heating purposes or non-ETS entities. Therefore, emissions related to heat flows that are relevant for free allocation were added in the case of imports from other ETS installations and deducted when exported to ETS installations. Emission data originated from the NIMs.

- Iron and steel: Waste gas transfers
  Given that some steel works transfer their waste gases to power plants that generate electricity for the grid, emissions caused by the combustion of these waste gases were added. The amount of emissions that were added relates to the net export of waste gases to installations that are outside of the NACE code 24.10. When the emissions related to the waste gas transfers were reported, this information was used. When only the energy content of the waste gases was reported, average emission factors were used to calculate the emissions. The average emission factors were based on information in the NIMs from installations that reported both emissions and energy content. The emission factor that was calculated for each year was weighted by volume to account for installations producing different waste gases (i.e. blast furnace gas, basic oxygen furnace gas and coke oven gas), as the emission factors of these waste gases differ.
  Given that electricity generation does not receive free allocation, a further deduction was made to this emission factor (that was equivalent to natural gas) so that any waste gas used for electricity production did not receive free allowances.

- Pulp and paper: Biomass use
  The pulp and paper sector is characterised by a large share of biomass input as well as substantial electricity exports. Following the standard rule outlined above would result in deducting more emissions than would be realistic. Therefore, a deviating approach was adopted: Whereas for the other sectors implicitly a natural gas emission factor was assumed, in the pulp and paper sector the share of biomass emissions in total emissions of the sector (both stemming from fossil fuels and biomass) was calculated based on NIMs information. In the pulp sector (NACE code 17.11) the share of biomass was 94% on average and in the paper sector (NACE code 17.12) the share was 57%. This fraction was deducted from emissions related to electricity generation within the sector.
  The deduction of verified emissions would have been higher if it had been assumed that all onsite electricity was produced from natural gas. Alternatively, no emissions would have been deducted for onsite electricity generation if biomass was the only fuel input. The fuel input from biomass is a key variable influencing verified emissions and this makes the results for the sector less certain than the results of the other sectors assessed.

The majority of the corrections to the assignment of verified emissions at sector level were within 10% of the average value from the EU Transaction Log (EUTL) (Figure 16).

Figure 22: Correction to the assignment of verified emissions at sector level for onsite electricity generation and heat/waste gas transfers (average for 2014 to 2018)



Source: Calculations based on NIMs data.

In addition to the corrections for the assignment of emissions, assumptions were made on the future development of the emissions for the period from 2021 to 2030, taking into consideration activity level changes and GHG efficiency improvements:

- First, it was assumed that emission levels for each NACE 4-digit change at the same rate as the annual average growth rate derived from the PRIMES modelling.
- Second, it was assumed that, on top, annual GHG emission factors per sector improve according to Table 34 given below. The abatement potential per sector is based on data from the Industrial Innovation study prepared by ICF and

Fraunhofer ISI[86]. For the chemicals and fertilisers sector, a study prepared by DECHEMA[87] for low-carbon energy and feedstock for the European chemical industry was used. For refineries, a study by CONCAWE was also used[88]. In addition, data gathered in the National Implementation Measures (NIMs) submitted by MS to the Commission in the context of the ETS implementation was also used for estimating improvement potentials by comparing the best installations in the sector with the rest.

Table 43: Assumed annual average improvement in the GHG emission efficiencies per sector for the modelling of emissions

Sector	Annual average GHG emission improvement
Cement	1.0%
Lime	1.0%
Refineries	1.5%
Iron and steel	1.0%
Fertilisers	2.0%
Ceramics	1.0%
Non-ferrous metals	1.5%
Chemicals	1.0%
Pulp and paper	2.0%
Glass	1.0%

Source: Commission assumptions based on Fraunhofer Institut, ICF and DECHEMA studies.

- **Cement**: The main potentials identified up to 2030 are linked to the use of low-carbon cement (using less limestone and therefore reducing process emissions) and to the reduction of the clinker to cement ratio.
- **Lime**: Abatement options are the use of best available techniques (BAT) as well as carbon capture and storage (CCS). A conservative assumption has been taken and it has been assumed that CCS will not play a major role in the abatement of the sector up to 2030.
- **Refineries**: The main abatement options identified are increases in process efficiency and fuel switching. CCS and renewable hydrogen will also play a role

[86] ICF and Fraunhofer ISI: Industrial innovation. Pathways to deep decarbonisation of Industry, 2019.
[87] DECHEMA: Low-carbon energy and feedstock for the European chemical industry, 2017.
[88] Concawe. CO_2 reduction technologies. Opportunities within the EU refining system (2030/2050). Qualitative & Quantitative assessment for the production of conventional fossil fuels, 2019.

in the future, but have been disregarded to make a conservative assumption up to 2030.

- **Iron and steel**: The applied improvement does not consider a shift from primary to secondary steel production. A 1% annual improvement rate is also in line with the potential identified based on NIMs data if highly emitting plants were to improve to a level between the median in the sector and the benchmarks applicable from 2021 to 2025.
- **Fertilisers**: Potentials still remain by using BAT options, for instance by abating nitrous oxide emissions in the nitric acid plants not yet having done it in the same order of magnitude as the best performers or by improving the efficiency of highly emitting ammonia plants to levels comparable with the top performers in the ETS. Initial projects regarding the use of hydrogen produced via electrolysis using renewable electricity are being implemented and could add some potential up to 2030.
- **Ceramics**: The main option identified is the use of BAT which would result in emission reductions of approximately 0.75% per year, which is in line with the data received as part of the NIMs. Other technologies deploying a little later (so lower uptake rates), but with a small contribution, are electrification of furnaces and microwave / vacuum drying, which could add another 0.25%.
- **Non-ferrous metals**: The main metals in terms of ETS coverage are aluminium and copper. The technologies used are different. The abatement potentials for reducing direct emissions in aluminium production are limited, as the use of inert electrodes seems to be limited until 2030. The reduction of emissions in copper production seems to be relatively easier as this is linked to flash smelting and waste heat recovery.
- **Chemicals**: Most of the options identified (used of biomethanol, hydrogen-based methanol, bioethylene) show quite high abatement costs. Up to 2030, the options with highest improvement potentials are the use of BAT. The reduction of emissions to levels similar to those of benchmark-setting installations is also identified as having a relevant abatement potential based on NIMs data.
- **Pulp and paper**: Only options increasing the efficiency of plants have been considered. Further use of biomass has not been included in the identified abatement options. The options identified are the use of BAT, improved drying techniques, enzymatic pre-treatment and better waste heat integration in the paper mill.
- **Glass**: The main improvement options identified are oxy-fuel combustion or switching to electricity, in addition to some obvious gains such as the phase-out of fuel oil and coal. Other options identified include the use of biomethane and the use of hydrogen, but their deployment up to 2030 is more doubtful and they were thus not considered.

9.2.3 Calculation of economic impacts

The outputs from the previous models to determine the free allocation and the projected emissions were then used as input data to determine the economic impacts. The potential carbon costs were calculated for 10 ETS sectors (i.e. cement, lime, refineries, iron and steel, fertilisers, ceramics, non-ferrous metals, chemicals, pulp and paper, glass) by multiplying the EU allowance price with the difference between projected emissions and free allocation.

The following assumptions were made:

- Net present value calculation: Future costs were estimated using the net present value (NPV) for all costs to be incurred between 2021 and 2030. A discount rate of 4% was used.
- Deflation: All costs were expressed in 2015 Euros. Data expressed in other monetary units were converted to 2015 Euros, using the indices shown in Table 35.

Table 44: Deflation indices used for the modelling of carbon costs

Year	Deflation index
2015	1
2016	0.991
2017	0.980
2018	0.967
2019	0.950
2020	0.936

Source: Calculations based on gross domestic product (GDP) deflators of the European Central Bank for the Eurozone.

- Table 40 shows the EUA prices assumed, in line with Section 5.2.1.

Table 45. EUA prices used for the modelling of carbon costs

Year	EUA price in the given year (in EUR)	
	Baseline (-43% overall ambition)	**Strengthened cap (-55% overall ambition)**
2021	26.0	42.0
2022	26.0	43.5
2023	26.5	45.0
2024	27.0	46.5
2025	27.0	48.0
2026	28.0	50.0
2027	28.5	53.0
2028	29.5	55.5
2029	30.0	57.5
2030	31.0	60.0

Source: Commission assumptions.

- Average data for the period from 2016 to 2018 from Eurostat's Structural Business Statistics (SBS) were then used to calculate the net direct carbon costs as % of value added, as % of production value and as % of EBITDA. EBITDA was calculated as value added at factor cost minus personnel costs. For the calculated ratios, the NPV of the ETS costs in the period from 2021 to 2030 was calculated (to take the positive trend in the ETS price into account). This value was then divided by 10 years, to provide an annual average of costs that is better relatable to current annual values, but it should be noted that in reality the costs will vary over time.

9.3 Models used for the extension of emissions trading or alternatives for maritime emissions

The PRIMES-Maritime module has been used to assess the impact of the various maritime policy options. It is a specific sub-module of the PRIMES-TREMOVE transport and the overall PRIMES energy systems model aiming to enhance the representation of the maritime sector within the energy- economy-environment modelling nexus. The module, which can run in stand-alone and/ or linked mode with PRIMES, produces long-term energy and emission projections, until 2050.

The coverage of the module includes the European intra-EU maritime sector as well as the extra-EU maritime shipping. It covers both freight and passenger international maritime. It considers the transactions (bilateral trade by product type) of the EU MS with non-EU countries and aggregates these countries in regions. Several types and sizes of vessels are considered.

PRIMES-Maritime features a modular approach based on the demand and the supply modules. The demand module projects maritime activity for each EU MS by type of cargo and by corresponding partner. Econometric functions correlate demand for maritime transport services with economic indicators considered as demand drivers, including GDP, trade of energy commodities (oil, coal, LNG), trade of non-energy commodities, international fuel prices, etc. The supply module simulates a representative operator controlling the EU fleet, who offers the requested maritime transport services. The operator of the fleet decides the allocation of the vessels activity to the various markets (representing the different EU MS) where different regulatory regimes may apply (e.g. environmental zones). The fleet of vessels disaggregated into several categories is specific to cargo types. PRIMES-Maritime utilises a stock-flow relationship to simulate the evolution of the fleet of vessels throughout the projection period and the purchasing of new vessels.

PRIMES-Maritime solves a market equilibrium problem, where demand and supply interact dynamically in each consecutive time period, influenced by a variety of exogenous policy variables, notably fuel standards, pricing signals (e.g. ETS), environmental and efficiency/operational regulations and others. The PRIMES-Maritime model projects energy consumption by fuel type and purpose as well as CO_2, methane, nitrous oxide and other pollutant emissions. The model includes projection of costs, such as capital, fuel, fixed and variable costs, projection of investment expenditures in new vessels and negative externalities from air pollution.

The module considers the handling of a variety of fuels such as fossil, biofuels (bioheavy, biodiesel, bio LNG), synthetic fuels (synthetic diesel, fuel oil and gas, e-ammonia and e-methanol) produced from renewable electricity, hydrogen (mainly for use in fuel cell vessels) and electricity in electric vessels. Environmental regulation, fuel blending mandates, GHG emission reduction targets, pricing signals and policies increasing the availability of fuel supply and supporting the alternative fuel infrastructure are identified as drivers, along fuel costs, for the penetration of new fuels. As the model is dynamic and handles vessel vintages, capital turnover is explicit in the model influencing the pace of fuel and vessel substitution.

PRIMES-Maritime, being part of the overall PRIMES model, is calibrated to the EUROSTAT energy balances and transport activity; hence the associated CO_2 emissions are assumed to derive from the combustion of these fuel quantities. The model has been adapted to reflect allocation of CO_2 emissions into intra-EEA, extra-EEA and at berth, in line with data from the EU maritime transport MRV regulation.

Annex 5: DESIGN ELEMENTS FOR ETS EXTENSION TO BUILDINGS AND ROAD TRANSPORT OR TO ALL FUELS EMISSIONS

Main features are referred to Section 5.2.3 and 6.3 of the impact assessment.

10 CAP SETTING AND LINEAR REDUCTION FACTOR

The cap is the maximum absolute quantity of GHGs that can be emitted by the covered activities to ensure the emission reduction target. It corresponds to the number of allowances put in circulation over a trading period. For the current EU ETS, a common EU-wide cap applies. Extension to emissions trading to the road transport and buildings sectors or all fossil fuel combustion outside the ETS through a separate ETS will require to set a EU-wide cap for those specific sectors.

The cap and the LRF of the new created ETS would not impact, in a first stage, the ambition and cap setting for the current EU ETS sectors.

For the impact assessment calculations it is assumed that the new ETS starts with MRV requirements as early as possible, with complete MRV data being available in 2025 and a cap applying as from 2026. It is important that the MRV system is working properly before the operations on this economically large new carbon market start. Applying the cap and corresponding surrender obligations only from the second full year would allow that problems emerging in the first submission year of verified data can be sorted out. This would increase the robustness of the system and would not harm investments in the necessary emission reductions, as actors know upfront the cap they need to achieve and anticipation effects can be expected. Other policies like the Effort Sharing Regulation, energy policies and CO_2 vehicle standards apply in the years not yet covered by the cap.

In the absence of verified data for the new sectors, the initial cap and the linear reduction factor (LRF) necessary to achieve the contribution of the new ETS to the 2030 target could be calculated using Effort Sharing Regulation rules and data currently applying to those sectors for determining the starting point of the trajectory defining the cap and the LRF. Sectoral data from the EU greenhouse gas emission inventory has been recently comprehensively reviewed for the years 2005 and 2016-2018 as part of the implementation of the Effort Sharing Regulation. For this impact assessment it is assumed that the LRF calculation would start from a hypothetical 2024 cap calculated using the comprehensively reviewed average 2016-18 emissions reported under ESR for the two sectors (inventory sectors 1.A.3.b Road transport, 1.A.4a Commercial/ Institutional and 1.A.4b Residential) and assuming up to 2024 a trajectory of emission reductions in line with the current ESR target (-30% by 2030). The end point would be the cost-effective emission reductions for 2030 as resulting from the MIX scenario, as illustrated in Figure 7 for option EXT1. The resulting EXT1 LRF is 5.15%. The resulting new ETS ambition level in the first years 2026 and 2027 will be still relatively moderate, allowing for a smooth start of the system.

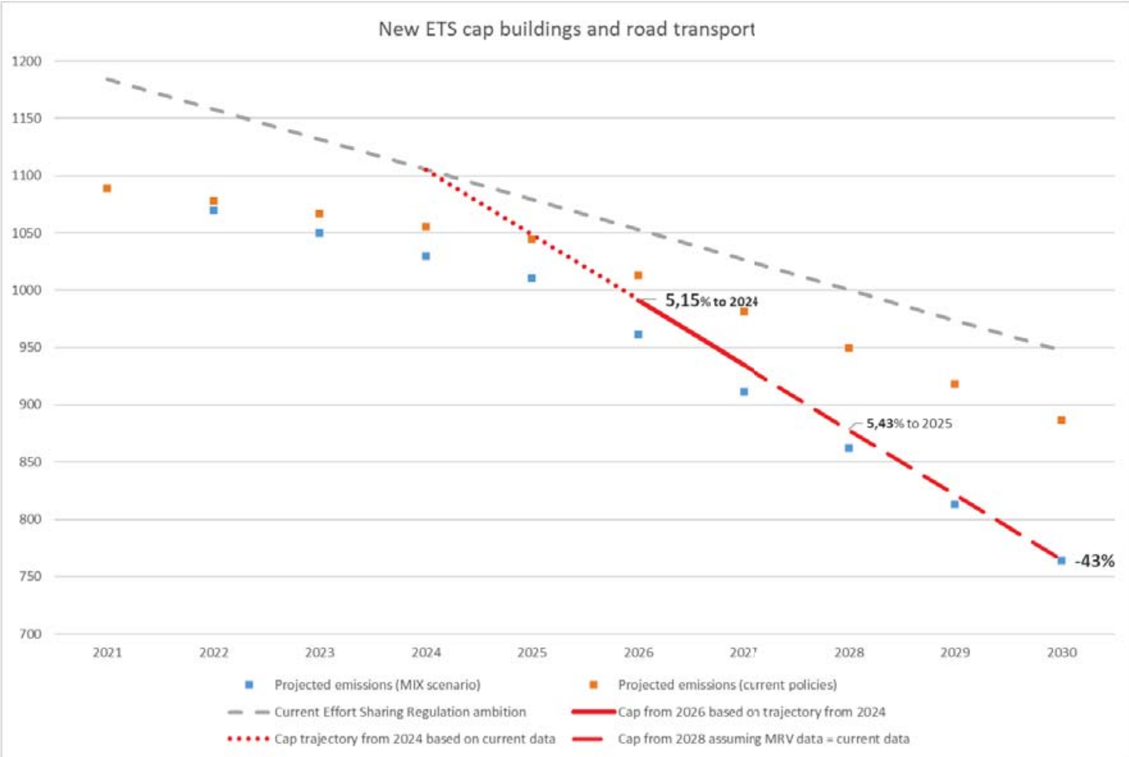
Two small adjustments to the inventory data referred are necessary to more accurately reflect the emission scope of the EXT1. On the one hand, a small amount of heating emissions reported under inventory sector 1.A.4b for commercial buildings is already covered by the existing ETS. Based on data reported by MS on the consistency of inventory data and ETS verified emissions for the years 2016 to 2018[89], this can be estimated as 2.172 Mt, which need to be deducted for the calculation of the cap. On the other hand, as explained in further detail in Section 14 of this annex, it is appropriate to cover fossil fuel supplies to small CHP and heat plants providing heat to the district heating network, that are excluded from the existing ETS. Based on inventory and Eurostat data for power and heat emissions and the district heating emissions covered by the existing ETS, this can be estimated as 6.5 Mt[90], representing less than 10% of district heating emissions. For the cap calculation, the 6.5 Mt need to be added.

Once there is sufficiently accurate verified data on the basis of at least two and ideally three years of MRV, the cap would be recalculated in 2028 on the basis of the actual emissions as ascertained through MRV and in case of significant deviations between 2025 inventory data and 2025 cap or large deviations between MRV data for 2025 and inventory data for 2025 the LRF would be adjusted. Rebasing the cap on at least two years of MRV data is important given possible temporary effects, such as of COVID and weather conditions, which may distort the representative emissions from these sectors.

[89] According to Article 7(1)(k) of Regulation (EU) No 525/2013 implemented by Article 10 and Annex V of Commission Implementing Regulation (EU) No 749/2014, all Member States have reported on consistency of reported emissions with data from the emissions trading system where relevant, including for sector 1.A.4a Commercial/Institutional. AT, BE, DE, DK, EE, EL, ES, FI, FR, HU, IR, IT, LT, LV, NL, PL and SK have reported a small share of ETS emissions in this sector between 2016 and 2018. The ETS emissions reported by Member States are aggregated to an EU-wide estimate.

[90] Data on emissions from the non-ETS district heating sector are not readily available and are estimated following the methodology set out in ICF et al. (2020) and based on data from the EU GHG emission inventory, Eurostat and the European Energy Agency. Inventory emissions for "public electricity and heat production" (category 1.A.1.a) cover both heat and electricity generation. To derive separate emission levels for heat and electricity, the emissions attributable to electricity generation are calculated based on the carbon intensity factor of electricity generation and the gross electricity generation from the energy balances (excluding autoproducers in line with the emissions data from category 1.A.1.a). Accordingly, emissions attributable to derived heat are calculated based on the difference between "public electricity and heat production" and the derived emissions from electricity generation. Emissions from ETS-covered district heating (estimated at 76 Mt for average 2016 to 2018 emissions) are subtracted from total heat emissions to calculate the residual non-ETS district heating emissions. The resulting estimates are refined based on a comparison of reported heat consumption in buildings and reported activity levels under the ETS. Non-ETS district heating emissions are scaled down for Member States with negligible district heating or where the available information suggests that district heating is fully covered by the ETS. The estimates on Member State level are aggregated to an EU-wide estimate.

Figure 23: Illustrating cap setting at the example of option EXT1



Source: Calculations of Commission services

The approach, the results and the underpinning data are presented in Table 41.

Table 46: Overview of relevant data for LRF calculation for options EXT1 and EXT2

	EXT1	EXT2
Average 2016-18 emissions	1225.87 Mt	1450,97 Mt
2024 hypothetical cap applying current ESR rules to these emissions	1105.40 Mt	1306.81 Mt
MIX emissions 2030	763.99 Mt	903.67 Mt
Resulting LRF (compared to 2024)	5.15%	5.14%
2025 value of cap trajectory to 2030	1048.50 Mt	1239.62 Mt
LRF compared to 2025	5.43%	5.42%

Source: Calculations of Commission services

11 MARKET STABILITY FOR THE NEW ETS

In view of the importance of a clear and stable carbon price signal to foster investments, several features which have contributed to reinforcing the stability of the current carbon market and in addressing market imbalances can also be used for the new ETS system.

Firstly, the new ETS system should be devised to ensure a smooth start. There is the need for the regulated entities to hedge and/or buy emission allowances in advance in order to mitigate their economic risk under the new system. Potentially disorderly purchasing patterns at the start should be avoided.

This can be addressed by auctioning a higher amount of allowances than the cap in the first year of the start of the system. This additional amount would be deducted from the auctioning volumes in later years in order to preserve environmental integrity, as was the case for the "early auctions" at the start of phase 3 of the existing ETS. This additional volume needed to "kick-start" the system would be determined in consultation with stakeholders, in order to consider all the relevant demand and supply factors and the uncertainties of these factors.

Secondly, a Market Stability Reserve could be introduced for the new ETS from the beginning and could operate in a very similar way to the MSR in the existing ETS. As discussed in the previous section, in the absence of verified data for the new sectors, there is a potential risk that the cap may be set too high (as in 2005-7 and 2008-12 phases) or too low. With a too high cap, the surplus of allowances could lead to a too weak price signal. With a too low cap a shortage of allowances could entail a too strong price signal, which could lead to challenges in terms of energy poverty and political acceptance of the system (even with distributional solutions).

Therefore a market stability instrument could be introduced[91]. Given the possible prospect of a future integration of the EU ETS and the new ETS, it would make sense that this market stability instrument is designed along the same lines as the market stability reserve under the EU ETS, including the principle of the free setting of the carbon price by the market, and with features adapted to the new sectors. The initial thresholds could be set based on estimates of hedging demand in the new sectors, which are however difficult to anticipate at this stage[92] and which would therefore need to be improved later. Similar to the existing MSR, the thresholds could be volume-based (e.g. upper and lower thresholds of 440 and 210 million allowances respectively). The quantity of allowances to be released from the reserve, if triggered, could be aligned with the rules for the current ETS (i.e. 100 million). As the new ETS would not start with a

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[91] With respect to an analysis of the German national ETS: see IW, page 28-29: "In order to containing price volatility, the ability to plan over the long term is important if a system should trigger large investments in more efficient technology and processes. Drastic price jumps should be avoided for this reason. A means to achieve this is the creation of certificate reserves that can be released into the market to smooth out price volatility. This approach contradicts the idea of controlling through annual targets but is in conformity with the recognition that it is important to meet a running emissions budget over multiple years."

[92] The hedging needs in the new sectors are quite uncertain. It is not possible at this stage to predict the likely scale of hedging from these sectors. Factors that are expected to influence the likely hedging behaviour include: the nature of the actors involved (level of sophistication, scale of emissions and liabilities, public of private nature, their contracting arrangements and degree to which they forward trade, the actors' credit strength and general level of confidence in the market.

surplus, the quantity to be taken out from the auctioning volumes if the total number of allowances in circulation exceeds the maximum threshold could the same as in case of a release (and not defined a percentage of the outstanding volume as in the current ETS).

Even though price-based triggers would theoretically be a possibility, these would bring a fundamental change to the EU ETS. In addition, as the IA for the existing ETS had found, such triggers could be more at risk of market manipulation than volume-triggers, notably because the EU carbon market is dominated by derivatives[93].

Thirdly, the MSR in the new ETS could initially be endowed with an initial holding of allowances which may be used to help mitigate the risk of starting the new emissions trading with a too low Union-wide cap that would not be sufficient to cover the emissions of the sectors of buildings and road transport. Another justification is the need for a reserve to mitigate the risk of excessive price increases, which could be caused by information that emission reductions materialise more slowly than projected or by factors other than market fundamentals (see below).

Fourthly, an additional provision could address measures to be taken in the event of excessive short term price fluctuation in the carbon market. Similarly to the market stability mechanism, allowances would be released from the reserve if certain conditions are met. However, the triggering conditions for the new mechanism would not be volume-based as the MSR, but instead based on differences in price levels between two periods. In addition, this mechanism would be reactive in order to address excessive price increases as soon as possible.

12 POINT OF REGULATION

The point of regulation is a key issue in establishing the new ETS as it refers to the obligated party or the entity to whom the emissions are attributed. In the current EU ETS, the point of regulation are industrial and energy installations, as well as aircraft operators, i.e. the emitters themselves. Such approach is not feasible for the new ETS given the large number of small emitters in the road transport and buildings sectors under EXT1 (many of which are private persons) and also in the other sectors under option EXT2. An upstream approach is more adequate, whereby not the emitters themselves but entities further up the supply chain, significantly smaller in number than the emitters, are regulated. The act that triggers a compliance obligation under the new ETS would then be the putting on the market of fuels for combustion in the covered sectors. As in the current EU ETS, regulated entities would need to have a permit under the new ETS for the activity that triggers a compliance obligation.

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[93] Commission staff working document SWD(2014)17 final.

To determine the precise point of regulation in the new ETS, several criteria would need to be considered. The first one would be the ***technical feasibility***, that is, the regulated entities must be able to monitor and report per fuel type the fuel volumes and information on its composition (on the basis of which emissions will be determined) and know, to the extent necessary, the end use(r) of the fuel. Other criteria to establish the point of regulation are that ***the carbon price which provides the incentive to reduce emissions can be passed on to consumers*** and that ***the administrative costs*** are proportional to the reduction effect. It is also necessary to consider interactions and consistency with existing measures deriving from the EU legislative framework on energy (e.g. Article 7 of the Energy Efficiency Directive 2012/27/EU as amended by Directive 2018/2002 on energy efficiency).

Because of the different supply chains, the analysis of the most appropriate point of regulation must be done separately for each of the different types of fossil fuel used (petroleum products, gas and coal). When establishing the point of regulation, it has to be kept in mind that the model needs to fit the different EU MS.

12.1 Technical feasibility

Regulated entities in an upstream system must be able to monitor and report accurately, per type of fuel, the fuel volumes put on the market. In option EXT1 (an emissions trading system for road transport and buildings), it has to be ensured that the regulated entity is able to distinguish energy flows for road transport and buildings from other energy flows. The regulated entity therefore needs to know the end-use of the fuel, that is, whether the fuel is used in road transport and/or it is used in buildings. In option EXT2 this sectoral distinction is not necessary. In both EXT1 and EXT2 options, emissions already covered by the EU ETS fall outside the scope of the new ETS. In order to avoid double coverage, in both options, the regulated entity therefore should be able to distinguish fuels for use by installations already covered by the EU ETS from those to be used by entities not covered by the EU ETS. Otherwise alternative solutions (such as compensation mechanisms) should be foreseen. It is also useful to look at how the point of regulation is set in other legislative acts concerning fossil fuel supplies:

In the Fuel Quality Directive, fuel suppliers are identified as regulated entities. Suppliers are identified as "*the entity responsible for passing fuel or energy through an excise duty point or, if no excise is due, any other relevant entity designated by a Member State*".

The Renewable Energy Directive makes MS responsible for achieving targets for the supply of renewable fuels. MS are required to set obligations on suppliers to deliver an overall share of fuels from renewable sources. A 'fuel supplier' is defined as "*an entity supplying fuel to the market that is responsible for passing fuel through an excise duty point or, in the case of electricity or where no excise is due or where duly justified, any other relevant entity designated by a Member State*".

Under Article 7 EED concerning energy efficiency obligation schemes, MS are required to designate, on the basis of objective and non-discriminatory criteria, obligated parties amongst energy distributors and/or retail energy sales companies operating in their territory and may include transport fuel distributors or transport fuel retailers. Most MS have chosen to obligate energy suppliers. However, in Denmark and Italy distribution companies are obligated, while in Portugal, the obligation is held by a non-profit private entity with a public function. Several MS employ a threshold above which energy companies are obligated.

Regulating at the point of the excise duty would in principle be beneficial because of the already existing monitoring and reporting mechanisms for tax purposes [94].

In the case of **oil**, there is a harmonized excise duty system that applies in all MS: excise duty on oil is levied in tax warehouses in the MS and the point of levying the tax on oil is the same in all MS. A tax warehouse, under Directive EU 2008/118 (and new Council Directive (EU) 2020/262), is a term for a premise approved under legislation of the MS in which the premises are located for the production, processing, holding, receipt or despatch of excise goods under duty suspension arrangements. Each tax warehouse is associated with an authorised warehouse keeper who is responsible for the management of the tax warehouse. Different tax warehouses can be kept by one and the same tax warehouse keeper. Since tax warehouses are storage premises where excise goods are held, processed or repackaged, they can be owned by entities along the supply chain, including refineries and fuel suppliers. [95]

Tax warehouses represent the advantage that all transport and heating oil (EXT1) and in general all oil for combustion (EXT2) pass through them. Moreover, data monitoring is already available at this stage of the supply chain which is used for tax reasons (energy tax) and for the excise duty point. The accounting records are subject to strict requirements and subject to supervision by the tax authorities. There would therefore be a solid and reliable basis for any monitoring and reporting requirement under the new ETS.

As regards the need under option EXT1 to distinguish oil for the road transport and buildings sector, it is worth noting that, as the tax rates for the use of oil in transport or for heating in buildings differ in most MS[96], tax warehouse operators usually know the

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[94] For a detailed analysis, see ICF et al. (2020), p.239.

[95] For more information, see ICF et al.(2020), p.143. Sometimes excise duties are due by registered consignees or other authorised persons. However, many of the liquid fuels released for consumption by such registered consignees or other authorised persons are received by these persons from a tax warehouse, see CE Delft, *Analysis of the options to include transport and the built environment in the EU ETS* (2014), p. 228-229.

[96] According to an evaluation study on the use of fiscal marking, "*Gas oil for heating benefits from tax relief in 22 Member States, while in the remaining countries exemptions/rebates were discontinued in recent years (Netherlands, Estonia, Slovakia, and Bulgaria) or have never been granted (Hungary). The Euromarker is utilised in all the 22 Member States providing tax relief (...)*". See the Evaluation study on the application of the provisions of the Council Directive 95/60/EC of 27 November 1995 on fiscal

final use of the products they supply and are able to distinguish oil product used in road transport and heating. Still, there will be instances where taxes cannot be used to distinguish oil product use in transport and heating[97]. Also, there will be instances where taxes cannot be used to distinguish between subsectors (eg road, rail, agricultural). Therefore additional monitoring responsibilities of tax warehouses may be needed. The fact that such arrangements already apply in several MS shows that it is possible to implement additional monitoring to make this distinction. Alternatively, with respect to the distinction of sub-sectors, it can also be envisaged to allow MS to apply the new ETS to all transport fuels, possibly with setting in place a compensation mechanism for subsectors other than road transport.

As regards the need under option EXT1 and EXT2 to distinguish fuels for combustion by entities already covered by EU ETS operators, often tax warehouses do not have a direct contact with the end-consumer, which makes that they do not distinguish fuels that are addressed to entities already covered by the EU ETS from fuels addressed to entities outside the EU ETS. Further specific consideration on this are in the section on MRV.

In many MS tax warehouses monitor biofuels and therefore have good knowledge of the share of biofuel[98].

Oil refineries, much lower in number than tax warehouses, could in principle also be chosen as the point of regulation. However, if so, imported and exported oil would need to be treated separately. Regulation at this level would not benefit from the existing monitoring system that already exists at the level of the tax warehouses. Also, at this level, it is not clear which share of the fuels will be used in the relevant sectors[99]. The overlaps with the existing ETS would need to be addressed (as some oil products are already included in the existing ETS). Under option EXT2, since a large part of the energy sector and major industry is supplied directly from the refineries, it can be expected that the latter are able to know the downstream regulated entity, but imported and exported oil will need to be treated separately[100].

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marking of gas oil and kerosene, available at: https://op.europa.eu/en/publication-detail/-/publication/6e0f7327-0704-11e8-b8f5-01aa75ed71a1/language-en

[97] ICF et al. (2020), p.247.

[98] UPEI Feedback Inception Impact Assessment – Revision of the EU Emissions Trading System and the EU Effort Sharing Regulation 26 November 2020 p. 2 "*Fuels suppliers currently report much data to authorities, e.g. for the purpose of statistics, energy taxation, blending of biofuel components, carbon intensity requirements. Hence, there is already precise and robust data available. No further separate system of monitoring, reporting and verification is necessary*."

[99] CE DELFT (2014) p. 22 and 23.

[100] ICF et al (2020), pp.434 and 435.

In the case of **gas and coal**, there is no harmonised tax warehouse system applicable in all MS. Although gas and to a large extent also coal is subject to excise duty, the excise duty on coal and gas does not necessarily target the same point in the supply chain.

In the case of **gas**, almost all MS levy excise duty from the supplier to the end customer.[101] This strengthens the argument that the point of regulation considered most appropriate is the fuel suppliers that supply directly to the end-users. These are companies that hold supply contracts with final consumers (households, companies)). A distinction must be made at the DSO level between the seller of the gas and the distributor of the gas. Although in some countries these might be vertically integrated companies the provisions of unbundling require separation between the business of operation of the grid and the business of supply. ETS regulation on the side of the sellers (suppliers) of the gas is preferable in this case[102]. Volumes supplied to consumers are transported by the system operators at transmission (TSO) and distribution level (DSO). Supply companies ship the gas and bill it to the customers, whereas metering the volumes and the gas quality is a task of the TSO and DSO.

Under option EXT1, the regulated entity should be able to distinguish fuels for the road transport and buildings sectors. In this respect it is worth noting that all gas for building heating is supplied by a gas supplier. The end customers are known by the gas suppliers and therefore it is easy for them to distinguish between the supply to buildings and other user. Under option EXT1, the regulated entity should also be able to distinguish supplies to entities already regulated downstream in the EU ETS. The gas suppliers have such possibility since they are in direct contact and know the end-consumers.

Some larger consumers may have a direct connection to the Transmission System Operators (TSO) network. These would typically be larger entities already regulated downstream by the EU ETS, which would not need to be captured in the new ETS. However, also entities not yet covered by the EU ETS, such as hospitals, hotels or petrol stations, may have a direct connection to the TSO and these entities would need to be captured under the new ETS. In practice, notwithstanding the direct connection to the TSO, these entities most often still purchase their gas with a supplier, which means that these gas supplies would be captured under the new ETS. A specific regulation may need to be foreseen for the few entities for which this would not be the case.

With respect to option EXT2, there would be no need to distinguish gas in function of the sectoral use. It would still be necessary to distinguish gas supplied to entities already

[101] ICF et al (2020), pp. 239-240

[102] In some countries, a distinction must be made at the DSO level between the seller of the gas and the distributor of the gas, as they are partly separated due to competitive regulation. Regulation on the side of the sellers of the gas is preferable in this case. See ICF et al. (2020), p.243.

covered by the EU ETS, which should not be a problem as the gas suppliers are in direct contact and know the end consumers.

Given that under this option EXT2 also small industry is covered, it could be that there are more end-consumers with direct connection to the TSO. Most likely however, also here these companies would still purchase their gas through a gas supplier, which means that these gas supplies would be captured under the new ETS. In those exceptional cases where a company would have a direct TSO connection and would not purchase its gas through a regional or local distributor, this may require a specific arrangement as described above.

TSOs could be an option as point of regulation for gas under EXT1 and EXT2, as they monitor the quantities of gas that are transported through their pipeline network. But it raises some difficulties. Regulating the Transmission System Operators raises legal questions as they are not the owners of the gas, but merely the transporters[103]. As mere transporters, they push volumes down to exit points charging their clients, the actual owners of the gas, a transport fee. They know volumes supplied, but, except for very large off takers, they will have no information on the end-consumers. This means that they will not know the sector to which he belongs and whether he is already regulated under the EU ETS and therefore already incurs a compliance obligation in the EU ETS. The lack of knowledge of the sector in which the gas will be used is a problem for option EXT1. The lack of knowledge of whether the end-consumer is already covered by the EU ETS is a problem for both options EXT1and EXT2. TSOs would not have such information on the end use of the gas themselves but would need to collect it from the gas owners and suppliers, which would be very cumbersome and involve cooperation from different actors.

In case of option EXT2, where it is not necessary to know the sectoral use of the gas, it could be envisaged to regulate at the level of the TSO all gas supplied to suppliers. In this case, gas volumes going to suppliers and thus regulated under the new ETS, could end up with entities already covered by the EU ETS. In this case, there would thus be a double burden for these entities already covered by the EU ETS and compensation mechanism would need to be foreseen.

Another disadvantage of the fact that TSOs are only the transporter of the gas is that they have no impact on the quality of the gas they transport. Biomethane is only injected at DSO level, and only rarely at the TSO level.

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[103] Regulating the owners of the gas that is being transmitted at TSO level seems not possible because the ownership rights of the gas cannot always be identified in the TSO.

In the case of **coal**, identifying an appropriate level of regulation is not evident and none of the possible avenues is without significant complexities. The reason for this is that the market for coal is very complex and much less regulated than the markets for oil and gas.

Not all coal products necessarily pass through an excise duty point, and where they do, there are no harmonised practices in Europe. For a selection of the ten MS (Bulgaria, Czechia, Germany, Hungary, Ireland, Italy, Lithuania, Poland, Slovakia, Spain) which are most relevant in terms of coal use, either for heating or for (small) industrial use, an analysis of their coal excise regime found that all of these MS have excise duty on coal, be it with a number of exemptions and reductions. Mostly, the seller to the final customer is the tax payer, but at least three MS (Germany, Ireland and Spain) have appointed the first supplier (importer or producer) as liable entity for excise duty purposes and sometimes payment of excise duty can even fall upon the user. Most of the ten MS have a separate category of excise duty (exemption or special rate) for coal use for households and Ireland for heating with a distinction between ETS and non-ETS customers. Some have special exemptions or tax reductions for the use of coal for heating in buildings other than households or district heating or for very specific heating purposes.

Under option EXT1, where there is a need to distinguish coal destined for the buildings sector from coal used for example in (small) industry, it makes sense to align where possible the level of regulation under the new ETS with the existing excise duty points to make the most of the already existing monitoring and reporting structures for taxation purposes. This despite the fact that, because excise duty is often levied from the final supplier, there would be a high number of entities to be regulated[104] and the many different emission factors that may apply due to the many different end products.

In the market for coal, tracking through the level of supply is challenging. At the level of distribution, it is possible to identify the supply streams to buildings since the distributors have a direct contact with the final consumer. Sometimes, because of tax reasons, tracking of relevant coal supplies will already be done. However, as mentioned above, not all countries have exemptions or special rates for the categories of coal use distinguished, and countries do not usually separate out coal supply to ETS and non-ETS consumers in their excise duty regime. Additional MRV structures will therefore need to be set up in at least a number of countries, with the associated administrative costs. For the countries that do have relevant separate excise duty categories, regulated entities and required proof varies, so harmonisation of the MRV structures for the new ETS across countries may be needed to ensure sufficiently robust rules and a level playing field across MS.

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[104] There is very limited information and insights available as regards the number of coal suppliers. ICF et al. estimates that there are around 3000. There is a large size range, including some very small suppliers.

If under option EXT1, regardless of the point at which the MS has put the excise duty, the level of regulation would be set higher (i.e. at the level of production or import), it would often not be possible for a regulated entity not acting as excise duty point to sufficiently distinguish the sectoral end use (only some large industrial customers and power plants would be known). It would therefore be necessary to set in place monitoring of the flows of coals to buildings throughout the supply chain..

In the case of option EXT2, it is not necessary to distinguish coal volumes meant for consumption in the buildings sector. It is however necessary to distinguish coal use outside the ETS from coal use within the ETS. For this distinction, the excise duty system is most often not useful. It could therefore be envisaged to set the level of regulation for the new ETS at the level of mine operators, producers and importers, regardless of where the MS have put the excise duty point. The number of entities to be regulated would be more limited.[105] However, it would often not be possible for the regulated entity to make the distinction between coal meant for use outside the ETS from coal meant for use by ETS operators. For those cases where the mine operator, producer or importer is not the directly selling to the consumer, a tracing mechanism should be set in place for them to obtain information on whether the consumer is an ETS-regulated entity. Alternatively, or additionally for those case where it would not be possible to do such tracing, compensation mechanisms would need to be set in place for those cases where coal supply is captured by the new system, while it should not have (e.g. because an ETS-operator does not buy directly from a regulated entity). Different solutions for compensation are possible, also entailing different costs and burden for the competent authorities, the regulated entities and the ETS operators.

Whichever avenue is followed, one main challenge will be establishing a monitoring and reporting system, implying high transaction costs.

12.2 Ability to pass-on the carbon price to the end-consumer

As regards incentives to reduce emissions, it is important to note that tax warehouses and fuel suppliers have only limited possibilities themselves to reduce emissions. Often they will not have the possibility themselves to reduce the carbon intensity of the fuels they put on the market (for example resellers or tank storage facilities without blending facility). The possibility of substituting fossil fuels with lower carbon alternatives is also not evident as they would need to be available in the market. Another option would be to simply put less fuel volumes in the market, but that would go against the regulated

[105] ICF et al. (2020), p.133-134 still estimated the number of coal mining companies at 198 in 2018. This number is expected to have reduced even more following recent closures of mines and mine companies. Information on the number of importers is limited and has been estimated at around 500.

entities' business.[106] Most emission reductions induced by the new ETS would need to come from the end consumers. It is therefore important that the price signal coming from the new ETS is passed on to the consumers.

With respect to **oil**, it can be assumed, in general, that the carbon prices on oil coming from the new ETS will be passed on to the end consumer even if there could be distortions in function of the size and market power of the customer.[107] At the same time however, there is a risk that little or no information about the carbon price is passed on to end consumers and that therefore there would be little awareness amongst the end consumers about the carbon price component. One solution to address the lack of awareness could be to list the CO_2 price separately on the bills for the end consumers[108].

In the case of **gas**, the gas supplier can pass on the price signal coming from the new ETS coverage to its customers. However, it could lead to a competitive disadvantage for gas suppliers compared to other ways of heating[109]. Given the relatively inelastic nature of demand, the price signal is however likely to be passed on.

In the case of **coal**, it is very likely that the CO_2 price signal will be passed on to the final consumer through the levels of the supply chain relatively undistorted.[110] The coal suppliers can inform the final consumer about the carbon costs given that they are in direct contact. Again, to increase awareness, the CO_2 price could be shown separately on the bill.

12.3 **Administrative cost**

With respect to **oil**, tax warehouses are already heavily regulated and already collect for tax reasons detailed data on oil volumes. They thus already have a solid basis on which to

[106] See also the analysis by IW with respect to the German national emissions trading for transportation and heating, pages 26 and 27.
[107] ICF et al. (2020), p.248 : "Since the world market prices for crude oil have to a large extend so far been passed on to the end consumer, it can be assumed that this would happen with a price signal from an ETS. However, the price signal could be distorted by the fact that large customers in the commercial building sector may have more market power than private customers, so that private customers may have to pay more than commercial customers."
[108] ICF et al. (2020).
[109] ICF et al. (2020), p.243: «Given the very low short-term price elasticities shown in Section 2.2.1, it should be possible to pass through the price at least in the short term. However, gas companies are increasingly having to compete with district heating, heat pumps and wood pellet heating. Against this background natural gas suppliers could face the challenge that passing on the price signal would lead to a competitive disadvantage in one of their main consumer markets. (…)" and page 433-434.
[110] ICF et al. (2020), p.251 : «With regards to the final consumers of coal, it can be assumed that demand from the final consumer is relatively inelastic in the short term and that, accordingly, the price signal can be passed on to the final consumer relatively undistorted in the short term. This is because distributors and retailers operate on a relatively limited regional market and transporting smaller quantities of coal over larger distances is not financially attractive and short-term adjustment processes are rather limited. (…)"

found their monitoring and reporting under the new ETS. Some additional monitoring duties may need to be imposed where and insofar their data today not distinguish the end use(r) of the fuels, to the extent relevant. There would be a high number of regulated entities, but thanks to the already existing monitoring systems, the cost for these entities would be moderate.

Due to the large number of tax warehouses, the costs for the public sector would be rather high. On the positive side, it should be easy for the public sector to identify the list of regulated entities with respect to oil, and the data submitted by the regulated entities can be expected to be reliable (because also used for tax purposes).

With respect to **gas**, when regulating suppliers, even if the number of regulated entities will be relatively high, the cost for the regulated entities of monitoring and reporting, including identifying the supply streams, are expected to be moderate. Given that the gas market is heavily regulated and that many suppliers act as excise duty points, it should be easy for the public sector to identify the list of regulated entities with respect to gas, and, as in the case of tax warehouses, the data submitted by the regulated entities for gas can be expected to be reliable.

With respect to **coal**, there is a relatively high number of coal suppliers, while the number of mine operators, producers and importers is limited.

In some cases, a monitoring and reporting mechanism would need to be set up from scratch and adequate fraud prevention measures set in place. In comparison to the markets for oil and gas, the administrative impacts would be significantly higher, both for the regulated entities and for the national administrations in terms of participants' identification, supervision and enforcement.

Especially with respect to the regulation of coal, the question of regulating small entities arises as there are many, sometimes very small coal suppliers which until now are hardly regulated. It is true that there will be a need for regulated entities to manage their carbon allowance needs. If they feel unable to do so themselves, entities can call upon financial advisors such as corporate banks to provide them with advice and services for the purchase of allowances and hedging of their risk. This would come at a cost.

Excluding small entities from the new ETS may seem advantageous in terms of limiting burden and impact for the entities concerned; however, this advantage would have to be weighed against the resulting environmental impact. Also, a system with de minimis thresholds such as the one used for the EU ETS does not seem appropriate in the case of the fuel supply based new ETS. In the case of the new ETS, there is a risk that such de minimis approach would trigger avoidance of the rules by organising businesses such that they remain under the thresholds. Alternative mechanisms to reduce the burden can be considered. Measures can be taken to facilitate the access by small entities to auctions for example by allowing them to form business groups that can bid on their behalf in auctions.

For the different types of fuel, expected administrative burden is summarised in the following table.

Figure 24: Expected administrative burden for the regulated entities depending on the type of fuel.

Fuel	Point of regulation	Administrative costs	Main drivers
Oil	Tax warehouses	Moderate	– Size of the regulated entities: variable, many players – Regulation in place: yes, heavily for taxation purposes. – Monitoring and reporting system in place: yes, administrative quantity metering system for monitoring and reporting already exists for the purpose of excise duty. – Possibility to identify the purpose of the fuel use (sector end use) for EXT1: yes, with additional costs, such as the need to put in place additional MRV requirements. – Possibility to identify the end user of the fuel (including ETS operators) for EXT1 and EXT2: yes, possible with additional limited costs, such as the need to put in place additional MRV requirements. – Information on the composition of the fuel: Not always available, so need to set in place of a system to collect this information
Gas	Gas suppliers	Moderate	– Size of the regulated entities: variable, moderate amount of players – Regulation in place: yes – Monitoring and reporting system in place: yes – Possibility to identify the purpose of the fuel use (sector end use) for EXT1: yes, with additional costs. Data on volumes and fuel quality are already collected since the delivery is done to end users, and suppliers can identify the purpose of the use of the fuel. – Possibility to identify the end user of the fuel (including ETS operators) for EXT1 and EXT2: yes, with additional costs.
Coal	Coal distributors	High	– Size of the regulated entities: typically smaller than oil and gas, many players – Regulation in place: no or with differences among MS or no reliable monitoring and reporting system. – Monitoring and reporting system in place: Only very limited. Monitoring and reporting system expected to be less accurate than oil and gas supplies. Risks of error and fraud identified because of the variation in coal quality, difficulties to identify all regulated entities and all of their deliveries, and because of difficulties to control import and export. – Possibility to identify the purpose of the fuel use (sector end use) for in EXT 1: yes, with high additional costs due to the high number of entities to be regulated and the many different emission factors that may apply to the many different end products.

			- Possibility to identify the end user of the fuel (including ETS operators) for EXT1 and EXT2: yes, with high additional costs due to the high number of entities to be regulated, and the many different emission factors that may apply to the many different end products. Excise duty infrastructure can be used to some extent but there are differences among MS.

Illustrative cost estimates under EXT1

The paragraphs below present illustrative cost estimates associated with (i) the additional activities regulated entities would need to implement upon inclusion in the new ETS, initially in preparing for system implementation, but also recurring costs after the system enters into force and (ii) the additional activities required from competent authorities for setting up the system and managing the system after implementation.

The estimates are inspired by information from two earlier studies on the administrative costs associated with the inclusion of regulated entities in aviation (small emitters) and maritime sector in the EU ETS carried out for DG CLIMA[111]. While they are the best estimates available, they should be treated with caution. There is a degree of uncertainty due to the lack of empirical data, the need to aggregate data and the possible impact the specific design of the new ETS might have, including the MRV system to apply which is still to be defined in detail.

For the purposes of the illustrative cost estimate, the **regulated entity** is assumed to be a supplier of **coal** that acts as excise duty point and thus already has in place a certain excise duty/energy tax infrastructure. Where this would not be the case, or to the extent that the existing infrastructure of the coal supplier is insufficient for the purposes of the new ETS the actual costs could be higher. For gas suppliers, the registry costs are estimated to be the same as in the table below but the other costs are expected to be lower. This is due to existing metering of gas which removes the need to monitor stock changes and batch metering as is the case for coal. For oil, also the registry costs are expected to be the same but other costs are expected to be somewhat lower. They may be

[111] ETS Aviation Small Emitters: Cost assessment of applying EU ETS on aviation small emitters and analysis of improvements potential by simplifications, alternative thresholds and alternative means of regulation 2014 and Commission Staff Working Document SWD (2013) 237 final.
Where monitoring and reporting infrastructure for sales is already in place for excise duty/energy tax system, this will facilitate the implementation of monitoring and reporting in a new ETS system. In a similar way, for small emitters in the aviation sector the use of Eurocontrol Support Facility and Eurocontrol data facilitated their implementation of monitoring and reporting.

higher though than for gas as some additional monitoring to certain customers may be needed. Thus as regards the 'per entity' costs, coal will be the highest, oil next highest and gas lowest. The overall costs depend of course on the total number of regulated entities. The estimated cost for a regulated entity is illustrated through the time required for each of the additional identified activities. It does not reflect compliance costs for the regulated entities, i.e. cost of allowances corresponding to emissions.

Table 47: Illustrative cost estimate for regulated entities under EXT 1 (supplier of coal)

Activity	**Required number of hours or cost estimate**
One off costs	
Preparation of the monitoring plan to monitor sales to buildings and road transport, where possible based on existing mechanisms for excise duty. Set up emissions calculations	75 hours, one-off
Implementation of the monitoring plan, where possible based on existing mechanisms for excise duty	100 hours, one-off
Setting up registry account	32 hours, one-off
Recurring costs	
Recurring monitoring and reporting according to the Monitoring plan[112]	45 hours, annual
Verification of reported emissions based on excise duty declarations where possible	1400 euros, annual
Trading and surrendering of allowances and other registry operations.	16 hours, annual
Estimated illustrative administrative cost result for regulated entities: for one-off costs a range between 6,085 EUR and 8,590 EUR and for recurring costs a range between 4,900 and 6,350 EUR[113].	

[112] In the existing ETS, where the MRV cost can be expected to be significantly higher than in a downstream model based on fuel supplies, average total costs of MRV per 18 month compliance cycle (as per 2014 compliance cycle as an indicative compliance cycle under phase 3 of the ETS) are approximately €59,000 per installation and the average annual cost per tonne of CO2e per 18 month compliance cycle is €0.16. The average cost per Member State per installation is €2,250 . See in this regard "Evaluation of ETS Monitoring, Reporting and Verification Administration Costs - Final Report- June 2016" - Amec Foster Wheeler Environment & Infrastructure UK Limited, for the European Commission. Other literature founds that for participants in the current ETS, the MRV cost has been estimated to represent about 70% of the total transaction costs and average MRV costs per entity have been estimated at around 22,000 €/year and 0.07 €/tCO2. See in this regard "Monitoring, reporting and verifying emissions in the climate economy", 25 March 2015, V.Bellassen, N.Stephan, I.Cochran, J.-P.Chang, M.Deheza, G.Jacquier, M.Afriat, E.Alberola, C.Chiquet, R.Morel, C.Dimopoulos, I.Shishlov, C.Foucherot, A.Barker, R.Robinson. Nature climate change, VOL 5, April 2015.

[113] For calculating the recurring costs, the one-off costs are multiplied with a factor, depending on how often they are expected to recur in a ten-year period. The lower end of the range is based on an assumed

Table 40 below represents the additional activities that will be required for the **competent authorities**, triggering either one-off costs or recurring costs. No estimates of the required number of hours for different categories of activities were available from the existing studies. Two types of one-off costs have been identified: (i) those associated with setting up the emissions trading scheme in general and (ii) those that could be additionally needed for setting up the tracking systems for fuel to its destination.

As regards the first type of one-off costs, information collected for the small emitters study suggested total one-off administrative costs of 1,048,000 EUR for 28 MS as a whole, with around 870 regulated entities (operators). In terms of set up costs in the new ETS, the preparation of materials and the identification of the participants is largely independent of the number of entities. The effort associated with the other activities will depend on the number of entities, although there will also be some economies of scale. In the absence of empirical information, it is assumed that 60% of that total one-off cost for competent authority scales with the number of entities, while 40% is independent of the number of entities. This gives estimates for one-off competent authority administrative costs across all MS of approximately 8.6 million EUR for EXT1, based on an assumption of 11,400 regulated entities[114].

Regarding the one-off costs associated to setting up the tracking systems, it is assumed that MS will use their excise duty procedures to the extent possible. Where no such existing schemes can be used, as identified in four MS with respect to coal, it is assumed that setting up the necessary tracking scheme would cost on average 200,000 EUR in each country. As different systems will exist across the 27 MS, it is further assumed that an additional 200,000 EUR will be needed to set up the necessary systems. This gives an additional total one-off costs for competent authorities of 1,000,000 EUR for the coal sales tracking system (200,000*4 + 200,000 EUR). Nonetheless, there are large uncertainties on these estimations, which also depends on the specific choices as regards to implementation and the starting position as regards existing systems in the MS.

As regards recurring costs, the average net[115] costs per entity for the competent authority from the small emitters study were around 1,000 EUR but with a very large range for different MS. In the absence of further information, it is considered a range of 1,000-

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hourly rate of 29.4 euro/hour while the upper end of the range is based on an assumed hourly rate of 41.5 euro/hour.

[114] [1,048,000/100*40] + [1,048,000/100*60 /870*11,400]

[115] Costs minus revenues from Member States fees

1,400 EUR per entity[116]. It is thereby to be noted that the number of regulated entities administered by each MS, the administrative structure and the allocation of responsibilities among the different levels of administration can also entail different costs among MS. Also, where the MS can fall back on MRV data that are backed reliable datasets that are used eg. for taxation purposes, the actual recurring cost for the MS could below the estimate. Recurring costs can also be expected to go down after the initial years, as experience with the new ETS will be gained both on the side of competent authorities as on the side of regulated entities.

Table 40: Costs for competent authorities under EXT 1

Activities triggering one off costs
Identify participants, where possible based on the existing excise duty regime[117]
Prepare materials including guidance notes and briefing materials
Inform participants and other stakeholders. Signpost briefing materials and help desk.
Approve monitoring plans for annual emissions for each regulated entity
Check details provided by regulated entities for the purpose of registry account application
Set up systems to avoid double coverage
Activities triggering recurring costs
Helpdesk for regulated entities and other stakeholders (incl. verifiers), answering queries
Approve monitoring plans for new entrants and approve changes to existing monitoring plans
Review annual emissions reports and verification reports, based on information verified by independent accredited verifiers[118]
Managing updated and new registry accounts, reviewing changes and confirmations; Check details provided by new participants and updates to existing participants.
Managing system for tracking.

As regards to aviation, data available on small emitters show that the average total recurring costs of EU ETS per small emitter were EUR 9,050 for 2011 and EUR 13,121 for 2012. 2012 includes EUR 2,887 for costs of allowances for operators, EUR 9,264 for costs of compliance and EUR 970 for MS costs. The projected annual recurring costs of EU ETS per operator starting 2013 amounted to EUR 11,121. The historical recurring

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116 Although not calculated directly from labour costs, this range represents the relative difference in labour costs used in the calculation of regulated entities.

117 Insofar not covered by the costs for the identification of the participants and the approval of the monitoring costs, and depending on the existing framework in the Member States, it may be that, would EXT1 be articulated through GHG emission permits for the new regulated entities, additional costs might arise both for the competent authorities and for the regulated entities related, respectively, to the approval, issue and maintenance of the permits, and to their submission.

118 In addition, a MS may face additional enforcement costs, which cannot be estimated because they would depend on the level of non-compliance.

cost items for MS amounted to EUR 559,000 for 2011 and EUR 507,000 for 2012. Based on the feedback received from the MS some decrease in costs per operator in 2013 was foreseen due to expected lower helpdesk costs[119]

12.4 Addressing possible double burden and loopholes/Interaction with the existing ETS

Double burden may occur when an ETS operator surrenders allowances to comply with ETS obligations and also pays a carbon price on fuel used, which may occur as a result from the introduction of the new ETS. There is therefore a double coverage of fuel being supplied to installations already covered by the EU ETS. Therefore, the risk of double counting affects installations already covered by the current EU ETS. Loopholes leads to evasion of the carbon price, e.g. large non-ETS gas consumers not purchasing gas from the distributors but a direct connection to the gas TSO network. This is also linked with the monitoring, reporting and verification design for these sectors.

This may justify *ex-ante* exemptions or *ex-post* compensation: fuels delivered to installations covered by the EU ETS may be exempted from the obligations arising from the new ETS. In cases where such an exemption would entail disproportionate administrative efforts, it might also be possible to compensate the facilities for such double coverage.

Carbon slippage and double counting requires the fuel supplier to discriminate on the intended use and destination of the fuel, and in particular if, when combusted, the fuel will incur with a compliance obligation.

To avoid carbon slippage, solutions range from to legally classify fuels that are destined for different categories of customers and uses as different products, which would require that the different fuels are distinguished and tracked separately all the way down the supply chain; to generally treat all fuels as if destined for a customer / use that is not covered by a downstream obligation, and to allow those customers / uses that have such an obligation to apply for a refund. Another option would be the possibility to opt- in, allowing customers the choice to remain under the existing ETS or to enter as an upstream customer. All those options need further analysis as they raise legal issues[120].

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[119] Cost assessment of applying ETS on aviation small emitters and analysis of improvement potential by simplifications, alternative thresholds and alternative means of regulation. 25 March 2014. PwC with the support of CE Delft and SQ Consult, for the European Commission. Page 17 and 18.

[120] ICF et al. (2020), p.267.

13 COMPLIANCE, ENFORCEMENT AND USE OF INFRASTRUCTURE

Stationary industrial installations and aircraft operators covered by the current EU ETS report their annual CO_2 emissions, which have been monitored based on a the monitoring plan. The monitoring plan is submitted to the national competent authorities together with the operating permit. This approved monitoring plan shall be used by the operator to monitor CO_2 emissions during the year. Operators report on their emissions once a year through the submission of a verified emissions report. On the basis of this report, an operator will surrender an equivalent number of emission allowances, every year by 30 April.

As far as linking the existing ETS to the new created ETS is an option that might materialise in the future, it would be preferable that the compliance cycle of the new ETS mirrors the compliance cycle of the existing ETS. The administrative authorities could also benefit from their experience in managing the ETS compliance cycle. Depending on MS' administrative structures, MS could decide to establish as the competent authority the same as the one actually responsible for the current EU ETS. Administrative burden and capacity building matters could arise, but relevant savings might occur. MS will be responsible in deciding the optimal competent authority according to their constitutional organization.

In case of a breach by the entities regulated under the new ETS of their compliance obligations, a sanction regime such as the one established under article 16(3) of the ETS Directive should apply. Any regulated entity who does not surrender sufficient allowances by 30 April of each year to cover its emissions during the preceding year shall be held liable for the payment of an excess emissions penalty. The excess emissions penalty is at present 100 euros for each tonne of carbon dioxide equivalent emitted for which the operator has not surrendered allowances. Payment of the excess emissions penalty do not release the operator from the obligation to surrender an amount of allowances equal to those excess emissions when surrendering allowances in relation to the following calendar year. The breach of the obligation to surrender allowances will entail the activation by competent authorities of effective, proportionate and dissuasive penalties to entities not complying with the rules.

As regards to Registry, the new ETS would in principle be implemented and operated through the Union Registry, and within the most optimal technical solution.

14 MONITORING REPORTING AND VERIFICATION

The extension of an emissions trading system to new sectors will require the design and the establishment of a new monitoring, reporting and verification (MRV) system, which is accurate, reliable and cost-effective. As a starting point, the new MRV system would need to comply with the principles of transparency, accuracy, consistency, comparability and completeness (as also stated in the current EU MRV framework[121]).

The MRV system will be important for the proper functioning and credibility of the new ETS, but also to collect adequate information for the re-assessment of the cap.

Under the EU ETS, the procedure of monitoring, reporting and verification consists of the following: EU ETS operators are required to have an approved monitoring plan for monitoring and reporting annual emissions. This plan is also part of the permit to operate. Every year, operators must submit an emissions report. The data for a given year must be verified by an accredited verifier by 31 March of the following year. Once verified, operators must surrender the equivalent number of allowances by 30 April of that year, in the absence of which they face penalties. Penalties will also be applied in case of errors or incompleteness in the emission reports.

In terms of optimization when establishing the MRV rules for the new regulated entities, lessons from the currents ETS MRV rules (on activity data, carbon content, biomass content, among others), the environmental taxes, regulations or markets systems can contribute to reduce the administrative burdens for the relevant entities. Also in view of a possible future integration of the new ETS with the current EU ETS, it makes sense to design the MRV system along the same lines as the one existing for the current EU ETS. An MRV cycle will be applied requiring regulated entities to monitor, to report every year to the competent authority and to surrender enough allowances to cover all its verified emissions.

Under an upstream ETS, the regulated entities (which are not the emitters themselves as in the current EU ETS) must be able to monitor and report, per type of fuel, the fuel volumes put on the market. They must know, to the extent necessary, the end use of the fuel to determine whether the fuel volumes put on the market are captured within the scope of the new ETS. Under EXT1, the end use of the fuel also needs to be identified. Emissions are determined indirectly via fuel quantities put on the market.

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[121] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation
Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

The monitoring and reporting rules would also be simpler than those applying to the current sectors. In the new sectors, only sales of largely standardised fuels for combustion purposes would be monitored. The new MRV system would share more similarities with the MRV applicable to aviation both in terms of costs and obligations.

MRV feasibility, requirements and further design choices are dependent on the point of regulation chosen and its specific nature.

The main MRV challenges for the extension of an emissions trading that have been identified are the following[122]:

The possibility for the regulated entity to ensure an accurate monitoring and reporting of CO2 emissions and to identify the end-user of the supplied fuel and distinguish fuels that will result in emissions in the transport and building sectors.

An important factor in the design of an ETS is that the regulated entity is able to accurately monitor and report CO_2 emissions. The most obvious monitoring option for the new ETS, which will necessarily be based on an upstream model, is the monitoring of volumes of relevant fuels put on the market. Standard emission factors based on the type of fuel can be applied to estimate the GHG emissions from the fuel consumption.

The main question is whether there is an adequate tracking mechanism for the relevant fuels if not, whether one could be developed at reasonable cost. Tracking mechanism for the use of fossil fuels by type is mostly dependant on the regulated entities.

Tax warehouse keepers need to keep track of the fuel buyers for tax reasons, directly providing a track mechanism by user and energy product. On the contrary, fuel suppliers do not always have to track the amount of fuels with the same accuracy because gas and coal are sometimes exempt from energy taxes, or in some cases, the energy taxes are not paid at their level. Nevertheless, they could in principle do so, which provides a good basis for building a tracking mechanism upon it[123].

CO_2 emissions from biomass are subject to specific rules under ETS. Therefore the blending of fuels with non-fossil fuels with biofuels or e-fuels raises an issue respecting the monitoring and reporting of accurate CO_2 emissions and needs to be analysed regarding the new regulated entities and its consistency with the Renewables Energy Directive and the Fuel Quality Directive.

The complexities involved in combining and delimiting upstream and downstream approaches for different sectors.

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[122] ICF et al. p.280 for further details.
[123] ICF et al. p. 303.

Some complexities can arise from combining upstream and downstream approaches for different sectors.

Excluded installations: One of the issues to solve will be how to deal with installations excluded from the current EU ETS according to Articles 27 and 27a of the EU ETS Directive (Directive 2018/410). One option would be to maintain the exclusion criteria in the new ETS. However, as excluded installations can be reintroduced into the EU ETS if conditions for reintroduction are fulfilled, then the entity becomes a regulated entity already covered by the EU ETS, for which the CO_2 emissions related to the fuel consumption should not reported twice. This has to be solved by identifying the end-user of the fuel supplied by the regulated entity.

District heating: A large share of the combined heat and power plants and district heating are already regulated under the EU ETS.[124] These entities are eligible for free allocation under the EU ETS.

It has been argued that there is a lack of level-playing field between the district heating sector (largely covered by the EU ETS) and other heat sources so far not covered by emissions trading (except for electricity). If emissions trading is extended to the buildings sector, fossil fuel supplies to small CHP and heat plants providing heat to district heating network would also need to be captured by emissions trading. Because of their small size, it does not seem appropriate to proceed to a general inclusion of the small CHP and district heating installations into the current EU ETS. It would on the other hand be appropriate to regulate the fossil fuels supplied to these entities for district heating purposes under the new ETS. It is thereby necessary to avoid slippage (making sure that all relevant fuel volumes supplied to small (non-ETS) CHP and heat plant for the purpose of producing district heat are captured), as well as double coverage (when fuel supplied to large (ETS) CHP and heat plants would also captured under the new emissions trading system). The MRV process would need to tackle boundaries challenges coming from the need to distinguish fuels supplied to ETS-district heating installations and fuels supplied to non-ETS district heating installations; from the need to allocate fuel supplies to power/heat separately, or from the need to know the end consumer of the heat[125].

The resulting cost and administrative burden for the regulated entity and the relevant administrative bodies and agencies.

[124] It is estimated that more than 90% of district heating emissions were covered by the ETS (76 Mt), while less than 10% were non-ETS district heating emissions (7 Mt) in the period 2016-2018.

[125] ICF et al. p.330: Identification of the end-user of the fuel means that the fuel supplier has to identify the share of heat delivered to every entity considered as part of the building sector (residential and commercial buildings, services, some hospitals), compared to the total heat delivered associated with the fuel burnt.

An MRV system results in costs and administrative burdens for the regulated entities and the relevant administrative bodies and agencies. Costs arise in each step of the MRV process.

If emissions trading is extended to road transport and buildings, the MRV complexity lie in the tracking of the end-user to avoid double-counting, loopholes or fraud[126].

The administrative burden for the MS administration would depend on various factors ranging from the administrative structure and specific organization of each MS, the number of competent authorities in each MS, the available resources, the number and size of the regulated entities and how the MRV process is set-up, including the activity to be monitored.

An extension of emission trading would increase by more than 100% the current number of regulated entities under the current EU ETS framework.

However, it is expected a lower complexity of the MRV rules for the new regulated entities, because only sales and distribution of largely standardized fuels for combustion purposes would be monitored. This corresponds to only one activity, but it is a new kind of parameter that the competent authorities need to consider when delivering their administrative tasks and activities.

Possibilities to reduce administrative costs could be to identify if some competent authorities already deal with the type of data to be monitored and reported by newly regulated entities in order to avoid double work when creating a new competent authority, develop simplified approaches for the new sectors, or to develop guidance documents, templates and IT tools for monitoring, reporting and verification activities.

The possibility for fraud of the regulated entity's monitoring and reporting system.

To ensure effectiveness and reliability of the ETS, fraud in the monitoring and reporting of CO_2 emissions by the regulated entities has to be made impossible or very costly. Regulatory solutions to prevent fraud under the MRV system have to be designed so to cover all possible situations as far as possible.

Experience has shown that the risk of fraud can be reduced increasing harmonization across MS, mainly by including monitoring, reporting, verification and accreditation requirements in regulations and issuing guidance documents and templates, as well as reinforcing the capacity of the competent authorities in MS.

The current legal framework for industrial installations and aircraft operators relating to MRV would be relevant starting points for any specific MRV requirements for the road

[126] ICF et al. (2020), p.333.

and buildings sectors, in particular in terms of reducing the possibility of fraud in the monitoring and reporting of emissions but would need to be adapted to introduce any new sectors. The possibility of fraud will depend on the regulated entity chosen and would need to expand or create new responsibilities for monitoring and reporting.

In the transport sector, the risk of fraud of an upstream system would typically relate to declaring false quantities of fuel sales or false shares of biofuels. However, this risk is minimal as tax warehouses have to comply with strict fiscal rules. The tax warehouse keepers are referred to in the ETD Directive under which MS are required to identify tax warehouses, keep registration of these entities and the type of fuels they trade. Therefore, the chances that those entities would not be identifiable and that would not implement or comply with ETS rules is very small. The same monitoring and enforcement measures used for excise duties could be used for ETS[127].

Furthermore, gas oil, widely used in road transport, but also for heating purposes, is subject to the Euromarker Directive[128]. This Directive requires that the gas oil that is released for consumption in the EU to a lower rate than the full excise duty rate has to be dyed with a yellow colour and to contain a tracer agent. Additional national markers may be applied in parallel. The application of the marker takes place in the tax warehouse before the gas is release for consumption. The quantities of the fuel that is marked are documented and reported by the tax warehouse. The marker is therefore an important tool for avoiding excise duty evasion in relation to consumption, and a control and enforcement measure to fight fraud.

Natural gas (LNG or CNG) is the only transport fuel that is not currently required to pass through a tax warehouse. Excluding them from the systems could stimulate a shift from the fuels covered by the ETS to natural gas. Two options can be considered: one is to consider appointing natural gas suppliers as the regulated entity, which will particularly be a feasible option as they could carry out this role for both the transport and building sector. Another option could be to establish the obligation to pass natural gas through tax warehouses[129].

To reduce the risk in monitoring the type and share of biofuel, gather data to determine the biofuel content would be a solution.

For the building sector, the choice of the tax warehouses as regulated entity allows to reduce fraud risk, but for gas and coal a new system will have to be developed. Tax warehouse keepers keep track of the fuel buyers for tax reasons, providing a track

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[127] ICF et al (2020) p.340.
[128] Council Directive 95/60/EC of 27 November 1995 provides for the designation of a common fiscal marker to be used for gas oils and kerosene (other than jet fuel) exempted or subject to a reduced rate.
[129] ICF et al (2020), p.340

mechanism by user and energy product, but fuel suppliers do not always have to track the amount of fuels with the same accuracy because gas and coal are often exempt from energy taxes[130].

15 TRADE OF ALLOWANCES

Under the new emissions trading system, a new type of allowances will be issued. As per the very nature of a cap-and-trade system, these allowances will be tradable. The question arises who should be able to trade these allowances: trading can be strictly limited to the regulated entities or it can be opened up also to other persons. The latter is the case for the ETS (both as regards primary trading at auctions and secondary trading).

Also with respect to the new emissions trading system, it makes sense to open trading to entities other than those entities that have compliance obligations under the new system. In order for a proper price discovery process, there needs to be sufficient liquidity in the market. Also, entities with compliance obligations under the new system are likely to need possibilities to hedge against price fluctuations, and will therefore need access to financial products that allow such hedging. Given the possibility of a future linking it makes sense to design trading under the new system along the same lines as for the existing ETS.

The main traders in the new type of emissions can expected to be the entities that would be regulated under the new regime, as well as financial intermediaries.

It is necessary to ensure a safe and efficient trading environment for the new type of allowances. For this an appropriate framework must be put in place, including a robust oversight regime designed along the lines of the one applicable to other financial markets. For the existing ETS, this is primarily achieved through the classification of emission allowances as financial instrument under financial market legislation.

If the new emissions trading system is set up under the umbrella of Directive 2003/87/EC, the financial framework that was put in place for the existing ETS will also apply to the trading in new allowances.

Finally, setting up the new emissions trading system under the umbrella of Directive 2003/87/EC will also allow the application of the VAT reverse charge mechanism to transfers of the new type of allowance.

[130] ICF et al. (2020), p.342

16 Coherence with other policies

16.1 Interactions with possible parallel coverage by Effort Sharing Regulation

For parallel coverage of emissions of buildings and road transport or all fossil fuels under a new ETS and under the ESR, there would be some administrative impacts. First, ESR administrative rules would continue to apply in parallel to the MRV rules for the new ETS. However, they are generic and the administrative costs related to the ESR implementation are limited and are independent from the emission scope, as they always start from GHG inventory emissions deducting (or not) emissions covered by the EU ETS.

In a nutshell, for the ESR there is no change envisaged compared to the current monitoring and compliance architecture. While there may be complexities resulting from differences in emission calculation methods under the EU ETS and under the GHG inventories, that will need to be further analysed, there is experience from dealing with such issues and related risks for ESR compliance for the industry sector, where such calculation methods differ more strongly. The impacts on monitoring and evaluation are further assessed in the ESR impact assessment Chapter 8 (How will actual impacts be monitored and evaluated).

Additional assessment of parallel coverage is included in the ESR impact assessment in sections 6.1.6, while sections 6.2.5 and 6.3.2 assess impacts of not covering those sector under the ESR.

16.2 Compatibility and implications of an ETS covering buildings with the relevant pieces of EU legislation in force

– *The Energy Performance of Buildings Directive 2010/31/EU, as amended*

The Energy Performance of Buildings Directive (EPBD) ensures reducing emissions both outside the scope of the ETS and within the ETS (i.e. electricity generation) by setting cost-optimal minimum energy performance standards for new buildings and existing buildings undergoing major renovation and other supporting energy efficiency measures related to buildings. By introducing a carbon price on top of its provisions, the price signal can provide an additional incentive to switching to decarbonized heating and cooling appliances in buildings, but even at very high price levels, it is very unlikely that will have an effect in accelerating renovations. It can however reduce their pay-back time, especially for light renovations.

An emissions trading system covering buildings as under option EXT1 can improve the energy performance in the building sectors by putting a price signal and therefore triggering investments in switching to more efficient or decarbonized heating and cooling appliances.

An ETS may incentivize investments for further achievement of the objective of the EPBD to drive energy performance of buildings (i.e. in line with the current legislation envelope improvements, technical buildings systems and boilers replacements, and on-building renewables[131]) as increased energy costs will increase the costs effectiveness of building energy efficiency measures. Additionally, it could ameliorate the full potential improvement of energy performance in the buildings sector driven by the EPBD[132] (both in terms of energy efficiency, meaning improvements to the building envelope, the technical buildings systems – boilers, air conditioning systems, ventilation units, etc – as well as how much renewables a buildings has on-site and how green its energy supply is).

However, in terms of key questions or issues for the integration of buildings into an ETS, the EPBD impacts in terms of emission reductions has to be taken into account when designing an emissions trading system covering the building sector. The cap will need to be set at a level that ensures a price signal beyond the implicit price already imposed by the EPBD in order to ensure any additional environmental benefit. The revision of the EPBD will enhance its role in promoting building decarbonisation through reinforced instruments which will be defined and which are not currently known with detail. As regards the impacts of the current EPBD, those are broadly covered by the EU Reference Scenario (for instance by incorporating the effects of the nearly-zero-energy-building provisions for new buildings), although it has to be recognized that not all the measures and effects of EPBD policies can be illustrated in detail with the use of energy system modelling, due also to the differences in national and climatic conditions across the EU.

The 2030 cap for the new sectors is based on a scenario which includes additional energy efficiency policies in the building sector which are however only approximated, and which will be complementary as regards the combined effect in achieving the 2030 55% goal. Besides that, the complementarity between ETS and EPBD should also look at their specific design measures. One element to look at is the cost-optimal methodology to calculate cost-optimal levels of minimum energy performance for buildings and building elements to be applied by MS. A carbon price on heating fuels could impact the cost-optimal balance between the investments involved and the energy costs saved throughout the lifecycle of the building. MS as a consequence may need to revise their standards accordingly. However, these standards need to be revised every five years in any case under the EPBD. The choice of regulated entities doesn't seem to have an impact on the

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131 Modelling for buildings has traditionally faced difficulties in reflecting the granularity of building renovation and therefore often simplified it by modelling different scenarios for increased levels of envelope improvements (insulation and windows) and then separately referring to boiler replacement as if totally disconnected (point raised for many years now, including during the preparation of the clean energy package).However, this should not lead to misunderstandings on the policy and its aims to improve the energy performance of the buildings stock. The current legal definition of energy performance, entails the best combination of building envelope measures (including façade, windows, roof and embedded insulation), but also equal footing on its technical buildings systems including of course boilers.

132 ICF et al. (2020).

EPBD framework as under an upstream approach such entities would not be directly involved in building renovations. Finally ETS auctioning revenues and related solidarity mechanisms like the Modernisation Fund could help EPBD objectives[133], as well provide or finance the financial incentives that MS are encouraged to put in place under Article 10 of the EPBD.

– *The Energy Efficiency Directive 2012/27/EU, as amended*

The objective of the Energy Efficiency Directive (EED) is to establish 'a common framework of measures to promote energy efficiency' to ensure that the EU's 2020 and 2030 energy efficiency targets are met[134]. The objective of the EED is coherent with the objectives of the ETS and both legal instruments, if carefully designed, can reinforce each other.

The EED currently contributes to GHG reductions by addressing energy demand, ultimately contributing to emissions reductions in sectors both within and outside the ETS. Energy efficiency improvements can have impact in price developments in the ETS. The impact of the current EED (via the REF) as well as further efficiency measures is factored into the cap-setting under option EXT1 as the 2030 cap is set based on scenarios combining the impacts of strengthened regulatory policies with carbon pricing.

Furthermore, the energy efficiency measures promoted by the EED would likely become more cost-effective if the building sector be fully brought within the scope of the ETS, due to higher costs for building heating with fossil fuels. This could therefore accelerate progress towards achieving the targets in the EED.

From 2014 to 2020, MS had been required to implement policy measures to achieve cumulative energy savings equivalent to annual reduction of 1.5% in national energy sales by the end of 2020. For the period 2021-2030, the EED requires MS to set national energy efficiency targets, and to establish policy measures and tools to achieve their targets. In 2018, as part of the 'Clean energy for all Europeans package', the Co-Legislators agreed on the new amending Directive on Energy Efficiency (2018/2002/EU) to update the policy framework to 2030 and beyond. The key element of the amended directive is a headline energy efficiency target for 2030 of at least 32.5%. It also includes an extension to the energy savings obligation in end-use, introduced in the 2012 Directive. Under the amending Directive, EU countries will have to achieve new energy savings of 0.8% each year of final energy consumption for the 2021-2030 period, except Cyprus and Malta which will have to achieve 0.24% each year instead. Article 7 EED allows MS for the first obligation period 2014-2020 to exclude a range of energy end

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[133] ICF et al. (2020).

[134] Article 1, Directive 2012/27/EU as amended.

uses when calculating their targets (transport, energy for own use etc.), and a number of exemptions up to maximum of a 25% reduction of the energy savings target. All MS have applied at least one of these exemptions to reduce their target for the period 2014 to 2020. MS may, for example, exclude from the calculation all or part of the sales of energy used, by volume, with respect to the energy savings obligation period by industrial activities listed in Annex I to Directive 2003/87/EC.

For the obligation period 2021-2030 and beyond, Article 7(5) EED as amended provides that, whether or not MS exclude, in whole or in part, energy used in transport from their calculation baseline or make use of any of the options in Article 7(4) EED, they must ensure that the calculated net amount of new savings to be achieved in final energy consumption over the 2021 2030 obligation period is not less than 0.8% (0.24% for Cyprus and Malta). For the obligation period 2021 to 2030, none of the MS used the flexibility provided in Article 7(4)(b) of the EED as amended.

MS must achieve the required cumulative end-use energy savings by establishing an energy efficiency obligation scheme (EEOS), adopting alternative policy measures, or a combination of both. A policy measure is defined as a regulatory, financial, fiscal, voluntary or information provision instrument formally established and implemented in a MS to create a supportive framework, requirement or incentive for market actors to provide and purchase energy services and to undertake other energy efficiency improvement measures (Article 2(18) EED). It is considered that well-designed EEOS can deliver significant, cost-effective energy savings over many years. This requirement drives measures in various sectors; to a large extent in the buildings sector, but also in transport and industry.

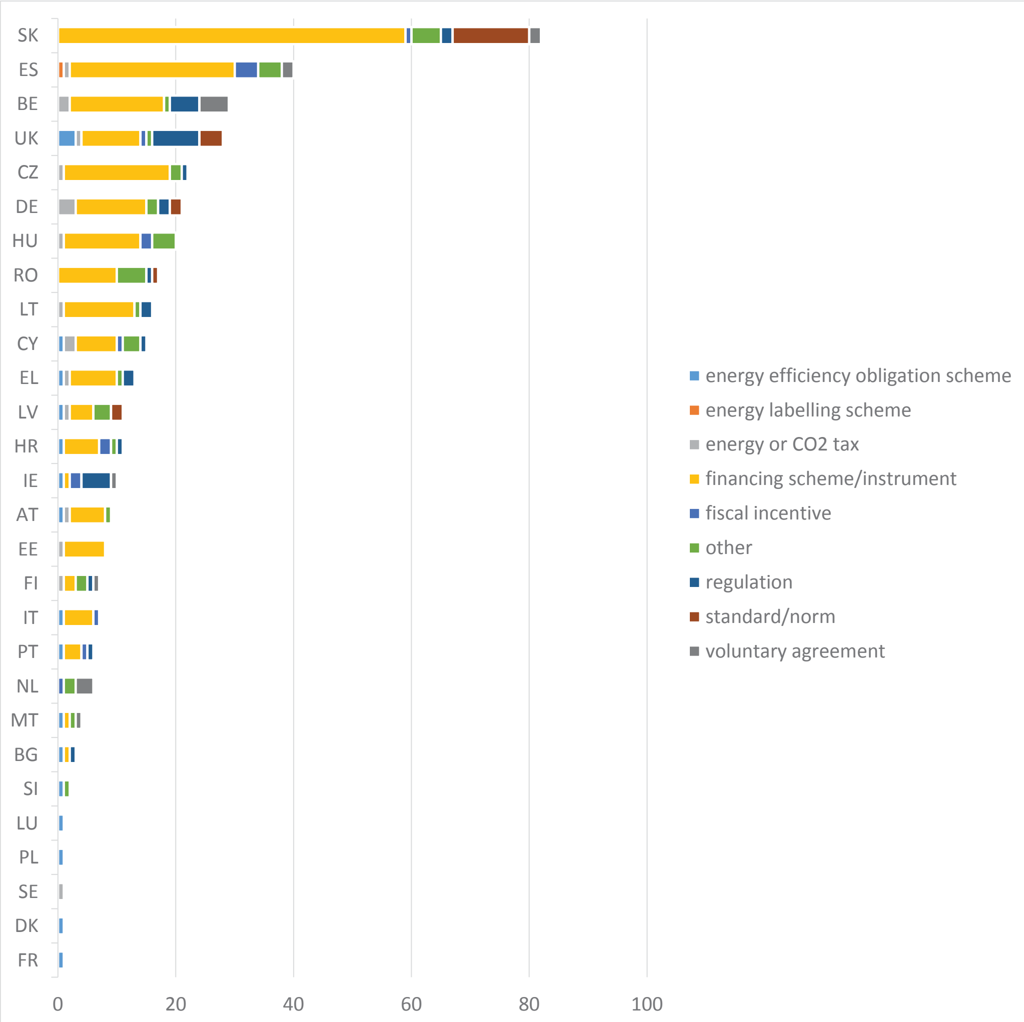
Regarding the obligation period 2014-2020, some MS notified only one policy measure, all of them but one implemented an EEOS. Sweden notified for instance only a taxation measure. Six countries reported more than 25 policy measures. All countries with more than 10 policy measures reported a mix of at least five different instrument types.

18 MS have notified 20 EEOSs for the purpose of reporting energy savings towards the 2014-2020 energy savings obligation[135]. Eleven MS had energy efficiency obligation schemes in place at the beginning of the 2014-2020 target period. Since then seven further EEOSs have been reported with three still to generate energy savings by the end of 2018 (as reported in the 2020 Annual Reports). Amongst the MS that report energy efficiency obligation schemes, four (Denmark, France, Luxembourg and Poland) report energy savings only from an EEOS. In the other 14 MS with energy efficiency obligation schemes, a combination of EEOSs and alternative measures is used. Only a few MS introduced White Certificates which are tradable and recognised as market-based

[135] The United Kingdom reports three EEOSs, two of which did not produce any new actions after 2012.

instruments to promote energy efficiency measures. Horizontal trading between obligated parties is relatively common amongst EEOSs in the EU whereas vertical trading is relatively rare, with two EEOSs (Austria and the United Kingdom) facilitating vertical trading, e.g. through brokerage mechanisms, and three EEOSs (France, Italy and Poland) allowing trading in the form of White Certificates.

Figure 25: Number of reported policy measures by Member State

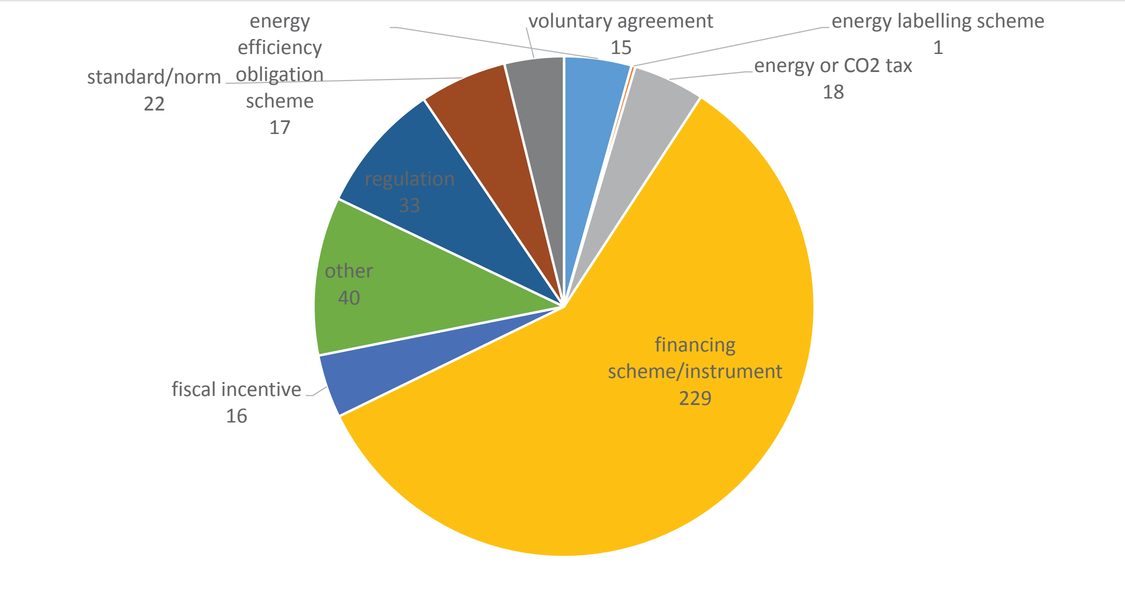


Source: Assessment of Commission services supported by technical assistance

The majority of the reported policy measures are financing schemes/instruments. The remaining of notified policy measures refers to other instrument types.

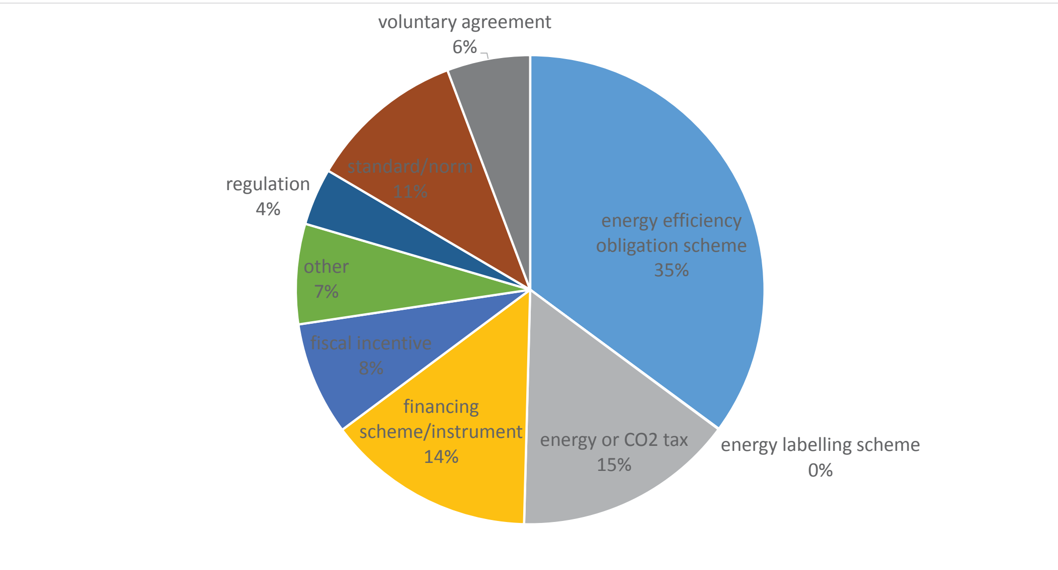
More than a third of the reported energy savings (around 35%) result from energy efficiency obligation schemes, whereas financial schemes contribute with 12% to the overall energy savings. Energy and CO_2 taxes contribute with 16%.

Figure 26: Number of reported policy measures by Member State, as of November 2020



Source: assessed by Commission services with technical support

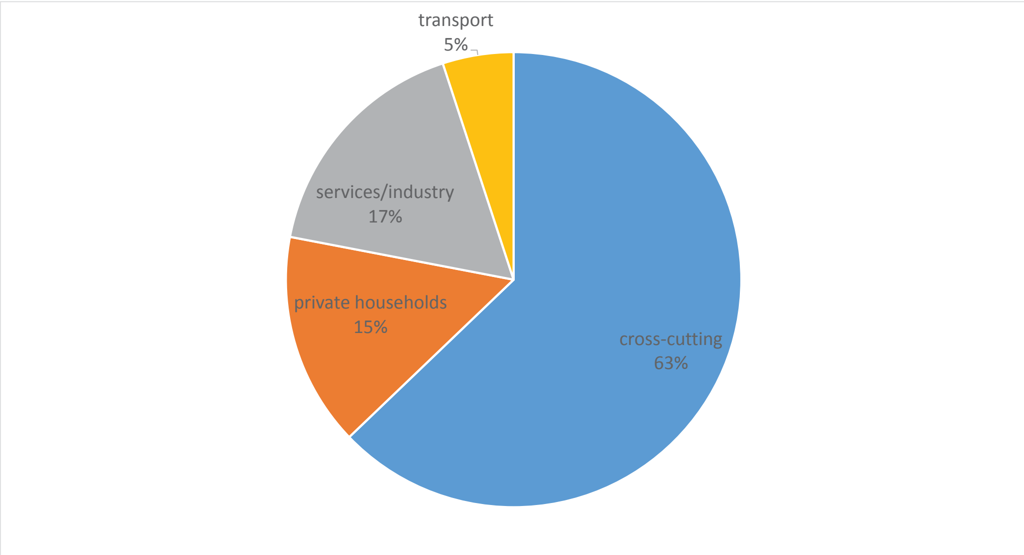
Figure 27: Share of reported energy savings by policy measure type on EU level, as of November 2020



Source: Commission services based on technical assistance

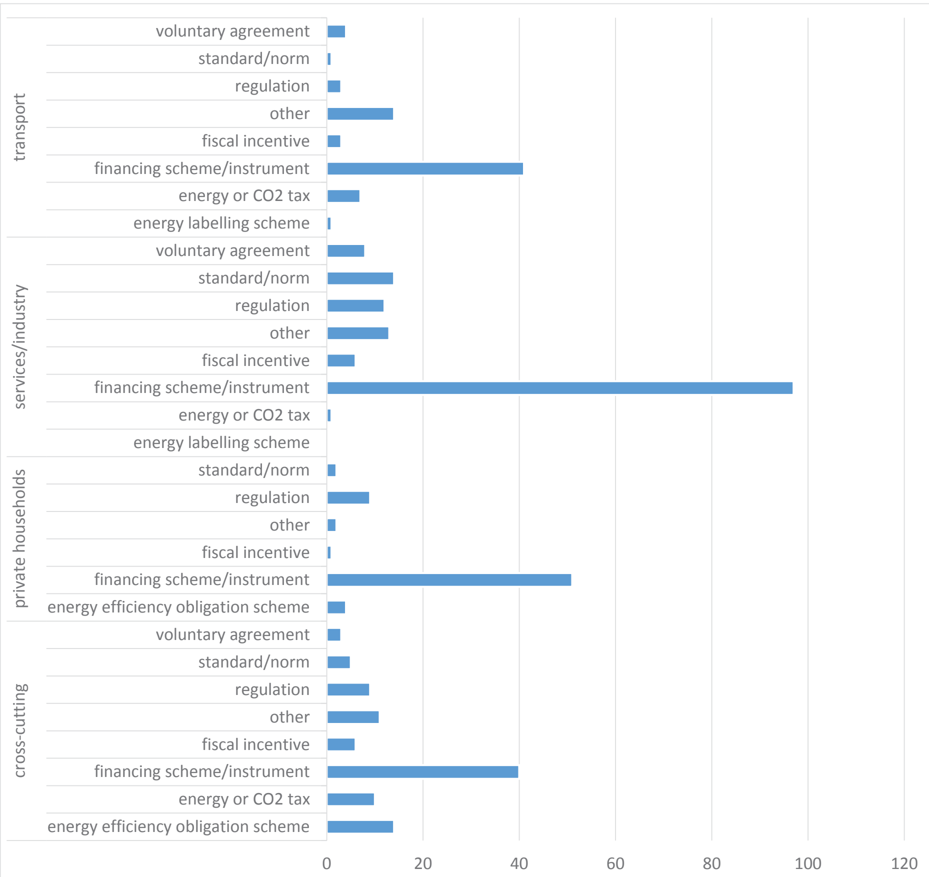
Regarding the sectors targeted by the policy measures under Article 7 EED, the major share of energy savings results from cross cutting measures, which cannot be attributed to a single sector. The two main instrument types in terms of energy savings, energy efficiency obligation schemes and taxation measures, are exclusively cross-cutting. The majority of measures (by count) is targeting services/industry, reflecting the heterogeneity of this sector.

Figure 28: Share of reported energy savings by sector on EU level, as of November 2020



Source: Assessment of Commission services based on technical assistance

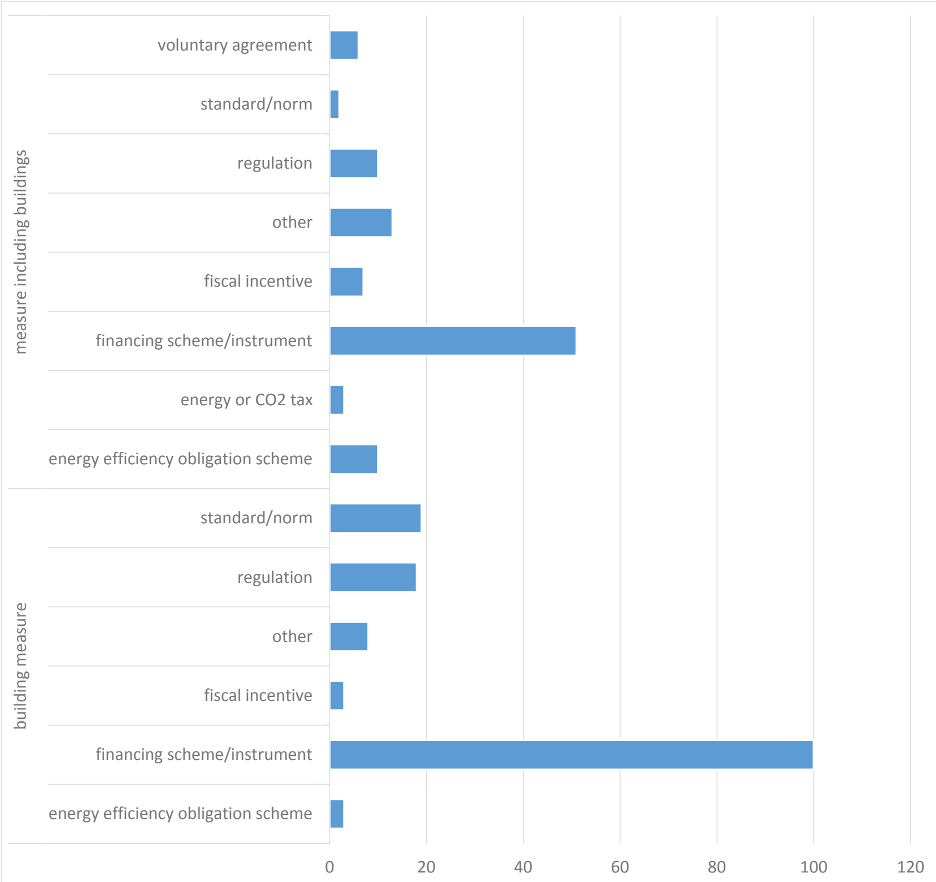
Figure 29: Number of policy measures by instrument type for targeted sector on EU level, as of November 2020



Source: Assessment of Commission services based on technical assistance

As buildings represent a major share of the EU's energy consumption, a broad variety of policy measures targets them exclusively or at least partially. Among the measures targeting buildings exclusively, financing schemes prevail.

Figure 30: Number of policy measures only targeting buildings and measures including buildings by instrument type on EU level, as of November 2020

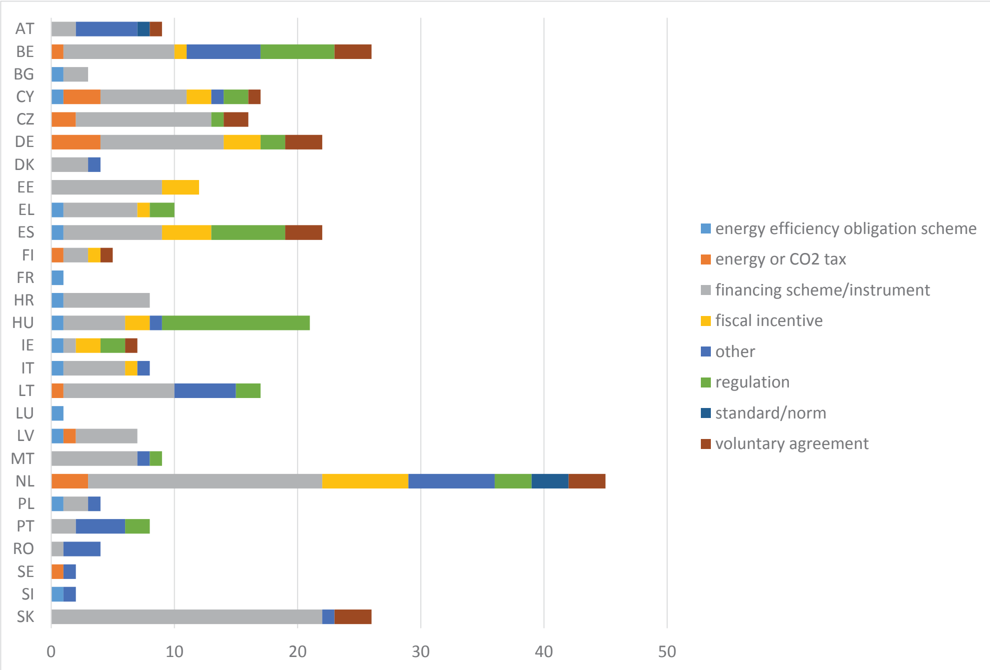


Source: Assessment of Commission services based on technical assistance

Several MS already implemented policy measures to achieve energy savings in the buildings sector in the period 2014-2020.

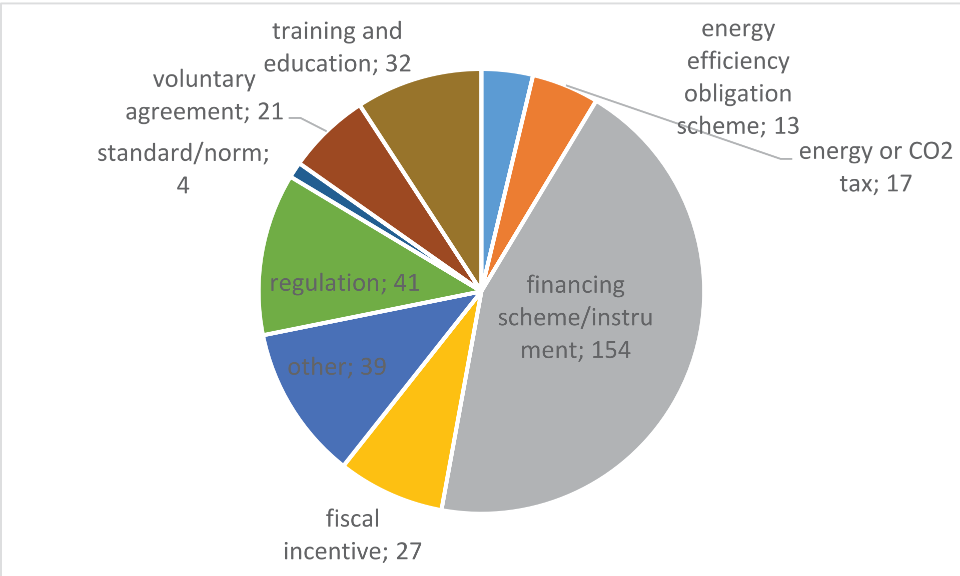
Regarding the obligation period 2021 to 2030, MS submitted with their first National Energy and Climate Plans the policy measures they intend to implement to achieve the required energy savings by 2030. The structure of the reported policy measures by type are very similar as for the obligation period 2014 to 2020. Around 50% of the policy measures are financial programmes. But again, when looking at the savings achieved by the different policy measure types, around 70% of the savings are achieved by the energy efficiency obligation schemes, and another 25% by the financial schemes. Consequently, most of the energy savings are achieved in the cross-cutting sector, and not in the individual sectors.

Figure 31: Number of reported policy measures by Member State, as of November 2020



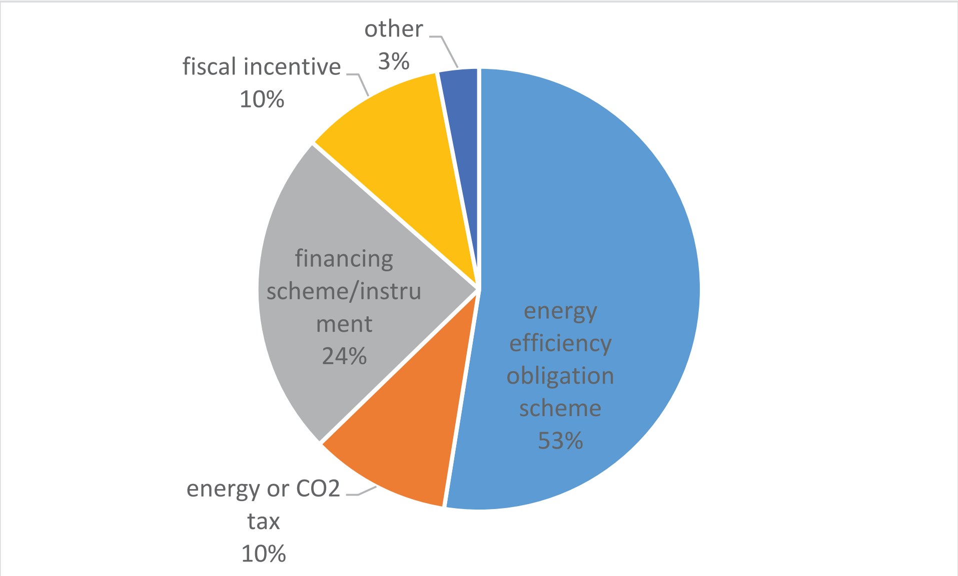
Source: Assessment of Commission services based on technical assistance

Figure 32: Number of policy measures by instrument type, as of November 2020



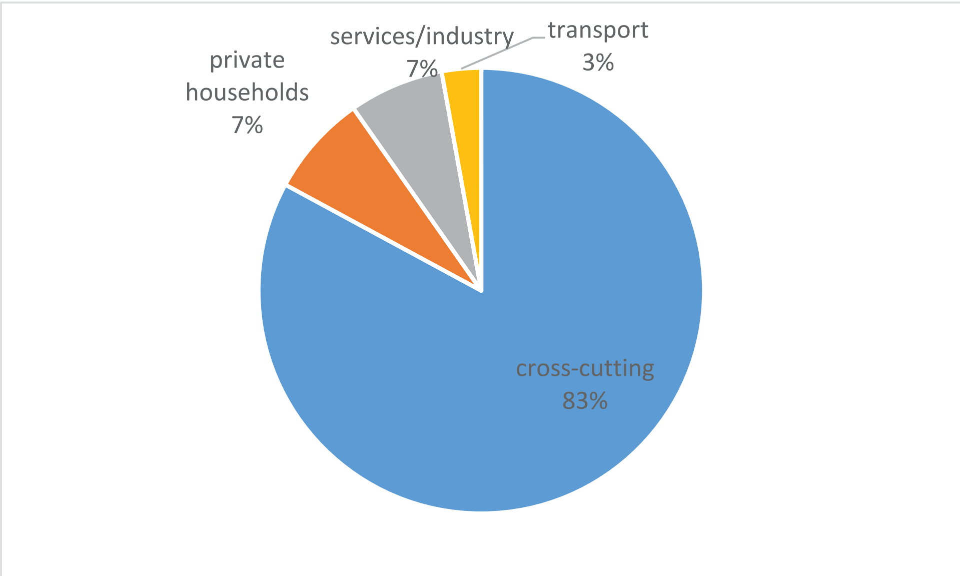
Source: Assessment of Commission services based on technical assistance

Figure 33: Share of cumulative energy savings 2021-2030 by instrument type, as of November 2020



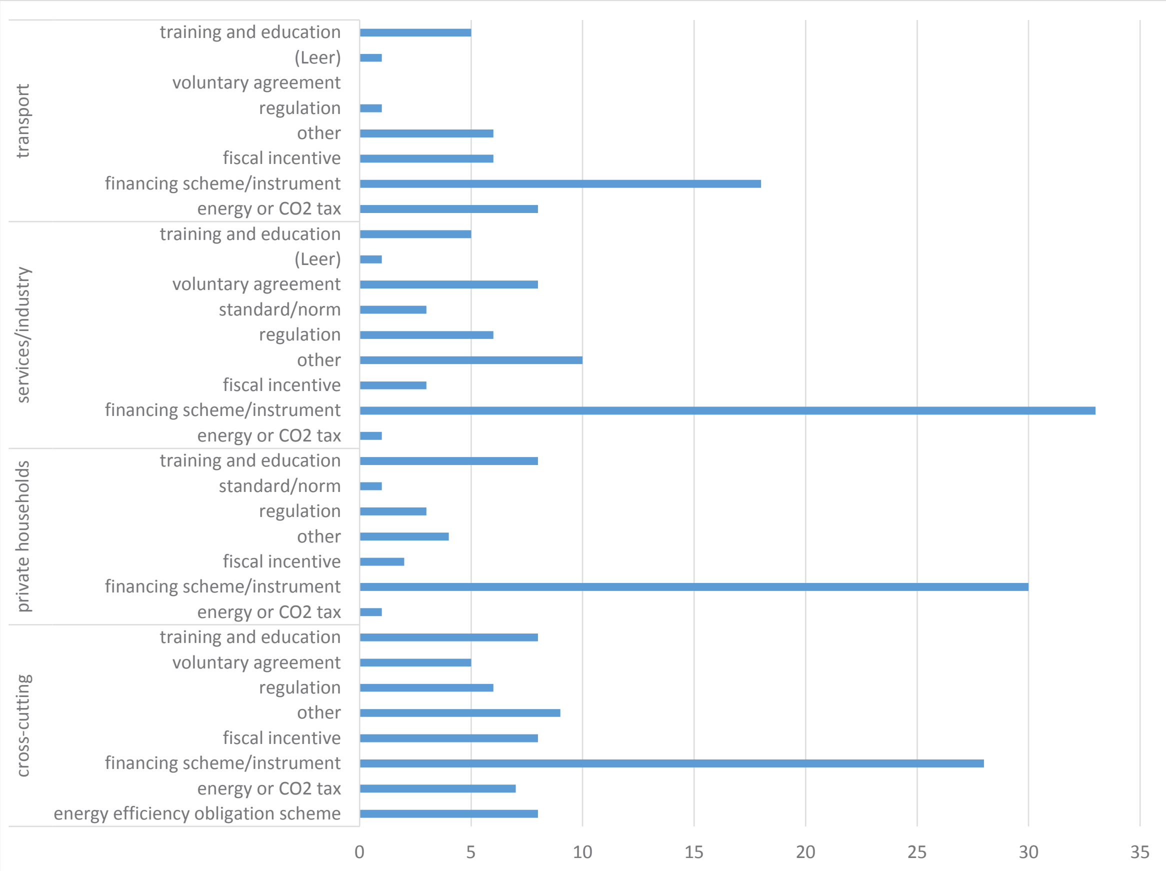
Source: Assessment of Commission services based on technical assistance

Figure 34: Share of cumulative energy savings 2021-2030 by targeted sector, as of November 2020



Source: of Commission services based on technical assistance

Figure 35: Number of policy measures (type) reported per sector, as of November 2020



Source: Assessment of Commission services based on technical assistance

Regarding the building sector, MS submitted a significant number of policy measures planned to be implemented in the 2021-2030 period. The scope of these measures varies from very specific measures focused on a given sub-sector or end-use, to a cross-cutting Energy Efficiency Act. The majority of these policy measures target buildings, alone or together with other sectors or end-uses. "Buildings" means here the building envelope and heating ventilation and air conditioning systems.

Of the policy measures strictly focused on individual actions in buildings, about half focus on residential buildings and some are cross-cutting (i.e. covering both, residential and non-residential buildings). The vast majority of the building focused policy measures are financial incentives, mostly financing schemes, and to a smaller extent fiscal incentives. The other building-focused policy measures are regulatory measures.

In addition, MS submitted a significant number of measures which do not strictly focused on buildings, but include them in their scope of eligible actions, together with actions covering other end-uses (e.g. appliances, lighting, industrial processes). This includes for example cross-cutting measures such as energy efficiency obligation measures or voluntary agreements, general behavioural and information measures or measures promoting energy management. About half of those including buildings in their scope cover both residential and non-residential sectors. More than a third are focused on the non-residential sectors (industry and services). A smaller rate of policy measures are focused on the residential sector.

According to the information submitted in the NECPs (Annex III), in the period from 2021 to 2030 at least 52% of the energy savings will be realized on buildings (the remaining 48% would come from cross-cutting measures which could also target buildings). These are to be achieved either via energy savings obligations scheme, which are currently in place in 15 EU MS, or alternative measures.

Measures adopted by MS to meet their obligations under the EED are likely to impact a broad range of entities, including regulated entities under option EXT1 such as energy suppliers. MS national EEOSs are likely to directly regulate suppliers of energy for building heating and cooling services, including suppliers of electricity, heat, gas, liquid and solid fuels. If the building sector is brought within the ETS and the obligation is set at the point of supply, suppliers of gas, liquid and solid fuels may be regulated under both schemes.

MS designate one or more obligated parties at national level that are required to achieve energy savings among final customers. The designation of an obligated party must be based on objective and non-discriminatory criteria as provided in Article 7a(2) EED.

Most MS have chosen to obligate energy suppliers. However, in Denmark and Italy distribution companies are obligated, while in Portugal, the obligation is held by a non-profit private entity with a public function. One of the UK's energy obligation schemes obligated both energy suppliers and licensed electricity generators.

Several MS employ a threshold above which energy companies are obligated. In other countries there is no threshold in place and small energy companies often participate through sector associations or other bodies that can act collectively on their behalf. Where thresholds are in place, they vary in the way they are defined. For example, in Ireland the threshold is set in energy terms, at a minimum of 600 GWh of sales per year, while in Austria and Latvia on 25 GWh and 10 GWh per year, respectively. In the UK, the threshold is set in terms of number of domestic customer accounts (250 000 in 2014, falling to 200 000 in 2019 and 150 000 in 2020, reflecting the increasing number of small electricity suppliers in the UK market.

The obligated parties' fuel and sector coverage also varies between schemes, with many programmes covering all fuels and sectors, e.g. Austria, France, Greece, Ireland, Luxembourg and Slovenia. However, where thresholds are sufficiently restrictive this can, in practice limit fuel coverage to electricity, gas, oil and district heating. In some programmes, fuel coverage is limited to electricity and gas (e.g. Italy and the UK), while in others it is limited to electricity only (e.g. Latvia and Malta). In a number of programmes transport sector fuel coverage is excluded (e.g. BG, IT, PL and the UK) while in the UK sector coverage is limited to the household sector.

In most schemes the fuel and sector coverage of the energy efficiency actions open to obligated parties matches the scope of the fuels and sectors used to calculate their obligation. This ensures that all the end-users that ultimately pay for the programme costs of the energy efficiency obligation scheme have the possibility to benefit from the energy efficiency actions brought about through the scheme. A narrower focus for energy efficiency actions would leave some end-users paying and unable to benefit, while a broader focus would enable some end-users to benefit without paying. However, in at least one energy efficiency obligation scheme (Italy) obligated parties can meet their obligations through energy savings generated outside of the sectors to whom they pass through costs, although in practice most energy efficiency actions save electricity and gas (the obligated fuels).

Fulfilling the obligations under the Article 7a EED will help the obliged parties to lower their GHG emissions and thereby also the ETS related costs.

Interactions or overlaps might occur regarding energy efficiency obligation schemes (including White Certificates) implemented or to be implemented by MS. In addition, overlaps might also occur regarding voluntary agreements established by MS with the industry sector (which is e.g. the case for Flanders), and other alternative policy measures, e.g. taxation measures or financial and fiscal schemes.

EEOSs tend to have stronger monitoring and verification regimes than the alternative measures (excluding taxation measures) that account for the majority of the energy savings reported under Article 7 EED.

Taxation measures implemented under Article 7 EED, e.g. taxes on fuel for transport (Czechia, Finland and Lithuania), cross-cutting taxes that cover transport (e.g. Cyprus and Greece), travel taxes, either km-tax or tolls for trucks (Austria, Belgium and Germany) or air passenger duty (Germany) have effects on the transport sector in terms of modal shift (e.g. to rail mode) or in reducing travel demand and improving the energy efficiency per goods carried (by providing an incentive to freight companies to optimize the truck loads).

MS already implemented other policy measures explicitly targeting modal shifts as part of their objectives. Half are umbrella policies for transport or mobility (Austria, Hungary, Romania, Slovakia and Spain). Three are related to metro extensions (Greece, Hungary and Romania). The three others are specific measures: companies' mobility plans in the Brussels region, City bike systems in Croatia, and subsidies to decrease cost of public transport in Hungary.

The majority, 45 of the 58 policy measures aim at improving the efficiency of transport modes, and particularly road vehicles (22 measures). The predominance of measures related to improving efficiency of transport modes might be because energy savings from these measures are easier to monitor, and their energy savings effects are easier to demonstrate.

The notified transport policy measures under Article 7 EED first target private passenger travels (26 measures), public transport (19 measures) and freight (14 measures) (one policy measure might target different travel types). A few measures had a specific scope: fleet management system for the Central government's vehicles in Cyprus, the PIMA Tierra scheme for tractors in Spain, waterway and air transport modernisation in Romania.

Interactions or overlaps might occur regarding energy efficiency obligation schemes (including White Certificates) or other policy measures under Art. 7.

The functioning and effectiveness of the energy savings obligation schemes as key delivery instrument could be affected. The two instruments would most likely have to rely on the same regulated entities, which could not always be easy to implement, because the obligated parties under the Article 7 energy savings obligation schemes are defined at MS level and consequently differ across the countries. Usually these cover energy suppliers, but can also be energy distributors (network operators). However, this is less an issue for MS using alternative policy measures under Art. 7b. The latter MS include Germany, which is in a particular position as there a national ETS targeting among others the building sector is being implemented.

– *the Renewable Energy Directive 2018/2001/EU*

The objectives of the Renewable Energy Directive (RED) are coherent with those of the ETS. Under option EXT1, the price signal of the ETS may contribute to the objectives of the RED by increasing the cost-effectiveness of renewable energy sources compared to fossil fuel energy sources. The emissions reductions achieved through the RED would potentially affect the scarcity of allowances and the price signal under the ETS. This is factored in through the cap-setting based on scenarios which fully include the RED impact.

The RED includes specific provisions for buildings (article 15 (4) and 15(5)) by requiring MS to introduce appropriate measures in their building regulations and codes in order to increase the share of all kinds of energy from renewable sources and requiring the use of minimum levels of renewables in new buildings and existing buildings that are subject to major renovation, in so far as technically, functionally and economically feasible. In addition, MS shall ensure that new public buildings, and existing public buildings that are subject to major renovation, at national, regional and local level, fulfil an exemplary role and they may allow that obligation to be fulfilled by complying with nearly zero-energy building provisions as required in Directive 2010/31/EU. Indicative targets for heating and cooling (Article 23) and requirements in renewables for district heating and cooling networks for 2021-2030 (Article 24) have triggered some increased RES shares in the heating supplied for buildings.

Indeed, in order to promote the use of renewable energy in the heating and cooling sector, Article 23 provides for an umbrella heating and cooling indicative target that covers all sectors, including buildings. The target is 1.3 percentage points as an annual average calculated for the periods 2021 to 2025 and 2026 to 2030. Up to 40% can be covered by waste heat, if a MS decides so.

Article 23(4) lists possible measures that can be used to fulfil the targets. Point a) relates to fuel switch. The rest of the measures relate to fuel switch in a more indirectly way. This list may be extended.

Article 24 mirrors the overall heating and cooling target established under article 23 by setting an indicative annual average one percentage point increase as an annual average in renewables for district heating and cooling networks for the period 2021 to 2025 and for the period 2026 to 2030. This target is indicative and optional.

As with the EED, there is likely to be some overlap in terms of the regulated entities covered. Regulated entities under MS measures to implement the RED are likely to include suppliers of fuel used in building heating and cooling, who would partly also be regulated entities under option EXT1[136].

- *the Ecodesign Directive 2009/125/EC;*

The objective of the Ecodesign Directive is to set a framework for Ecodesign requirements for energy-related products that are placed on the EU market. The implementing measures set minimum performance requirements and information requirements for specific products. The Directive specifies that the level of energy efficiency or consumption must be set aiming at the life cycle cost minimum to end-users for representative product models, taking into account the consequences on other environmental aspects. The Ecodesign Directive and its measures are complementary to that of the ETS. Inclusion of the building sector in the ETS would possibly support the goals of the Ecodesign Directive: the increased costs of using inefficient heating and cooling equipment could drive faster uptake of more efficient products that meet the Ecodesign requirements for boilers and water heaters. The Ecodesign Directive could also partially assist in limiting the potential negative social impacts of including space heating and cooling in the ETS by providing final residential consumers with products that could aid in reducing the costs of heating and cooling[137].

- *the Energy Labelling Regulation (EU) 2017/1369*

[136] ICF et al. (2020).
[137] ICF et al. (2020).

The Energy Labelling Regulation lays down a framework for the labelling of energy-related products. The Commission will review and rescale EU energy labels for key products like space heaters, water heaters, air conditioning systems in the coming years. Energy labels incentivize consumers to choose the best performing appliances. Pursuant to Article 7(2) of the Energy Labelling Regulation, where MS provide incentives for specific products with energy labels, such incentives shall aim at the highest two significantly populated classes. The Energy Labelling Regulation and its delegated acts for heating and cooling appliances are complementary with the ETS. Like the inclusion of the building sector in the ETS does via a price signal, energy labels steer consumers towards more energy-efficient heating and cooling appliances, while Article 7(2) of the Energy Labelling Regulation steers financing towards the most efficient appliances.

– *the Energy Taxation Directive (Directive 2003/96/EC)).*

Broadly speaking, the objectives of the Energy Taxation Directive (ETD) are in line with those of the ETS and their coexistence could reinforce their effectiveness. Indeed, under the ETD (Article 9 and Annex I), energy taxes are decided on a MS level, but there are minimum excise duty rates that MS must apply to energy products for motor, heating and electricity fuels. However, even if the minimum excise duty levels are often translated into "effective carbon taxes" in MS by using the carbon intensity of the respective fuel, often energy excise duties are levied for reasons other than pricing in part of the carbon externality.

The ongoing revision of the ETD, planned for the second quarter of 2021, includes as one possible option for discussion, taxation rates based on a carbon content to the sectors not covered by the ETS, on top of the energy content. This option would incentivize products with low or zero content (as hydrogen, advanced biofuels and renewable electricity) and would allow to differentiate among various fossil fuels, such as less CO_2 intensive natural gas and more CO_2 intensive coal.

The ETS and the ETD would potentially overlap, as both Directives would send a price signal to end users that should reduce their demand for energy, and ultimately reduce GHG emissions. In addition, exemptions for ETS installations would have to apply[138].

In any case, if extending emission trading to buildings, a key challenge is to identify the regulated entities. The tax warehouse operators could be an appropriate regulated entity but would present some difficulties as natural gas and coal do not pass through tax warehouses, and some MS specifically exempt these fuels from energy taxation when used in residential heating.

[138] ICF et al. (2020).

Table 48: Effective 2020 carbon price by Member States

Sector	Fuel	Min.	AT	BE	BG	HR	CY	CZ	DK*	EE	FI*	FR*	DE*	EL	HU	IE*
Transport	Diesel	110,8	133	201	111	139	134	143	144	125	240	244	183	138	114	166
	Petrol	158,9	213	231	160	231	190	221	279	249	373	347	315	310	164	266
	LPG	40,4	84	301	56	4	40	49	173	62	153	85	113	139	93	63
Residential heating	Diesel	7,5	35	6	9	20	27	9	120	134	142	101	47	147	122	42
	Heavy Fuel Oil	4,8	19	5	8	7	5	6	122	18	141	89	30	12	7	31
	LPG	13,3	14	6	0	4	0	0	103	18	144	112	45	19	93	25
	Natural Gas	5,3	30	8	0	5	46	6	159	19	155	86	52	5	0	0
	Coke and coal	3,2	18	4	3	3	3	3	104	10	120	88	28	3	0	0

Sector	Fuel	Min.	IT	LV	LT	LU	MT	NL	PL	PT*	RO	SK	SI*	ES	SE
Transport	Diesel	110,8	207	139	125	119	138	169	113	172	115	132	146	127	219
	Petrol	158,9	322	225	206	209	216	354	170	295	165	246	201	223	288
	LPG	40,4	87	92	98	33	13	113	62	105	44	59	65	19	115
Residential heating	Diesel	7,5	145	20	8	4	62	181	19	139	123	141	84	35	144
	Heavy Fuel Oil	4,8	20	5	5	5	12	12	5	33	5	37	29	5	134
	LPG	13,3	61	0	0	3	13	113	4	105	39	0	24	5	142
	Natural Gas	5,3	21	8	5	19	15	208	5	29	6	7	33	12	147
	Coke and coal	3,2	5	8	3	11	3	5	3	23	3	3	25	7	113

*Figures for countries with a * include national CO_2 taxation. Calculations based on the "Taxes in Europe Database"*[139]

16.3 Compatibility and implications of an emissions trading system for road transport with the relevant pieces of EU legislation in force

– *Vehicle CO_2 performance standards*[140]

Reducing CO_2 emissions from road transport in the EU has been driven through fleet-level emissions standards, which set annual CO_2 performance targets for the new vehicle fleet of manufacturers to meet by a certain date, thereby encouraging the supply of efficient and zero- and low-emission vehicles. The CO_2 standards and inclusion of transport into the ETS follow the same emissions reduction objective through different complementary approaches: the CO_2 standards address the CO_2 efficiency of new fleet while ETS would cover the fuel use in the entire vehicle stock.

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[139] https://ec.europa.eu/taxation_customs/tedb/splSearchForm.html, calculations using the official EU emission intensity factors as in COMMISSION IMPLEMENTING REGULATION (EU) 2018/2066.

[140] Regulation (EU) No 333/2014; Regulation (EU) No 253/201; Regulation (EU) 2019/631: Regulation (EU) 2019/1242

As the CO_2 performance standards have generally been effective at lowering emissions in the light-duty vehicle transport sector and are expected to be so in the heavy-duty sector with the application of the new CO_2 performance standards, including the road transport in an emissions trading system have to be carried out without weakening the existing and future standards.

ETS coverage could be complementary to the CO_2 standards to the extent that it could address possible rebound effects, whereby customers drive more as their vehicles become more efficient due to lower usage costs[141]. An ETS inclusion would increase the price of every additional kilometre driven. ETS coverage could also address one of the deficiencies of the CO_2 standards, which is that as it is achieved under testing conditions, it does not capture real-life emissions. In addition, an increase in fuel prices through the ETS could increase demand for more fuel-efficient vehicles, allowing for fulfilment of the efficiency objectives of the car manufacturers.

The entities concerned by the regulations on vehicle CO_2 performance standards are the vehicle manufacturers. An inclusion of transport into an ETS would not lead to overlaps in terms of regulated entities. While pricing can have a complementary impact to other policies, supporting fuel shift and logistics improvements, as well as purchase decisions, and other regulatory instruments, like the CO_2 standards, are necessary to tackle market barriers and failures[142]. Pricing supports these other instruments. In fact, without instruments such as vehicle standards addressing the supply of vehicles, pricing policies would be less effective, due to the low price elasticities in road transport.

In the short term, the current estimated low price elasticities of road transport are due to the long investment lead times of private car users. The relatively low price elasticities in general are also due to the market barriers, such as split incentives (for instance between first and second owner, company cars), short-term consumer perspective, a lack of information, lack of access to finance, lack of alternative fuels infrastructure, lack of internalisation of externalities ranging from climate change to innovation, lack of access to public transport, etc.

For instance, private consumers typically severely discount future fuel savings[143], only taking these into account on average up to a time horizon of a few years[144]. Furthermore, there are split incentives between the first and second owner of the car. Purchasers of new cars have preferences skewed away from fuel economy and towards factors such as

[141] ICCT, *op. cit,* p. 5; CE Delft, *Analysis of the options to include transport and the built environment in the EU ETS* (2014), p. 60

[142] Impact assessment on the cars and vans CO2 emission standards.

[143] See e.g. Greene, D. L., Evans, D. H., Hiestand, J., *Survey evidence on the willingness of U.S. consumers to pay for automotive fuel economy (2013)*. In: Energy Policy. 61, pp. 1539–1550.

[144] See e.g. Greene, D. L., Evans, D. H., Hiestand, J., *Survey evidence on the willingness of U.S. consumers to pay for automotive fuel economy (2013)*. In: Energy Policy. 61, pp. 1539–1550.

comfort and power[145], and even more so if the car is purchased as a company car, and fuel expenses are paid by the company.

– *The Eurovignette Directive 1999/62/EC*[146]

The Eurovignette Directive provides the legal framework for charging heavy goods vehicles (HGVs) for the use of certain roads and infrastructure. It currently does not apply to light duty vehicles (LDVs) or passenger transport. The Directive aims to eliminate internal market distortions and promote a step-wise harmonisation of vehicle taxes and fair infrastructure charging. It is predominantly concerned with infrastructure charging, thus implementing the user pays principle in addition to the polluter pays principle. The road charges are predominantly meant to be invested in optimizing the transport system and in particular infrastructure maintenance, while the revenues collected from external cost charges should be used to make transport more sustainable.

The Eurovignette Directive is currently being revised. The Commission proposed the variation of infrastructure charges according to the CO_2 emissions for trucks and buses and the extension of the scope also to light duty vehicles[147]. The co-legislators agree in their negotiating positions on extending its scope to all HGVs and LDVs.

– *Renewable Energy Directive*

The Renewable Energy Directive 2018/2001 (REDII)[148] and the inclusion of transport in an ETS would be compatible. However, the increase in supply of renewable energy for transport due to REDII could lower the number of allowances necessary for transport under the ETS leading to a lower carbon price, which would need to be taken into account when designing the new ETS.

Concerning the regulated entities, the entities concerned in the RED II are the fuel suppliers, who must demonstrate that the minimum share of energy supplied for transport fuels from renewable sources is met. REDII includes a reporting and monitoring methodology for the energy content of transport fuels, covering petrol, diesel, natural gas, biofuels, biogas, renewable liquid and gaseous transport fuels of non-biological origin, recycled carbon fuels and electricity supplied for transport. These reporting requirements are potentially complementary for ETS inclusion.

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[145] ICCT 2019/2020 EU vehicle market statistics. Between 2001 and 2018 average CO_2 emission levels for new cars, according to the official test procedure, have decreased by about 30%, vehicle weight has increased by +10% and engine power has increased by +30%.

[146] Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures, OJ L 187, 20.7.1999

[147] COM(2017) 275

[148] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources

Even if tax warehouses is the regulated entity under a new and separate ETS, considering that natural gas (LNG or CNG) currently does not pass through tax warehouses, gas suppliers could be considered as a regulated entity. In this case, it would be possible to draw on the pre-existing system for natural gas in REDII to monitor flows for this fuel[149].

Moreover, concerning biofuels, the monitoring and reporting requirements in REDII regarding mass balances of biofuels would make it easier for tax warehouses to monitor the type and share of biofuels in transport fuels by strongly reducing the risk of fuel suppliers declaring higher shares of biofuels than there are in reality[150].

– *Energy Taxation Directive*

The Energy Taxation Directive[151] lays down minimal tax rates for motor fuels and electricity, above which MS can establish their respective rates. These minimum tax rates have remained unchanged since 2003, and are currently unrelated to the CO_2 emissions or energy content of energy products.

Energy taxation and ETS coverage highly overlap, as they both provide a price incentive to consumers to reduce the CO_2 impact of their mobility behaviour.

As regards to regulated entities, energy taxes are applied as excise duties, which are ultimately paid by the consumer. The transport fuels concerned by the Energy Taxation Directive are held in tax warehouses until they are released for consumption, at which point the excise duty must be paid. The amount of these fuels which is consumed for transport is therefore monitored and registered by tax warehouses.

16.4 **Compatibility with other pricing instruments at Member states level**

As regulated under the Effort Sharing Regulation, MS have put in place climate and energy policies applicable to road transport and buildings sectors, including pricing instruments. As regards to carbon pricing, those instruments range from no or only minimal carbon pricing, to the settlement of a carbon price from decades. Where carbon pricing instruments are in place, they have been introduced as part of a broader package of policies, or as part of national strategies aiming to achieving the respective climate targets. When managing overlap between the national carbon pricing instruments and the ETS, administrative solutions as exemptions to fuels or emissions that are priced under the ETS have been exempted from the coverage of the national pricing tool. Other market-based instruments have also been put in place in MS, as tradable energy efficiency obligations, as well as other measures to mobilise mitigation potentials and to

[149] ICF et al. (2020), p. 386
[150] ICF et al. (2020), p.386.
[151] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity

address market imperfections that are not addressed through the carbon price. Therefore, complementary measures have been used up to date.

16.5 Additional consideration on policy compatibility for a possible extension to all fossil fuels for the sectors not under the ETS

– *ETS Directive*

Small industrial installations are either excluded from the scope of the Directive (Annex 1) or can excluded from its scope by MS if certain conditions are met (Articles 27 and 27a).

An evaluation of the impact of Article 27 has found that the around 4500 installations excluded from the ETS under Art. 27 accounted for a fraction equivalent to 4.5Mt CO_2e or 0.3% of total verified emissions in the ETS in 2013[152]. If these SMEs would be subject to a carbon price under this option, they would pay a different (possibly larger) carbon price than competitors subject to the ETS and there would be the need for a mechanism to tackle carbon leakage.

The main considerations which were taken into account when excluding small installations from the scope of the ETS were that a) the costs of participation are unduly high for them; b) participation renders the conditions for SMEs to succeed more difficult and c) the emission reductions that can be achieved are not worth the effort.

For industrial installations currently under the ETS, there would be the need for a reimbursement mechanism as these installations would otherwise have to pay twice a carbon price: once upstream and once under the existing ETS.

– *Renewable Energy Directive*

In case all fossil fuels were included in an ETS, all sectors would have an incentive to use more biofuels to avoid the carbon price, driving up the demand for biofuels in all sectors outside the scope of the existing ETS plus transport and housing. For the transport sector, this would make it marginally more difficult to meet its biofuels objectives.

– *Energy Taxation Directive*

In the case of all fossil fuel covered under an ETS, the increase of the fuel price would be more palpable for the uses specified in Article 8 of the ETD (which establishes derogations in the form of significantly reduced tax rates for motor fuels that are used for industrial and commercial purposes, in particular in agricultural, horticultural or

[152] Evaluation of the EU ETS Directive, 2015 (Environment Agency Austria, Ecologic, Sustainable Quality Consult.

piscicultural works, and in forestry; for stationary motors; for construction machinery and for vehicles intended for use off the public roadway), as they start from a much lower base.

- *EU Agricultural Policy*

The partial exemption specified in article 8 of the Energy Taxation Directive for diesel and kerosene used might need to be revised.

Annex 6 Specific elements of maritime transport options

17 COMMON DESIGN ELEMENTS FOR ALL MARITIME OPTIONS

17.1 Overview of the different policy options

The table below summarises the main combination of policy options considered for maritime in this impact assessment.

Table 49: Summary of maritime transport policy options

Geographical scope / Policy option	MINTRA	MEXTRA50	MEXTRA100
MAR1	Inclusion of maritime emissions from all intra-EEA voyages and emissions at berth in the EEA in existing ETS	Inclusion of maritime emissions from all intra_-EEA voyages, emissions at berth in the EEA and 50% of extra-EEA voyages in existing ETS	Inclusion of maritime emissions from all intra-EEA voyages, emissions at berth in the EEA and all extra-EEA voyages in existing ETS
MAR2	A separate ETS for maritime covering emissions from all intra-EEA voyages and emissions at berth in the EEA	A separate ETS for maritime covering emissions from all intra-EEA voyages, emissions at berth in the EEA and 50% of extra-EEA voyages	A separate ETS for maritime covering emissions from all intra-EEA voyages, emissions at berth in the EEA and all extra-EEA voyages
MAR3	Carbon levy covering emissions from all intra-EEA voyages and emissions at berth in the EEA	Carbon levy covering emissions from all intra-EEA voyages, emissions at berth in the EEA and 50% of extra-EEA voyages	Carbon levy covering emissions from all intra-EEA voyages, emissions at berth in the EEA and all extra-EEA voyages
MAR4 (MAR1+ standards)	Inclusion of maritime emissions from all intra-EEA voyages and emissions at berth in the EEA in existing ETS in combination with standards	Inclusion of maritime emissions from all intra-EEA voyages, emissions at berth in the EEA and 50% of extra-EEA voyages in existing ETS in combination with standards	Inclusion of maritime emissions from all intra-EEA voyages, emissions at berth in the EEA and all extra-EEA voyages in existing ETS in combination with standards

17.2 **Regulated entities**

The regulated entity is the party that would be held accountable to comply with the legislation including the monitoring and reporting of emissions and bearing the cost of emitted carbon or complying with any other form of regulation.

The structure of the maritime sector involves a range of ownership and commercial arrangements which need to be taken into consideration when deciding which legal entity should bear the responsibility for compliance under an ETS or other forms of carbon pricing policies. The main difficulty of defining the regulated entity is linked to the fact that ship ownership and operation often lie in the hands of different actors, with shipowners having control over technical improvements of the ship and ship operators being in charge of implementing operational emission reductions.

The two types of regulated entities considered in this analysis are “companies” and ship commercial operators based on the following definitions:

- ***Companies:*** This category includes shipowners as well as any other organisation or person, which has assumed the responsibility for the operation of the ship from the shipowner, such as the manager or the bareboat charterer. These companies would also be the ones that have agreed to take over all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention, as defined under the SOLAS regulation and identified with their IMO company identification number. While shipowner-operators can implement technical energy efficiency solutions, improve ship operation (e.g. optimised speed) or use sustainable alternative fuels to reduce GHG emissions, shipowners involved in certain forms of charterers contracts have much less control on the operation of their vessels.
- ***Ship commercial operators:*** This category includes all entities, which has assumed the responsibility for the commercial operation of a ship and which is responsible for paying for the fuel consumed. This could be a manager, a time charterer, a bareboat charterer or a shipowner. Operators are most likely able to implement and benefit from operational optimisation dependent on their contractual obligations, but they might not be in a position to implement technical energy efficiency improvements.

These two options differ in terms of their coherence with existing legislation, their alignment with the polluter-pays principle and their ability to pass carbon costs.

In terms of **coherence** with existing legislation, the use of companies as regulated entities would ensure an alignment of the policy options with both the EU maritime transport MRV regulation and the IMO Data Collection System. It would allow building on the experience gained so far and it would reduce administrative costs for both the industry and public authorities. Linking the definition of regulated entities with the International Safety Management code would also mean that companies can be identified through their unique IMO number, which was introduced in 2004, as a measure to enhance maritime safety, security and environmental protection, and to facilitate the prevention of maritime fraud. This could ease future implementation. The European Commission has already proposed to amend the definition of companies in the EU maritime transport MRV regulation in that sense[153]. On the contrary, using ship commercial operators would diverge from existing international and EU regulation. In addition, it would oblige revising the EU maritime MRV regulation in order to ensure that each ship operator (e.g. a time charterer) monitor, report and verify its CO_2 emissions. It may also be impractical and costly to operate a policy that regulates all time charterers, especially those chartering vessels for a short period. It would also lead to some

[153] Proposal for amending Regulation (EU) 2015/757 in order to take appropriate account of the global data collection system for ship fuel oil consumption data, COM(2019) 38 final, 2019/0017 (COD)

enforcement issues as Port State Control inspections would have limited ability to take action at ship level in case of none-compliance.

In terms of following the **polluter-pays principle**, both options present some pros and cons. While the focus on "ship commercial operators" would ensure that the entity purchasing the fuel is the one that pays for the generated climate costs, it would fail to take into account the shipowner's responsibility, who is the liable entity in terms of the technical performance of the ship and the entity that has ultimately the power of decision when it comes to implementing technical energy efficiency measures. If the responsibility of the carbon costs was attributed to companies, it would be fully in line with the polluter-pays principle in case of shipowner-operators or bareboat charterer in charge of vessel's operation. However, it would not bring to light the responsibility of commercial operators in case vessels are time chartered, as charterers have a direct influence on the way vessels are operated.

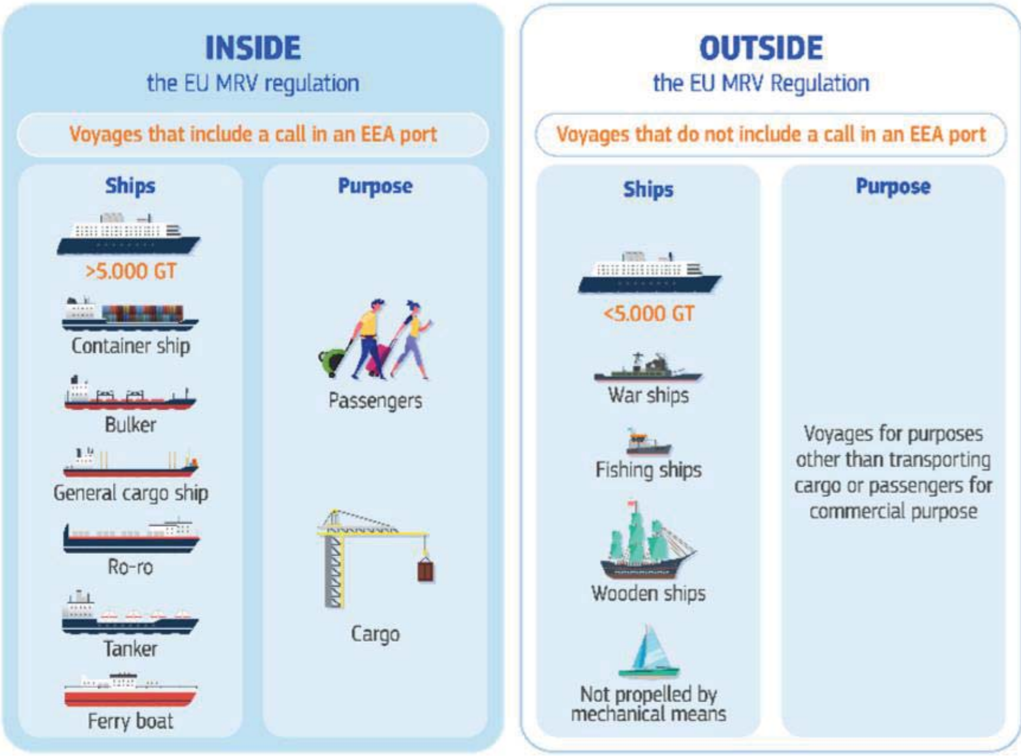
In terms of **costs pass-through**, some organisations have explained in their feedback why the use of commercial operators as regulated entities would help shipowners from the tramp shipping industry transfer the carbon pricing costs along the supply chain and ensure a level playing field. In general, the cost related to CO_2 emissions could be classified under voyage costs, which is generally borne by companies when directly engaged in shipping activities. However, when a vessel is hired under a charter party agreement the responsibility for the voyage costs might fall either on the charterers or on the companies depending on the service the ship is expected to perform. Charter party agreements are mostly classified either as bareboat, time or voyage charters. Each of these types of charter parties has its own peculiarities in relation to the allocation of the voyage costs, as well as in relation to the distribution of all the obligations, rights, and risks between the contracting parties. Under bareboat and time charter contracts, as opposed to voyage charter parties, the charterers are responsible for the operation of the ship, hence for the bunker fuel and all the port charges arising during the voyage. Accordingly, if carbon pricing is applied to maritime emissions, bareboat and time charterers would be directly linked to the CO_2 emissions resulting from the combustion of the fuel onboard the ship. However, in the case of voyage charter parties, it might result in new obligations for the entities involved. New clauses could be added to charter parties for the purpose of reflecting carbon pricing. This may imply that a company would need to either charge emission related cost at the end of the contract when a charterer reports emissions from its operations, or charge a "deposit" from the outset whereby the unused money would be returned to the charterer in the end of the contract period. A charterer could also purchase allowances and transfer them to the company, which will then surrender them to the regulator.

17.3 Regulated ships and activities

The regulated ships would be the ones covered under the EU maritime MRV regulation, which exempts for proportionality and subsidiarity reasons all ships below 5.000 gross tonnage as well as all warships, naval auxiliaries, fish-catching or fish-processing ships, wooden ships of a primitive build, ships not propelled by mechanical means, or government ships used for non-commercial purposes. In addition, the EU maritime MRV regulation only covers the ship movements that serves the purpose of transporting passengers or cargo for commercial purposes.

The figure below illustrates the type of ships and activities inside and outside the scope of the EU maritime MRV regulation.

Figure 36: Scope of the EU maritime transport MRV regulation



Source: 2019 EU MRV annual report on CO2 emissions from maritime transport

17.4 Geographical scope

According to the EU MRV maritime transport regulation, a voyage means any movement of a ship that originates from or terminates in a port of call and that serves the purpose of transporting passengers or cargo for commercial purposes. For inbound voyages to an EEA port, the starting point for the emissions calculation would be the last port of call outside the EEA and the end point would be the first port of call within the EEA. For outbound voyages leaving the EEA, the starting point for the emissions calculation would be the port of departure within the EEA and the end point would be the first port of call outside the EEA.

In this context, intra-EEA voyages represent all the voyages done by a ship between two EEA ports of call, while extra-EEA voyages represent all the incoming voyages from the last non-EEA port to the first EEA port of call and all outgoing voyages from an EEA port to the next non-EEA port of call.

The table below presents the various geographical scopes considered under this impact assessment. Each column corresponds to a category of CO_2 emissions and each row corresponds to a specific geographical scope.

Table 50: Overview of the different maritime geographical scope

Geographical Scope	[A] Intra EEA voyages	[B] Outgoing Extra EEA voyages	[C] Incoming Extra EEA voyages	[D] 50% of all outgoing & Incoming Extra EEA voyages	[E] At Berth
MINTRA	✓	✗	✗	✗	✓
MEXTRA50	✓	✗	✗	✓	✓
MEXTRA50 variant 1	✓	✗	✓	✗	✓
MEXTRA50 variant 2	✓	✓	✗	✗	✓
MEXTRA100	✓	✓	✓	✗	✓

17.5 Legal feasibility of maritime options

All proposed options are legally feasible. Including the maritime transport under the ETS (MAR1) would have Article 192(1) TFEU as its legal basis and would therefore be adopted with the ordinary legislative procedure. Directive 2003/87/EC has no provision prohibiting the inclusion of emissions from the maritime sector in the EU ETS. Inclusion of the maritime sector in the existing EU ETS would require amending this Directive as well as its Annex I, similar to the way in which the Directive was amended to include the aviation sector.

Establishing a separate scheme for ETS for the maritime sector (MAR2) is not excluded by any provision of EU law. However, it would require a separate (new) legal instrument that could take the form of a Directive or Regulation depending on the content of the instrument.

Introduction of a levy on GHG emissions from ships (MAR3) would not be possible within the current system of EU excise duties since the levy would not be based on the sale of a product; hence, the EU would have adopt a new Directive under Article 192(2) TFEU. Therefore, the level of effort associated with legal procedures in this policy option is comparable with MAR2 and is legally feasible.

The additional legal considerations related to MAR4 are linked to the carbon intensity standards. They could be based on Article 192(1) TFEU. In this case, it would be adopted by qualified majority, on the basis of the ordinary legislative procedure. From the perspective of international law, the imposition of standards will be closely linked to the provisions of the relevant international treaties and may impact the design of the measure. However, the measure is legally feasible based on the EU MS' competence as port States (under UNCLOS) and the GATT.

18 Design elements specific to maritime ETS options (MAR1, MAR2 and MAR4)

18.1 Maritime ETS cap and LRF

The ETS cap on emissions determines the ambition level of the ETS and is the maximum absolute quantity of GHGs that can be emitted by the covered activities to ensure the emission reduction target. The cap's yearly trajectory is declining based on the linear reduction factor (LRF), which is set as a percentage applied to a reference value. For the existing EU ETS, the cap trajectory is currently set at 2.2% per year applied to the mid-point of the period 2008 to 2012 of the ETS sector scope (i.e. stationary power and industry sector and intra EU aviation).

In view of the European Climate Law[154], the legislation on the EU ETS, the ESR, and LULUCF need to consistently deliver the "at least -55%" reduction of net greenhouse gas emissions by 2030 compared to 1990. The -55% economy wide target is a "domestic" EU target which does not preclude the EU ETS from regulating beyond the "domestic" target scope.

The cap and the LRF approach of the maritime ETS options (MAR1, MAR2 and MAR4) are comparable because, either for an own ETS (MAR2) or for the extension of the existing ETS (MAR1 and MAR4), the cap and LRF will need to be consistent with the -55% economy wide "domestic" target[155], while then being applied to the relevant maritime ETS scope (MINTRA, MEXTRA50 or MEXTRA100). The options with extension of the existing ETS (MAR1 and MAR4) imply an increase of the existing ETS cap by the relevant maritime scope emissions and a revised cap trajectory commensurate with the -55% target. The changes to the LRF compared to the AMB options described would be limited, for example the integration of MAR1 into AMB 2c would reduce the LRF by 0.02 % points. For the ETS strengthening options with the one off cap reduction ("rebasing"), i.e. AMB2b, AMB2c and AMB3c, it means that the cap after rebase will be increased by the maritime scope emissions, which will result in a net one off reduction smaller than the estimated in Section 5.2.2 (options without rebasing will just see a cap increase by the maritime scope emissions followed by a revised LRF). The amount of free allocation under the ETS would

[154] In order to reach the climate-neutrality objective set out in Article 2(1), the binding Union 2030 climate target shall be a domestic reduction of net greenhouse gas emissions (emissions after deduction of removals) by at least 55 % compared to 1990 levels by 2030.

[155] In order to ensure this compatibility with the net 55% greenhouse gas reduction target, in line with the European Climate Law, emissions allocations excluding LULUCF and including international intra-EU aviation and international intra-EU navigation would have to be 52.8% lower in 2030 compared to 1990, with LULUCF making up the remainder of the reductions to reach the -55% target. Emissions estimates for 1990 are based on EU UNFCCC inventory data 2020, converted to IPCC AR5 Global Warming Potentials, notably for methane and nitrous oxide. However, international intra-EU aviation and international intra-EU navigation are not separated in the UNFCCC data from the overall international bunker fuels emissions. Therefore, 1990 estimates for the intra-EU emissions of these sectors are based on (a combination of) data analysis for PRIMES modelling and 2018-2019 MRV data for the maritime sector. Once 1990 emissions in the intra-EU scope have been estimated, the 2030 emissions space excluding LULUCF can be calculated. This emissions space is partly taken up by the sectors covered by the Effort Sharing Regulation (ESR), which are assigned a target of -40% by 2030 compared to the 2005 baseyear of the Effort Sharing Regulation. The remainder is taken up by the EU ETS sectors (stationary installations, intra EU aviation, intra EU navigation), taking into account that navigation is partly covered under both the ESR and EU ETS. To the extent that extra-EU maritime navigation is included in the ETS, while not part of the net 55% target, it follows a similar cap trajectory, as explained in the main text.

also increase. Options with an own ETS (MAR2), will not impact the existing ETS reference cap, but would similarly impact its LRF because of cumulative target would have to be consistent.

For all options, data from the EU maritime transport MRV regulation for the years 2018 and 2019 would be used to determine the LRF and the cap increase in order to base the system on recent, robust and verified data.

18.2 **Maritime allowance allocation**

Auctioning requires participants to purchase any required allowances on an auctioning platform or an intermediary based on their own judgement of their needs. Auctioning of allowances can promote active trading in the market and early revealing of the carbon price in the system, thereby providing a strong price signal for emission reductions. In addition, auctioning of allowances can raise revenue that can be recycled to promote emission reductions further (ICAP, 2019). Under the ETS, auctioning is the basic principle for allocation, as it is the simplest, and generally considered to be the most economically efficient, system. It also eliminates windfall profits and put new entrants on the same competitive footing as existing operators[156].

Free allocation of allowances, alternatively, can help establish an ETS in the early stages because it directly benefits businesses with activities in the area. For energy-intensive industries where there is a risk that businesses or their production centres would relocate to places outside of the scope of the ETS (i.e. carbon leakage), free allocation has been agreed as a derogation from the principle of auctioning so as to reduce this risk. Free allocation does not compromise the price signal of an ETS, as businesses that are allocated allowances for free can reduce their own emissions and then sell their freely allocated allowances on the market instead, and reductions of their emissions will still be incentivised because it will avoid additional costs. However, as noted by the European Court of Auditors[157], if a sector can pass through the costs of EU ETS, then there is less justification for it to receive free allocation. In this context, free allocation is less relevant for the maritime sector compared to other sectors, due to the limited risk of carbon leakage when equal treatment on routes is ensured and due to the possibility of passing on costs.

When ETS revenue is used to tackle climate change for particular sectors, it has similarities with free allocation. For example, the ETS funded Innovation Fund has over €22 billion to fund the commercial deployment of innovative technologies to tackle climate change. The shipping industry can currently benefit from this Fund for deployment of renewables and for energy storage (batteries, hydrogen, synthetic ammonia etc.).

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[156] Article 10 and recital 15 of Directive 2009/29/EC, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0029

[157] European Court of Auditors, special report 18/2020: The EU’s Emissions Trading System: free allocation of allowances needed better targeting

In case allowances were freely allocated, **benchmarking** appears as the most appropriate method to determine the number of allowances to be allocated. This method relies on performance standards for the emission intensity of a product or a sector (benchmark). Regulated entities are then allocated allowances based on these benchmarks. This option can reward early abatement by regulated entities. The effectiveness of benchmarking is heavily dependent on the quality of data (ICAP, 2019). A similar approach to benchmarking was used in the aviation sector to allocate allowances on the basis of tonne-kilometres. However, the use of benchmarks to allocate free allocations to shipping companies would be more complex as it would entail the development of dedicated benchmarks for every ship size and type. Another challenge is the change in activity level observed in some ship segments, which would make the distribution of free allocations ex-ante more difficult.

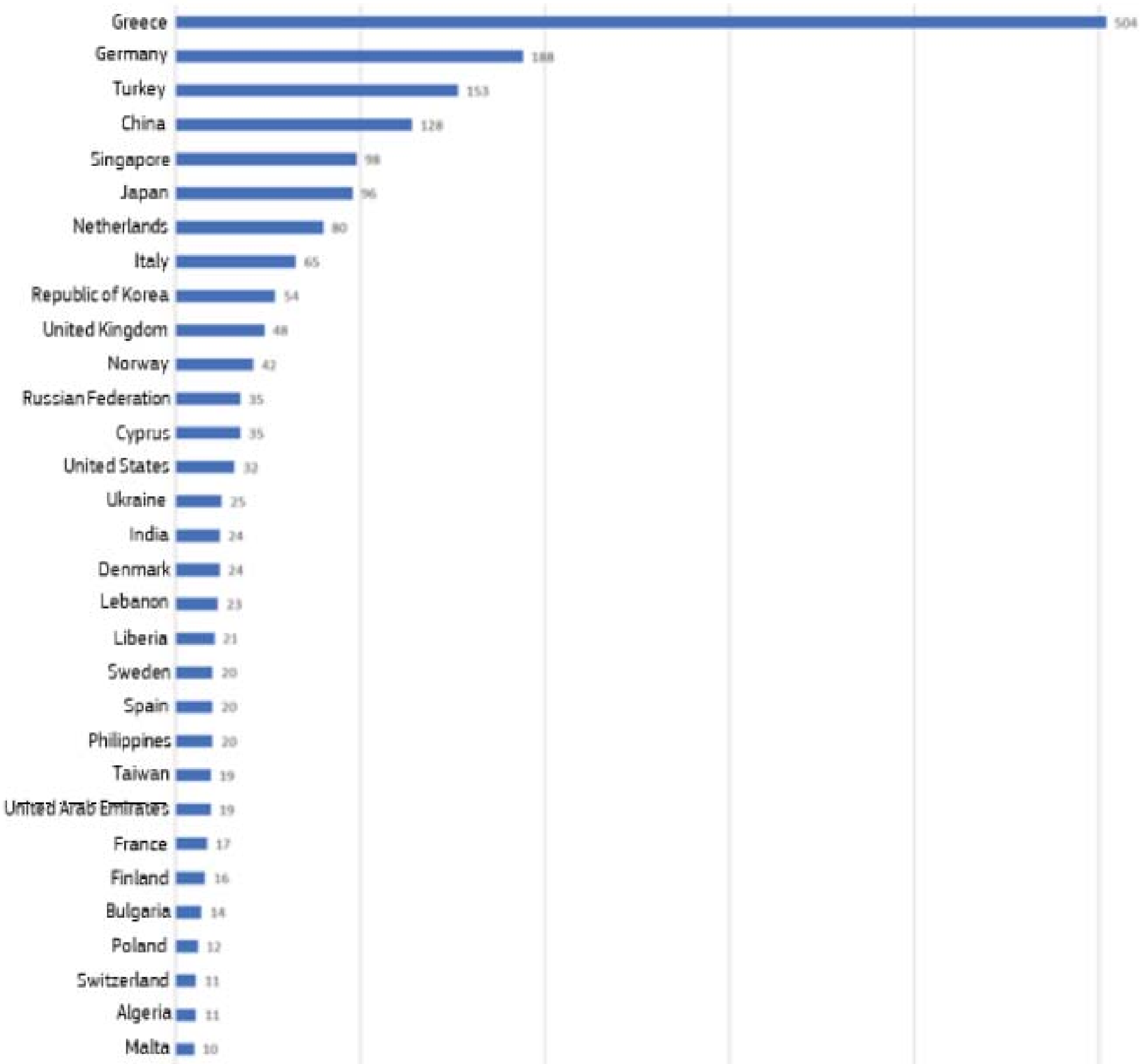
18.3 **Administering authority**

To reduce administrative costs, each regulated entity would be associated with one administering authority. The administering authority could be assigned on the basis of different criteria, considering the specificities of the maritime sector. Such criteria could be the origin of documents of compliance in relation to the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention[158], EEA port call activity or the origin of companies. As mentioned in the feedback received by stakeholders, an EU authority could possibly act on MS' behalf in order to reduce administrative burden and increase effectiveness (e.g. in relation to the monitoring and reporting of emissions). In any case, the legislation should ensure the equal treatment of all regulated entities independently from the administering arrangements.

In case the association is based on the country where the regulated entity is registered, the first EU MRV annual report showed that in 2018, around half of the companies falling under the EU maritime transport Regulation were European with a quarter of the shipping companies coming from Greece and 10% from Germany.

[158] A company can possibly have various documents of compliance according to the flags and the ship types

Figure 37: Origin of companies that reported under the EU maritime transport regulation in 2018



Source: 2019 EU MRV annual report on CO2 emissions from maritime transport

18.4 MRV and Enforcement

When expanding the ETS to cover maritime emissions, the MRV process should be in line with the rules applied in other ETS sectors. It should also build on the existing EU maritime transport MRV regulation.

In the ETS, the monitoring and reporting of greenhouse gas emissions needs to follow the EU Monitoring and Reporting Regulation (MRR – Commission Regulation (EU) No 601/2012). As a first step, operators of installations and aircraft operators need to submit a monitoring plan to the Competent Authority for check and approval before start of operation. Thereafter, operators carry out monitoring during the calendar year according to the approved monitoring plan. In case of significant changes to the monitoring methodology, operators submit an updated monitoring plan for approval. Operators then submit a verified annual emission report (AER) to the Competent Authority that needs to be verified by an independent accredited verifier. Operators then surrender allowances before 30 April and where needed, operators submit a report on improvements to the monitoring methodology before 30 June. Competent Authorities are in charge of enforcing penalties in case of non-compliance.

The EU maritime transport MRV regulation follows a similar sequence. As a first step, the legislation requires shipping companies to produce a monitoring plan that has to be assessed by an independent verifier. Then, companies can proceed to the second step of the MRV process, which consists of the monitoring and reporting of the relevant parameters. The data produced by this ongoing monitoring activity is reported on an annual basis. In the third step of the MRV process, companies must prepare an emission report in THETIS-MRV[159] based on their monitoring activities. In a fourth step, independent accredited verifiers have to corroborate the emission reports submitted by companies. Verifiers should assess the reliability, credibility, and accuracy of the reported data and information in line with the procedures defined in the legislation. When an emission report has been satisfactorily verified, the verifier drafts the verification report, issues a document of compliance and informs the Commission and the flag State of this issuance. This document confirms a ship's compliance with the requirements of the Regulation for a specific reporting period. Then, the Commission has to make information on CO_2 emissions and other relevant information publicly available by 30 June each year. The information is available at individual ship level, aggregated on an annual basis. Finally, MS implement and enforce the EU MRV process by inspecting ships that enter ports under their jurisdiction and by taking all the necessary measures to ensure that ships flying their flag are compliant with the regulation. Non-compliance should result in the application of penalties fixed by MS. Those penalties should be effective, proportionate, and dissuasive. Expulsion is a last resort measure when a ship is non-compliant for two or more consecutive reporting periods.

The figure below summarises the main steps of the EU maritime transport MRV process.

[159] THETIS-MRV is the IT tool behind the EU maritime transport MRV regulation. It provides a single portal for market actors where they can report CO2 emissions and other relevant information. It also gives access to all publicly available information. THETIS-MRV lessens the administrative burden by facilitating the exchange of information between companies, verifiers, the European Commission, flag States and the public. The THETIS-MRV portal is hosted by EMSA: https://mrv.emsa.europa.eu/#public/emission-report.

Figure 38: Main steps of the EU maritime transport MRV process

Source: 2019 EU MRV annual report on CO2 emissions from maritime transport

While the two MRV processes present many similarities, one could note the following differences.

- Under the EU maritime transport MRV system, data is checked on a ship level and not on a company/operator level. Should shipping (ISM) companies be the regulated entity, it will be necessary to aggregate emissions data of all ships belonging to every ISM company covered by the ETS. This aggregation could be done automatically through THETIS-MRV, if the regulated entity option falls on the ISM Company (i.e. aggregating emissions from all ships managed by the ISM company).

- Contrary to the monitoring, reporting and verification system applicable to stationary installations and aviation, the EU maritime transport MRV system for shipping does not foresee the approval of monitoring plans and the review of verified annual emissions report by competent authorities. Currently, monitoring plans and annual emissions reports only have to be satisfactorily verified by an independent accredited verifier. If this new approach were to apply to maritime, competent authorities could be supported in this task by the European Maritime Safety Agency with their expertise on MRV data and related tools. THETIS-MRV could for instance be used as an automated system to facilitate the exchange of information related to the monitoring plan, the annual emission report and the verification activities between the operator, the verifier and competent authorities. It should be noted that monitoring plans can already be created and assessed in THETIS-MRV on a voluntary basis. In addition, guidelines and criteria could be developed to harmonise and smoothen the process at competent authorities' level. For instance, THETIS-MRV is already supporting companies by providing warning and error messages when they are entering seemingly incorrect or incomplete data, etc.

- The timing for submitting the annual emissions reports is slightly different as in the ETS, operators have to submit their annual verified GHG emissions report to the Competent Authority before 31 March, while in the EU maritime transport MRV regulation, companies have to submit their verified emission report by 30 April of each year. However, nothing prevent a company in the EU maritime MRV regulation to submit their emission report before that deadline. This is likely to happen if companies face the obligation to pay an excess emissions penalty in case of the non-surrendering of allowances.

Enforcement

Administering authorities, would ensure that all companies under their responsibility surrender sufficient allowances or pay the levy in due time. Information about the compliance status of regulated entities would be derived from the registry and made accessible to the relevant authorities. The ones under non-compliance would be sanctioned based on penalties set at EU level and enforced by the competent authorities. The penalty for failure to surrender allowances (e.g. Article 16(3) of the EU ETS Directive) would apply to maritime regulated entities. Payment of the excess emissions penalty would not release the company from the obligation to surrender an amount of allowances equal to the excess emissions.

In addition, in line with the "name-and-shame" sanction foreseen in the EU ETS Directive, administering authorities would have to ensure publication of the names of companies which were to be found e.g. in breach of requirements to surrender sufficient allowances. In case the penalties could not be recovered, it is envisaged that ports would have the power to detain or deny entry to ships belonging to the companies that are found not to be in compliance, until the matter is satisfactorily resolved.

As a last resort, mirroring the additional penalty for non-compliant aircraft operators for which national enforcement actions have not succeeded in ensuring compliance (Article 16(5) of the EU ETS Directive), the administering authority could request that the European Commission considers imposing an operating ban on non-compliant shipping companies as a last resort measure.

Penalties for other offences such as MRV compliance could continue being set and enforced at MS level, in line with the EU maritime transport MRV Regulation. In the event that a ship has failed to comply with MRV requirements for two or more consecutive reporting periods and where initial enforcement measures have failed to ensure compliance, the competent authority of the MS of the port of entry (i.e. the port state) may issue an expulsion order which again should be communicated to the Commission, EMSA, other MS and the flag state concerned. Subsequent to this, all MS can refuse entry of the ship concerned into any of its ports until the company fulfils its MRV obligations.

18.5 Design elements for simplification and limitation of the administrative burden

a. Pooling mechanism

As proposed by the European Parliament in the context of the revision of the EU maritime transport MRV regulation, an option to limit the administrative burden for small and medium sized companies and companies that are not frequently active within the defined geographical scope is to set up a pooling mechanism (called the **Ocean Fund** in the EP report) to which eligible maritime transport companies may pay an annual membership contribution in accordance with their level of emissions (as reported under Regulation (EU) 2015/757). This entity shall then buy and surrender allowances collectively on behalf of member companies. The membership contribution per tonne of emissions shall be set by the Fund by 28 February each year, but shall be at least equal to the highest recorded primary or secondary market settlement price for allowances in the preceding year.

However, the advantages of such mechanism can be questioned given that the administrative burden linked to purchasing and surrendering allowances is limited compared to MRV tasks. Moreover, the pooling mechanism poses a number of practical and legal challenges. First, it is a complex mechanism, which can reduce the effectiveness of enforcement. Second, there is a possible price gap between the carbon price paid by market actors "as-they-go" and the price of ETS allowances. This might require the establishment of a settlement mechanism. Third, it is potentially incompatible with current legislation: the pooling system being an intermediary mechanism for the ETS market, this poses issues within the current legal framework for the auctioning and secondary market, including as the price is different. Finally, the issue of legal responsibility if the fund defaults will have to be addressed.

b. Exemptions

The EU maritime transport MRV regulation already implements a number of exemptions. It does not apply to ships with gross tonnage (GT) of less than 5.000, it does not apply to warships, naval auxiliaries, fish catching or fish-processing ships, wooden ships of primitive build, ships not propelled by mechanical means or government ships used for non-commercial purposes. In addition, it only covers emissions from voyages for the purpose of transporting goods or passengers for commercial reasons.

Applying the proposed measures to ships above 5.000 GT would reduce the number of ships covered by at least 44% and exclude around 95% of SMEs. According to Recommendation 2003/361/EC, an SME can be defined according to three criteria: under 250 members of staff and have either an annual turnover which does not exceed € 50 million, or an annual balance sheet total which does not exceed € 43 million. The table below presents the annual turnover, number of enterprises and persons employed in the water transport sector in 2018. As indicated by the turnover per enterprise, on average, the enterprises with 50 – 249 employees can be considered SMEs, as two of the criteria are fulfilled. However, it is not possible to conclude that all of the enterprises in the 50 – 249 category would meet the SME criteria, as the annual turnover of some of them might exceed the EUR 50 million threshold. At the same time, it is possible that a greater proportion of enterprises would fall under the SME definition than those displayed in the table below, as there may be companies which exceed the turnover criterion yet meet the balance sheet criterion (which is not considered in this analysis). With these limitations in mind, if we assume that all companies in the 50 – 249 category are SMEs and that a ship over 5.000 GT requires more than around 20 people to be operated, retaining a threshold of minimum 5.000GT for regulated entities would exclude around 95% of all SMEs in the water transport sector.

Table 51: Turnover, number of enterprises and persons employed in water transport in 2018

Number of employees	Total	>250	50-249	20-49	10-19	0-9
Turnover (million €)	126,721	84,158	15,357	5,552	2,815	18,802
Number of enterprises	c	102	362[160]	540	817	16,727
Persons employed	c	c	38,903	16,721	10,995	c
Turnover per enterprise (million €)	**N/A**	**825.1**	**42.4**	**10.3**	**3.4**	**1.1**
Meets SME defining criteria, **on average**	×	×	Medium		Small	Micro

c: confidential data

18.6 Other discarded design elements for the maritime sector

Regulating ports or fuel suppliers: Based on the previous 2013 impact assessment support study[161], it is not considered a reasonable alternative to set the regulated entity as either the port or the fuel supplier in an ETS as neither party can directly influence investment decisions or the operation of ships and therefore do not have direct control over the majority of the sector's emissions.

Regulating ships and not companies: While it is also possible that the point of regulation could be the vessels themselves, identified by their IMO number, this would require the designation of the legal person who would have to ensure compliance with the regulation on behalf of the ship. As the vessel cannot fulfil the obligations of MRV and surrendering allowances itself, it cannot be considered a legal entity in its own right.

An upstream emissions trading system for maritime transport making bunker fuel suppliers based in the EU liable for the emissions from the fuel sold is not suitable, as it will trigger evasion due to ships being able to carry fuel for several months and thus easily being able to refuel outside of the EU to avoid the carbon price.

Non-alignment with the EU Maritime transport MRV regulation in terms of ships covered: The proportionality of policy actions in the maritime sector is highly dependent on the categories and the size of ships covered. In general, in order to reduce administrative burden while ensuring a high environmental impact, any measures should aim at high coverage of emissions with a minimum number of ships covered. This is the reason why the EU maritime transport MRV regulation was set with the minimum threshold of 5.000 gross tonnage. It was decided for the same reasons not diverge from this conclusion and to keep the scope of the EU maritime MRV regulation

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[160] The 2017 figure used as an estimate, as 2018 figure considered confidential.

[161] 2013 Support study for the impact assessment of a proposal to address maritime transport greenhouse gas emissions, Ref: CLIMA.B.3/SER/2011/0005, https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/ghg_maritime_report_en.pdf

in terms of ships covered. According to a recent study[162], around 33.000 ships between 400 and 5.000 gross tonnage performed intra-EU voyages in 2019 and emitted around 17.5 million tonnes of CO_2 emissions. Including these smaller vessels would seriously increase the number of ships covered by the system from 12.000 to 45.000 ships and it would increase administrative costs. It would also have a limited impact in terms of the amount of GHG emissions covered under the EU maritime transport MRV regulation.

[162] Data from the Finnish Meteorological Institute –to be noted that a number of ships report AIS signals only with their MMSI number which poses some challenges for being uniquely identified through their IMO number and might have therefore not been captured in the modelling estimates

EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 601 final

PART 3/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

{COM(2021) 551 final} - {SEC(2021) 551 final} - {SWD(2021) 557 final} - {SWD(2021) 602 final}

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19 REQUIREMENTS OF THE LEGAL REVIEW CLAUSE

When the European co-legislators introduced the MSR into the EU ETS in 2015, they introduced an obligation into Article 3 of the MSR Decision for the Commission to conduct a review of the reserve within three years of its start of operation (i.e. by the end of 2021)[1] and at five-year intervals thereafter, on the basis of an analysis of the orderly functioning of the European carbon market: paying particular attention to the percentage figure for the MSR feed, the numerical value of the threshold, and the number of allowances to be released from the reserve; looking also into the impact of the reserve on growth, jobs, the Union's industrial competitiveness and on the risk of carbon leakage.

Another aspect to be considered in the review was introduced in 2018, namely concerning the invalidation mechanism set out in Article 1(5a) of the MSR Decision[2].

Article 3 of the MSR Decision requires the Commission to submit, where appropriate, a legislative proposal to the EP and Council.

In what follows, the results of this review are presented, in two sections: (i) an analysis of whether the MSR has reduced the historical surplus, and (ii) an analysis of whether the MSR has improved market resilience. The results are based on a study conducted by Vivid Economics to support the European Commission in the review of the Market Stability Reserve (MSR) of the EU ETS ("the Vivid study")[3].

The study concluded that taking into account all sources of net demand in the calculation of the TNAC and in the threshold-setting would improve the impact of the measure on market resilience. Future changes to the MSR should try to minimise regulatory complexity to the extent possible while maintaining market balance.

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[1] Article 3: "*The Commission shall monitor the functioning of the reserve in the context of the report provided for in Article 10(5) of Directive 2003/87/EC. That report should consider relevant effects on competitiveness, in particular in the industrial sector, including in relation to GDP, employment and investment indicators. Within three years of the start of the operation of the reserve and at five-year intervals thereafter, the Commission shall, on the basis of an analysis of the orderly functioning of the European carbon market, review the reserve and submit a proposal, where appropriate, to the European Parliament and to the Council. Each review shall pay particular attention to the percentage figure for the determination of the number of allowances to be placed in the reserve pursuant to Article 1(5) of this Decision, as well as the numerical value of the threshold for the total number of allowances in circulation and the number of allowances to be released from the reserve pursuant to Article 1(6) or (7) of this Decision. In its review, the Commission shall also look into the impact of the reserve on growth, jobs, the Union's industrial competitiveness and on the risk of carbon leakage*."

[2] See in this regard Article 2 of Directive (EU) 2018/410 amending article 1 of the MSR decision, by adding a new paragraph 5a: "*Unless otherwise decided in the first review carried out in accordance with Article 3, from*

[3] Vivid Economics (2021) – « The Review of the EU ETS Market Stability Reserve », unpublished.

20 MSR AND THE HISTORICAL SURPLUS

20.1 The Total Number of Allowances in Circulation (TNAC)

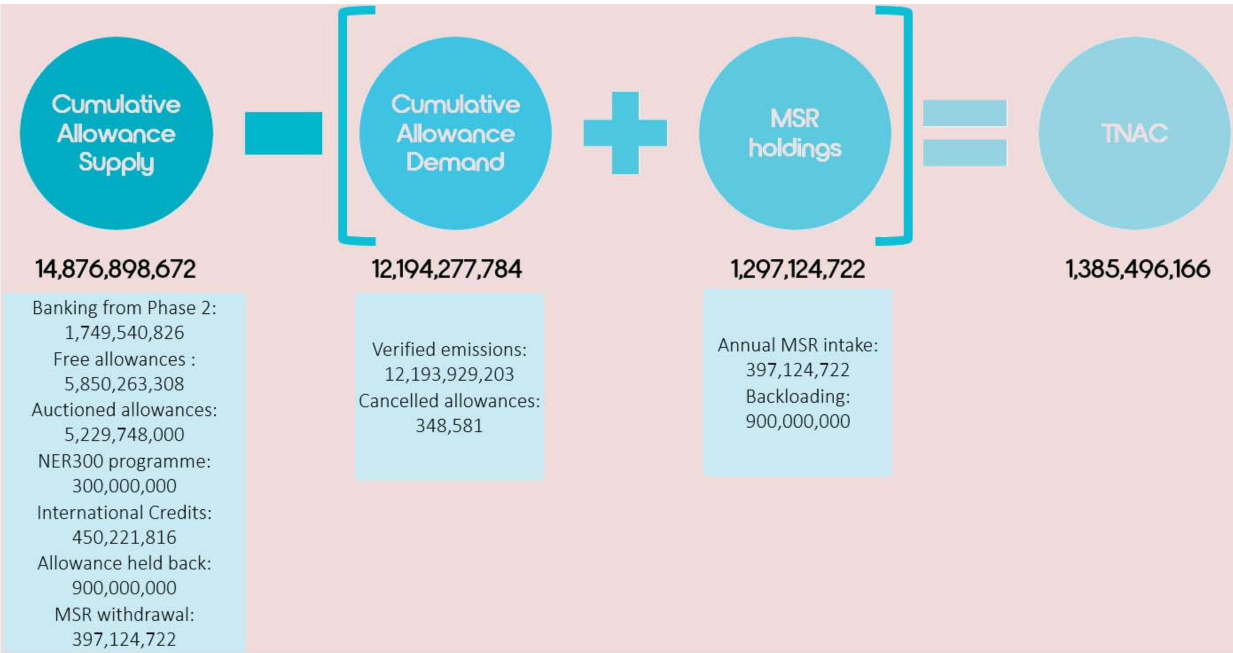
The EU ETS cap defines the number of allowances that are made available to market participants, where allowances that are not used can be banked for future use. Regulated entities as well as non-compliance market participants may bank allowances between years and trading periods without constraint. Therefore, allowances accumulate in holding accounts when they are not needed for compliance.

Credits from international projects are incremental to those distributed under the cap. Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) and Emission Reduction Units (ERUs) from Joint Implementation (JI) that are issued under the Kyoto Protocol can be used for compliance up to a predefined limit. In Phase 2, these could be used directly for compliance, whereas in Phase 3 these credits had to be exchanged for EU allowances. These allowances cannot be used for compliance under Phase 4 of the EU ETS.

The Total Number of Allowances in Circulation (TNAC) estimates the cumulative amount of banking by market participants. The TNAC captures the total supply of allowances issued in accordance with the cap that have not been used for compliance, voluntarily cancelled, or otherwise made unavailable to market participants. The TNAC also includes allowance supply from international credits. Since 2017, the TNAC is calculated and published each year by the European Commission.

Each May, the TNAC from the previous calendar year is calculated and published by the EU Commission. The TNAC publications include data on underlying supply and demand components as recorded on 1 April. As an example, Figure 26 depicts an example of the 2019 TNAC, published in May 2020.

Figure 26: 2019 TNAC Calculations



MSR adjustments are based on 24% of the TNAC (12% post-2023) when it exceeds the pre-defined thresholds of 833 million allowances. When the TNAC is shown to exceed the upper threshold, auction volumes are reduced from 1 September of the current year to 31 August of the following year. These allowances are placed in the MSR. When the TNAC falls short of a 400 million allowance threshold, auction volumes are increased by 100 million in the same year of the TNAC publication by injecting allowances held in the MSR.

The TNAC is an important indicator of a surplus or deficit of allowances in the market, and therefore provides an indication of market balance and allowance prices. The TNAC is a quantity-based indicator to of allowance scarcity. A large or growing TNAC is an indicator of a lack of scarcity in the short-term, which may be associated with low market prices and therefore insufficient incentives to abate emissions. Likewise, a very low TNAC is an indicator that there is not sufficient supply in the market, including enough available allowances to optimise low-carbon investment strategies across time periods. This may be associated with high allowance prices and volatility.

The historical build-up of the TNAC led to market imbalances and very low prices in Phase 2 and Phase 3 of the EU ETS, motivating the introduction of measures to address this imbalance, including the MSR. The historical evolution of the TNAC is described in the following section, along with a description of how the market imbalance was addressed through policy interventions and the introduction of the MSR.

20.2 **The historical surplus**

The TNAC is an indicator of a surplus or deficit of allowances in the market, and therefore provides an indication of market balance and allowance scarcity. A large or growing TNAC is an indicator of a lack of scarcity in the short-term, which may be associated with low market prices and therefore insufficient incentives to abate emissions. Likewise, a very low TNAC is an indicator that there may not sufficient supply in the market, including enough available allowances to optimise low-carbon investment strategies across time periods.

There was a historical build-up of the TNAC, that led to market imbalances in Phase 2 and Phase 3 of the EU ETS, motivating the introduction of measures to address this imbalance, including the MSR.

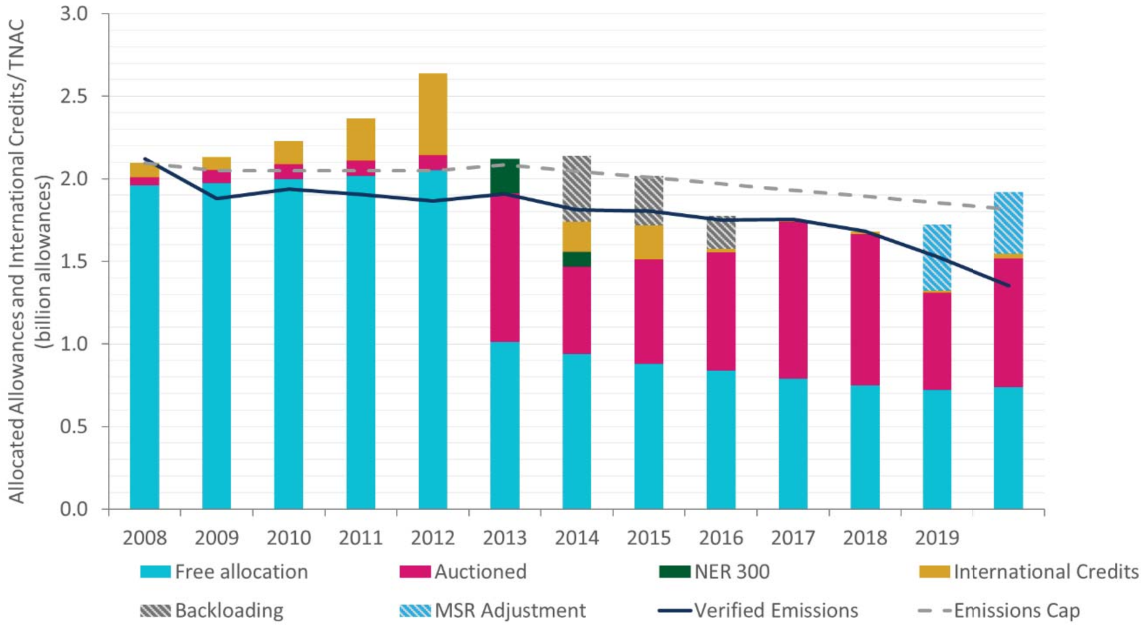
In Phase 2 of the EU ETS (2008 to 2012) the number of allowances that were put into circulation exceeded demand, leading to a buildup of 1.75 billion unused allowances in the system. Total supply of allowances exceeded demand in every year except 2008. The volume of allowances allocated for free or auctioned exceeded verified GHG emissions each year post 2008. This supply-demand imbalance resulted in the initial build-up of the TNAC over the period.

Market participants were able to carryover these unused allowances into Phase 3, adding supply equivalent to 11% of the cumulative cap over Phase 3.

In Phase 3, actual GHG emissions were lower than anticipated when the cap was set. This low underlying demand would likely have resulted in the continued growth of the TNAC in the absence of market intervention. The allowance surplus was further exacerbated by delivery of allowances under the NER300 program and continued use of international credits.

The growing TNAC at the beginning of Phase 3 also lead to the price of EU allowances fell to lows of €4.46/t and €6.00/t in 2013 and 2014 respectively.[4] These low prices would have provided very little incentive to regulated entities to reduce emissions or invest in low-carbon technologies. Given these structural market imbalances could not be dealt with by the market itself within a reasonable timeframe, the European Commission approved the backloading of 900 million allowances and subsequently the introduction of the MSR as a long-term solution[5].

Figure 27: TNAC composition Phase 2 and 3



Source: Vivid Economics based on European Union Transaction Log

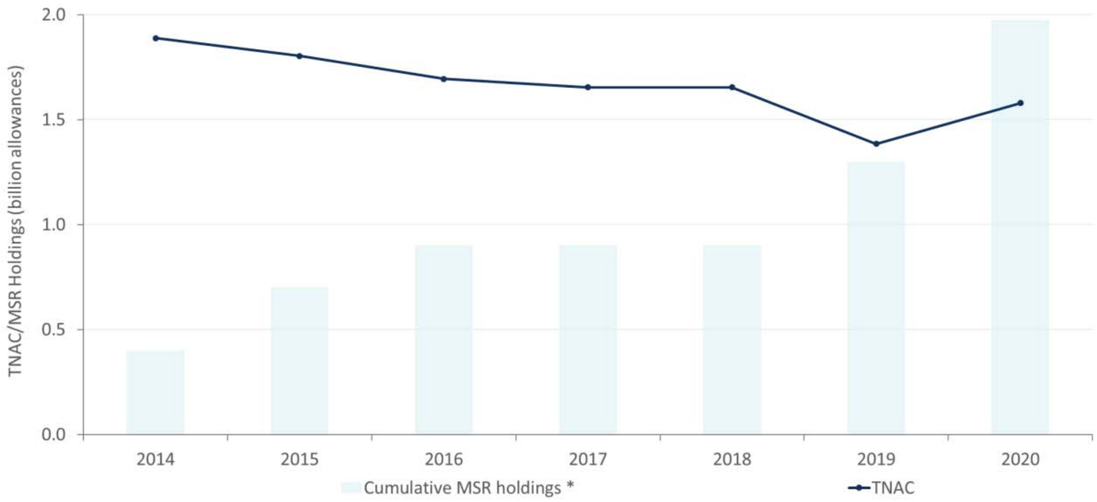
Other policy changes helped reduce the TNAC over Phase 3. These included the removal of unallocated allowances from the New Entrants Reserve and allowance adjustments from installations that had closed or reduced their production or production capacity (compared to the ones initially used to calculate Phase 3 allowance distribution). Estimates put these unallocated allowances at 550 to 700 million allowances through 2020[6]. Restrictions on international credit entitlements also significantly constrained allowance supply. The TNAC was further reduced by voluntary cancellation of allowances, totalling 441 393 allowances from 2013 to 2020.

[4] https://ember-climate.org/data/carbon-price-viewer/
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0018&from=EN
[6] https://ec.europa.eu/clima/policies/ets/reform_en

20.3 The introduction of the Market Stability Reserve (MSR)

The MSR was introduced as a permanent rules-based approach to addressing market imbalances. The MSR was introduced in 2015, amended in 2018 and became operational in 2019[7]. The MSR was chosen over other policy options since it could both resolve the historical allowance surplus as well as automatically respond in the event of future supply-demand imbalances.

Figure 28: Recent evolution of the TNAC



Note: the 2020 MSR holdings include the unallocated allowances from Article 10a(7) of the ETS Directive. The unallocated allowances from Articles 10a(19) and 10a(20) of the ETS Directive were not available at the time of the publication of this document.[8]

Source: Vivid Economics based on European Union Transaction Log

20.4 The impact of the MSR on the historical surplus

The MSR has begun to address historical imbalances with its first two years of operation leading to intakes of nearly 700 million allowances. This includes an adjustment of 397 million allowances withdrawn from auction volumes over 2019-20, and over 300 million allowances to be withdrawn from auction volumes over 2020-21, representing 24% of the previous year's published TNAC in each case. These adjustments alongside others such as backloading reduced the 2019 TNAC to 1 385 million allowances, or 29% below its high in 2013. In 2020, reduced emissions due

[7] Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, OJ L 264, 9.10.2015, p. 1. See: https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ:L:2015:264:TOC&uri=uriserv:OJ.L_.2015.264.01.0001.01.ENG

[8] See C(2021) 3266 final - Communication from the Commission - Publication of the total number of allowances in circulation in 2020 for the purposes of the Market Stability Reserve under the EU Emissions Trading System established by Directive 2003/87/EC.

to COVID 19 resulted in an increase of the TNAC to 1 579 million allowances. This will result in a higher MSR intake over the period 2021-2022 of 379 million allowances.

Intakes to the MSR are expected to continue reducing auction supply in coming years, with the TNAC remaining well above the upper threshold, and the COVID-19 pandemic reducing demand. With a depressed demand for allowances, the TNAC would grow in the absence of MSR adjustments. As such, the MSR will continue to address the historical surplus built up over Phase 2 and 3 while simultaneously responding to the impact of the demand shock stemming from the COVID-19 pandemic. According to the Vivid study, **in a scenario where GHG emissions fall by 155 $MtCO_2e$ in 2020, but then rebound to market balance by 2023, the TNAC would be expected to fall below the upper MSR threshold of 833 million allowances in 2023**.[9] **In the absence of the COVID-19 pandemic, the TNAC may have reached this outcome in 2022.** With a counterfactual intake rate of 12% addressing this imbalance is likely to have taken a substantially longer period of time.

According to the Vivid study, the MSR and backloading measures may also have played an indirect role in relation to EU allowance prices and helped restore historical prices from all-time lows. However, the increase in the allowance price from historical lows cannot be fully attributed to the MSR and may also be due to the broader strengthening of the EU ETS in 2018, and expectations for future ETS adjustments[10] [11].

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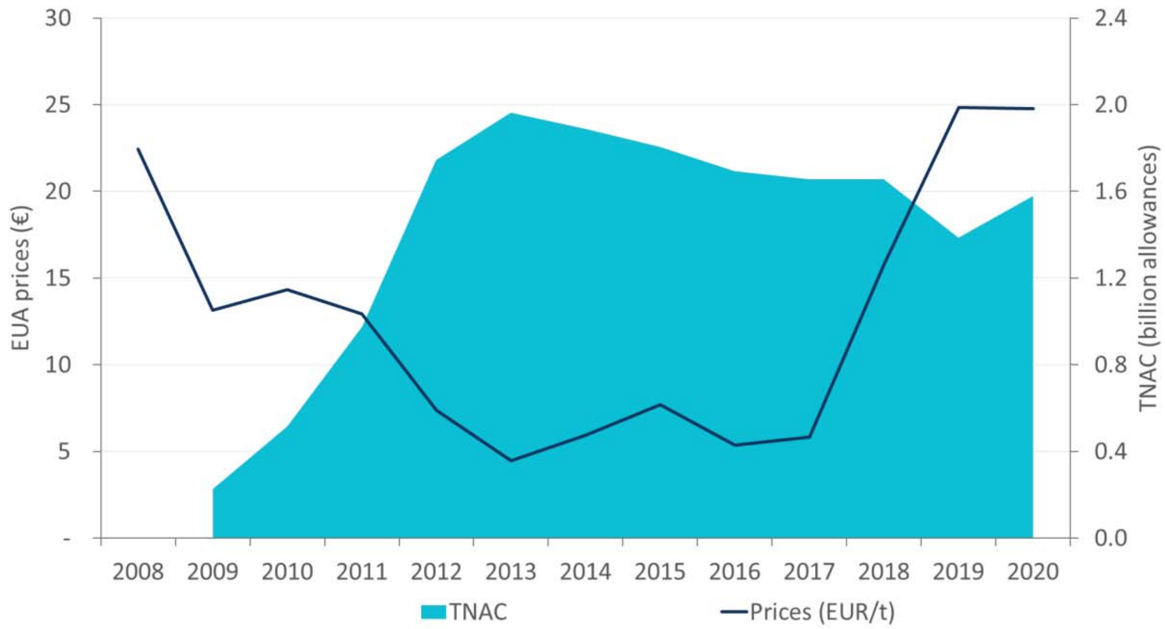
[9] The 155 $MtCO_2e$ drop in emissions is based on analysis using the PRIMES energy system model, estimating the impact of COVID on GHG emissions. Emissions pathways are fictional and static in the sense that they do not incorporate price effects in this analysis. The PRIMES model has also been used in the 2030 EC Impact Assessment https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF

[10] https://ercst.org/background-note-the-eu-ets-market-stability-reserve-coping-with-covid-19-and-preparing-for-the-review/

[11] https://www.eionet.europa.eu/etcs/etc-cme/products/etc-cme-reports/etc-cme-report-3-2019-trends-and-projections-in-the-eu-ets-in-2019

Figure 29: Allowance price evolution compared to the TNAC



Note: EUA Prices (€) (LHS); TNAC (billion allowances) (RHS)

Source: Vivid Economics based on [European Union Transaction Log, EEX/ICAP]

20.5 Net demand from other sources

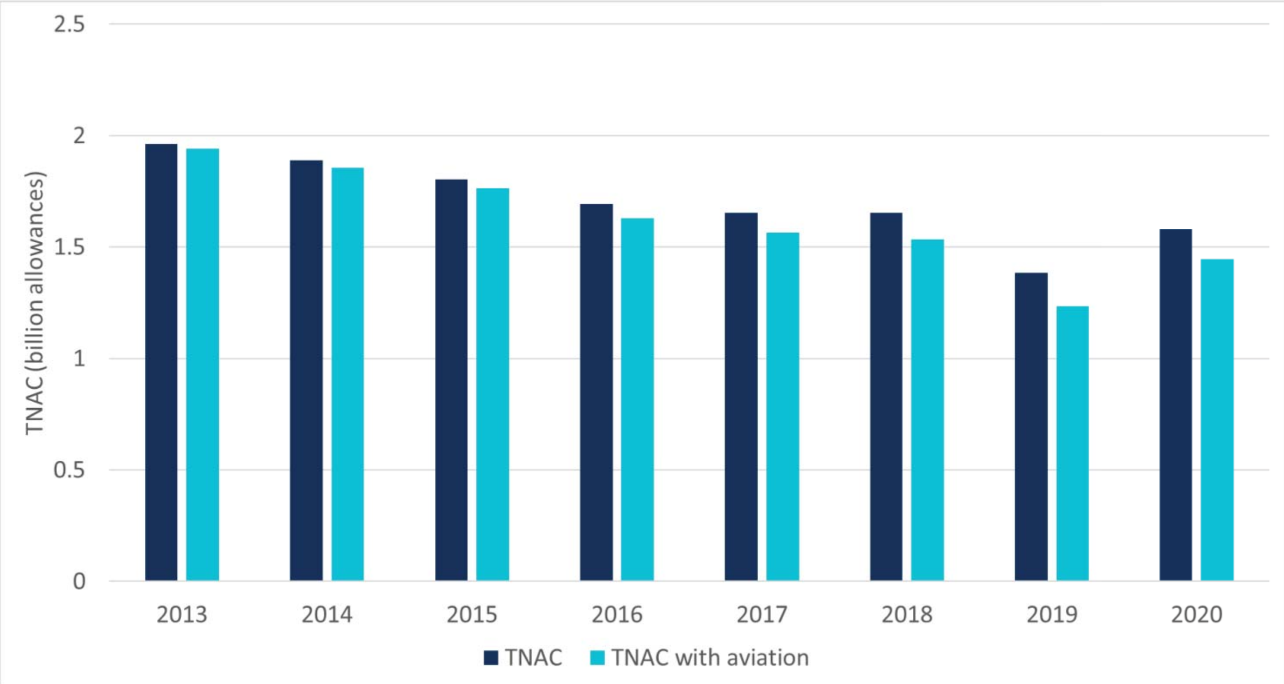
The TNAC as currently defined does not include aviation demand or supply, nor net demand from linked Emission Trading Systems.

20.5.1 Aviation

According to the Vivid Economics study, the inclusion of aviation would have reduced the TNAC in each year of Phase 3, impacting MSR adjustments (Error! Reference source not found.**).** When included in calculations, net aviation demand reduces the TNAC, resulting in lower total allowances in circulation than recorded at present. Thus far, this impact has been limited with the largest difference occurring in 2019 when net aviation demand was the highest at approximately 151 million cumulative allowances. The corrected MSR adjustment would result in an intake of 303 million allowances in 2020 which is 8.8% lower than the MSR adjustment made without aviation.

With the forecasted growth in aviation emissions, there is a strong case for the inclusion of net demand from aviation in TNAC calculations going forward. Aviation emissions in 2020 were significantly lower due to COVID-19, which may limit aviation's demand for EU allowances, but demand is projected to grow thereafter[12].

Figure 30: The TNAC with and without net aviation demand



Source: Vivid Economics based on [European Union Transaction Log]

20.5.2 The Swiss ETS

The Swiss ETS linked with the EU ETS on January 1st, 2020 after a 10-year process of negotiations. The Swiss ETS covered about 10% of the country's total GHG emissions in 2019, or 4.72 $MtCO_2e$ (2017 data)[13]. EU and Swiss operators can surrender allowances from either system to meet their emissions liabilities[14].

Allowances allocated under the Switzerland's ETS are available for market participants and will form part of the TNAC publication starting in May 2020[15]. Since allowances are fully fungible between the two systems, allowances auctioned or allocated for free under the Switzerland system will need to be treated the same as EUAs for the purpose of calculating the TNAC. These figures should be included in subsequent TNAC calculations.

Likewise, verified emissions from Switzerland's covered entities will represent demand for allowances and may need to be included in future TNAC calculations.

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[12] https://www.eurocontrol.int/sites/default/files/2020-04/eurocontrol-aviation-recovery-factsheet-27042020.pdf
[13]https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=64
[14] https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/faq_linking_agreement_part2_en.pdf
[15] https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/faq_linking_agreement_part2_en.pdf

20.5.3 Market behaviour

The Vivid study also looked at changes in market behaviours related to the introduction of the MSR, and whether the evolution of market behaviours would have an impact on the levels of the MSR thresholds. The MSR's upper and lower thresholds (currently 400 and 833 million allowances respectively) represent a range of estimates of the required efficient level of hedging demand, however emerging sources of additional demand other than utility hedging could require changes to threshold levels, especially if those changes result in higher overall holdings.

- **Utilities have actively managed their carbon exposure in some markets by hedging.** There is some evidence that larger industrials, especially in the oil and gas industry, also hedge to some extent, but it is less common overall compared to utilities. Many large utilities companies have increased their hedging timeframes in recent years due to concern over rising carbon prices, such as RWE, who have hedged some proportion of their liabilities as far out as 2030[16].
- **The Vivid Economics study found that hedging demand from utilities is likely to fall due to high EU allowance prices triggering increased abatement and the coal phase-out.** Below a price of €30, EU allowance pricing did not have a significant impact on business decisions by utilities. However, if price increases are sustained, utility companies may look at changing investment or abatement decisions. Increased investment in abatement reduces the volume of hedging demand because of reduced EU allowance compliance requirements in the future. Sustained higher prices could also reduce the profitability of some higher emissions power plants. Therefore, as prices remain high and as MS proceed with planned coal phase-outs, utility hedging demand is likely to fall with the sector's carbon exposure.
- **Industrials have historically not undertaken significant hedging given the large number of banked allowances they hold. The Vivid Economics study found that industrial demand is increasing in volume and frequency.** There are still many small industrials which have no active EU allowance exposure management. However, an increasing number of industrials which did not buy much volume historically (for example, large chemical firms) now undertake hedging over multi-year timeframes. Most small to mid-size industrials trade via intermediaries such as banks, traders, or other financial institutions rather than using in-house trading teams. As free allowances decrease, banked allowances are used, and prices increase, industrials are expected to increase strategic behaviour, including hedging.

Short-term speculative trading in the market was relatively low in the mid-2010s following the downturn in carbon prices. Prior to 2014, a significant number of participants traded speculatively in the market in relatively large size, with a focus on short-term trades (less than 1 year holding periods). However oversupply in the EU allowance market and depressed prices reduced the number of short-term speculators. Drivers of oversupply included the global financial crisis and the

[16] https://carbon-pulse.com/94238/

EU credit crisis, with carbon trading desks shrinking substantially. Some of the remaining players still held large positions, though most predominately participated in the carry trade[17].

- **Short-term speculation increased in volume over 2018 and 2019, driven by price expectations.** By the end of 2017, the implementation of the MSR and other policy announcements contributed to increased market confidence. There were signs of increasing EU ambition and several research houses published “buy” recommendations for the EU allowance market. This led to an increase in speculative trading, although increased volatility meant that trading sizes were significantly smaller compared to earlier speculative activity. Short-term speculative trading is less impactful on the overall holdings compared to other types of activity because holding periods are less than 1 year.
- **Short-term trading volumes fell over 2020, with increasing speculation from long-term investors.** Volatility reduces the amount of allowances most short-term traders can hold because of capital requirements. The cost of holding positions became increasingly more expensive as the market saw significant volatility from COVID-19. At the same time, awareness of the EU’s climate ambition increased among investors with the announcement of the EU’s net zero commitment and a strengthened 2030 carbon target. Volume shifted to long term investors and hedge funds seeking to generate returns from price increases over several years. These long-term positions have a direct effect on TNAC holdings by removing EU allowances from circulation, similar to the effect of banking and hedging.
- **The size of long-term speculative holdings in the market is estimated to range between 50 $MtCO_2e$ to 100 $MtCO_2e$.** This includes over-hedging by utility firms and the long-term positions held by investors. Utility desk maximum positions are estimated to range from between 1 to 10 $MtCO_2e$. For long term investors, fund positions are estimated to range between 1 to 5$MtCO_2e$. Overall, the total size of this market is estimated to be less than 100 $MtCO_2e$. An increase in total speculative holdings in the market from 50-100 to 200+ could affect market balance, but this scenario is considered extremely unlikely by market participants.
- **Most recently, there have been some very small volumes from participants in the market who buy EU allowances voluntarily for non-speculative reasons.** Corporates who are looking to hedge against climate change fall into this group. There are also socially motivated buyers who voluntarily cancel EU allowances without associated emissions (for example, CarbonKiller or World Carbon Fund) or offer a decarbonisation service for investment funds (Cap2). It is not expected that this segment of the market will be large enough to affect the TNAC.

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[17] The carry trade seeks to exploit differences in the relative prices of spot and future EUA contracts relative to other risk-free assets. Simultaneously buying spot EUA contracts vs selling EUA futures contracts creates a risk flat position, which held over time can generate a risk-free return. Over Phase III this rate of return was around 4-5%.. This is sometimes referred to as “optimising cost of cash” or a “contango trade” and does not reflect an outright investment or holding in the underlying EUA instrument.

To sum up, the Vivid Economics study found that there is no evidence that increases in industrial hedging or speculative behaviour have substantially offset decreases in utilities hedging. Market participants interviewed as part of this analysis considered it unlikely that either industrial hedging or speculative behaviour would become significant enough in the next few years to pose a problem for market balance.

21 MSR AND EU ETS RESILIENCE

The Vivid Economics study also looked at the impact of the newly-introduced MSR on the resilience of the EU ETS.

The study began by the simplest indicator of market balance, the TNAC in relation to the MSR thresholds. The TNAC thresholds for MSR intakes and releases are set in a manner that aims to reflect the range of secondary market holdings that would be consistent with the efficient functioning of the allowances market. The study indicated that the TNAC definition is a more accurate measure of market balance when it accounts for all relevant sources of supply and demand, such as aviation operators and the link with the Swiss ETS. Further, demand stemming from other regulated compliance options might need to be considered going forward. Moreover, the appropriate level of the TNAC thresholds are subject to change with market developments, policy design and participants' hedging needs.

The study also proposed other indicators for assessing whether a market is "resilient", being able to function well under a range of plausible circumstances and returning the market to balance in a reasonable timeframe following a shock. Aside from supply-demand balance, an assessment of market stability should include characteristics such as allowance price levels and price volatility, market liquidity, and how the market interacts with other climate and energy policies. The study then looked at the types of events and market shocks that could impact market stability in the EU ETS, and whether the MSR's response is sufficient to restore market stability in a timely fashion:

- **Exogenous events or shocks** - changes to the environment where the ETS operates, without changes to the ETS design or market characteristics themselves. Exogenous events could include changes to the economy that increase or decrease emissions below/above ex-ante expectations, in a temporary or definitive manner; changes in relative prices (particularly for energy); breakthroughs in low-carbon technologies; and anticipated and unanticipated policy changes.

- **Market-related shocks** - changes to market design and in market participants' behaviour. Changes to market design could include changes to the linear reduction factor (LRF), linking to other ETS systems, and new legislated sources of allowance demand. Changes in market participants' behaviour include changes in hedging demand or speculative holdings, or changes in behaviour related to the voluntary cancellations of allowances.

The study found that the time to return the TNAC to acceptable levels after a demand shock is significantly faster under a 24% MSR intake rate as compared to a 12% intake rate, and specifically that only the 24% rate can reduce the TNAC to below the upper threshold in the event of a lasting negative demand shock. The MSR's response to negative and positive demand shocks was tested with a constant MSR intake rate of 12% or 24% in all years. It takes two additional years to return to TNAC thresholds after a temporary negative demand shock under a 12% intake rate as compared to a 24% intake rate. Similarly, it takes one additional year in the case of the temporary positive demand shock to reach TNAC thresholds under a 12% intake rate as compared to a 24% intake rate, as there is a need to continue correcting for the historical imbalance for a longer period of time. All these scenarios fall within ‘reasonable’ timeframe definitions of commentators (see ERCST, 2019)[18]. However the MSR does not return the TNAC to within the acceptable level in the case of a lasting negative demand shock given a 12% intake rate.

The study suggested that the market price for allowances is determined by allowance supply and demand levels both today and perceived future conditions. Allowance prices are determined by allowance demand relative to allowance supply as is primarily determined by the cap. Since market participants have the ability to bank allowances, the relative level of market supply to demand, both today as well as in the future, will impact allowance prices. Given that firms have imperfect foresight (i.e., market-related and exogenous future events are unknown), allowance prices will also reflect expectations about an unknown future, which may prove to be inaccurate. For example, if market participants believe the stringency of the system will increase in the future, economic growth accelerate, or low-carbon technologies will fail, this will inflate market prices today. As such the MSR’s adjustments to auctioning volumes are expected to have only a partial impact on the allowance price.

The impact of the MSR on price formation in case of shocks depended on whether the shock was expected, or anticipated.

If the demand shock is unexpected, the MSR would cushions the price effect from a negative temporary demand shock, supporting additional GHG mitigation. The MSR immediately helps support short-term prices in response to negative demand shocks by buoying expectations about future prices, regardless of the delay in its actual impacts on supply. Although the MSR’s mechanistic effect on the TNAC has more than a year-long delay and takes place gradually over time, it has the ability to shape price expectations immediately as market participants anticipate a reduction in the future supply of allowances. The MSR’s role in increasing short term prices after demand shocks can help firms invest in low-carbon technologies today, benefiting from innovation while avoiding market outcomes such as stranded assets. The MSR’s restrictions to auctioning volumes increase short-term allowance scarcity and drives up prices. Academic modelling shows that this should incentivise firms to adopt low-carbon technologies and invest in other

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[18] https://ercst.org/wp-content/uploads/2019/07/20191008-MSR-review-draft-paper-presentation-v.1-1.pdf

abatement solutions[19]. This could stimulate early innovation and help avoid higher-carbon lock in of capital assets.

However, if the drop in demand is known ahead of time, then the MSR could have a counterproductive impact on allowance prices[20]. The MSR's adjustment to supply could be counterproductive when the TNAC is high due to future expectations about allowance scarcity. This could occur, for example, through a policy announcement that the LRF were to be increased. In this case, compliance-based actors might abate more GHG emissions today in order to save their allowances for future use. As such, emissions would fall and the TNAC would rise in the current period, triggering the MSR. In this case, the MSR would reduce auctioning volumes further, introducing even more scarcity in the market where it is not needed. The TNAC in this case could be an inaccurate indicator of overall market stringency over the lifespan of the program, and the MSR adjustment could work in a counterproductive direction.

Recent empirical analysis suggests that the MSR may have had a stabilising effect on prices, indicating many of the theoretical channels that could drive price volatility may not materialise in practice. Gerlagh et al. (2020) and Azarova and Mier (2020) cite the COVID-19 induced demand shock as evidence that the MSR works well in stabilising EUA prices for short term demand shocks[21,22]. EUA prices did not fall below 15 EUR, despite the EU's GDP declining by an estimated 7% and industry production in the EU-27 declining by nearly 20% in April[23]. Interviews with financial market participants suggest that without the MSR, prices would have dropped substantially more than what was observed over the COVID-19 induced demand shock. However, there is not yet literature on the degree to which the MSR has impacted price volatility in the ordinary operation of the market.

The study also found that **the MSR introduces additional market complexity to the operation of the EU ETS through the addition of rules which influence market supply, interactions with other policies and ultimately prices.** The MSR's rules-based approach provides transparency and a degree of predictability, however complexities regarding changes to auction schedules and updates to data impacting TNAC calculations could make it hard for market participants to understand or predict the MSR's future. As a quantity-based mechanism, the MSR's indirect impact on price needs to be estimated by market participants adding a level of complexity to allowance price projections.

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[19] https://www.pik-potsdam.de/members/pahle/mauer-et-al-2019.pdf/at_download/file
[20] Marcu et al. (2020), Gerlagh et al. (2020), Healy et al (2019)
[21] https://link.springer.com/article/10.1007/s10640-020-00441-0
[22] https://www.ifo.de/en/publikationen/2020/working-paper/msr-under-exogenous-shock-case-covid-19-pandemic
[23] https://ec.europa.eu/eurostat/statistics-explained/index.php/Impact_of_Covid-19_crisis_on_industrial_production#Development_of_industrial_production_in_2020

Market participants may struggle to form rational expectations on EUA prices given both the MSR's response to allowance demand and supply, and the subsequent feedback effects from the MSR's actions. Flues and van Dender (2020) argue that the MSR increases price uncertainty in the market as the quantity of emission allowances in circulation does not provide any focal point about future price levels[24]. **The addition of the invalidation mechanism adds uncertainty regarding the absolute quantity of allowances that will be available in the future.**

Moreover, in the future, the MSR could be prone to threshold effects. Threshold effects are small deviations in the TNAC around the threshold can result in significant supply shocks if the deviations trigger the MSR. This can lead to oscillatory price behaviour around the threshold. This could be exacerbated by speculation to take advantage of the TNAC being near the threshold where speculators change their banking behaviour to trigger the MSR, increasing volatility further. So far, the TNAC has remained far above the upper threshold so such behaviour has not been observed.

21.1 The MSR and competitiveness impacts

As shown earlier, the MSR is designed to ensure market balance and thereby both directly and indirectly affects competitiveness through several channels. These can include impacts via market prices, price volatility, market liquidity, strategic behaviour, market sentiment, predictability, complexity and transparency.

According to the Vivid study, the MSR's impact on competitiveness is yet to be directly discussed in the broader academic literature, given its recent introduction and limited evidence of carbon leakage from the initial phases of the EU ETS. MSR adjustments to auctioning volumes restrict short-term supply, and therefore put upward pressure on allowance prices. However, many other factors, such as the perception of increasing ambition in the future and developments in mitigation technologies will also impact allowance prices. Disentangling the level of price rise that is attributable to the MSR relative to other events occurring concurrently is challenging, but it is broadly agreed that the MSR contributed, in part, to the price rise. Given free allocations throughout Phase 3 and Phase 4 for EITE sectors, these firms only experience a proportion of any MSR induced price rises. Interviews with market participants indicate that the most important aspects with respect to competitiveness considerations are the LRF and decisions on free allocation and CBAMs for EITE sectors.

Price stability and predictability are important for investment decisions and therefore a firm's longer-term competitiveness position. Investment in mitigation and

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[24] https://www.oecd-ilibrary.org/taxation/carbon-pricing-design-effectiveness-efficiency-and-feasibility_91ad6a1e-en

low-carbon technology is fundamental to a smooth progression to period of higher carbon prices. The MSR plays a supporting role in increasing certainty on the EUA price path, but the MSR also adds to regulatory complexity. To the extent that the MSR helps ensure price stability it will also support competitiveness. However, this is unlikely to significantly impact competitiveness as excessive volatility has not been observed since the introduction of the MSR.

Modelling performed in the context of the Vivid study suggests that over the longer term, the impact of the MSR on market prices is small relative to the potential impact of other policies, such as a strengthened LRF. Given the relatively small difference in these price levels the effect of the MSR on competitiveness is likely to be minor. This alongside the ongoing high level of allocations to free allocations suggests that the MSR is unlikely to have had any significant effect on competitiveness over the period of its operation.

For EITE firms who are able to abate at low cost, EUA price increases may increase competitiveness. If EITE sectors receiving free allocation are able to mitigate at a lower price than the EUA price they would be able to sell excess free allowances. EUA price rises could support competitiveness for these firms. An increase in EUA prices will increase the net value of the firms who hold allowances in excess of their current liabilities. In this sense, any MSR induced allowance price rises will benefit them in the short term.

Annex 8: Design options for the Market Stability Reserve

22 Sensitivity analysis for the MSR

22.1 Performance of each MSR design option given future shocks

This section provides stress tests to assess how different MSR designs interact with changes in external market conditions. The modelled performance of the MSR under different market and policy outcomes can be used to assess the resilience of the MSR. The results of these stress tests will inform the extent to which negative outcomes may be mitigated or accentuated by the MSR.

We consider two types of stress test:

- **Shocks**, such as a reduction in economic demand or an increase in complementary policy ambition due to coal phase outs. These can largely be incorporated into the model based on reasonable estimates of magnitude to assess the outcome, with some complementary qualitative analysis as required.

- **Induced imbalances,** such as strategic speculative behaviour aiming to destabilise the ETS by purchasing large quantities of allowances. These imbalances have been designed by identifying areas of potential risk in the current MSR design and constructing scenarios which could lead to destabilising outcomes based on these risks. Given the nature of these risks, we will complement modelled results with a discussion of the potential risks and outcomes. We identify two potential induced imbalances below.

Shocks may operate through different impact channels, but ultimately have the same effect on market outcomes. For example, increased speculation and increased hedging demand both provide a temporary increase in demand for allowances. On the other hand, a reduction in economic activity (and associated emissions) or a coal phase out both permanently reduce demand for allowances. These shocks have different root causes, but ultimately pose the same implications for the functioning of the MSR.

We therefore classify the stress tests based on their ultimate impact channel. They are:

- **An anticipated increase or decrease in EU allowance demand.** These shocks include announcements of complementary policies such as coal phase outs, and technological breakthroughs for low-emissions technologies. Their effect on future emissions can be anticipated before the effects start to materialise. These shocks can be modelled as an exogenous change in market participants' expectations for future emissions. While shocks can also result in an unanticipated increase in EUA demand, this less likely than a decrease in demand for allowances due to sustained decarbonization efforts across the economy. This analysis therefore focuses on the impact of an anticipated reduction in allowance demand, modelling the announcements of further coal phase outs beyond what is confirmed by 2020.

- **An unanticipated increase or decrease in EU allowance demand**. Temporary shocks of this type include a change in long-term speculation or hedging demand from compliance entities, while permanent shocks include a change in abatement costs or economic activity relative to expectations. To estimate the impact of an unanticipated reduction in EUA demand, we analyse a shock similar in size to the 2020 COVID-19 shock, but occurring in 2025. COVID-19 represents a large shock by historic standards, illustrating the impact of a tail risk to EUA demand materialising. We also assess the impact of a similar magnitude of shock but in the opposite direction (i.e. an unanticipated increase in EUA demand). This could happen for example due to a sudden nuclear incident causing nuclear energy to be replaced with natural gas or coal.

- **Induced holdings to stimulate tightening.** This could occur where market actors deliberately hold allowances in order to induce additional tightening from the MSR, inflating the prices. For instance, speculators or actors seeking to enhance the overall ambition of the EU ETS could buy and hold enough allowances to corner a large share of the TNAC, triggering the MSR repeatedly and creating a price spiral. To assess the impact of induced holdings, we analyse the prospect of non-compliance entities holding a significant number of allowances from 2025.

The plausible magnitude of shocks used in stress tests is informed by numerous sources, including literature review, interviews and surveys with market participants and quantitative analysis. For stress tests based on external factors such as coal phase out in MS, a literature review and internal analysis has provided sensible estimates of magnitude. To analyse factors with less publicly available data, such as hedging and speculative demand, we have complemented our understanding with input from interviews and surveys with market participants.

As indicated in annex 4, Section 9.1.4, the modelling outputs are not intended to be used as forecasts for prices and emissions. In particular the modelling focuses on carbon prices as adjustment variable and does not well cover the overall policy mix. However, when combined with qualitative and quantitative insights, the model can provide useful indications of the direction and size of impact.

The stress tests implemented here are summarised below

Table 23: Stress tests analysed in the model

Type of stress test	Specification of stress test implemented	Other causes of similar stress	Key issue for current MSR design
Anticipated decrease in EU allowance demand	Communicated policy measures, specifically coal phase out.	• Technological breakthrough with deployment delay.	Anticipated reductions in EU allowance demand can lead to an increase in cumulative emissions under current ETS policy. A reduction in future demand means firms need to bank less. They then have more liquidity in the current period, reducing prices.
Unanticipated decrease in EU allowance demand	Economic activity (and emissions) below expectations.	• Reduced demand for hedging. • Reduction in abatement costs. • Additional complementary policy measures e.g., larger coal phase out.	MSR has a partial and delayed response to negative demand shocks and price drops. Its effectiveness depends on timing of shock
Unanticipated increase in EU allowance demand	Economic activity (and emissions) exceeds expectations	• Increased long-term speculation. • Increasing hedging demand from industrials. • Increase in current abatement costs. • NGOs or governments buy and bank allowances permanently. • Complementary policies underperform, e.g., energy efficiency and renewable targets.	Sudden increases in demand for EU allowances can lead to an increase in EU allowance prices. The MSR is not suited to positive demand shocks, as it was designed to remove a surplus.
Induced holdings to stimulate tightening	Non-compliance entities hold a large number	• Speculators seek to corner market to induce price increases.	The MSR removes allowances from future auctions if the TNAC is above the threshold,

Type of stress test	Specification of stress test implemented	Other causes of similar stress	Key issue for current MSR design
	of allowances for long-term investment	• Actors seek to hold allowances to induce tightening and increased emissions reductions from ETS sectors.	regardless of the price level. Actors without compliance obligations could use this to multiply their impact on the emissions market by holding a large share of the TNAC over multiple years to drive price rises and additional mitigation.

Source: Vivid Economics

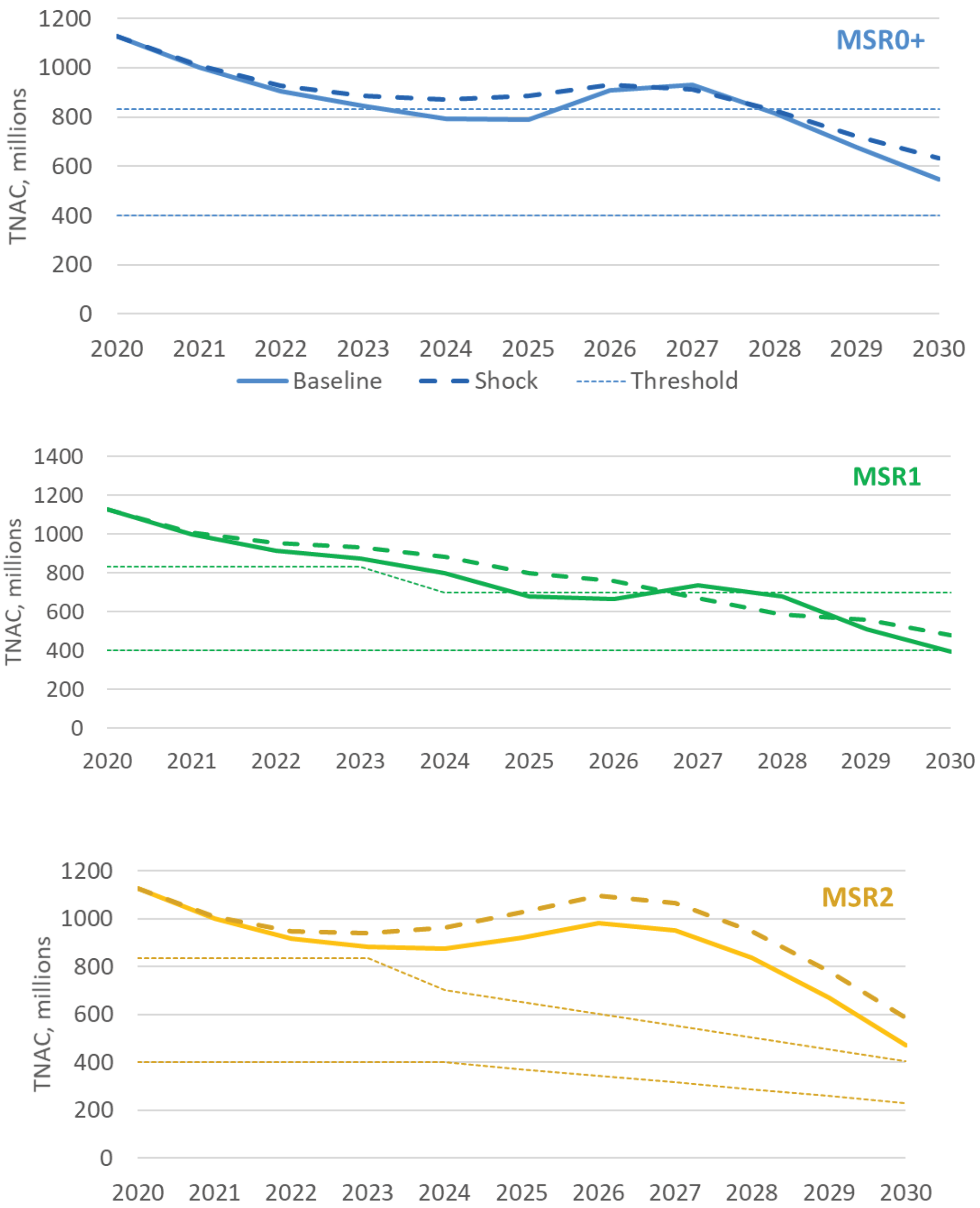
22.2 **Anticipated decrease in EUA demand: coal phase out**

The regulated phase out of coal power has the potential for a significant permanent reduction in EUA demand. The coal phase out is expected to reduce EUA demand by up to 277 million allowances by 2030. Half of this reduction is built into baseline emissions. The shock here simulates a scenario where the other half of emissions reductions are also realised, reducing EUA demand by 27 million allowances in 2021 and up to 138.5 million allowances by 2030. This shock is expected to be larger than other likely sources of anticipated demand reduction such as complementary policy measures or significant progress in industrial abatement technologies. It therefore represents the upper limits of a realistic shock.

An anticipated reduction in EUA demand leads market participants to anticipate lower future prices, leading to a reduction in abatement. If prices fall, compliance entities would rather pay for emissions than invest in abatement. However, this only partially offsets the reduction in emissions from the closure of coal plants, such that total emissions are still lower in the coal phase out scenarios. In other words, the reduction in emissions pushes up TNAC (as there is an excess supply of allowances) while the *expectation* of future emissions reductions reduces TNAC.

Intakes increase under all MSR designs when faced with an anticipated reduction in EUA demand, but MSR1 and MSR2 generate a stronger response than MSR0+ due to higher intake rates. Under MSR0+, the shock results in cumulative intakes from 2021-2030 increasing by 0.22 billion (from 1.24 billion EUAs to 1.146 billion). Under MSR1, there is an increase of 0.24 billion allowances (from 1.50 billion to 1.74 billion), reflecting the higher intake rate and lower thresholds for activation of the MSR. MSR2 results in an increased cumulative intake of 0.0.22billion, the same as MSR0+ but lower than MSR1.

Figure 31: TNAC under an anticipated reduction in EUA demand

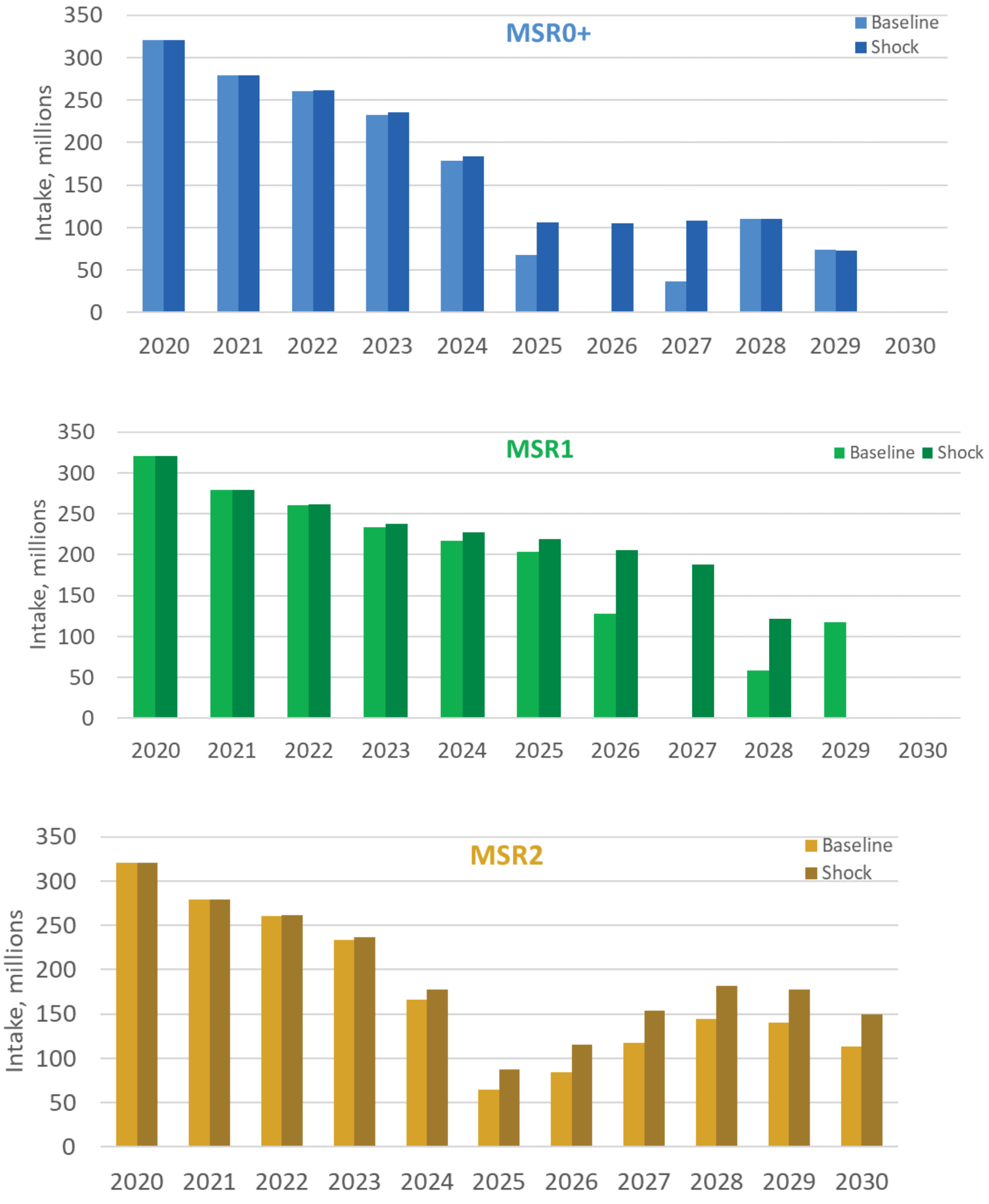


Source: Vivid Economics

The shock bumps TNAC up further, resulting in prolonged intakes into the MSR throughout the 2020s for MSR0+ and MSR2, and till 2028 for MSR1. While MSR1 intakes more allowances than MSR0+ and MSR2, the intakes are large and concentrated between 2021-2028. MSR0+ and MSR2 have a more long drawn out response, taking longer to neutralise the shock as intakes continue till 2030. This is due to the relatively low intake rates compared to MSR1. MSR2 gradually ramps up intakes as the impact of the shock gets bigger.

The 2030 TNAC is therefore lowest under MSR1, followed by MSR2 and finally MSR0+. Under MSR1, TNAC in 2030 is 47 million higher with coal phase out. This compares to 1110 million under MSR2 and 45 million under MSR0+.

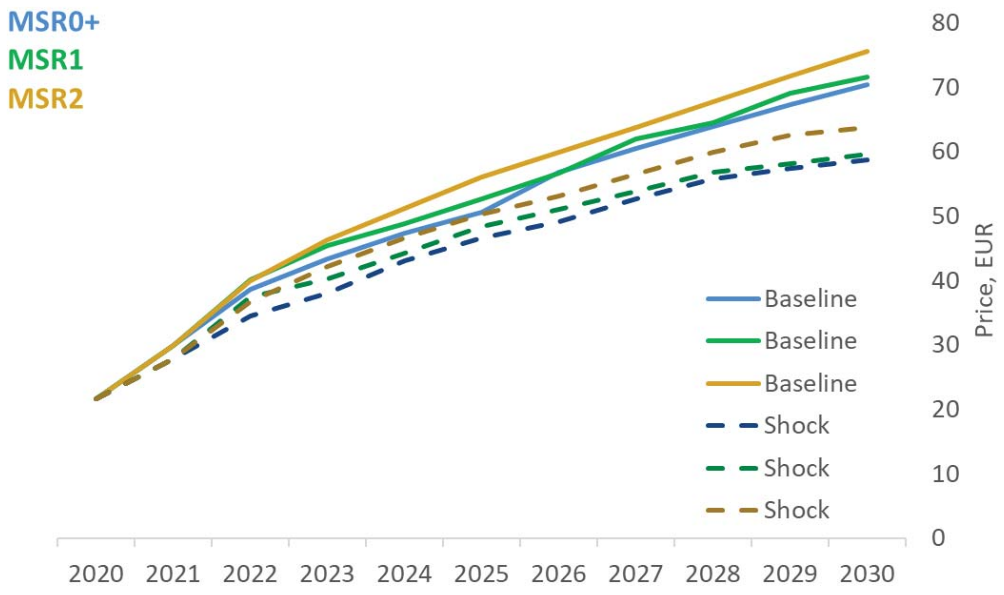
Figure 32: MSR intakes under an anticipated reduction in EUA demand



Source: Vivid Economics

A long-term reduction in EUA demand leads to a consistent decrease in price across MSR designs. As the reduction in emissions is assumed to be permanent, firms have a lower demand for allowances. Prices therefore remain lower to 2030, despite the higher cumulative intakes across all design options. The reduction in prices cause by the shock (measured against the respective reference case) is fairly consistent, at around 10 EUR in all MSR designs. This indicates that the MSR is not well suited to maintaining a particular price level in the event of an anticipated long term shock, which permanently alters the available allowances and firm behaviour.

Figure 33: EUA prices under an anticipated reduction in EUA demand

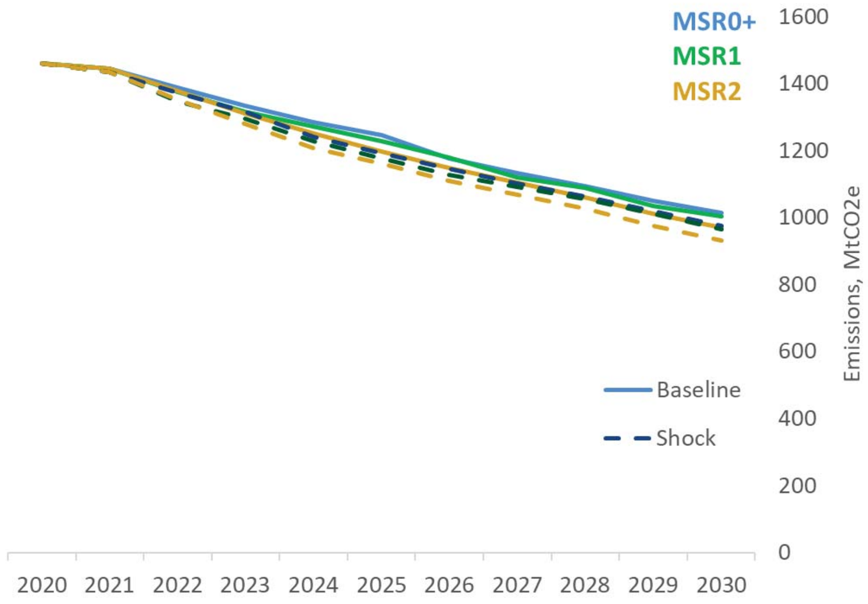


Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

Emissions reductions from the coal phase out persist across all MSR designs. These results do not support the 'green paradox' theory, whereby anticipated emissions reductions lead to entities reducing abatement behaviour. This is due to the fact that the impact of the coal phase out on emissions is realised gradually, with additional reductions occurring each year from 2021-30. The emissions reductions realised from 2021 offset the reduction in abatement due to lower anticipated emissions levels in future years, leading to a consistent reduction in emissions relative to the baseline.

Figure 34: Emissions under an anticipated reduction in EUA demand



Note: *Prices are shown in constant 2015 Euros.*

Source: Vivid Economics

22.3 Unanticipated change in EUA demand: economic shock

A sudden economic downturn can result in reduced emissions and an unanticipated decrease in EUA demand. Conversely, an economic boom could result in higher demand for EUAs. In this section we explore four different variations of an economic shock:

- **A temporary economic recession**. This tests the impact of a 155 Mt shock occurs in 2025, lasting for one period before economic production and baseline emissions bounce back to previous levels. The magnitude of the shock is based on the 2020 emissions impact of COVID-19, which represents an unprecedented reduction in emissions.

- **A temporary economic recession with a shorter anticipation horizon for the firm**. This scenario tests the impact of a temporary shock (as outlined above) when firms have a shorter time horizon (3 years instead of 10 years).

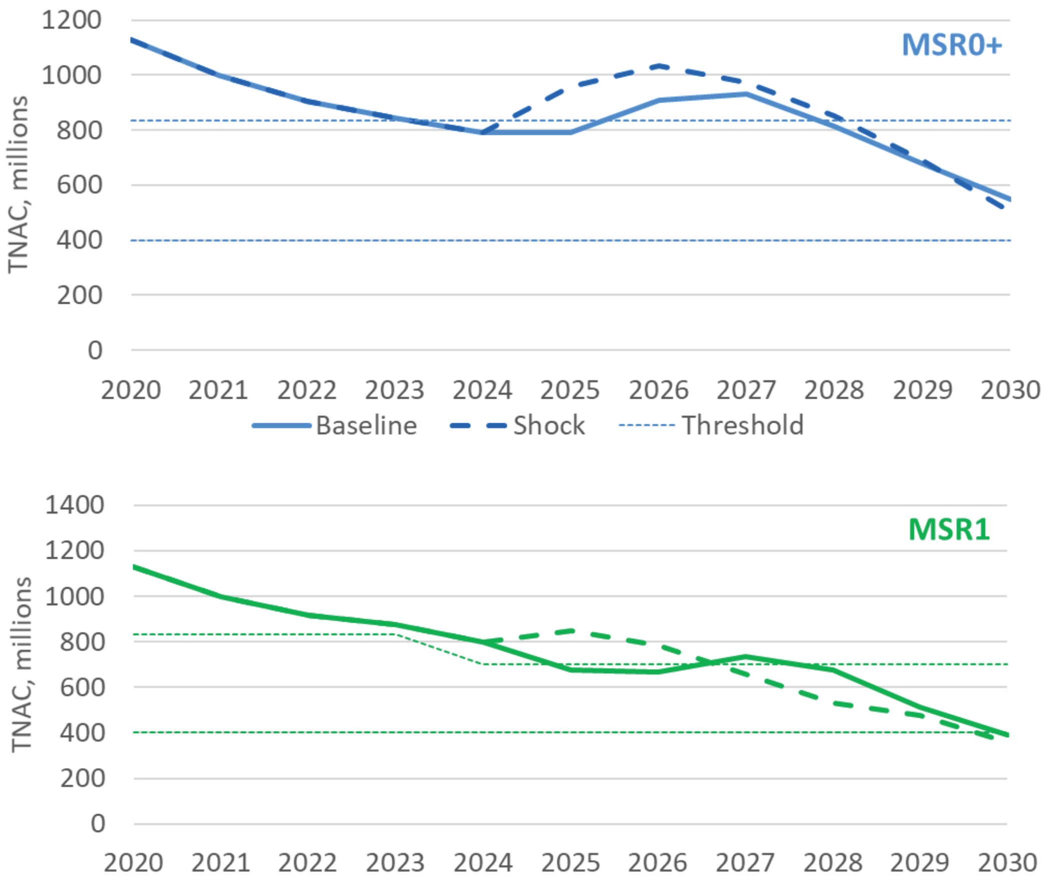
- **A persistent economic recession**. This tests the impact of a 155 Mt shock in 2025, which halves in 2026 (78 Mt), and halves again in 2027 (39 Mt). The 39 Mt reduction is considered structural and remains persistent to the end of 2050.

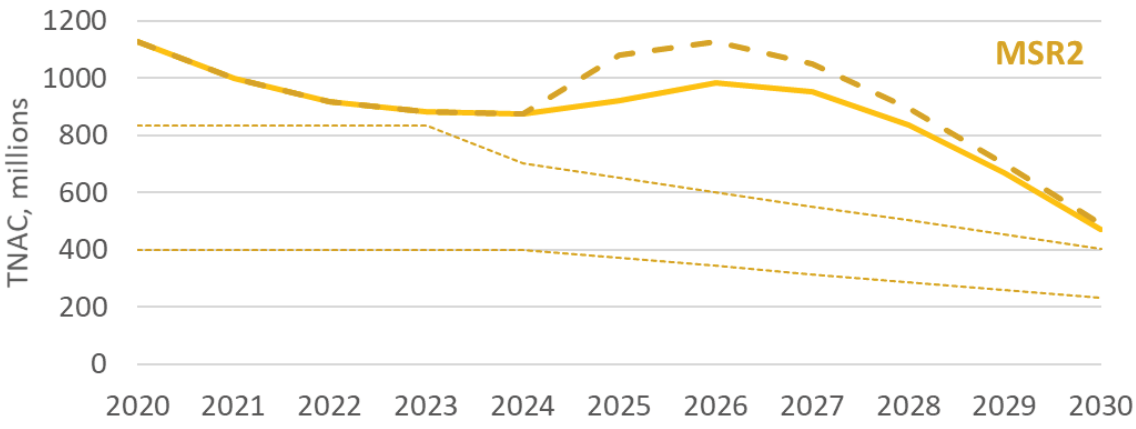
- **A persistent economic boom**. Finally, we consider a scenario where there is an unanticipated increase in EUA demand rather than a decrease.

(1) Temporary reduction in EUA demand

An unanticipated reduction in EUA demand leads to an increase in TNAC across MSR designs as firms bank excess allowances, but different intake rules lead to varied reactions. The initial change in TNAC is fairly similar across different MSR designs, with TNAC increasing in 2025 in response to a negative economic shock. However, subsequent reaction to the shock is dependent on the MSR design. MSR0+ is just able to bring the TNAC back in line with the baseline by 2030, five years after the shock occurs. MSR1 reduces the surplus quicker due to the higher intake rate. The larger intakes as a result of the shock even result in TNAC dipping below what it would have been without a shock. This result is due to threshold effects. MSR2 is able to reduce the surplus by 2030. Under MSR0+ and MSR1 intakes stop by the end of the decade. However, declining thresholds mean that intakes continue under MSR2.

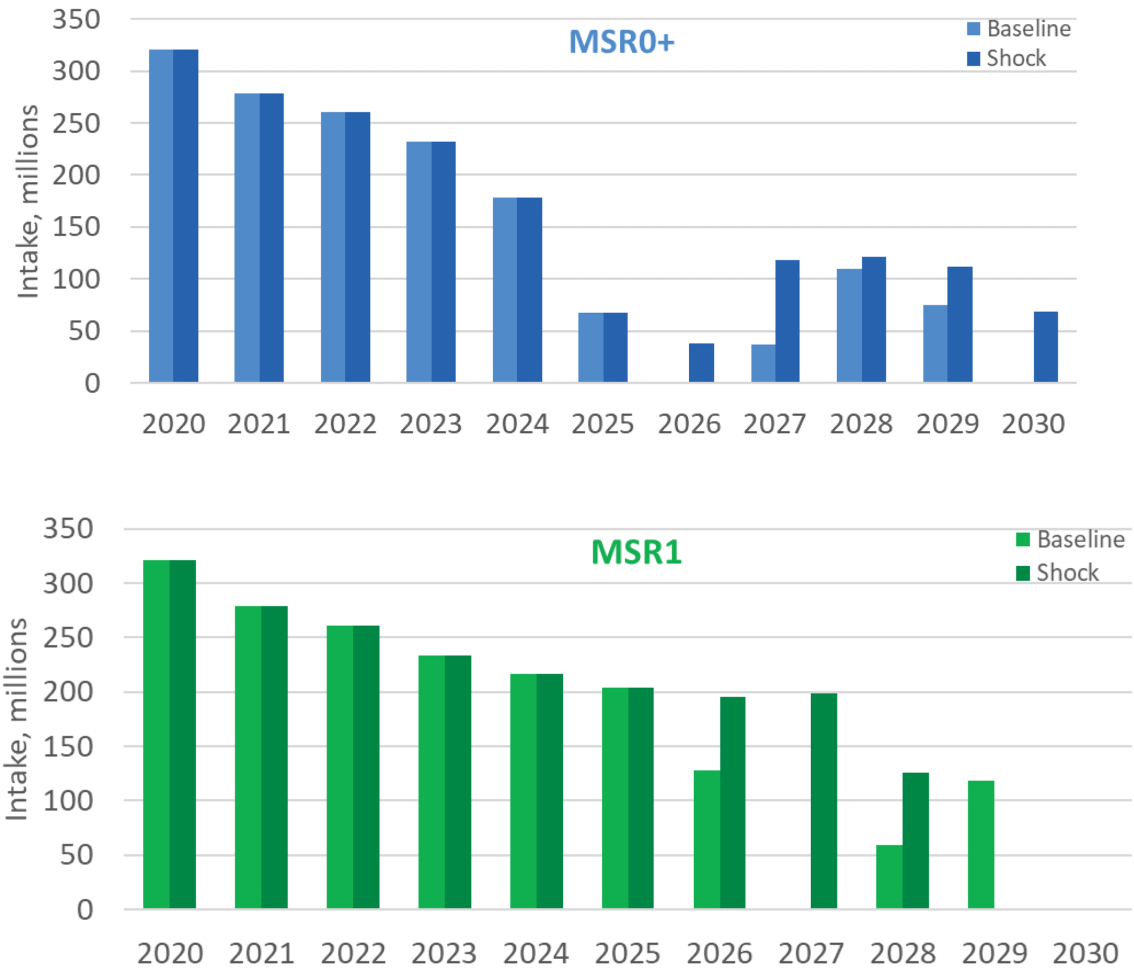
Figure 35: TNAC under a temporary reduction in EUA demand

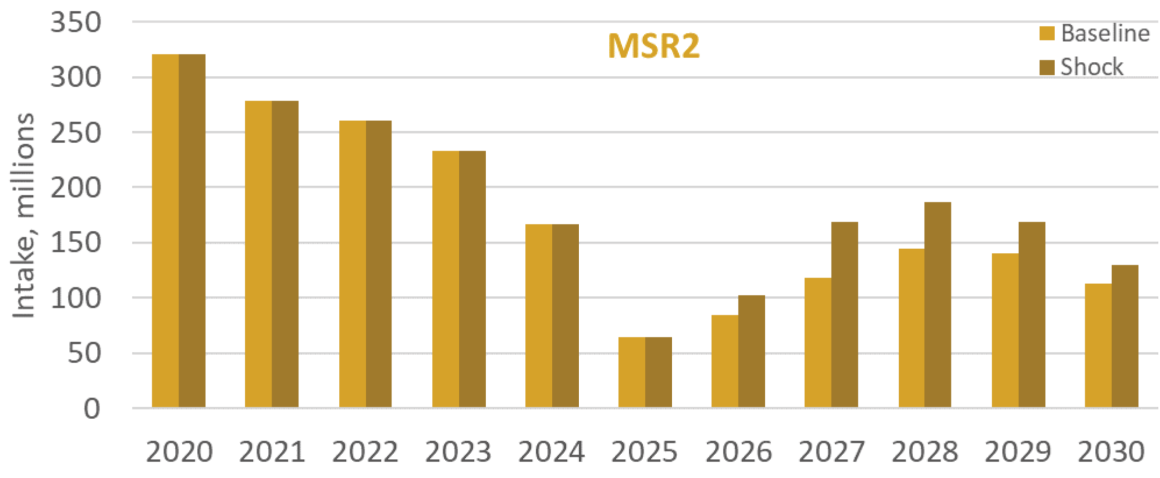




Source: Vivid Economics

Figure 36: MSR intakes with a temporary reduction in EUA demand

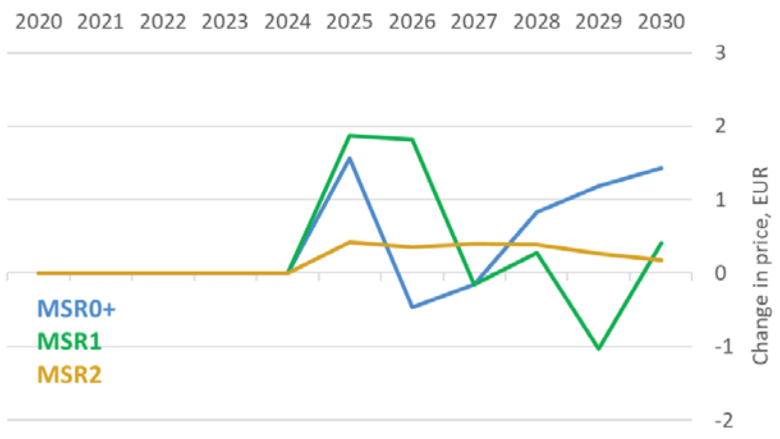




Source: Vivid Economics

The price response to an unanticipated shock is limited and equivalent across MSR designs, in part due to an assumption on 10 year foresight for firms. In the years following the initial demand shock, prices relative to the reference case without the shock are broadly the same, with some small deviations for MSR0+ and MSR1 due to threshold effects. The variation between designs is in the range of 1.5 euros. This is due to the temporary nature of the shock and the MSR's delayed time scale of action. By the time the intakes kick in, economic activity has returned to normal. The price trajectory is unstable for MSR0+ and MSR1 due to changing expectations of the size of intakes in future periods. This contrasts with a relatively stable price path under MSR2. This is also due to modelling assumptions, as firms anticipate that the long-term emissions trajectory is relatively unaffected.

Figure 37: EUA prices relative to baseline under a one period unanticipated reduction in EUA demand



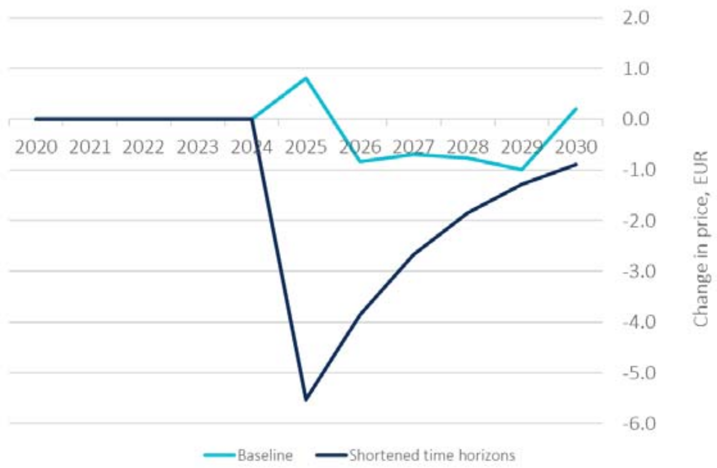
Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

(2) Temporary unanticipated reduction in EUA demand with shortened time horizons

The relatively muted price response in the previous section is partially a result of the modelling assumption that firms have a 10 year forward looking horizon. While this horizon is likely appropriate for the medium term without any economic disturbances, firms typically behave in a more short-sighted fashion in times of crises. We therefore tested this reduction in EUA demand with a 3 year time horizon. Results show that there is a more dramatic decrease in price when firms have a shorter time horizon.

Figure 38: EUA prices relative to baseline (for MSR0+)



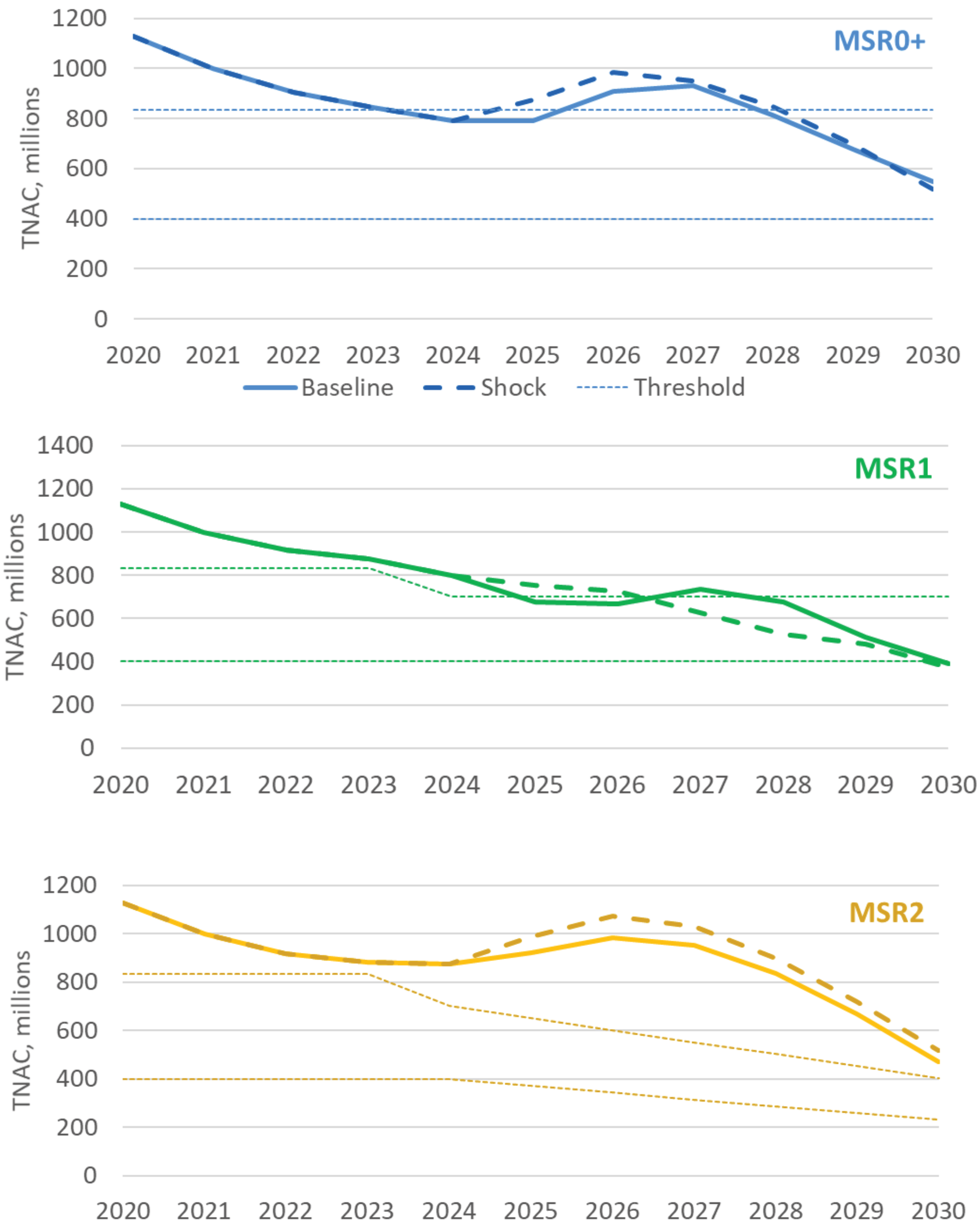
Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

(3) Persistent and unanticipated reduction in EUA demand

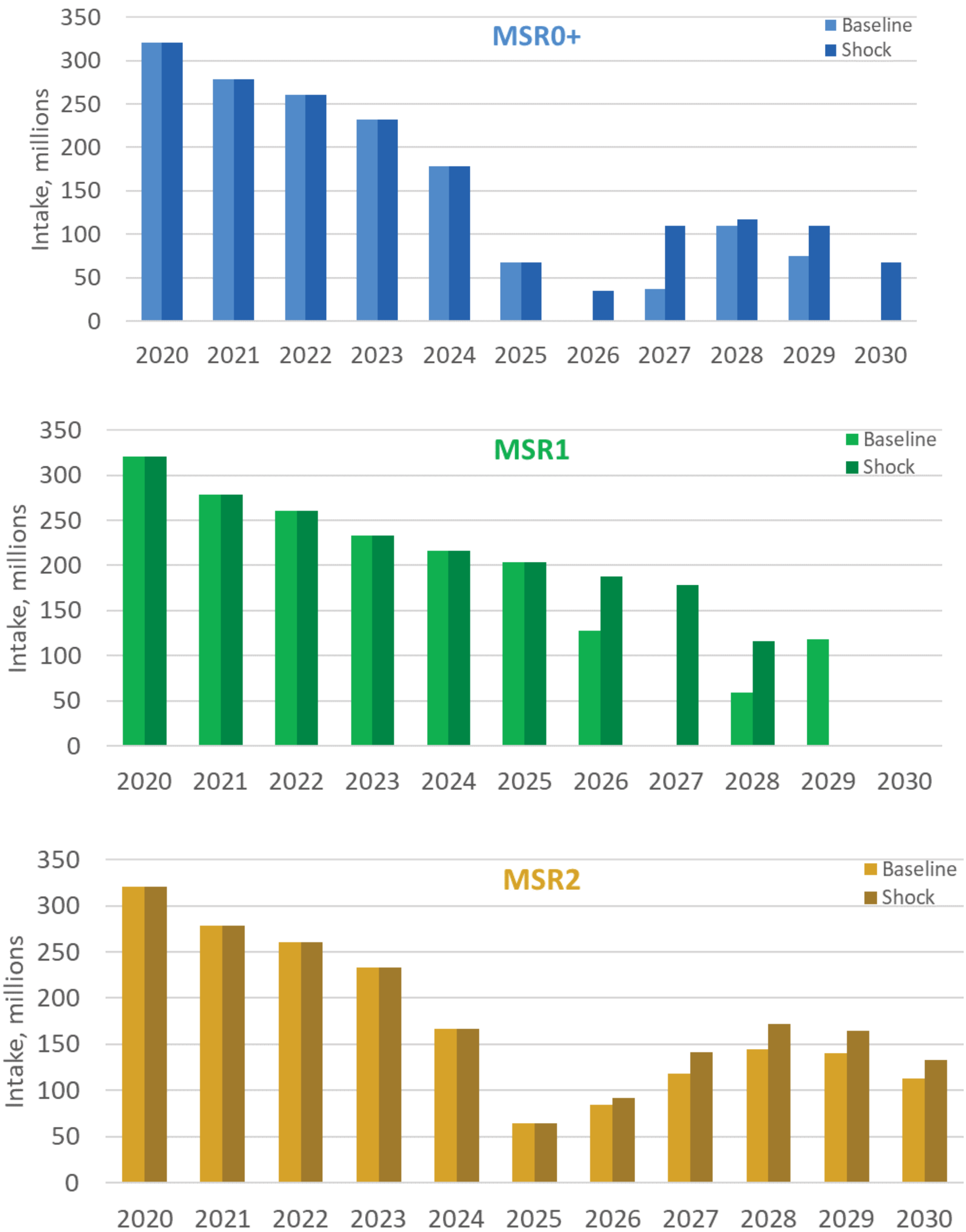
The key difference between a temporary and persistent reduction in EUA demand is the effect on prices, which fall more significantly and remain slightly lower than the baseline through to 2030. Prices fall by around 10 EUR in 2025 when the shock occurs and remain about 4 EUR lower than the counterfactual without the shock across all MSR designs in 2027. This price impact persists to 2030 due to the long-term persistence assumed in this case. The price impacts vary slightly by MSR design, with MSR1 making the quickest recovery due to the higher intake rate. However, differences of this small size (approx. 2 EUR) should be interpreted with caution.

Figure 39: TNAC under a persistent unanticipated reduction in EUA demand



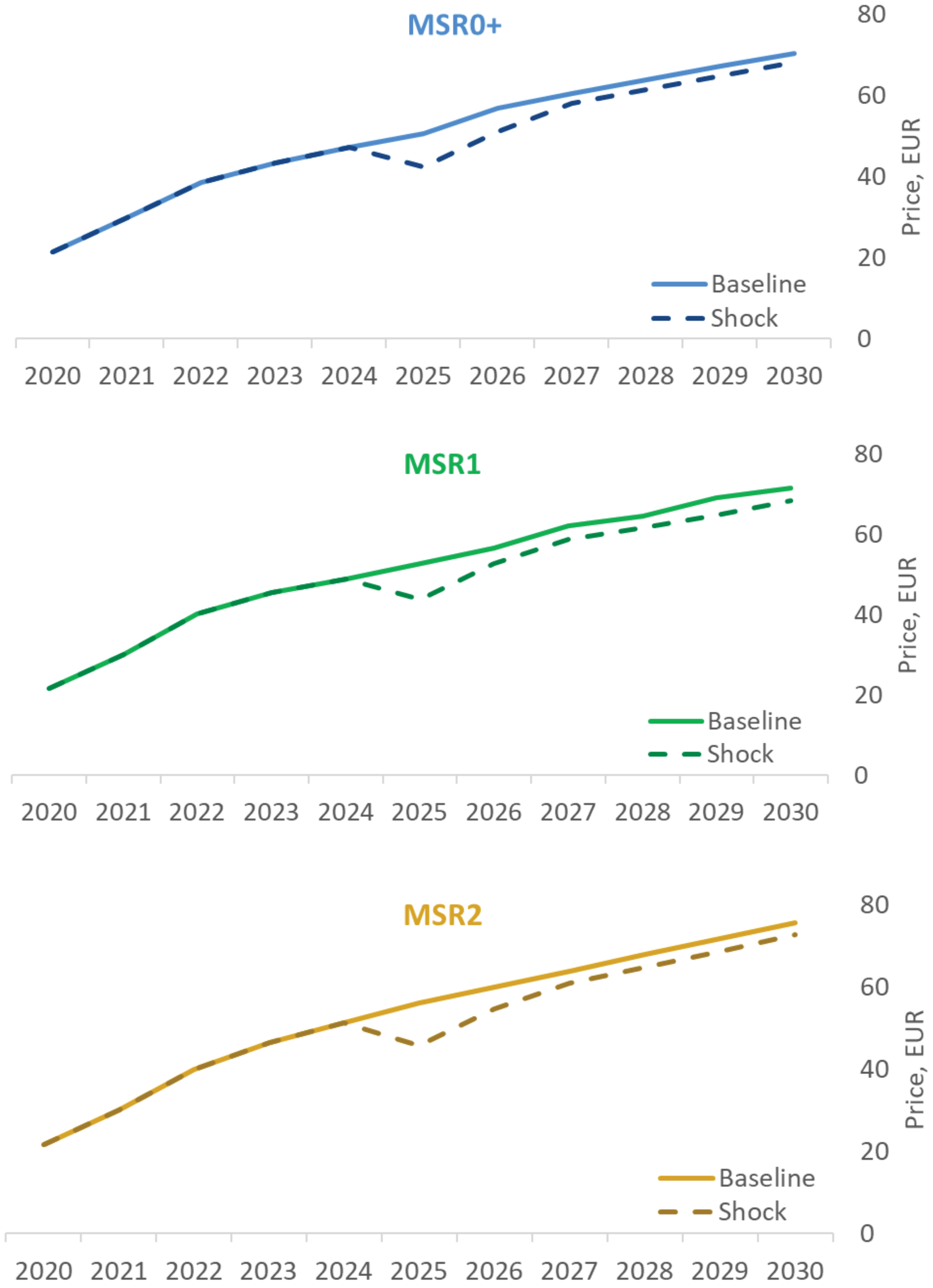
Source: Vivid Economics

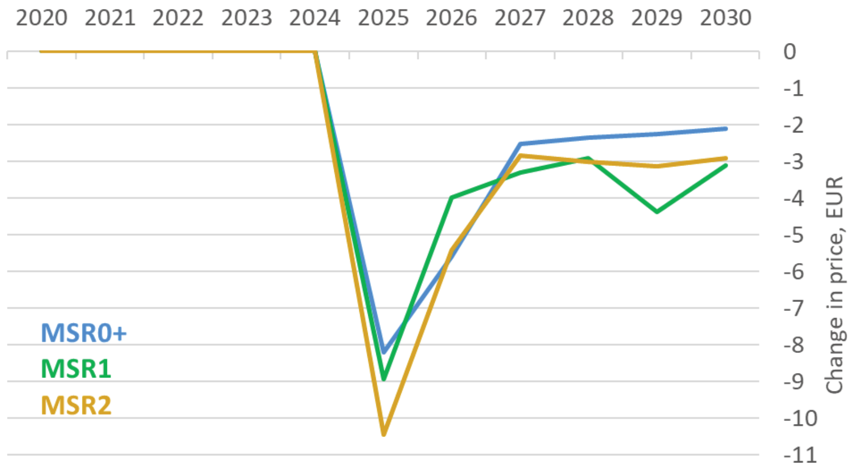
Figure 40: MSR intakes with a persistent unanticipated reduction in EUA demand



Source: Vivid Economics

Figure 41 EUA prices under a persistent unanticipated reduction in EUA demand





Note: Prices are shown in constant 2015 Euros.

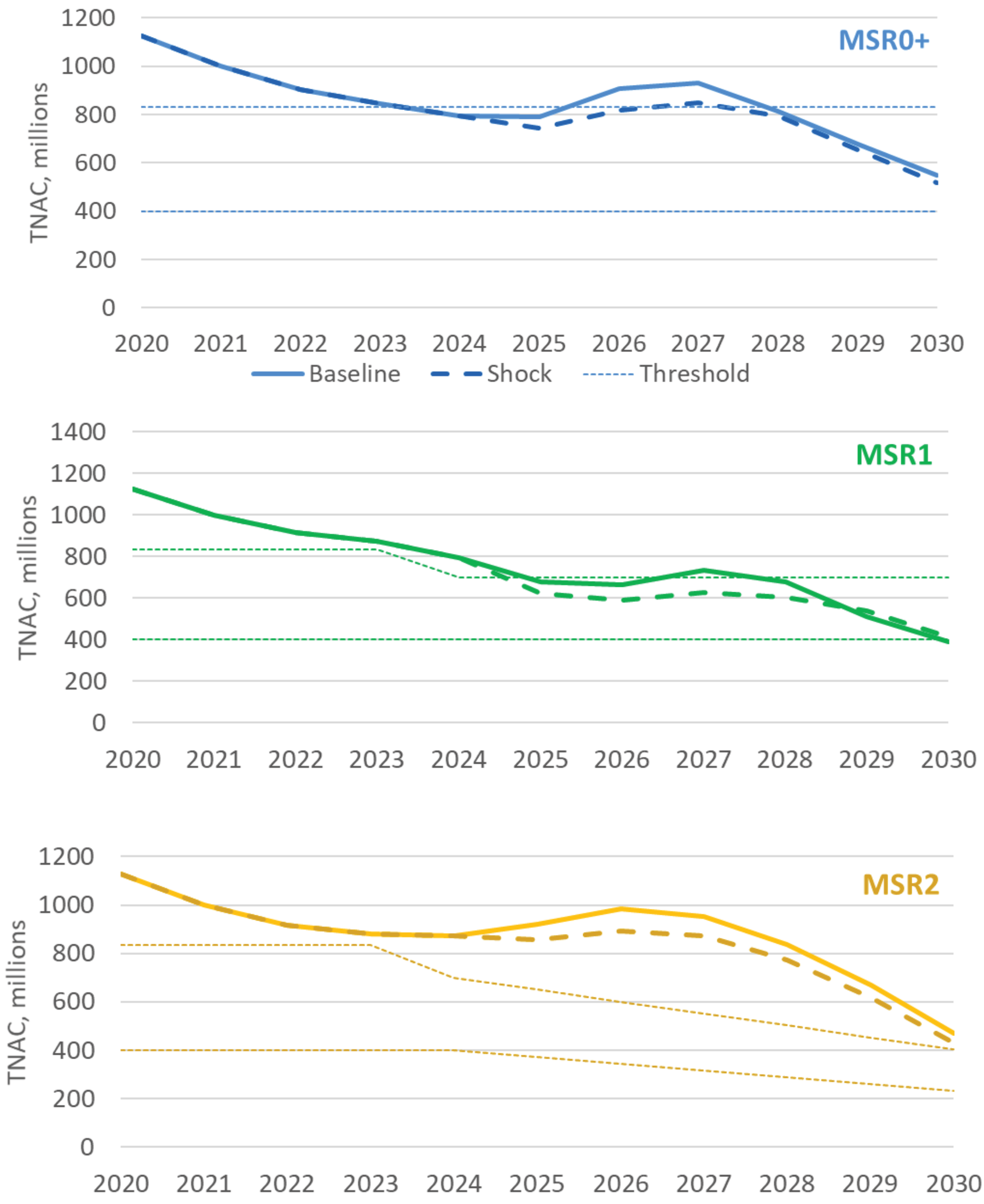
Source: Vivid Economics

An auction reserve price, which is part of MSR3, could provide a faster and more effective response to negative demand shocks. The MSR3 design outlines an auction reserve price that starts at €25 in 2025 and increases by a real rate of 3% each year, reaching €29 in 2030 if unadjusted. While this price floor does not bind in the scenarios tested, it could serve to bolster market participants' confidence in the system in case of a larger demand shock. A minimum price also unlocks investment in abatement options below the price floor by removing uncertainty around future prices and market evolution. Alternative projections of price impacts should also be considered, as these results reflect outputs of one model and do not constitute a definitive forecast of prices.

(4) Persistent unanticipated increase in EUA demand

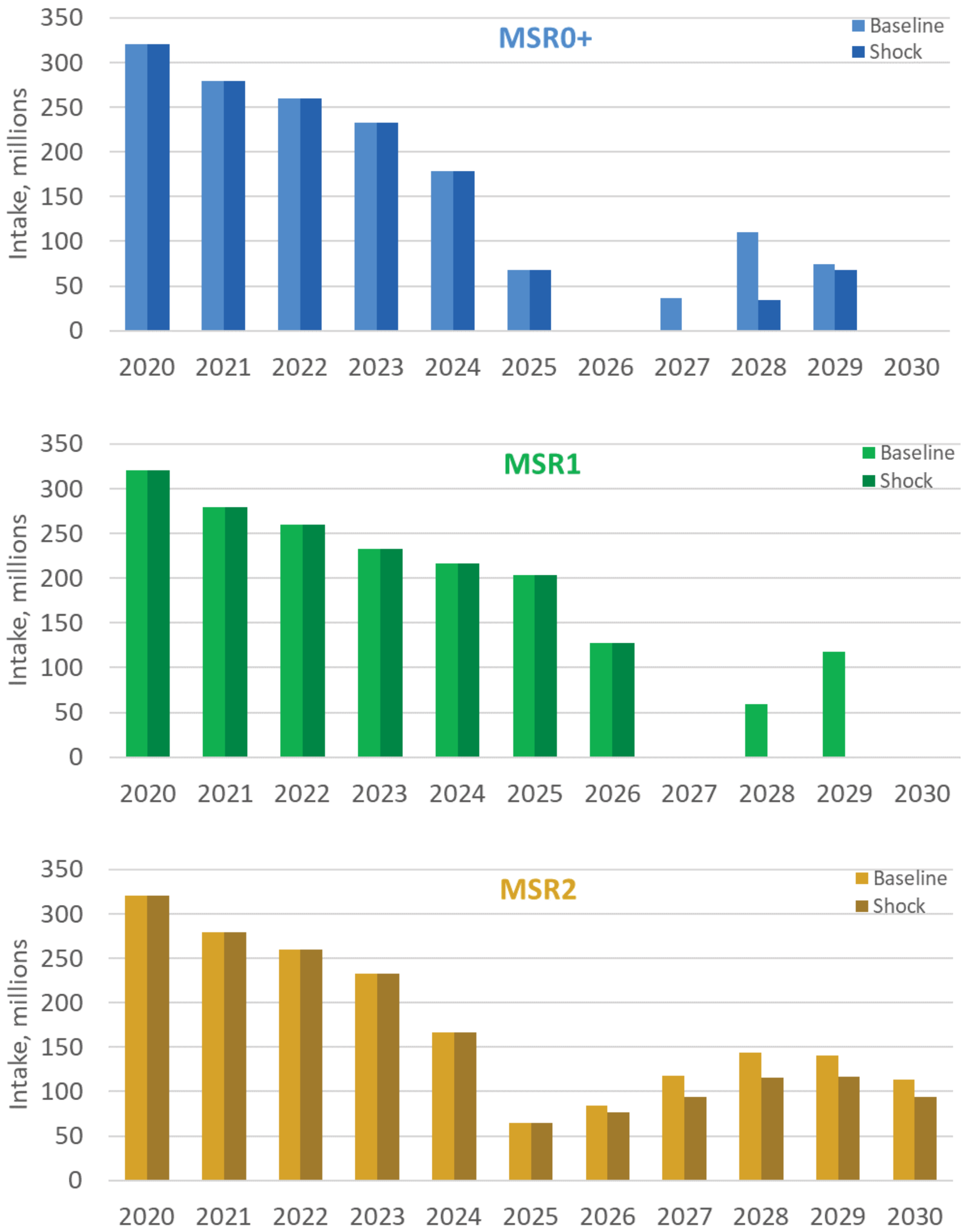
A persistent increase in EUA demand mirrors the results presented for a persistent decrease in demand, and has been included for completeness. Prices increase by around 12 EUR in the initial period of the shock, with this differential reduced to around 4 EUR across all MSR designs by 2027. This price impact continues to 2030 due to the long-term persistence assumed in this case.

Figure 42: TNAC under a persistent unanticipated increase in demand for EUAs



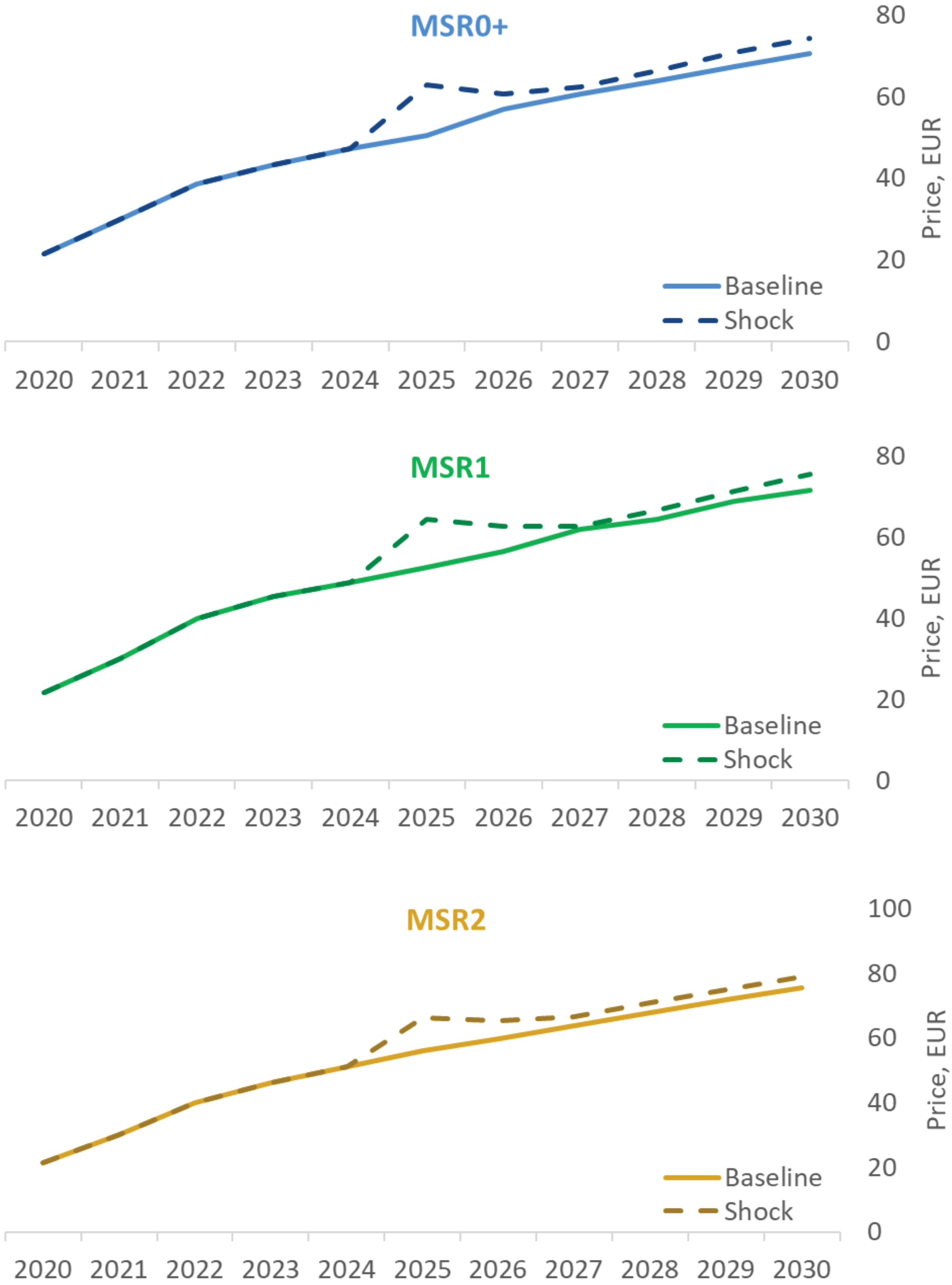
Source: Vivid Economics

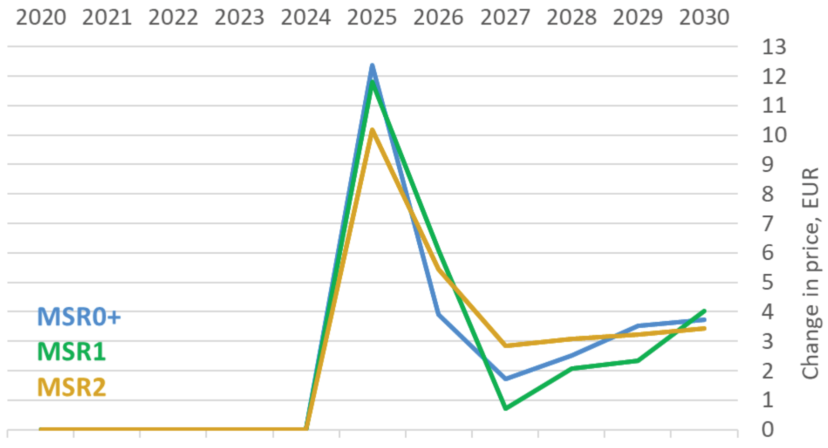
Figure 43: MSR intake under a persistent unanticipated increase in demand for EUAs



Source: Vivid Economics

Figure 44: EUA prices under a persistent unanticipated increase in EUA demand





Note: Prices are shown in constant 2015 Euros.

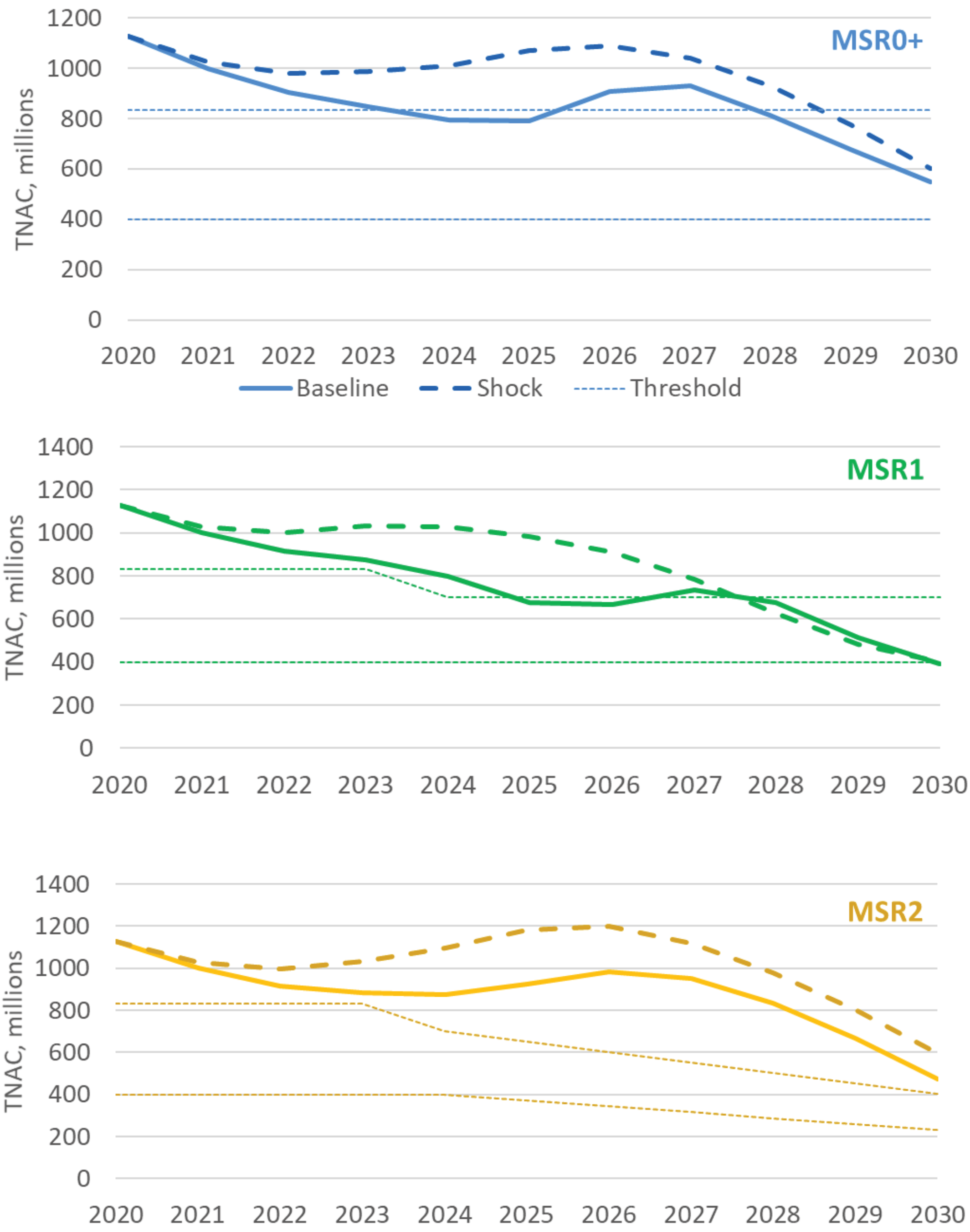
Source: Vivid Economics

22.4 **Induced holdings to stimulate tightening**

In some cases, actors may seek to leverage the MSR's design to deliberately drive prices up. An artificially high TNAC means the MSR is triggered more often, causing intakes and rising prices. For instance, long term investors may hold a large share of allowances to increase prices and return on investment, and environmental NGOs may hold allowances to drive increased climate action through higher prices. The shock modelled assumes that allowances being held by non-compliance entities from 2025, are driving up TNAC by 240 million, as well as increasing prices in the ETS.

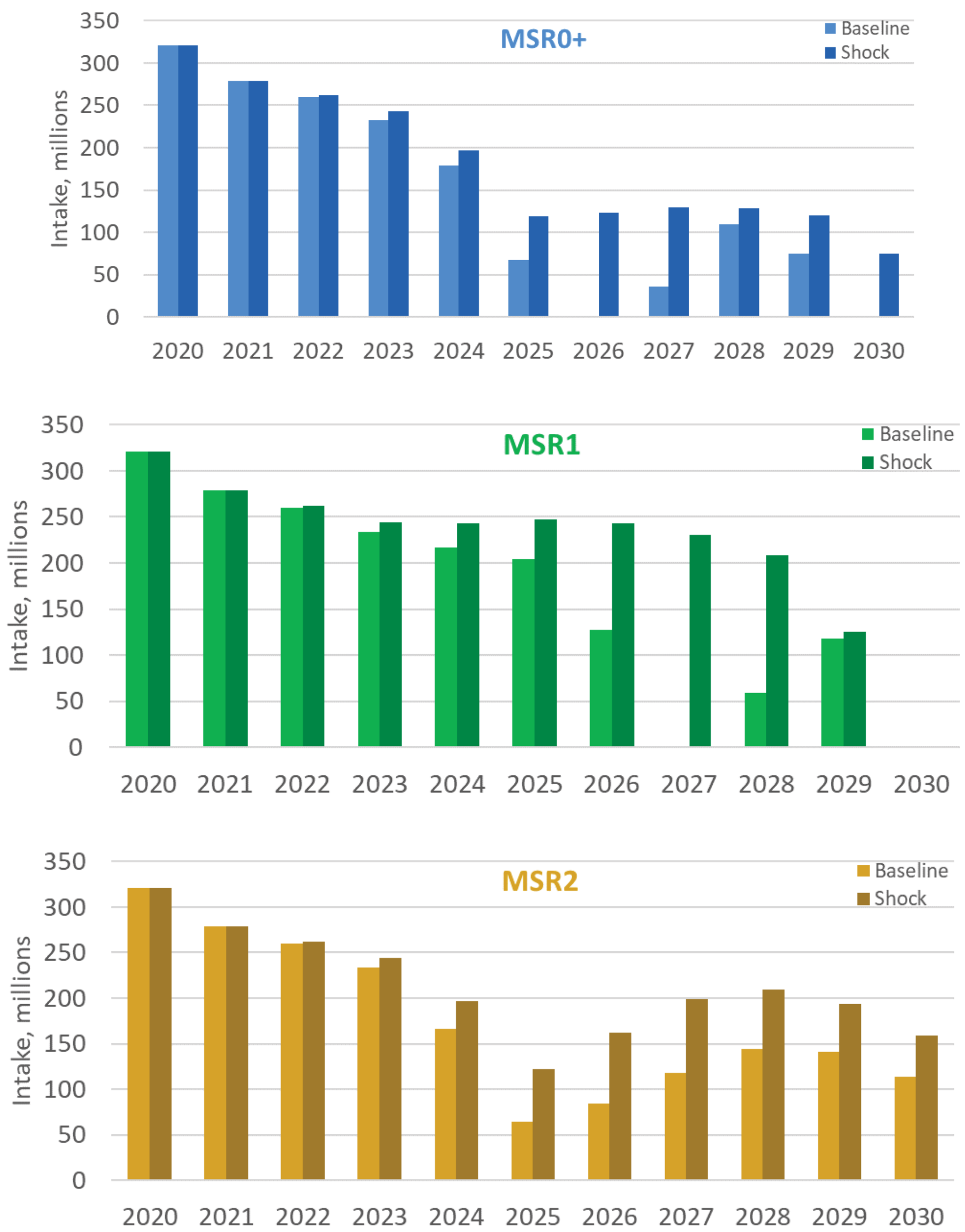
MSR1 results in the largest intakes due to induced holdings. An induced holdings shock increases EUA demand, ultimately leading to an increase in TNAC and intakes across all designs. Due to the way the intakes are structured, MSR2 intakes allowances more slowly and avoids sharp threshold effects. Note that if these induced holdings remain inaccessible to market participants, the higher intake rates will also have negative impacts on liquidity for compliance entities.

Figure 45: TNAC under an induced holdings shock



Source: Vivid Economics

Figure 46: MSR intakes under an induced holdings shock

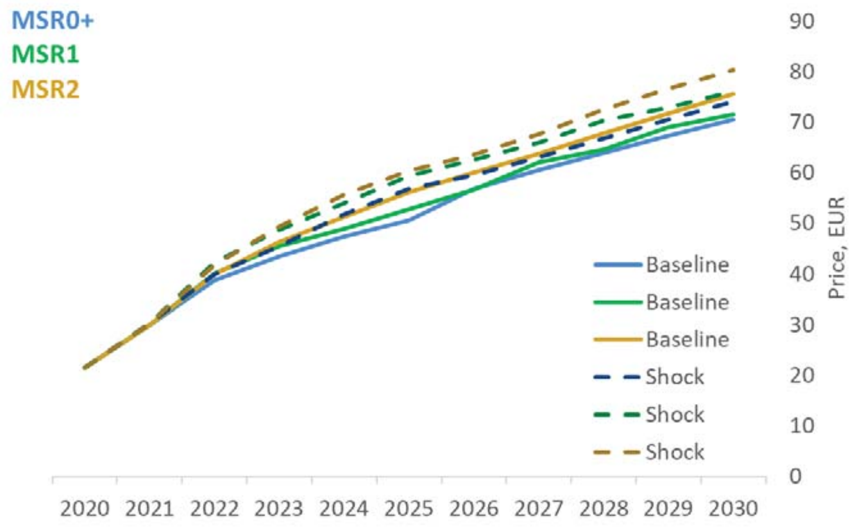


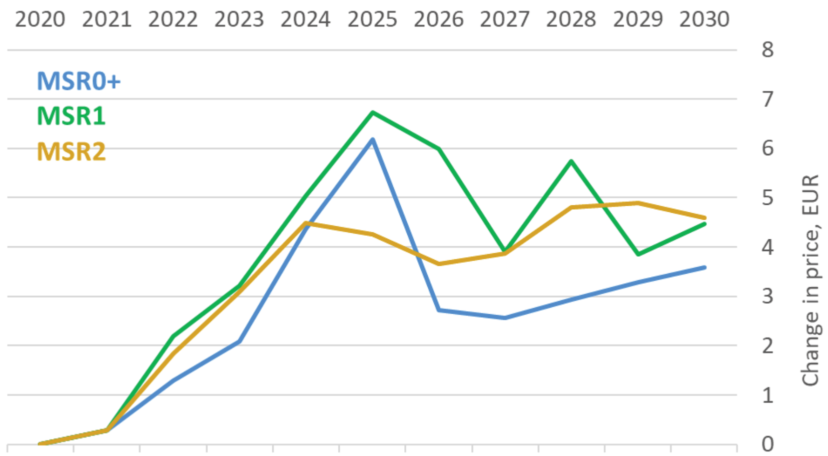
Source: Vivid Economics

An induced holdings shock increases prices in all MSR designs, but is exacerbated by higher intake rates and lower thresholds. As expected, the holding shock instigates prices increases as supply of allowances falls short of demand. Prices are driven up by further reductions in auctioned allowances, as the higher TNAC leads to increased intakes to the MSR. In the interim period, prices are stabilised, as firms benefit from the early abatement activity undertaken when allowance supply was tighter. However, prices increase again relative to the case without induced holdings as TNAC approaches zero, as firms have been unable to bank as many allowances as desired, and the MSR continues to reduce supply relative to the case without the shock. Prices are increased most under MSR1 followed by MSR2, where higher intake rates cause the induced shock to reduce cumulative allowance supply most.

MSR1 results in sharper price increases than MSR2 due to threshold effects. The graph below shows the change in price between the 'shock' scenario and the respective baseline case for each MSR design. MSR1 results in the highest increase in prices, but also the most volatile ones because of the large intakes when the threshold is crossed. In practice, this volatility may be more pronounced than modelling shows. This is because the model is only able to represent an annual time period (which abstracts away from within-year volatility), and assumes firms have a 10 year anticipation horizon (which may not hold in practice, resulting in more myopic and erratic behaviour of short term prices).

Figure 47: EUA prices under induced holdings





Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

Insights from interviews and discussions with market participants suggest that the likelihood of speculation triggering a price spiral is low. The primary reason that the likelihood is small is because of the relatively small size of the speculative market. Short-term speculators do not tend to hold large positions and would be more likely to sell in the event of a larger-than-expected price increase. Long-term investors represent a small part of the market (less than 100 million allowances) so would not be a significant driver of a price spiral. Speculative activity may also serve to reduce prices as investors may be incentivised to sell off a portion of holdings if the EUA price exceeds internal price targets. However, this market is changing rapidly and high-profile investment in EUAs may cause the size of the market to expand suddenly and dramatically.

23 POLICY VARIATION SENSITIVITIES

23.1 MSR results for the extreme cap scenarios

In this impact assessment, we consider three cap scenarios, a central one (AMB2a), and two extremes (AMB1 and AMB2b), which represents differing levels of stringency over the 2021-2030 period. All cap variations lead to an equal level of allowance supply in 2030, with variations in the annual allowance supply from 2024-2030.

23.1.1 Market balance

Detailed modelling results for each MSR option under the different cap variations are presented below. The figures present the modelled level of the TNAC, the intakes into the MSR and the effective cap level – the cap as it would be affected by MSR intakes or releases. The qualitative insights regarding the MSR designs discussed in Section **Error! Reference source not found.** remain unchanged in these cap variations, although there are some important differences in the numerical results driven by the adjusted cap trajectories. The key observations are summarised below:

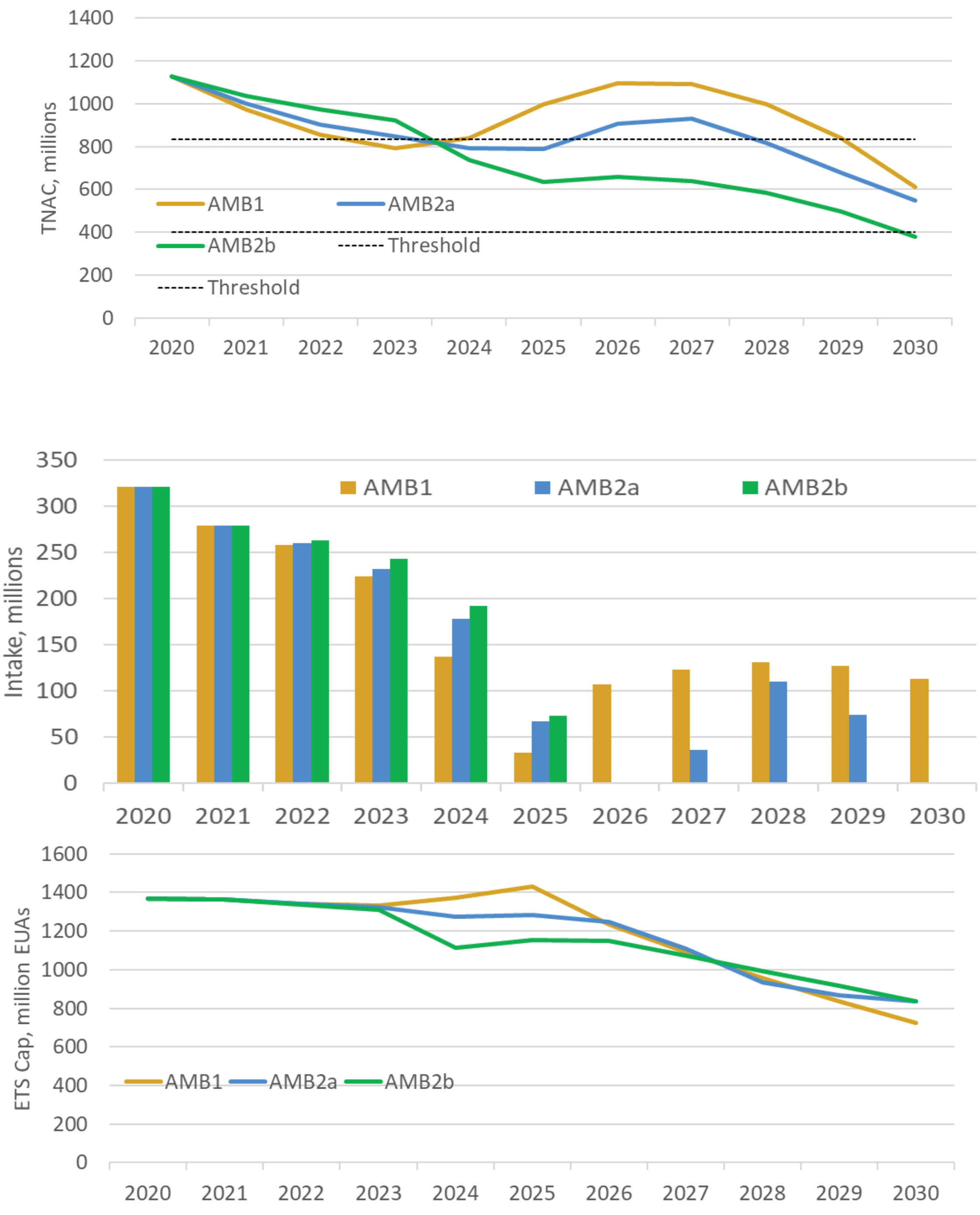
- **A tighter Phase IV cap (e.g. AMB2b) results in a lower TNAC between 2024 and 2030.** This is a direct result of a reduced supply of allowances available to market participants. The resulting differences in the level of TNAC across the cap variations is more pronounced between 2025 to 2027, after which the impact of MSR intakes become observable from the narrowing differences across the cap variations. By 2030, the difference in TNAC between AMB1 and AMB2a typically lies within 100 million. The same is true when comparing 2030 TNAC between AMB2a and AMB2b under the different MSR options.

- **A tighter Phase IV cap has two immediate implications for the MSR: (a) fewer MSR intakes, and (b) shorter intake period and potentially earlier releases.** For instance, under MSR1, the MSR intakes become zero by 2027 under AMB2b with MSR1, three years earlier compared to AMB1. In this particular example of AMB2b with MSR1, TNAC in 2027 goes just below the lower threshold of 400 million, resulting in releases from the MSR by 2029. The extent to which (b) occurs, and by how much, is sensitive to model parameters. This creates some uncertainty for market participants facing MSR0+ and MSR1, because intakes are discontinuous at the upper threshold, swinging from over 100 million in a particular year to zero in the next year. Depending on whether market expectations are met, this ‘threshold effect’ can produce kinks in the price path. Meanwhile, this is not the case for MSR2, as intakes continue throughout the period.

- **Across all MSR options, the main analytical statistics under AMB2a are nested between AMB1 and AMB2b.** For this reason, the impact discussion in the main text, which is based on AMB2a, can be interpreted as the midpoint of policy ambitions in the EU ETS cap.

With MSR0+, the lower intake rate is unable to limit the increase of the surplus as of 2025, across cap scenarios.

Figure 48: TNAC, intake and cap post-MSR adjustments under cap scenarios under the baseline design MSR0+

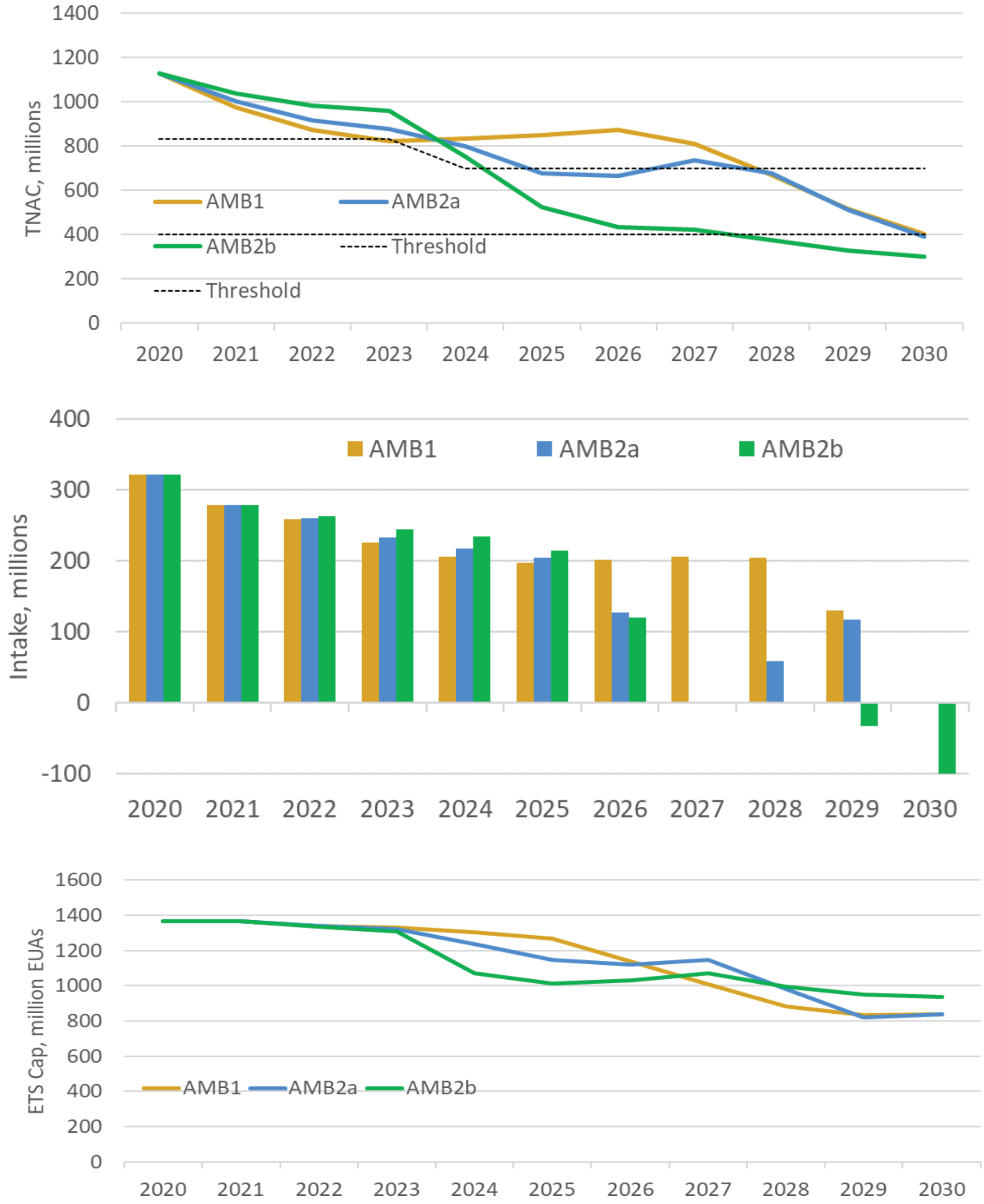


Source: Vivid Economics

The higher intake rate under MSR1 leads to a larger volume of intakes into the MSR, more quickly offsetting the relative slack in AMB1 and AMB2a. Cumulative intakes are 1 billion higher under AMB1 than under AMB2b. The relatively high supply of allowances in the short term under AMB1 leads to more banking, a higher TNAC and therefore larger intakes to the MSR. Under AMB1, there are intakes to the MSR until 2030, whereas the final year of intakes under AMB2b is 2027. This leads AMB1, the least stringent cap, to have a lower effective supply than AMB2b during the period 2026-

2030 (see the bottom graph in Figure 49). The post-MSR cumulative supply of allowances under AMB1 is 10.6 billion, compared with 10.7 billion under AMB2b.

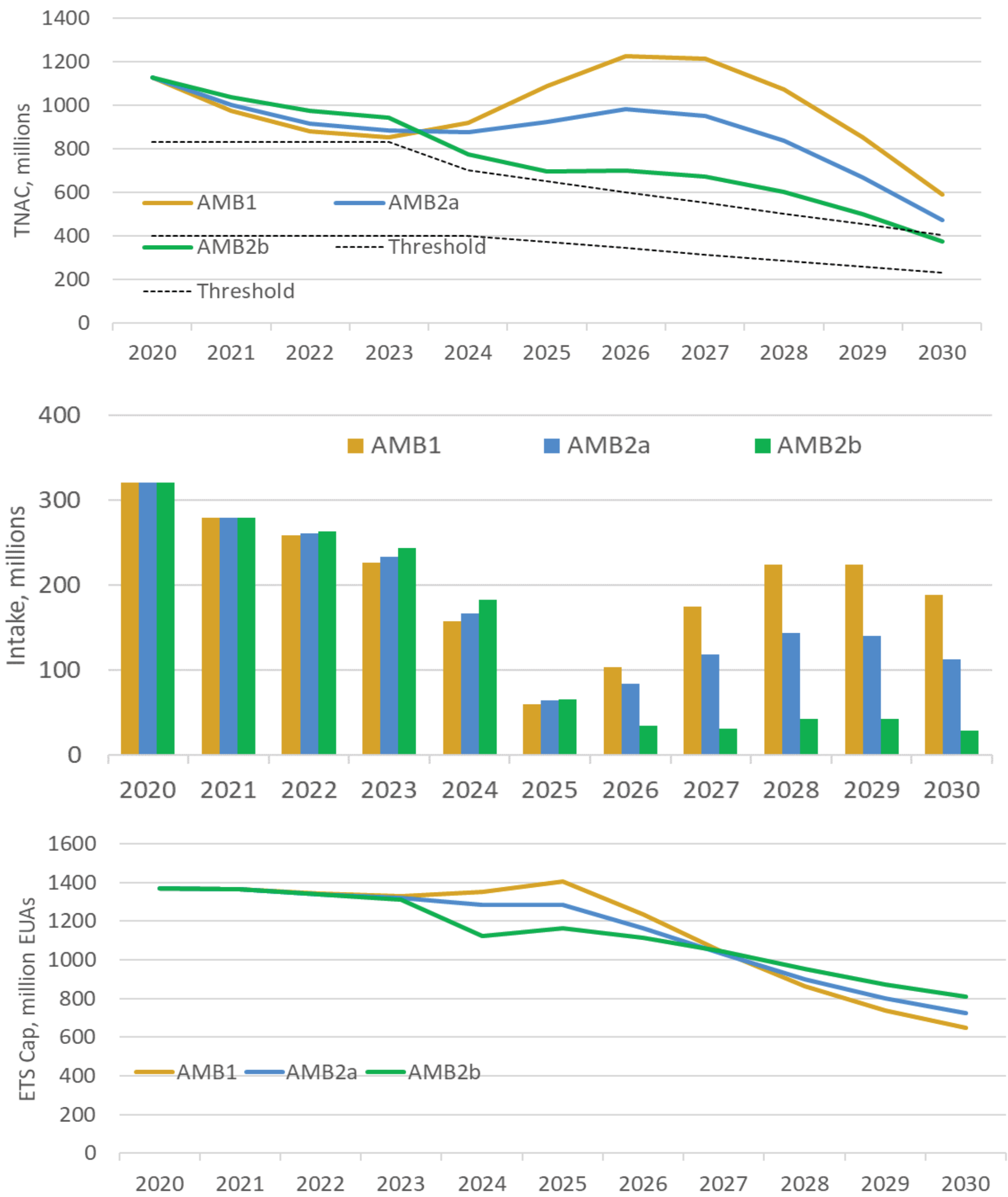
Figure 49 TNAC, intake and cap post-MSR adjustments under cap scenarios under MSR1



Source: Vivid Economics

A similar outcome is seen under MSR2, where the higher availability of allowances under AMB1 results in larger intakes into the MSR, lowering the effective cap. Unlike MSR0+ and MSR1, there is no threshold effect to account for in MSR2, as the TNAC remains above the (declining) upper threshold to 2030 in all cap variations. However, the higher intake rate of 33% leads to consistently higher intakes under the looser cap scenarios, which brings cumulative supply down substantially in these scenarios.

Figure 50: TNAC, intake and cap post-MSR adjustments under cap scenarios under MSR2

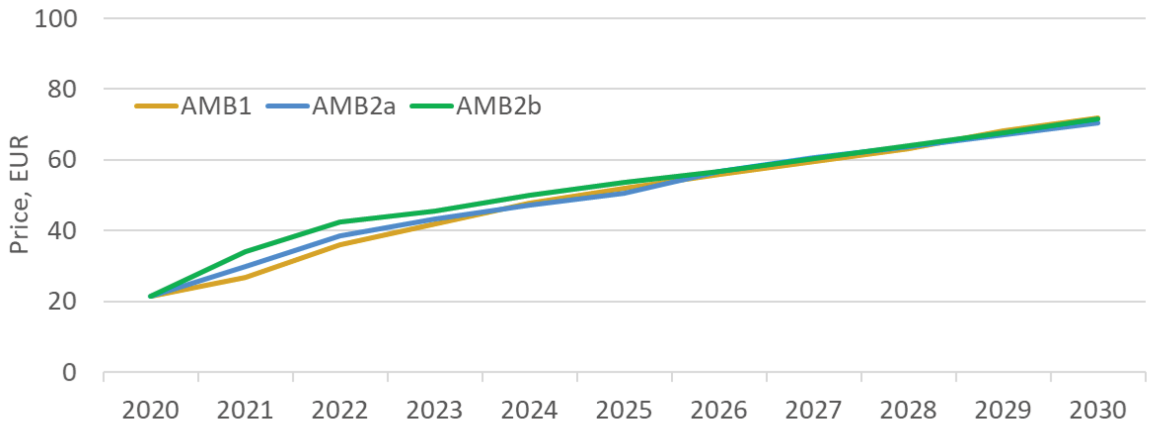


Source: Vivid Economics

23.1.2 Stylised carbon prices

Differences in prices across different cap scenarios are smaller because supply under a less stringent cap would be tightened by larger intakes to the MSR (see Figure 51 below). Caps which are initially less stringent, such as AMB1, have a higher surplus of allowances in earlier periods due to greater annual supply. This increases the TNAC during 2021-2030, which subsequently increases intakes into the MSR, reducing auctioned allowances and the effective cap. This leads to similar price outcomes across the different caps.

Figure 51: Carbon price with MSR0+, for the cap scenarios AMB1, AMB2a, AMB2b



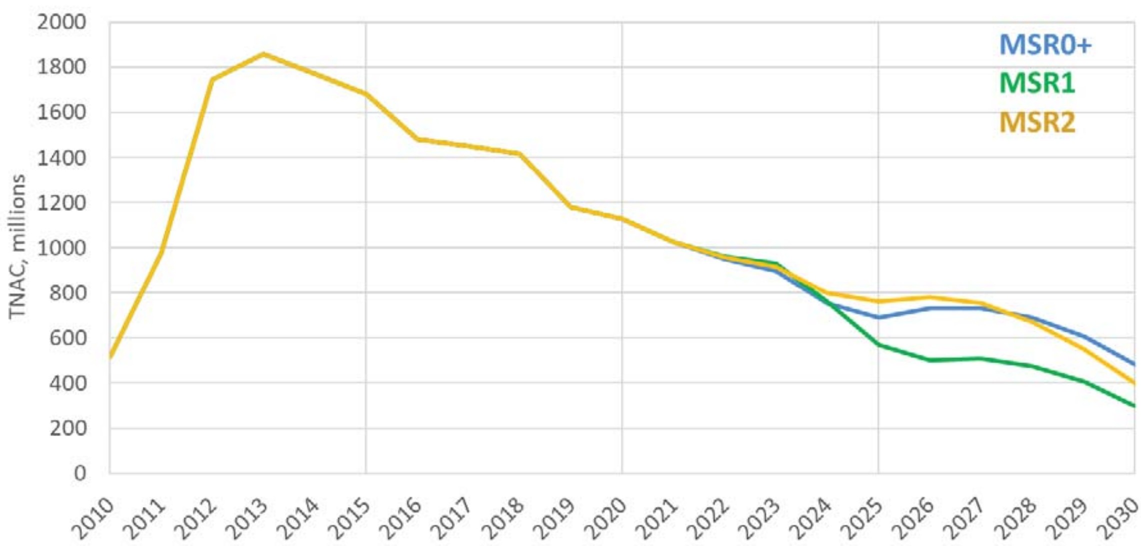
Source: Vivid Economics

23.2 MSR results for AMB2c

In what follows, the modelling results for cap scenario AMB2c are also presented. The key observations are summarised below:

- **The higher intake rate of MSR1 reduces the TNAC the highest with this cap option, possibly leading to releases in 2030.** The outcomes with MSR0+ and MSR2 have similar trajectories, although the TNAC with MSR2 is nearly 100 million lower at the end of the period, possibly leading to releases from the MSR.

Figure 52: TNAC for MSR0+, MSR1 and MSR2, for cap scenario AMB2c

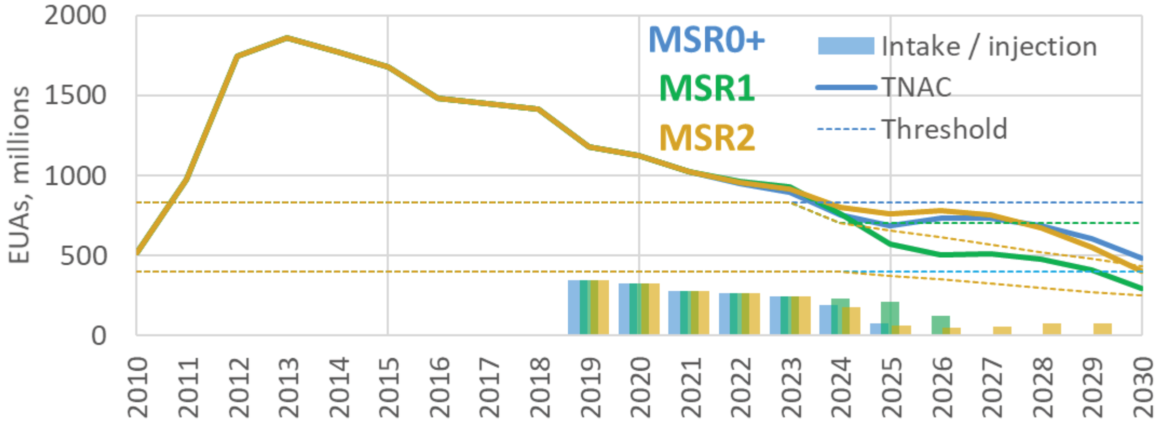


Source: Vivid Economics

- **Intakes**

The behaviour in terms of intakes is consistent with the other cap scenarios. Intakes with MSR0+ and MSR1 last until the middle of the period, while with MSR2, due to the decreasing cap, they continue up to 2029.

Figure 53: TNAC and intakes for MSR0+, MSR1 and MSR2, with cap scenario AMB2c

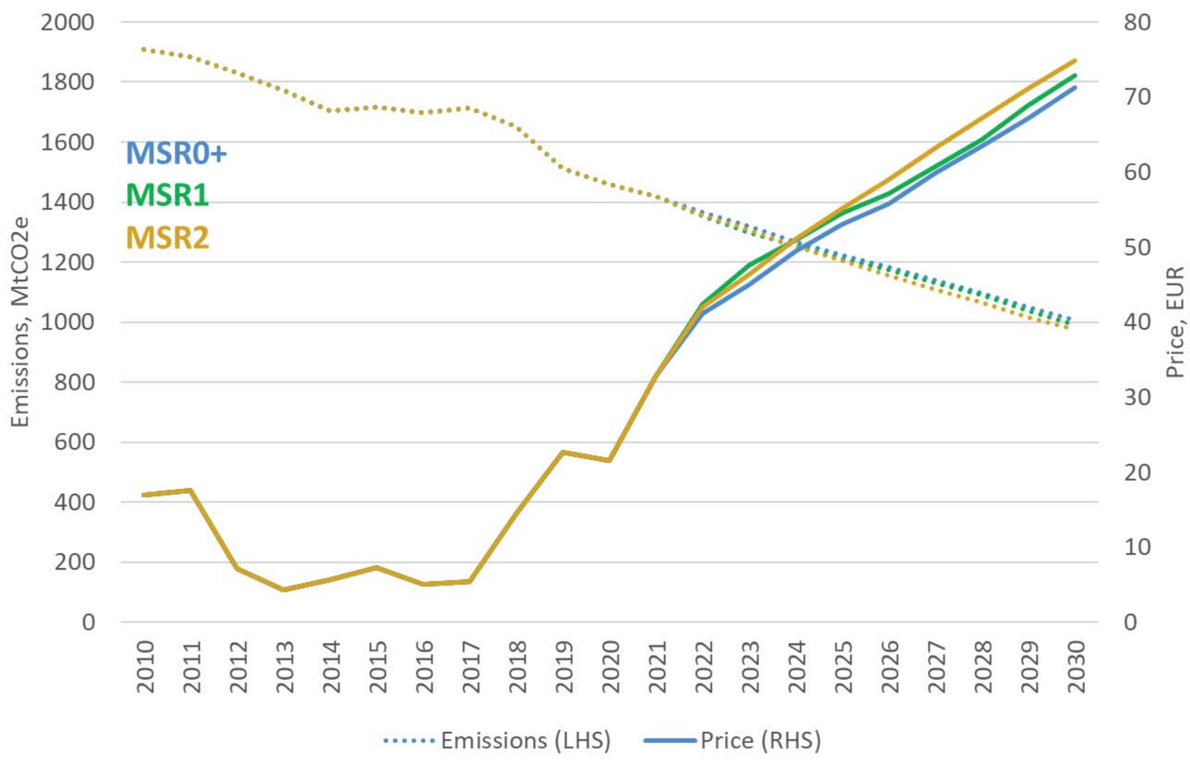


Source: Vivid Economics

- **Prices and price volatility**

The price results are comparable to the other price scenarios, in particular with AMB2a and AMB2b.

Figure 54: Stylised presentation of carbon price and emissions for MSR0+, MSR1 and MSR2, for the cap scenario AMB2c



Note: Prices are presented in constant 2015 prices.

Source: Vivid Economics

23.3 **MSR results for a hybrid MSR option**

This section analyses the outcomes of an MSR option that combines elements from the various MSR options presented in Section **Error! Reference source not found.** above.

Table 24: Parameters of a hybrid MSR option

	Hybrid MSR option
Intake[25]	If the TNAC is above 1096 million

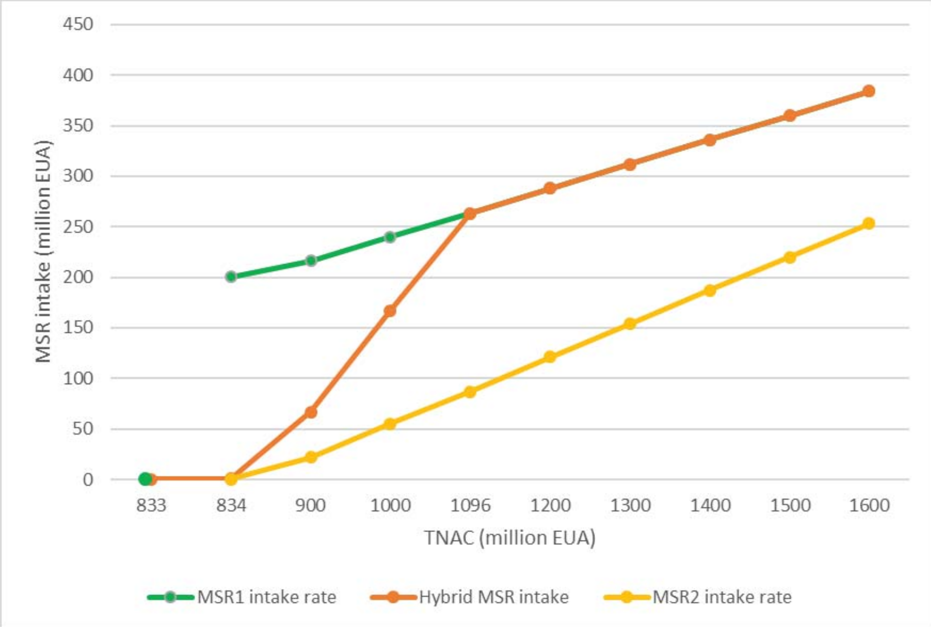
[25] For a TNAC of 833 million, the intake is 0. For a TNAC of 834 million, the intake is 834-833 million = 1 million allowances. For a TNAC of 900 million, the intake is 900-833 = 67 million allowances. For a TNAC of 1096 million, the intake is 1096-833 = 263 million allowances. For a TNAC of 1100 million allowances, the intake is 24%*1100 = 264 million allowances.

	Hybrid MSR option
	allowances, 24% of the TNAC If the TNAC is below 1096 million allowances but above the upper threshold, the difference between the TNAC and the upper threshold
Injections	100m
Upper threshold	833m
Lower threshold	400m
Invalidation mechanism	Invalidate excess above lower threshold
Auction reserve price	-
MSR review	Every three years

This option keeps the current MSR threshold of 833 million, in order to guarantee a sufficient level of liquidity in light of uncertainties about future liquidity needs, including hedging volumes, and introduces more frequent reviews of the MSR. This option introduces a gradual approach to the intake, depending on the level of the TNAC If the TNAC is between the upper threshold and 1096 million allowances, the difference between the TNAC and the upper threshold is put in the MSR. If the TNAC is above 1096 million allowances, then 24% of the TNAC is put in the MSR. At 1096 million allowances, the two options would result in approximately the same intake. Using a gradual approach for the intake rate allows at the same time to avoid the threshold effect (since the intake near 833 million allowances is very low), while keeping the efficient intake of the 24% rate for higher levels of the TNAC.

Figure 55 below shows the intakes that would result at various TNAC levels, for the hybrid MSR option, compared to MSR1 (24% of the TNAC) and MSR2 (33% of the difference between the TNAC and the upper threshold).

Figure 55: Intake profile for the MSR hybrid option, MSR1 and MSR2 at various TNAC levels



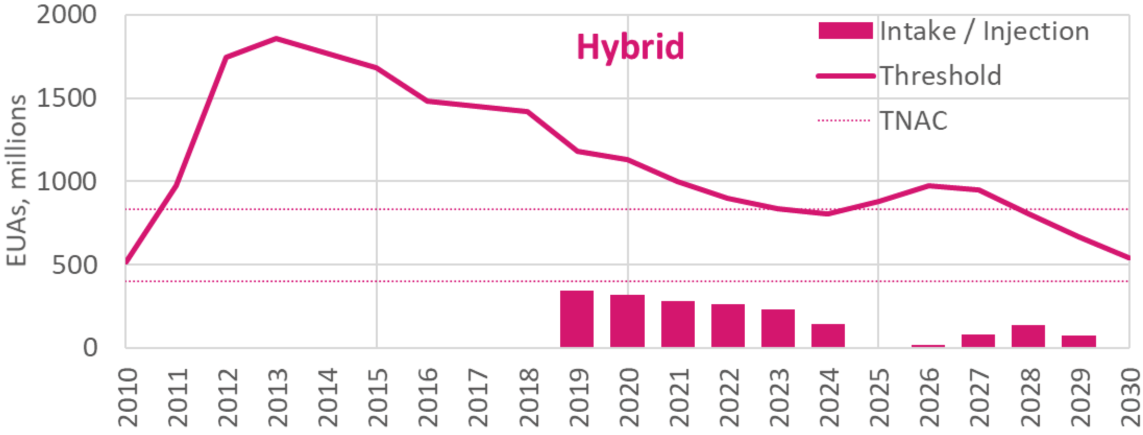
Source: European Commission

The main results for this option are summarized below:

For the central cap scenario AMB2a, **the hybrid MSR option results in a TNAC similar to MSR0+ and MSR2**. The TNAC briefly jumps back above the upper threshold of 833 million allowances in 2026 and 2027, before returning between the two thresholds. The modelling shows that this MSR option avoids the threshold effect in 2024, when the TNAC is very close to the upper threshold of 833.

In terms of intakes, this option results in intakes similar to MSR0+, 20 % lower than MSR1, and 24% lower than MSR2.

Figure 56: TNAC and intakes for MSR0+, MSR1, MSR2 and the hybrid MSR option, for central cap scenario AMB2a

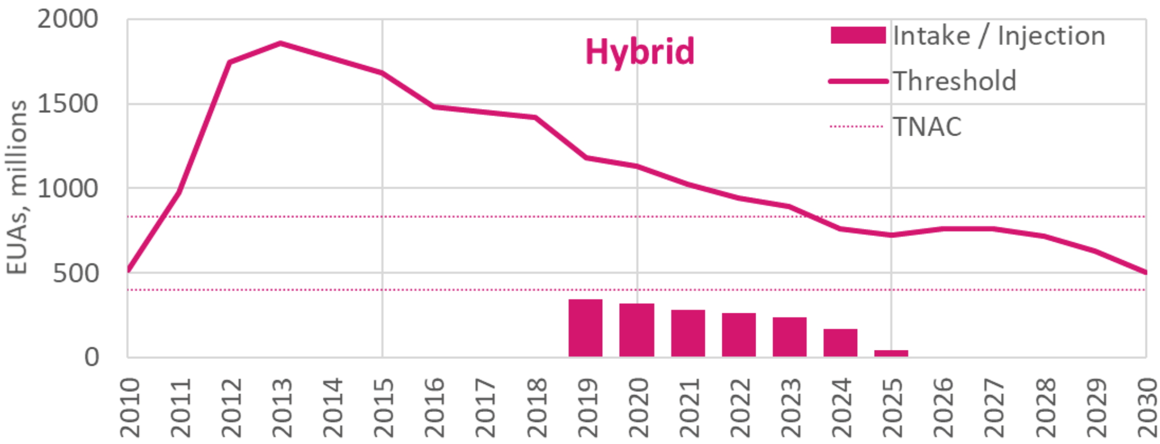


Source: Vivid Economics

For tighter cap scenario AMB2c, the hybrid MSR option reduces the TNAC in a similar manner to MSR0+, all the while avoiding the threshold effect. The TNAC stays between the two thresholds constantly after 2023.

In terms of intakes, this option results in intakes 26% lower than MSR1, and 25% lower than MSR2.

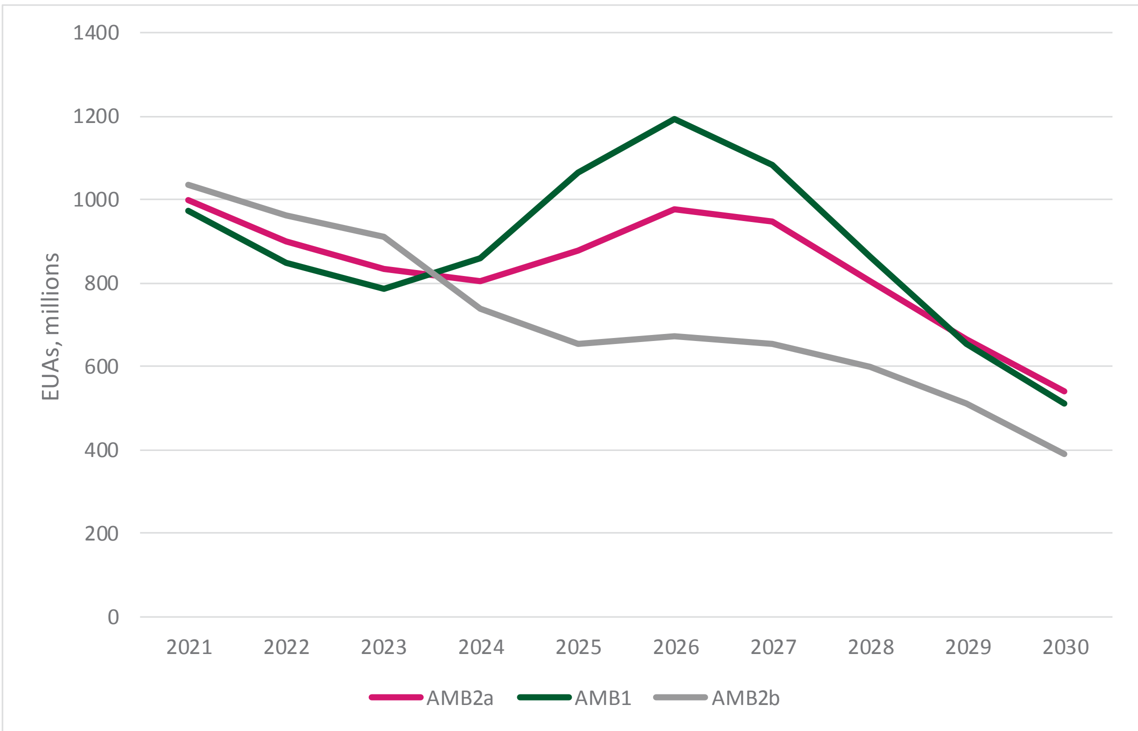
Figure 57: TNAC and intakes for MSR1, MSR2 and the hybrid MSR option, for cap scenario AMB2c



Source: Vivid Economics

A comparison of this hybrid MSR option across for the extreme cap scenarios AMB1 and AMB2b shows that the outcomes of this MSR option depend on the cap scenario chosen. For the less stringent AMB1 cap, the TNAC would be above the upper threshold from 2024 until 2028. With the tightest cap option AMB2b, the TNAC would stay between the thresholds as of 2023.

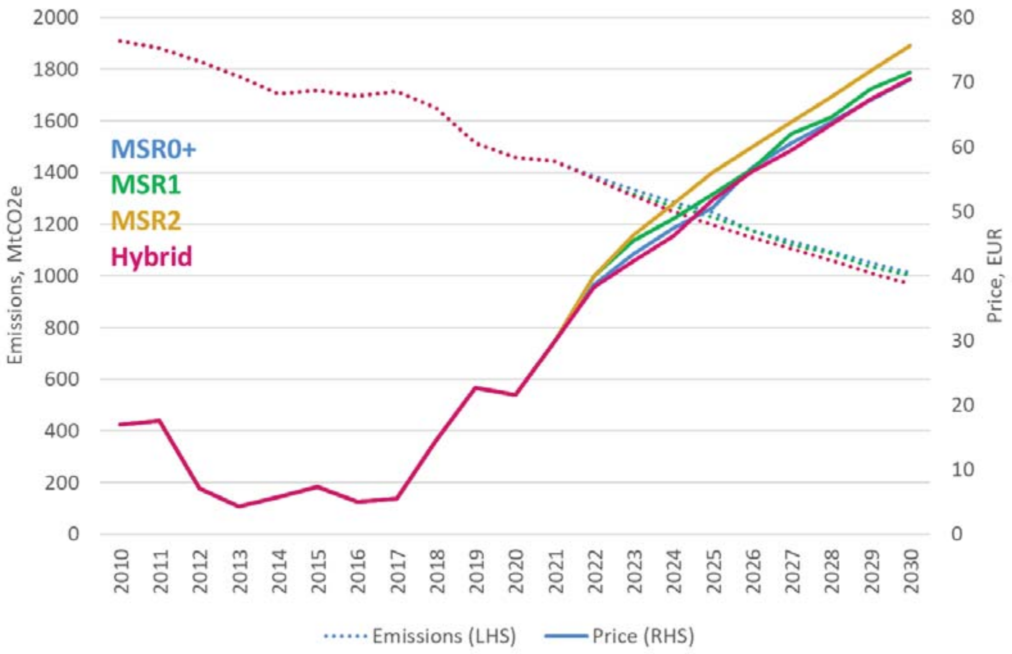
Figure 58: Evolution of the TNAC with the hybrid MSR option, for the cap scenarios AMB1, AMB2a, AMB2b



Source: Vivid Economics

In terms of impact on carbon prices and emissions, this option results in similar outcomes to MSR0+. **Since this option also eliminates the threshold effect, this option does not induce price volatility when the TNAC is close to the upper threshold.** Even if the intake rates are different above and below the level of 1 096 million allowances, the difference in MSR intake around this level is too insignificant[26] to create market volatility.

Figure 59: Evolution of the stylised carbon price and emission level for the MSR options, for cap scenario AMB2a



Note: Prices are presented in constant 2015 prices.

Source: Vivid Economics

Due to the lower intake levels, this option results in the highest auction volumes and therefore highest auction revenues, despite the lower price. The auction volumes are similar with, or slightly higher than MSR0+.

23.4 Introduction of a Carbon Border Adjustment Mechanism

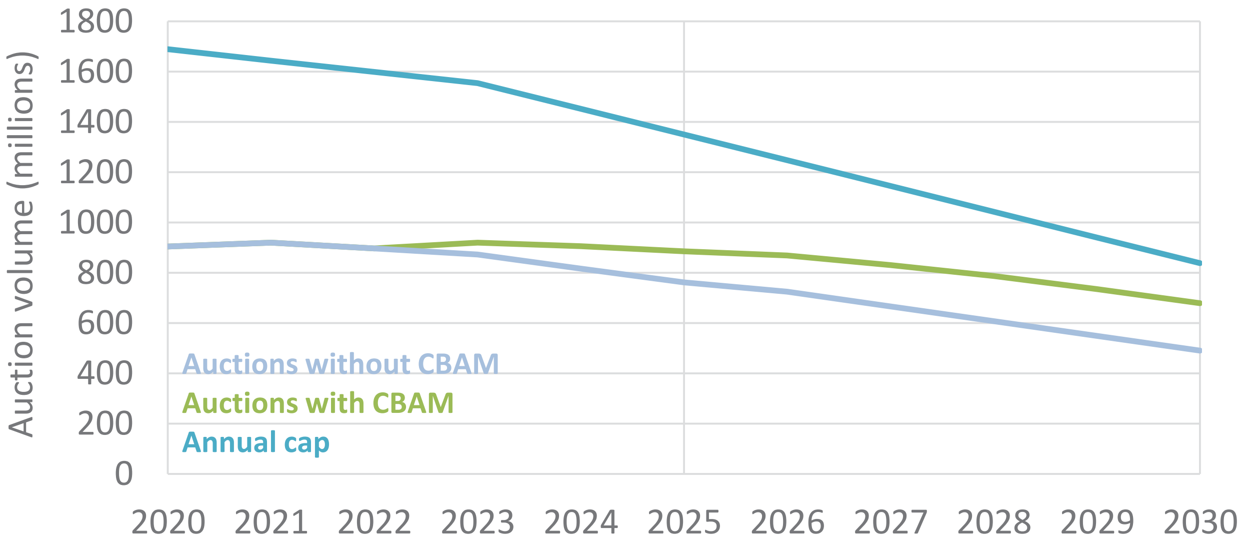
The introduction of a CBAM is being considered as an alternative to free allocations to prevent carbon leakage. A CBAM prevents carbon leakage and safeguards competitiveness by imposing a tariff-like adjustment to emissions-intensive imports and/or exports to account for differences in carbon prices between the EU and its trading partners. Free allocations could be phased out for some sectors if a CBAM is introduced,

[26] If the TNAC is 1 096 million allowances, the intake would be 1096 – 833 = 263 million allowances. With a TNAC of 1097 million allowances, the intake would be 1097 * 24% = 263.28 million allowances, or 280 thousand allowances more. The difference in intake between the two levels is only 0.1%, too low to be significant.

forcing them to participate in the market. This is likely to increase the number of allowances required for banking and hedging, resulting in a higher TNAC.

The analysis in this section investigates the impact of different MSR designs with a hypothetical CBAM. Since the precise design and scope of a CBAM is not yet available, the analysis makes the simplifying assumption that firms in the steel and cement sectors will be subject to a CBAM in 2023, and see their free allocations phased out gradually between 2023 and 2030. In this scenario, free allocations within the EU ETS each year drop from 43% of the cap towards 21% of the cap in 2030, remaining constant post-2030. The share of auctions under the cap increases correspondingly, as shown in Figure 60 below.

Figure 60: Auction volumes with and without a CBAM (prior to MSR adjustment), under cap AMB2a

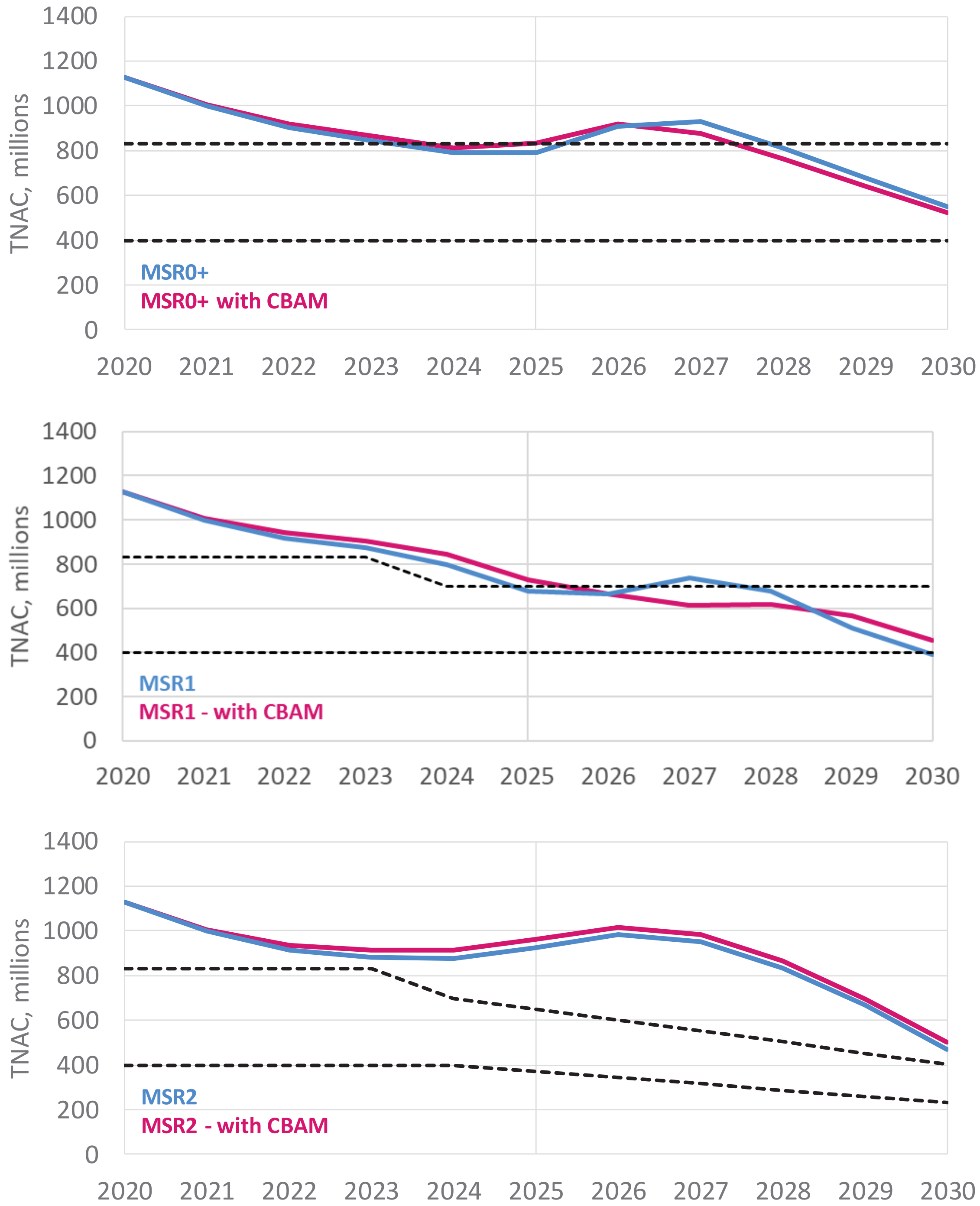


Note: Auction volumes shown include the 3% flexibility buffer.

Source: Vivid Economics

The inclusion of a CBAM increases TNAC (and MSR intakes), but do not change the conclusions made in previous sections comparing the different MSR options. Across all the MSR options, the introduction of the hypothetical CBAM specified above results in a level increase in TNAC by 50 to 100 million for most of the 2020s. In some cases, such as MSR1, the inclusion of a CBAM shifts the point in which TNAC goes below the upper threshold back by a year. This has the direct consequence of prolonging intakes for an extra year. However, whether this 1-year shift occurs is sensitive to the particular cap and model parameters, regardless of the MSR design.

Figure 61: TNAC with and without a CBAM under the three MSR options (with cap setting of AMB2a)



Source: Vivid Economics

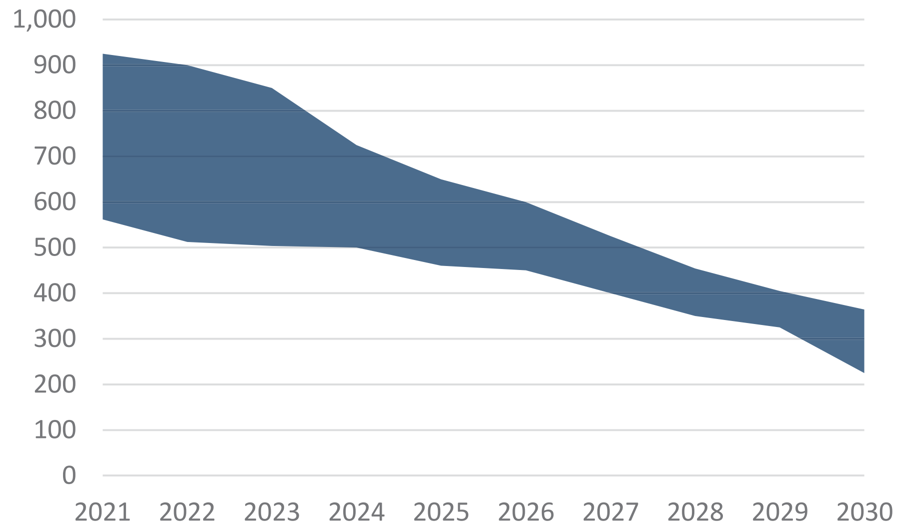
The introduction of a CBAM reduces the rate at which allowances are invalidated within the MSR. Under MSR0+ and MSR1, allowances within the MSR that exceed the auction volume in the previous year is invalidated. As there are more auctioned allowances under the CBAM scenario, the MSR stock declines slower. By contrast, there is no such distinction under MSR2, under which allowances that exceed the lower threshold are invalidated. It should be noted that the MSR stock is influenced by both the invalidation threshold (e.g. prior year auction for MSR0+ and MSR1, upper threshold for MSR2) and the size of MSR intakes. This directly affects the number of allowances in the MSR available for release beyond 2030 but lies outside of the scope of this impact assessment.

Moreover, as explained above, the level of the cap in 2030 influences the most the evolution of the carbon price. As such, the introduction of the CBAM would not have a significant influence on the carbon price in the results of the model.

24 ESTIMATES OF FUTURE HEDGING NEEDS AND POTENTIAL IMPLICATIONS FOR THE MSR THRESHOLDS

The Vivid study also performed an analysis of hedging needs and expectations on their evolution. The study pointed to significant uncertainties in this estimate, in terms of the total number of banked allowances, as well as which sectors or companies are likely to engage in hedging activities in the future. **The study found that utility hedging is expected to decrease significantly by 2030 as emissions decrease, which will be partially offset by increases in industrial hedging.**

Figure 62: Range of estimates for hedging demand from utilities to 2030



Source: Vivid Economics, drawing from ICIS and BNEF estimates

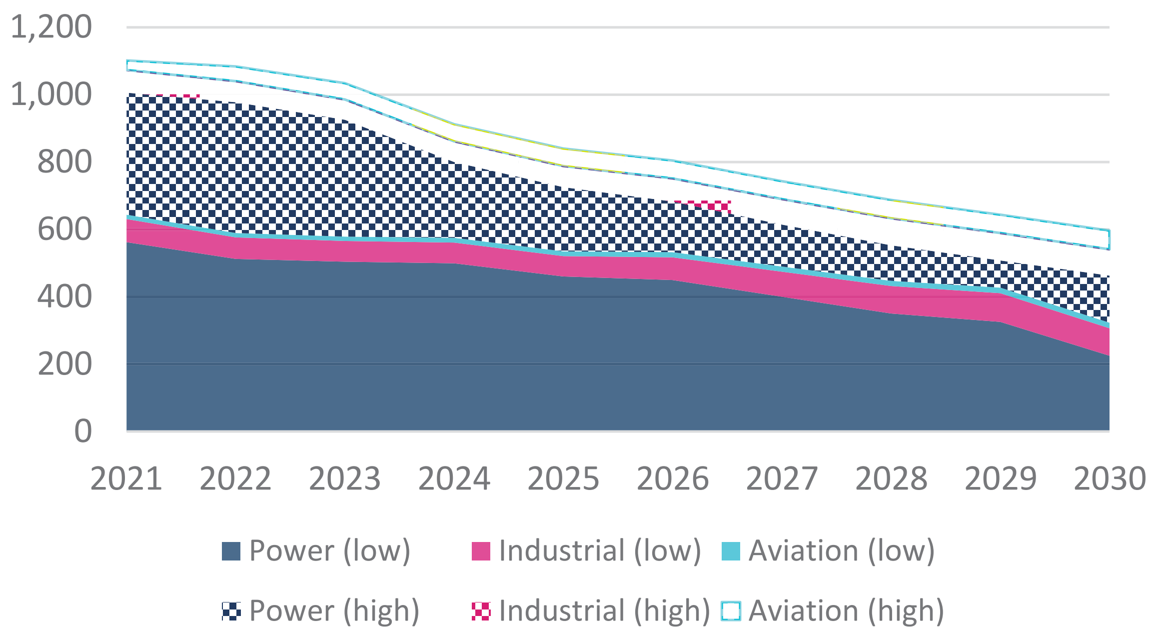
The study estimated increased demand due to industrial hedging ranges from 75 to 300 million allowances in 2030.

- Industrial hedging is generally expected to increase, although the potential size of the market and growth trajectory is extremely uncertain. Projections for industrial hedging demand are not readily available. This necessitated a scenario-based approach to estimate the potential size of this demand. Estimates range from 50 to 150 million allowances in 2021, increasing to 75 to 175 million allowances by 2030.

- **Hedging demand from airlines currently covered by the ETS is expected to increase up to 2030, but its pathway is highly dependent on the airline industry's recovery from COVID-19.** Airline hedging is estimated to be less than 25 million allowances in 2021, partially driven by projected decreases in emissions due to COVID. 2030 estimates range from 20 to 75 million allowances.
- The study estimates excluding the impact of a possible Carbon Border Adjustment Mechanism (CBAM), leading to additional demand in 2025 of approximately 50 million allowances, increasing to over 100 million in 2030

The estimates for total hedging demand to 2030 are between 300 and 600 million allowances, assuming no changes in other aspects of ETS design (especially free allocations).

Figure 63: Makeup of total hedging demand for EU allowances to 2030



In view of these uncertainties, the Vivid study found that upper and lower threshold recommendations of 700 and 400 million allowances respectively fall within a reasonable range of hedging expectations. In general, hedging demand is expected to decrease overall as emissions decrease, implying that a mechanism to reduce thresholds over time, like in MSR2, may be appropriate.

EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 601 final

PART 4/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

{COM(2021) 551 final} - {SEC(2021) 551 final} - {SWD(2021) 557 final} - {SWD(2021) 602 final}

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Annex 9: Detailed analysis on the framework to address the risk of carbon leakage

The total ETS cap is divided into a part that is auctioned and a part that is made available to installations for free to address the risk of carbon leakage. For the period 2021-2030, the total cap is set to be divided in a 57% auction share and a 43% free allocation share, once the Innovation and Modernisation Funds as well as the free allocation buffer of 3% are deducted from the cap.

Based on the results of the OPC, there was no agreement on how a strengthened ETS cap should be divided between auctioning and free allocation. While some stakeholders, including the majority of EU citizens and academic/research institutes and some NGOs, argued for an increase in the auction share, many private sector respondents preferred the continuation of the current auction share of 57%. Many respondents selected the option "other" and provided individual replies, for instance asking to abolish free allocation (NGOs) or stressing the risk of carbon leakage and the need to avoid the application of the cross-sectoral correction factor (private sector).

25 ANALYSIS OF THE IMPACTS OF RAISING THE AUCTIONING SHARE TO 70%

The starting point of the ETS Directive is that in principle, all allowances should be auctioned, and free allocation is granted transitionally[1]. The rule is that everything that is not allocated for free is ultimately auctioned. Providing a percentage figure for the auction share increases transparency, predictability and the functioning of the carbon market.

Increasing the auctioning share would increase revenues that can be used to invest in climate-related purposes, but it would also reduce the number of allowances available for free allocation and therefore reduce the protection against the risk of carbon leakage[2].

In this section we analyse the environmental and economic impacts of the discarded option of increasing the auction share to 70% (increasing auction revenues and

[1] Recital (8) ETS Directive: "The auctioning of allowances remains the general rule, with free allocation as the exception. (…)"

[2] In 2019, a total of 77% of the revenues were used, or are planned to be used, for climate and energy purposes. https://ec.europa.eu/clima/sites/clima/files/strategies/progress/docs/com_2020_777_en.pdf, page 16.

decreasing free allocation)[3] from the year the revised cap strengthening takes effect, i.e. 2024 (AMB2a, AMB2b) or 2026 (AMB1; AMB3c) – AUS1.

25.1 Environmental impacts associated with an increased auction share

A change in the auction share may have an environmental impact, because it influences both the ETS's revenues and its compliance costs. An increase in the auctioning share raises more revenue, which can be used for climate purposes that reduce emissions. It also reduces the free allocation share, resulting in a stronger carbon price signal but also increasing the likelihood of triggering the CSCF, resulting in additional carbon leakage risk.

25.2 Economic effects associated with an increased auction share

Increasing the auction share means reducing the free allocation volume, which in turn has impacts on the risk of carbon leakage.

To determine the final free allocation volume, the contribution to the Innovation Fund (in the existing ETS, 325 million allowances over the 2021-30 period are sourced from free allocation) needs to be taken into account just as the free allocation buffer of 3% of the cap which is sourced from the auction volume and used in case the CSCF risks being triggered.

An update of the auction share to 70% from 2024 or 2026[4] onwards while keeping all other elements unchanged will reduce free allocation volumes and hence impact competitiveness through an early triggering of the CSCF (Table 45). This effect is significant: comparing Table 45 to Table 6 (main text), the CSCF may be triggered between 1 and 3 years earlier and lead to a 25% to 36% lower free allocation budget compared to the respective cap scenario without increase of the auction share.

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[3] To note that one way in which the auctioning share would be increased, but which we do not consider here, is the introduction of a CBAM for a sector and the subsequent switch of that sector's free allocation share into allowances to be auctioned. Alternatively, a CBAM with the current auction share (option 1) would act as increasing the availability of free allowances for the remaining sectors.

Table 54: Impacts of a 70% auction share on free allocation for different cap trajectory options

	Baseline	AMB1 and AUS1	AMB2a and AUS1	AMB2b and AUS1	AMB2c and AUS1	AMB3c and AUS1
Total cap (2021-30) - EU-27+EEA	13781	12 596	12 201	11 712	11 845	12 270
Auction share	57%	70% from 2024 for AMB2a, AMB2b and AMB2c; and from 2026 for AMB1 and AMB3c				
Free Allocation (excluding Innovation Fund)	5601	4419	3931	3785	3825	4322
Free allocation buffer (3%)	413	378	366	351	355	368
Delta to baseline for total free allocation	-	-20%	-29%	-31%	-30%	-22%
Year when CSCF is triggered	-	2028	2026	2026	2026	2028
Average CSCF for the period 2026-30	100%	70%	52%	46%	47%	66%

On the other hand, an increased auctioning share will raise additional revenues and reinforce incentives to reduce emissions. Table 46 below shows that the number of allowances auctioned over the period 2021-2030 would roughly be between 600 million and 1 billion higher with a 70% share compared to a 57% share (the difference depending on the cap scenario, excluding MSR impacts).

Table 55: Total auction volumes under different cap scenarios comparing a 57% and a 70% auction share (in millions, for the period 2021-2030[5]

Auction share	Current Legislation	AMB1	AMB2a	AMB2b	AMB2c	AMB3c
57%	7.091	6.475	6.269	6.015	6.084	6.305
70%		7.147	7.259	6.941	7.028	6.935

For the avoidance of doubt, this analysis does not take into account the increase of the auctioning of the share that may be the consequence of implementing a CBAM for

[5] Indicative cumulative figures for regular auctioning and 10% solidarity redistribution, i.e. funds and free allocation buffer are not accounted.

selected sectors. The possible impact that 'moving' relatively large recipients such as the iron and steel sectors and the cement sector from free allocation to CBAM has been quantified in Section 6.1.2.2.5.

26 EVIDENCE ON EXISTENCE OF CARBON LEAKAGE

Literature on the ETS has found limited evidence of carbon leakage or a related loss of competitiveness in the initial ETS phases. Joltreau and Sommerfeld (2019) estimate that competitiveness impacts in the first two phases of the EU ETS were minimal. They argue that large allowance over-allocation in the initial phases, combined with the ability to pass costs onto consumers in some sectors are the cause for the lack of competitiveness impacts[6]. Branger, Quirion, and Chevallier (2016) estimate there is no evidence of carbon leakage in steel and cement during Phases 1 and 2 of the EU ETS[7]. Many other factors like the cost of production capital, market access or the availability of labour are important for production decisions. In most cases, carbon liabilities are likely only a small component of the production and investment decision, meaning the risk of leakage is low. The relatively low importance of energy costs for EU industries may also limit the competitiveness impacts of the EU ETS. However, the EU ETS has provisions to protect against carbon leakage risk, for example free allocation of allowances to EITE sectors and state aid for indirect costs. This may also help to explain why there has been no evidence of leakage to date. Additionally, EUA prices have been relatively low thus far, so carbon costs have only played a small part in the production decision for periods studied. In the long term, with increasing proliferation of carbon pricing globally, the scope for transferring productive capacity closes; therefore, the risk of competitiveness impacts and leakage is reduced. Free allocation to industries which can pass through costs may lead to windfall profits for firms (assets rising more than liabilities).

27 FREE ALLOCATION FORMULA

The level of free allocation granted to an installation to address the risk of carbon leakage is the result of a calculation:

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[6] Joltreau, E., & Sommerfeld, K. (2019). Why does emissions trading under the EU Emissions Trading System (ETS) not affect firms' competitiveness? Empirical findings from the literature. Climate policy, 19(4), 453-471.

[7] Branger, F., Quirion, P., & Chevallier, J. (2016). Carbon leakage and competitiveness of cement and steel industries under the EU ETS: much ado about nothing. The Energy Journal, 37(3).

Free allocation = Benchmark × Historical Activity Level × Carbon Leakage Exposure Factor (CLEF) × Cross-Sectoral Correction Factor (CSCF)

The following main factors are taken into consideration:

- the benchmark applicable to the different products manufactured in the installation and, when this is not possible, its energy inputs or process emissions. Benchmarks have been used since 2013 and reflect in principle the average emissions of the 10% best installations in the ETS for different sectors;

- the historical activity level of the installations, which is updated when the average activity level of the two preceding years changes by more than 15%;

- the carbon leakage exposure factor (CLEF) that takes into consideration the carbon leakage risk for the specific sector to which the installation belongs. Currently, this factor can only take two values: 100% for sectors considered to be at risk of carbon leakage, and 30% (reducing to 0% by 2030) for sectors not at risk of carbon leakage, with the exception of district heating where it remains set at 30% until 2030. In practice, the current impact of this factor is limited, as around 94% of the emissions from industrial installations originate from sectors at risk of carbon leakage;[8]

- the cross-sectoral correction factor (CSCF): if the free allocation demand exceeds the amount available for free allocation that is determined by the ETS Directive[9], free allocation is adjusted in a uniform manner by applying the CSCF, which reduces the free allocation received by all installations. This was the case in phase 3.

Free allocation is granted for direct emissions. However, in the case of some product benchmarks, the exchangeability of fuel and electricity is taken into account (in order to account for production processes where either fuel or electricity can be used to produce

[8] European Court of Auditors, The EU's Emissions Trading System: free allocation of allowances needed better targeting, 2020.

[9] The total amount available for free allocation depends on the ETS cap trajectory, the mandatory auction share and the amount earmarked for the innovation fund.

heat or mechanical energy). In these cases, an additional factor is used which is the ratio of the direct emissions to the total emissions[10].

28 Carbon leakage list

The impacts of the tiered approach were assessed using the carbon leakage indicators of Table 47. These indicators were calculated for the carbon leakage list applicable for the period from 2021 to 2030, based on data for the period from 2013 to 2015. The use of more recent data, including of updated average emission factors for electricity production would obviously lead to different results.

Table 56. Carbon leakage indicators of selected sectors at risk of carbon leakage

NACE code	Sector	Carbon leakage indicator (CLI)
19.10	Coke oven products	20.119
19.20	Refined petroleum products	3.222
23.51	Cement	2.455
20.15	Fertilisers and nitrogen compounds	2.418
24.10	Basic iron and steel and of ferro-alloys	2.121
20.13	Other inorganic basic chemicals	1.638
23.11	Flat glass	1.457
14.11	Leather clothes	1.147
23.31	Ceramic tiles and flags	1.049
20.14	Other organic basic chemicals	1.049
24.43	Lead, zinc and tin production	1.031
23.52	Lime and plaster	1.021
20.11	Industrial gases	1.021
17.11	Pulp	0.987
17.12	Paper and paperboard	0.836
23.13	Hollow glass	0.631
10.81	Sugar	0.630
20.17	Synthetic rubber in primary forms	0.604
20.12	Dyes and pigments	0.519
10.62	Starches and starch products	0.515

[10] European Commission, Guidance Document N°2 on the harmonised free allocation methodology for the EU ETS post 2020 - Guidance on determining the allocation at installation level, Version 15 February 2019.

24.51	Casting of iron	0.488
24.44	Copper	0.421
23.14	Glass fibres	0.417
23.20	Refractory products	0.412
20.60	Man-made fibres	0.412
20.16	Plastics in primary forms	0.312
24.45	Other non-ferrous metal production	0.280
24.31	Cold drawing of bars	0.259
24.20	Tubes, pipes, hollow profiles and related fittings, of steel	0.229
23.19	Manufacture and processing of other glass, including technical glassware	0.228
23.99	Other non-metallic mineral products n.e.c.	0.221

Source: European Commission, EU ETS phase 4 Preliminary Carbon Leakage List - Carbon Leakage Indicator underlying data, 2018.

29 DESIGN ELEMENT TO MAKE FREE ALLOCATION CONDITIONAL ON DECARBONISATION EFFORTS

The ETS Directive allows ETS countries to compensate sectors or subsectors at risk of carbon leakage for incurred significant indirect costs due to electricity consumption. The recently revised state aid rules for this indirect cost compensation introduced conditionality provisions for granting this aid. A similar conditionality could be introduced for free allocation covering direct carbon costs. By making free allocation conditional on decarbonisation efforts, the specific objective of incentivising the uptake of low-carbon technologies would be supported. This would in turn make industry more resilient against the risk of carbon leakage in the future. Making free allocation conditional on decarbonisation efforts would also be in line with the "Energy Efficiency First" principle enshrined in Article 2(18) of the Governance Regulation[11].

The conditionality provisions in the state aid rules concern installations covered by the obligation to conduct an energy audit under Article 8(4) of the Energy Efficiency Directive. These installations need to spend a part of their compensation to implement improvements under certain conditions. Several possibilities are given, of which one is deemed to be the most relevant in the context of free allocation. The concerned installations should demonstrate that they implement the recommendations made in the framework of the energy audit, to the extent that the payback time for the relevant investments does not exceed a certain number of years and that the costs of their investments is proportionate. Energy efficiency investments with payback periods of up to three years are generally considered to be economically profitable[12]. Compared to that, a conditionality with a longer payback of five years would provide stronger incentives that are better aligned with the increased emission reduction ambition.

The introduction of conditionality is expected to have only a minor effect on the overall framework for free allocation. If installations do not meet the criterion for conditionality, they would see their free allocation reduced. This means that the likelihood or the extent to which a CSCF would need to be applied would be reduced. In this sense, free allocation would become more targeted as it would better protect sectors that are difficult to decarbonise.

The conditionality would affect large installations that are required to carry out an energy audit. The costs of implementing the recommendations of the energy audit would be determined on a case-by-case basis by the auditors and will vary between the various

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[11] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.

[12] SWD(2020) 190 final.

sectors and installations. The conditionality would ensure that energy efficiency investments are made where the payback periods are considered reasonable. Furthermore, the condition that the costs should be proportionate provides some flexibility during implementation.

The implementation of conditionality would add some complexity to the system, as MS would need to ensure that the recommendations identified in the energy audits have been put into practice. Nevertheless, the ETS already builds on third-party verification for the annual reporting of emissions and activity levels. This system could be extended for taking into consideration the conditionality of free allocation with a relatively low level of effort, for instance by including information on the obligation to carry out audits in the installation, the findings of the audits and the actions taken to implement them.

30 DESIGN ELEMENT TO BROADEN THE SCOPE OF FREE ALLOCATION

Under the current legislative framework, free allocation is granted up to 100% of the relevant benchmark level. 52 product benchmarks and two fall-back benchmarks for heat and fuels were defined for phase 3. The definitions of the processes and emissions covered (system boundaries) are mostly based on the prevailing production routes at the time when the benchmarks were set[13]. Ongoing and future technological developments to reduce GHG emissions might lead to situations where installations would partly or completely lose their free allocation when decarbonising their production activities. As a consequence, the free allocation regime could lead to unequal treatment of industrial installations and effectively act as a barrier to the use of decarbonisation techniques.

The following potential barriers have been identified:

- Installations falling out of the scope of the ETS: This could for example happen when installations partly replace their heat supply provided by combustion through increased use of electricity and therefore fall below the thermal capacity thresholds of 20 MW that apply for some activities listed in Annex I to the ETS Directive. It could also happen when installations completely decarbonise and no longer emit any GHGs.

- Installations falling out of the system boundary definitions of a benchmark: A few benchmark definitions and boundaries refer to specific processes and fossil fuel

[13] Commission Decision of 27 April 2011 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council.

inputs which might not encompass less carbon-intensive production routes. For example, the product benchmark for hydrogen refers to steam reforming of hydrocarbon feedstock, but the production of hydrogen through electrolysis of water is not described.

- Benchmarks with exchangeability of fuel and electricity: For 14 of the 52 product benchmarks, the consumption of electricity is taken into account in the determination of the benchmark value. Therefore, the benchmark value is higher compared to a situation where those indirect emissions would not have been considered. However, for the purpose of free allocation, these benchmarks are multiplied with a factor to ensure that emissions related to electricity consumption are excluded. The factor is defined as the ratio between the direct emissions and the total emissions, defined as the sum of direct and indirect emissions, attributed to the sub-installation. This definition can disincentive GHG emissions reductions. First, if an installation reduces its direct emissions through means other than electrification and indirect emissions remain unchanged, free allocation will decrease. Second, if an installation switches from fossil fuel to electricity as heat source, free allocation will decrease unless it is a very carbon-intensive fossil fuel such as coke or lignite that is replaced. This is because the factor that is used for calculating the indirect emissions relates to electricity use. In some cases, such installations could be eligible for indirect cost compensation, thereby mitigating the risk of barriers to electrification. However, not all ETS countries grant indirect cost compensation, not all benchmarks with exchangeability of fuel and electricity correspond to sectors exposed to a genuine risk of carbon leakage due to indirect emission costs, and the maximum aid intensity for indirect cost compensation is generally limited to 75%.

The broadening of the scope of free allocation would provide additional incentives and/or reduce barriers for installations to reduce GHG emissions, enabling the stronger emission reductions required post-2030 by using low-carbon technologies to achieve climate neutrality by 2050.

An example may illustrate this effect: A plant that decides to produce green hydrogen from electricity instead of using the conventional natural gas-based process would, under current rules, fall out of the ETS. The plant would thus not face carbon costs and it would not get free allocation. In the case of a very efficient conventional fossil-fuel-based plant that is already operating below the benchmark and can thus sell surplus allowances on the market, these additional revenues would be lost. This would come on top of the investment costs and the increased operating costs. Broadening the scope would effectively prevent that those plants converting to low- or zero-carbon technologies are facing competitive disadvantages. Once there are a few plants in a sector using low- or zero-carbon technologies, the related benchmarks will also be further reduced during a subsequent update. This would then provide further incentives for other plants to also reduce their emissions.

Potential changes in the ETS Directive or relevant implementing legislation to broaden the scope of free allocation in order to incentivise the use of low-carbon technologies include:

- Avoid the use of thresholds expressed as total rated thermal inputs in Annex I to the ETS Directive: Annex I could refer to production capacity thresholds for the concerned activities (i.e. production or processing of ferrous and non-ferrous metals, production of secondary aluminium, production of gypsum (products) and production of carbon black). Furthermore, relevant activities that are currently only covered by the activity ‘combustion of fuels in installations with a total rated thermal input exceeding 20 MW’ could be explicitly listed, also adding production capacity thresholds.

- Avoid that installations with partly or completely decarbonised processes fall out of the ETS or cannot enter it: This would for example concern installations that reduce their total rated thermal input below the aforementioned threshold values or installations that do not have any GHG emissions due to complete electrification or use of hydrogen as only fuel.

- Revise benchmark definitions in relevant implementing legislation: To align with the principle of ‘one product, one benchmark’, relevant product benchmark definitions could be redefined to remove references to specific feedstock or production process so that they will include future low-carbon production routes. The heat benchmark definition could be revised to include heat produced from electricity.

- Abandon the concept of exchangeability of fuel and electricity in relevant implementing legislation: The benchmark definitions would be revised and the values updated in order to only take into account direct emissions. Using a revised benchmark definition, an installation that partly electrifies would keep the same amount of free allocation.

Regarding possible changes to benchmark-based allocation, stakeholder opinions were divided whether additional product benchmarks or revised definitions of product benchmarks should be introduced to incentivise innovation. While industry representatives were more sceptical, other stakeholders were more positive (see Annex 2).

If changes to the definitions of the activities covered by the ETS and to the boundaries and definitions of the benchmarks used to attribute free allocation were introduced, this could mean that more production would be eligible for free allocation. This is for example relevant for installations producing hydrogen and ammonia which could benefit from free allocation even if the hydrogen were produced via electrolysis using green electricity. The production of these energy carriers is likely to increase in the future. The hydrogen strategy sets the target of installing at least 6 GW of renewable hydrogen electrolysers in the EU by 2024 and 40 GW of renewable hydrogen electrolysers by 2030.[14] Each 1 GW of electrolyser capacity produces between 40 000 and 100 000 tonnes of renewable hydrogen per year.[15] With the current benchmark value for hydrogen production of 6.84 EUAs/t, free allocation would thus be in the range of 1.6 to 4.1 million allowances in 2024 and in the range of 11 to 27 million allowances in 2030. On the other hand, it is expected for many other sectors that low-carbon technologies rather replace existing technologies and would thus not affect the overall framework for free allocation. In essence, the impact depends on the extent to which low-carbon technologies are used in the future.

If only direct emissions were to be considered for benchmark setting purposes, the installations that electrify would have an even higher impact on the benchmark update rates. This would push most benchmarks in which there is exchangeability of fuel and electricity towards the maximum benchmark update rates (32% under current legislation) therefore slightly reducing free allocation demand. On the other hand, the power sector is decarbonising fast and this trend is expected to continue, therefore most of the benchmarks considering the exchangeability of fuel and electricity should be updated at high rates in any case.

In general, higher and earlier demand of innovative low-carbon technologies will likely speed up their development and the process of reducing their costs. In the long run, abatement costs for energy-intensive industry sectors will therefore likely decrease. However, this positive economic impact on industry is expected to be rather limited until 2030.

The broadening of the scope of free allocation requires some changes to the ETS Directive and related implementing legislation. Moreover, the number of installations under the scope of the ETS could slightly increase resulting in a small increase of the administrative burden.

Overall, it is expected that the impact of broadening the scope of free allocation on the framework to address the risk of carbon leakage is rather limited. Nevertheless, the likelihood or the impact of the CSCF could slightly increase. On the other hand,

[14] COM(2020) 301 final.
[15] https://www.hydrogen4climateaction.eu/2x40gw-initiative

installations using innovative technologies or electrifying would benefit from an increased protection against the risk of carbon leakage.

The broadening of the scope would allow installations introducing innovative low-carbon technologies to benefit (more) from free allocation. It can be expected that this would speed up the uptake of such technologies triggering a positive and sustainable impact on employment, i.e. for technology providers.

31 INDIRECT COST COMPENSATION

31.1 **Introduction**

Article 10a(6) of the ETS Directive provides that MS should adopt financial measures in favour of sectors or subsectors which are exposed to a genuine risk of carbon leakage due to significant indirect costs that are actually incurred from GHG emission costs passed on in electricity prices. These financial measures need to be in accordance with State aid rules and should not cause undue distortions of competition in the internal market. The state aid guidelines for indirect cost compensation were revised in the period from 2018 to 2020 for their application in phase 4 of the ETS[16]. Indirect cost compensation is based on Union-wide benchmarks for electricity consumption per unit of production and on the weighted averages of the CO_2 intensity of electricity produced from fossil fuels in the concerned geographic areas.

The revised state aid guidelines foresee to update the electricity consumption efficiency benchmarks, the geographic areas, and the CO_2 emission factors in 2025. By that time, the Commission will also assess whether additional data is available that allow improving the methodology used to calculate the CO_2 emission factors. Finally, following the review and possible revision of all climate-related policy instruments to achieve the 2030 climate target (notably the ETS Directive) and the initiative for the creation of a CBAM, the Commission will check whether any revision or adaptation of the guidelines is necessary to ensure consistency with, and contribute to, the fulfilment of the climate neutrality objective while respecting a level playing field.

Only 20% of the respondents in the OPC find that MS should maintain flexibility to grant indirect cost compensation or not, subject to state aid control. 80% are in favour of some form of change, but there is no clear majority for a preferred change. 50% of respondents

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[16] Communication from the Commission. Guidelines on certain State aid measures in the context of the system of greenhouse gas emission allowance trading post-2021. OJ C 317, 25.9.2020, p. 5.

are in favour of further harmonisation of indirect cost compensation at EU level. The large majority of these respondents originate from the private sector. Only four federal authorities from MS replied to this question, out of which three were in favour of further harmonisation, while one preferred that MS maintain flexibility. Approximately 25% of respondents stress that the rapidly on-going decarbonisation of the electricity production in the EU should lead to a phase-out of indirect cost compensation. The majority of these respondents represent EU citizens and NGOs. Few respondents (5%) suggest binding requirements so that MS granting compensation do not spend more than a fixed share of their auctioning revenues.

31.2 **Target for maximum indirect cost compensation**

In accordance with the ETS Directive, MS shall seek to use no more than 25% of the revenues generated from the auctioning of allowances for indirect cost compensation. Each year, MS providing such financial measures are required to publish the total amount of compensation provided per benefitting sector and subsector. The report shall also set out the reasons if the compensation exceeds the target of 25% of the revenues generated from the auctioning of allowances. Table 49 summarises the data published by MS on indirect cost compensation.

Table 57: Indirect cost compensation by Member State

Member State ([1])	**Duration of the scheme**	**Compensation disbursed for indirect costs incurred in the preceding year (in EUR million)**			**Number of beneficiaries (installations)**			**Percentage of auction revenues spent on indirect cost compensation**		
		2017	**2018**	**2019**	**2017**	**2018**	**2019**	**2017**	**2018**	**2019**
DE	2013–2020	289	202	219	902	891	898	34.1 %	17.6 %	8.5 %
BE (FL)	2013–2020	46.7	31.7	35.9	107	106	107	43.6 %	27.3 %	11.4 %
BE (WL)	2017–2020	— ([2])	7.5	7.5	— ([2])	30	29	— ([2])		
EL	2013–2020	12.4	16.8	16.8	52	50	50	8.4 %	8.5 %	3.2 %
ES	2013–2020	84	6	172.2	136	151	183	23 %	1.2 %	13.3 %
FI	2016–2020	38	26.7	29.1	55	58	61	40.0 %	28.2 %	11.6 %
FR	2015–2020	140	98.7	102.1	296	296	286	60.0 %	31.8 %	12.4 %
LT	2014–2020	1	0.24	0.3	1	1	1	4.8 %	0.8 %	0.3 %
LU	2017–2020	— ([2])	3.4	4.2	— ([2])	2	4	— ([2])	50 %	23.2 %
NL	2013–2020	53.5	36.9	40.3	92	96	92	37 %	19.5 %	8.0 %
SK	2014–2020	10	10	6	5	7	8	15.4 %	11.4 %	2.6 %

([1]) Poland and Romania started indirect cost compensation schemes for costs incurred from 2019 onwards.
([2]) The Walloon and the Luxembourgish compensation schemes were approved by the Commission in 2018 for costs incurred from 2017 onwards.

Source: Carbon market reports for 2017[17], 2018[18] and 2019[19].

The total indirect cost compensation granted by the 10 EU MS in 2019 for costs incurred in 2018 amounted to around EUR 633 million. That was almost EUR 200 million more than the amount paid out in 2018. The notable increase compared to the previous year can be explained, on the one hand, by the significant budget increase of Spain (from EUR 6 million in 2018 to EUR 172 million in 2019), and on the other hand by the slight increase of the carbon price used to calculate the compensation[316].

The indirect cost compensation granted by Norway in 2017, 2018 and 2019 amounted to NOK 469 million, 513 million and 1.39 billion, respectively (equivalent to EUR 50 million, 53 million and 141 million)[20].

Approximately half of the MS with an indirect cost compensation scheme in place exceeded the 25 % target in 2017 and 2018, while no exceedance was reported in 2019. Two main reasons were given by MS for exceeding the 25 % target:

- In some MS (e.g. France), the GHG intensity of the electricity produced is relatively low which implies lower auctioning revenues. However, the same MS might have a large cluster of electricity-intensive industries which are eligible for indirect cost compensation.
- The carbon price used for indirect cost compensation was based on the year that precedes the year whose carbon price was used to determine the auction revenues. A decrease in the carbon price therefore led to an increase in the percentage of auction revenues spent on indirect cost compensation.

31.3 **Further harmonisation of indirect cost compensation**

The main argument in favour of further harmonisation of indirect cost compensation at EU level is to avoid potential market distortions, as some Members States provide compensation while others do not. At the time of writing this document, 12 EU MS (i.e. Belgium, Finland, France, Germany, Greece, Lithuania, Luxembourg, the Netherlands,

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[17] COM(2018) 842 final, 17.12.2018.
[18] COM(2019) 557 final/2, 16.1.2020.
[19] COM(2020) 740 final, 18.11.2020.
[20] Consultation on the revision of the ETS Guidelines on certain State aid measures in the context of the amended EU Emissions Trading Scheme 2021-2030 – response from the Norwegian Government.

Poland, Romania, Slovakia, and Spain) and Norway provide compensation for indirect costs.

The option of a mandatory Union-wide compensation scheme, financed by using national auctioning revenues, was assessed during the last revision of the ETS Directive. The analysis indicated that more harmonised arrangements for indirect cost compensation had benefits, but that care was needed to avoid red tape and lock-in of emission-intensive production methods[21]. Finally, the Commission proposal for a revised ETS Directive retained the system that indirect cost compensation is granted at MS level[22]. The European Parliament and the Council agreed to this approach during co-decision.

The update of the state aid guidelines for indirect cost compensation for phase 4 of the ETS included a number of modifications. Some of these changes aimed at reducing potential market distortions, such as more targeted aid to fewer sectors, better calculation of costs and updated CO_2 emission factors.

31.4 **Phase-out of indirect cost compensation**

The GHG emission intensity of total electricity generation in the EU-27 was 45% lower in 2018 than in 1990 (decreasing from 510 g CO_2 equivalents/kWh to 281 g CO_2 equivalents/kWh over the period). Since 2010, the decrease has been almost exclusively because of the transition from fossil fuels to renewable fuels in electricity generation, with carbon costs increasing in relevance especially since 2019[23]. The reduced carbon intensity of electricity production should thus result in reduced indirect carbon costs. However, for the purpose of calculating indirect cost compensation, only the price-setting plants are taken into consideration, because it is the price-setting plants that determine how much carbon costs are passed on. In the near future, it is expected that fossil-fuelled power stations will continue to set the marginal electricity price for a significant part of the hours. Even though fossil-fuelled power generation will likely shift from coal to gas, carbon costs will thus continue to be passed through to consumers to a significant extent. Moreover, these carbon costs will reflect increasing carbon prices due to the strengthened cap. Therefore, indirect carbon costs, although potentially declining, can be considered still relevant in the period from 2021 to 2030.

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[21] SWD(2015) 135 final.
[22] COM(2015) 337 final.
[23] European Environment Agency: Indicator assessment - Greenhouse gas emission intensity of electricity generation in Europe, https://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-electricity-production-3/assessment, retrieved 30 April 2021.

31.5 **Conclusion**

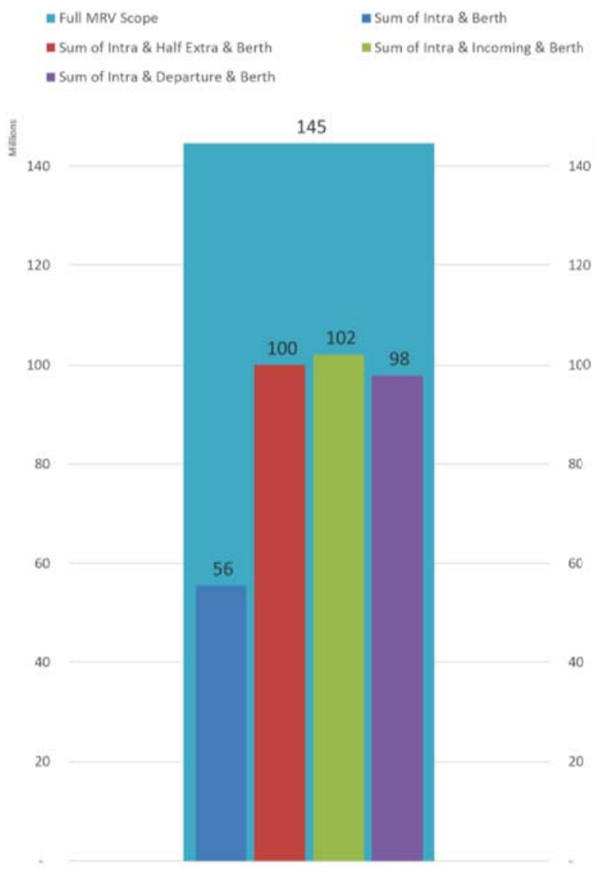
The current and expected future trend of decarbonising electricity generation makes it hard to justify additional measures for indirect cost compensation, but the expected increased carbon price justifies continuing with the current approach of the ETS Directive until 2030. The respective state aid guidelines were recently updated to adapt them for phase 4 of the ETS, also with a view to reducing potential market distortions. In any case, the guidelines are foreseen to be checked after the revision of the ETS Directive and the establishment of a CBAM. Important elements of the guidelines will be updated in 2025.

Annex 10: Detailed analysis on the economic and social impacts of the maritime initiative

32 Impacts of the different maritime geographical scopes

The choice of the geographical scope is key as it directly influences the amount of CO_2 emissions that would be covered by carbon pricing. The following graph illustrates that the covered emissions can vary up to threefold depending on the selected geographical scope.

Figure 77: Share of CO_2 emissions covered for different geographical scope based on past EU maritime transport MRV data (EEA including EU28)

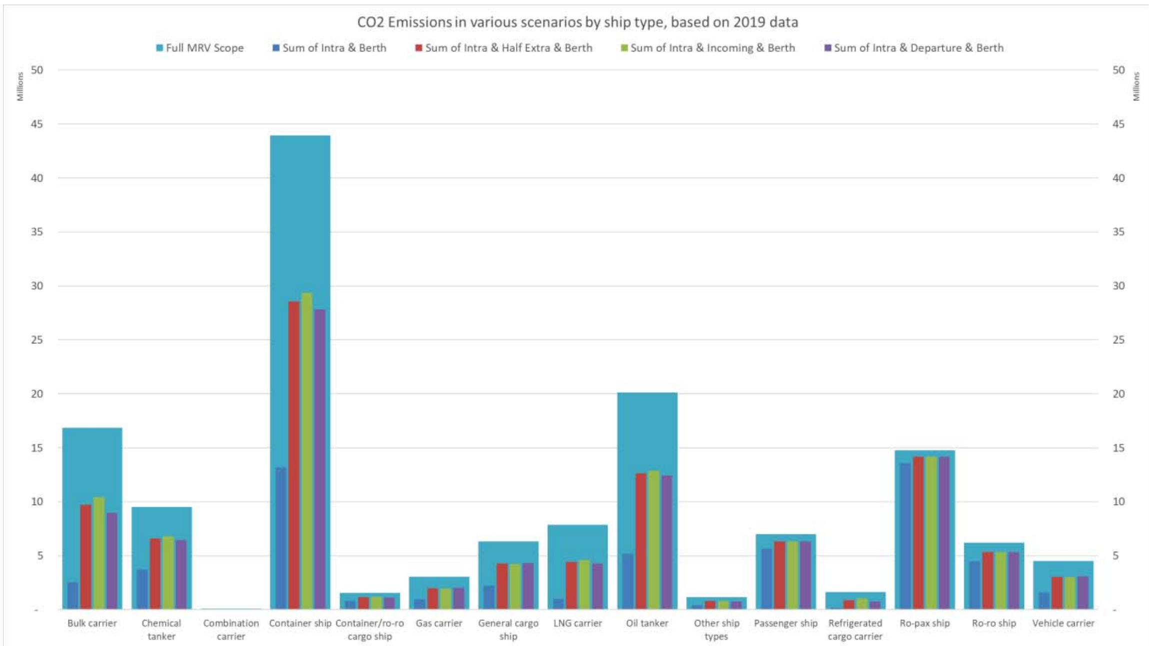


Source: EMSA, 2019 data from THETIS-MRV

The two following graphs illustrate the impact of the geographical scope on market actors. The first one shows that a measure focusing on emissions from intra-EEA voyages (MINTRA) would typically cover most of the emissions from ro-pax ships (roll-on/roll-off passenger vessels), passenger ships and ro-ro (roll-on/roll-off ferries carrying cars and other wheeled cargo), as most of their voyages happen between ports located in the EEA. On the contrary, it would only cover around a third of the emissions from container ships and tankers, and around a quarter of the emissions from bulkers. Addressing extra-EEA emissions would significantly increase the proportion of emissions coming from the largest trading segments i.e. deep-sea shipping.

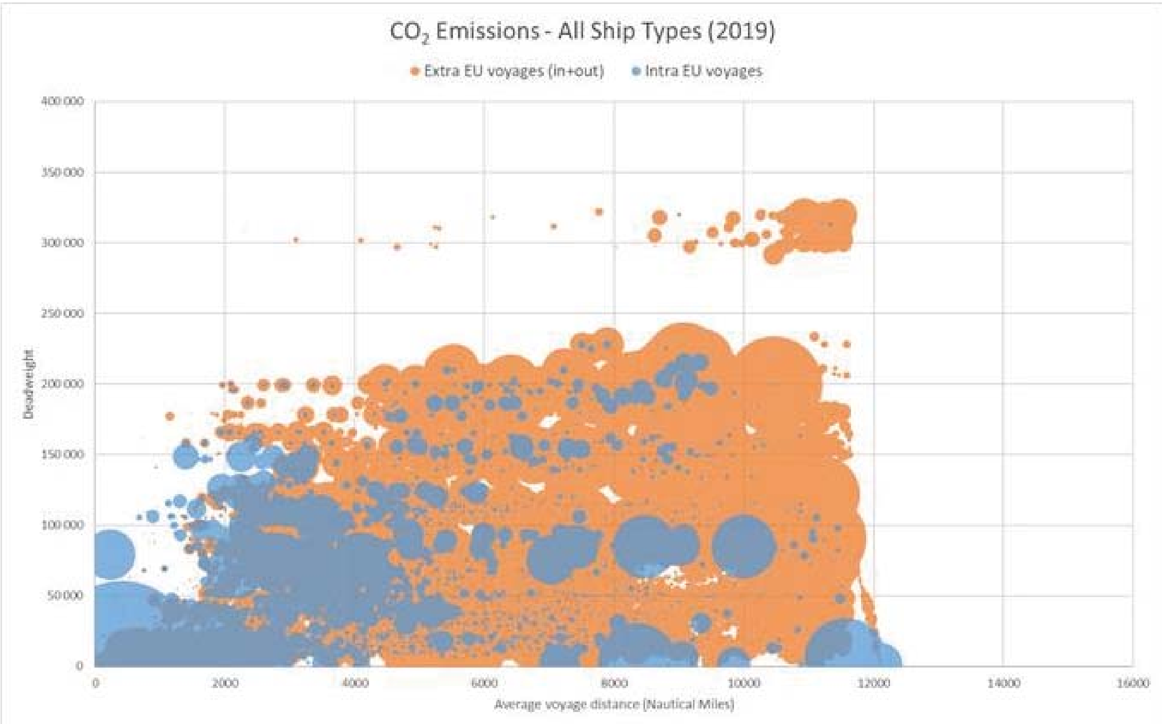
The second graph shows that, in general, intra-EEA voyages involve smaller ships on shorter distances.

Figure 78: Share of CO_2 emissions covered for different geographical scope and different ship type



Source: EMSA, 2019 data from THETIS-MRV

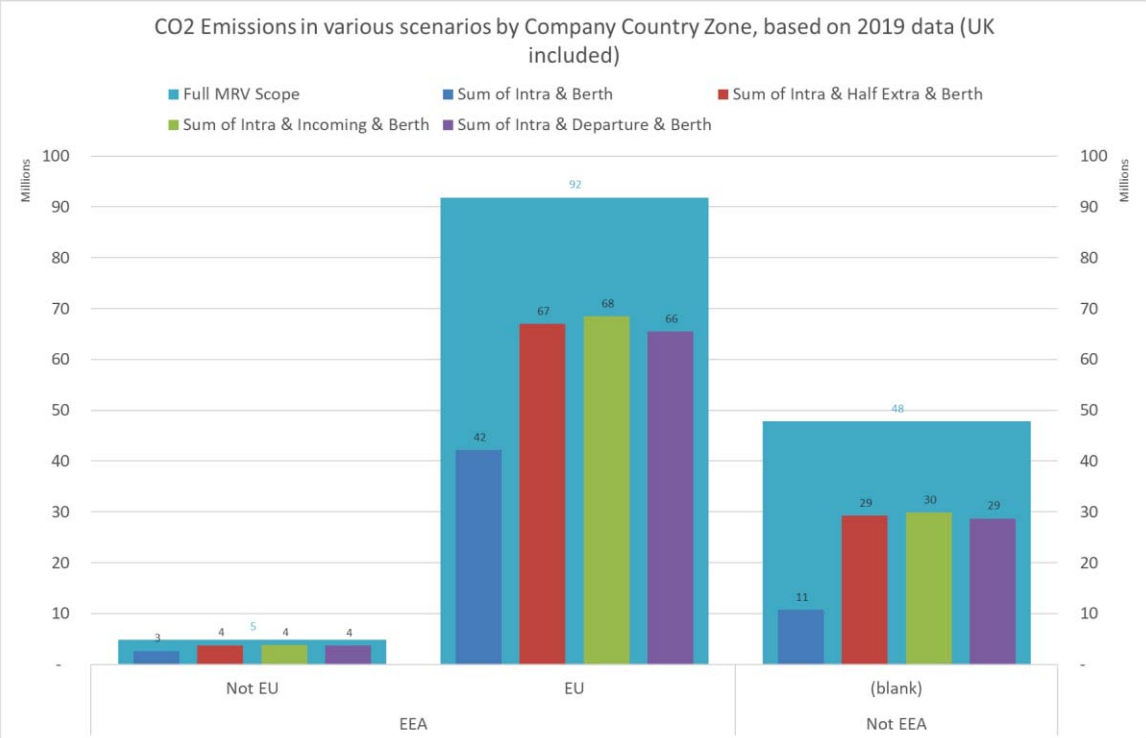
Figure 79: CO_2 emissions related to intra EEA and extra EEA voyages per average voyage distance and ship size (dwt)



Source: 2019 EU MRV annual report on CO_2 emissions from maritime transport

Finally, the graph below shows that independently from the selected geographical scope, most of the CO_2 emissions covered by carbon pricing would come from ships owned or operated by an EEA based companies.

Figure 80: CO_2 emissions per origin of companies for different geographical scopes



Source: EMSA, 2019 data from THETIS-MRV

33 IMPACTS ON THE EU INTERNAL MARKET

33.1 Impacts on competition between shipping operators

No maritime policy option is expected to put the EEA shipping operators in a disadvantaged position compared to non EEA shipping operators. Indeed, as any policy option will be flag-neutral, the policy will apply equally to all ships calling into EEA ports. However, ships calling more often into EEA ports may have the advantage of shorter pay-back periods when investing in GHG mitigation measures.

Moreover, as shown in previous analysis and as supported by some industry stakeholders views, the use of a size threshold would not create a general distortion of trade competition between short sea shipping and deep sea shipping activities as they are not serving the same market (e.g. short sea shipping competes mainly with road transport). However, as shown in the table below, exempting vessels below the threshold of 5.000 gross tonnage might advantage the ships right below that size limit in comparison to the ones just above, particularly for general cargo ships and chemical tankers.

Table 58: Share of the global maritime fleet by type of vessel and size category

Vessel type	Share of size by vessel type		
Size category (GT)	**100-400**	**400-5000**	**>5000**
Oil Tankers	10.0%	39.9%	50.0%
Bulk Carriers	0.0%	0.0%	100.0%
Container ships	0.0%	6.6%	93.4%
Chemical Tankers	7.3%	36.9%	55.8%
Crude Tankers	0.0%	0.0%	100.0%
General Cargo	19.3%	72.1%	8.6%
LNG Carriers	0.0%	1.8%	98.2%
LPG Carriers	0.9%	45.5%	53.6%
Ro-Ro	3.8%	24.9%	71.3%
Cruise Ships	2.8%	24.5%	72.7%
Car Carriers	0.0%	2.8%	97.2%
Multi-purpose	0.0%	53.2%	46.8%
Ferries	38.7%	45.4%	15.9%
Refrigerated	0.0%	57.9%	42.1%
Dredgers	18.6%	52.8%	28.6%
Tugs	26.7%	66.3%	7.0%

Source: Ricardo analysis based on Clarksons[24] fleet data

33.2 **Impacts on modal shift**

The increased cost of shipping resulting from carbon pricing could eventually cause a shift from maritime transport to other modes of transport, provided that those are not covered by similar measures or carbon pricing. Road transport under the MIX scenario will be subject to a number of decarbonisation policies fostering the use of more sustainable modes of transport. Risk of modal shift under MAR1 is therefore considered inexistent and unlikely under MAR4. From an environmental point of view there is a

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radical difference in shifts to road transport (negative) or shift to electrical trains (positive). The geographical scope is not expected to have much impact on modal shift, as only the intra-EU voyages are likely to compete with other modes of transport.

This modal shift is confined to transport routes where alternatives via other modes exist. If it does occur, it will most likely happen in unitised (e.g. containers, pallets, trucks) short sea shipping, including roll-on roll-off ships and lift-on lift-off ships, which represent a significant part of the CO_2 emissions reported in the EU maritime transport MRV system. For intercontinental shipping, other transport mode alternatives hardly exist. Elasticity estimates of short sea bulk transport suggest that these are not very sensitive to price, which is interpreted as being caused by little competition with other modes of transport. To substitute a medium-size bulk carrier by road transport may require hundreds of trucks. Small changes in overall cost are therefore not likely to make bulk cargo-owners change to another mode. In 2015, the introduction of the Sulphur Emission Control Area lead for instance to an increase of EUR 181/tonne of fuel without having a significant impact on modal shift[25].

On routes where unitised cargo is transported and maritime transport competes with road transport and rail, modal shift is also unlikely due to a range of climate and transport policies applying to other modes of transport, such as CO_2 standards, fuel tax, possible ETS extension to road transport, speed and daily driving limits but also practical obstacles such as congestion. On the maritime side, the relative low cost of freight transport by sea or the influence of long-term contracts are noticeably likely to restrain market actors from switching to other modes of transport. Also, EU investments in port infrastructure incentivise a modal shift from road to waterborne transport. A study estimates that the taxes paid by trucks in 2019 were much higher than for shipping under the MAR1 and MAR4 options[26].

The likelihood of a modal shift to road or rail is thus linked to the cost of the option chosen as well as the unlocking of existing rail cargo infrastructures. All policy options will have an impact on fuel costs, and hence on the total costs associated with short-sea shipping. A case study presented in this annex evaluates the increase of modal shift under the assumption that no additional measures compared to the actual situation are taken for road transport. A cross elasticity of 0.31[27] is assumed for shifting cargo from short-sea shipping to road. This will mean that for a 10% increase in total costs the share of road transport is estimated to increase by 3.1%. Under those assumptions, it is estimated a

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[25] SECA Assessment: Impacts of 2015 SECA marine fuel sulphur limits (CE-Delft 2016)

[26] https://www.transportenvironment.org/press/top-shipping-polluter-overtakes-power-plants-coal-shuts-down

[27] Indicator measuring the sensitivity of freight operators to changes in the cost of short-sea shipping as calculated in a recent study, Comi and Polimeni (2020) which developed a modal choice model for Ro-Ro competition with respect to road and rail transport in the Mediterranean basin.

4.9% increase in modal shift for MAR1. Modal shift is estimated to be higher for MAR2 and MAR3 (20%) as the carbon price will be higher than for MAR1 and MAR4. However, as mentioned before these impacts will be lower as measures under the Green Deal and Smart and Sustainable Mobility Strategy will incentivize a shift towards the least carbon intensive modes of transport (rail, inland navigation and maritime transport). The Smart and Sustainable Mobility Strategy has set for milestone to increase rail freight transport by 50% in 2030 and waterborne transport by 25%. This will require investments to address the scarcity of transhipment infrastructures and multimodal terminals and a better integration of maritime transport in the entire logistic chain.

33.3 Impacts on the price of a selection of ten commodities

Section 6.2.2.4 outlines the impacts on commodity prices and international trade flows for a selection of 10 commodities, which were selected for detailed analysis based on the following criteria:

- The **relevance** of the commodity in terms of EU competitiveness, considering factors such as the size of the sector in the EU, the share of exports and imports, profit margins, transport costs, and the evolution of the seaborne trade balance of the commodity. Competitiveness is defined at the EU-27 level, considering the position of all MS as a trading bloc relative to the rest of the world, and examining impacts at the aggregate level.
- The **technical feasibility** of the analysis, in terms of readily available data on commodity prices, current trade flows, own price elasticities, cost pass-through rates, initial demand and market shares of domestic and overseas producers.

The **following commodities were selected:** Crude oil, Refined petroleum products, Natural gas, Iron ores, Iron and steel, Cereals, Perishable goods, Office and IT equipment, Motor Vehicles, Organic chemicals.

The scale of the impacts from the policy measure, and the agent bearing these impacts (producer, manufacturer, retailer or consumer) depends on the following factors:

- **Cost pass-through.** The extent to which a change in freight rate is passed on from ship operators to their customers. For each commodity, three of the most common trade routes with the EU are selected to illustrate the change in freight rate for each commodity according to the geography of its trade. It is important to note that the analysis assumes that freight rates change in response to the real costs of shipping, with an aim to capture the upper bound of effects of an increase in shipping costs. However, freight rates may not directly reflect costs of shipping, especially given that contract structures in the maritime industry are complex and may be agreed for long time periods in certain cases.

  It is assumed that if freight rates increase, shipping operators absorb the additional cost for commodities which are price elastic, but pass it on to their customers for commodities which are unresponsive to price changes. Cost pass-through also relates to the ability of producers, manufacturers and retailers to pass costs through to the next link in the supply chain. This in turn depends on levels of market concentration, demand price elasticity, and substitutability of inputs.

- ***Ad valorem*** – *i.e.* the percentage of the price of the commodity attributed to the cost of shipping: higher *ad valorem* of freight rates will lead to greater changes in the price of the commodity. As mentioned above, in order to reflect the variety of freight rates across routes, multiple trade routes are selected for each commodity.
- **The own-price elasticity of demand** for the commodity. This reflects the percentage change in consumer demand relative to the percent change in the price of the commodity. High elasticities (with an absolute value close to or greater than one) suggest a strong consumer response to the change in price, while low elasticities (with an absolute value closer to zero) suggest only a very small consumer response to the change in price.
- **Armington elasticities** - the ability to substitute imports with domestic products. Armington elasticities compare the change in the price of an imported good with the demand for the same good produced domestically. They therefore assess the extent to which imported and domestic goods are substituted for each other, and thereby the degree to which an increase in the cost of imports would make local products more competitive. However, it is important to note that Armington elasticities are difficult to estimate empirically, with few data or literature sources available.

33.4 Impacts on EU countries and regions heavily dependent on shipping

The level of exposure to changes in shipping costs has been assessed based on a series of indicators, which resulted in EU countries having been classified into three broad groups as detailed below:

- **Most exposed** (countries with high levels of international trade, which are heavily reliant on shipping) :
    - Ireland, the Netherlands, Cyprus, Greece, Malta, Sweden.
- **Exposed** (Countries with high indicators for one of any of the following: high levels of international trade compared to GDP and relying on sea transport for more than half the volume of international trade, be it intra- or extra-EU or Countries where international trade is mostly undertaken by sea) :
    - Shipping most important for intra-EU trade: Finland, Estonia, Latvia, Lithuania, Croatia.
    - Shipping most important for extra-EU trade: Portugal, Spain, Italy, France, Bulgaria, Germany, Belgium.
    - Shipping important for all trade: Denmark, Romania.
- **Least exposed** (do not rely on maritime transport):

- o Austria, Czech Republic, Hungary, Poland, Slovakia, Slovenia, Luxembourg.

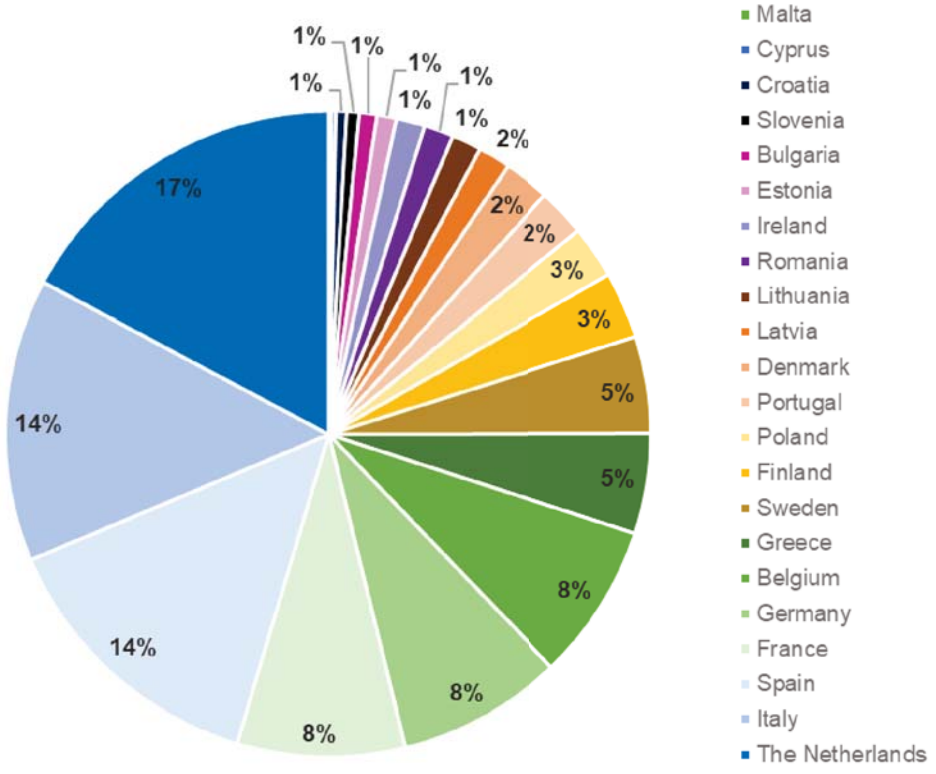
Exposure can manifest itself through a loss of competitiveness on the global market as a result of more expensive exports, or through reduced competition and standard of living as a result of more expensive imports. It can also be beneficial, should the policy result in a drop in freight rate, although this is likely to be smaller as cost savings would be retained by shipping operators.

To identify EU countries and regions most affected by changes in the shipping sector, a number of key indicators have been used:

Freight activity

In 2019, 3.5 billion tonnes of goods were handled (loaded and unloaded) in the key EU-27 ports (Eurostat, 2020a). The primary countries handling goods in the EU-27 are the Netherlands (17%), Italy (14%) and Spain (11%), which together, comprise nearly half of the total weight of goods handled in the EU-27.

Figure 81: Proportion of gross weight of goods handled in key EU 27 ports by Member States in 2019



Source: Eurostat, 2020

Whilst the graph above conveys the spatial distribution of goods handled in the EU, it does not communicate the importance of shipping to individual national and regional economies.

International trade intensity

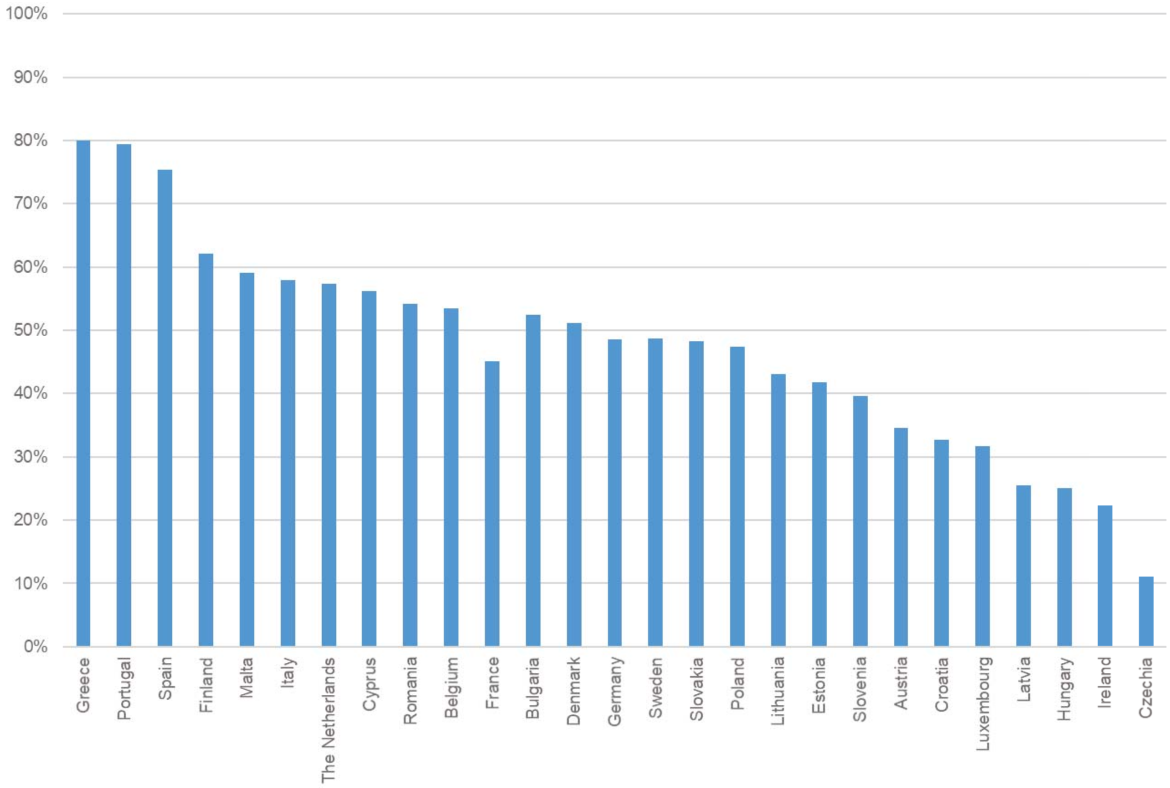
In 2019, the EU-27 exported €5.2 trillion and imported €5 trillion worth of products and services. Intra-EU trade comprised 59% of exports and 61% of import. Germany accounted for the most significant proportion of activity, comprising 23% of intra-EU trade and 26% of extra-EU trade. This was followed by the Netherlands (11% intra-EU trade, 14% extra-EU trade) and France (10% intra-EU trade, 11% extra-EU trade) (Eurostat, 2020b).

In 2019, total exports and imports represented 49% and 46% of EU-27 Gross Domestic Product (GDP), respectively. However, there are signification variations between MS, and some national economies are less reliant upon trade than others. From the figure below, it is clear that Luxembourg, Malta and Ireland are particularly reliant upon trade.

Extra-EU trade by sea

In the EU-27, extra-EU imports and exports transported by sea account for 51% of the total value of traded goods (Eurostat, 2020d). This proportion is much higher for island countries such as Malta and Cyprus, and Greece, as well as countries with significant stretches of coastline, including Portugal, Spain and Italy. In these countries, extra-EU imports and exports transported by sea account for over 50% of the total value of traded goods. Although Ireland is an island economy, the value of shipped imports and exports comprises 22% of total traded goods, due to the high value associated with goods which are transported e.g. via air . This shows that even within island economies, some are likely to be more impacted by a change in the cost of shipping than others. The high value of goods transported via maritime transport to Spain and Portugal can be attributed to their geographical location, as these countries are often the first ports of call in Europe for ships travelling from North and South America, as well as from the west Coast of Africa and South Africa. Extra-EU maritime trade is prominent in the EU's outermost regions, in particular in the regions located in the Caribbean Sea, which have a high maritime transport connectivity with neighbouring third countries.

Figure 82: Extra-EU trade (imports and exports) by sea as a proportion of total extra-EU trade in 2019, measured in €



Source: Eurostat, 2020

Intra-EU trade by sea

As with extra-EU trade, any substantial change in shipping costs will disproportionately affect countries which rely on sea transport rather than other modes to transport in order to import and export products and services within the EU. This is an important factor to examine, as for all EU-27 countries (with the exception of Ireland), intra-EU trade is greater than extra-EU trade (Eurostat, 2020b).

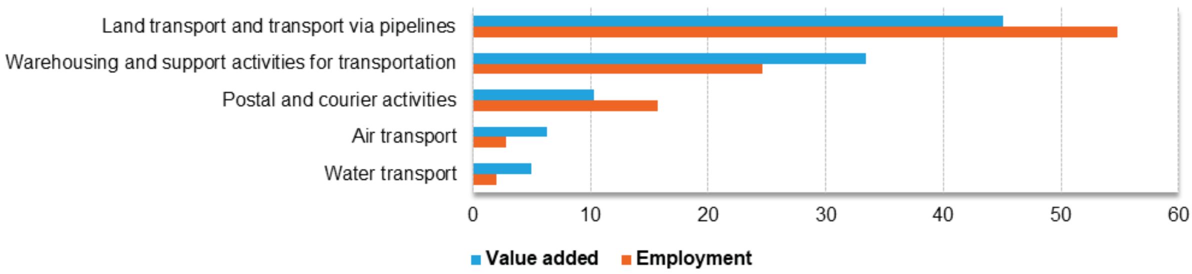
Top cargo port regions

Rotterdam, Antwerp and Hamburg have maintained their positions as Europe's key ports from 2009 to 2019. Of the key ports, seven were located in the Mediterranean (Algeciras, Marseille, Valencia, Trieste, Peiraias, Barcelona and Genova), eight were located in the North Sea region (Rotterdam, Antwerp, Hamburg, Amsterdam, Le Havre, Bremerhaven, Dunkerque and Wilhelmshaven), three ports were located in the Baltic Sea (Göteborg, Riga and Talinn), one in the Black Sea (Constanta), and one on the Atlantic coast (Sines). It is important to note that although some regions are not represented in the top 20 ports, this could be linked to the composition of their national port infrastructure. For example, Denmark and Finland have a relatively high number of medium-sized ports, rather than a lower number of larger ports.

Employment

Given the significance of maritime transport to these port regions, it is important to consider the level of employment in the maritime sector. Employment in water transport comprises the smallest segment of the transportation and storage sector in the EU-27, at 5% (next Figure). However, it is clear that the proportion of value added from the water transport segment greatly exceeds the proportion of employment in the sector. In addition, the water transport subsector recorded the highest wage-adjusted labour productivity in 2017, with apparent labour productivity equivalent to 230% of average personnel costs (Eurostat, 2020f).

Figure 83: Sectoral analysis of transportation and storage value added and employment in the EU-27 in 2017 (% share of sectoral total)



Source: Eurostat, 2020

Specific climatic conditions

From the stakeholder consultation, the Swedish Shipowners Association indicated the importance of accounting for the cost burdens faced by countries in/near the Arctic region, particularly during the winter. They noted that it is important to cover measures on how to mitigate any negative consequences derived from an EU ETS for ships operating in winter conditions, for instance, in the Baltic Sea.

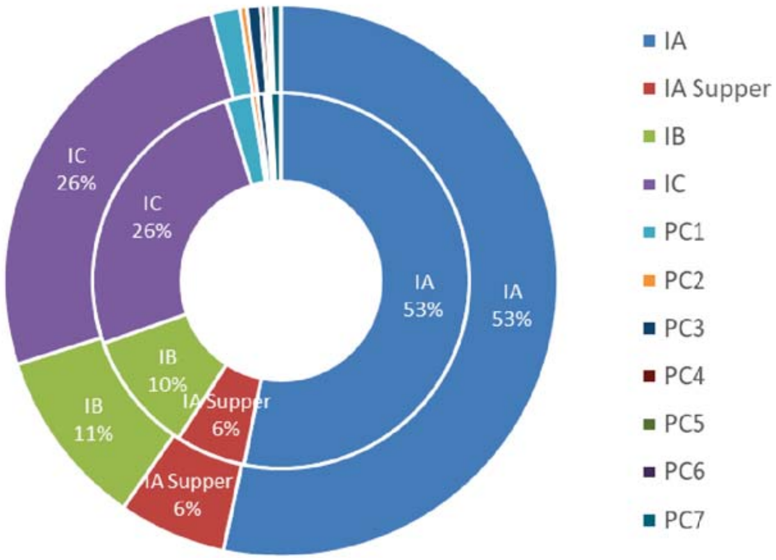
Similarly, the Confederation of Finnish Industries stated that Finland's foreign trade depends heavily on maritime transport, due to its geographic situation (80% of foreign trade is associated with maritime transport). They noted that their maritime operators are challenged by Arctic winter conditions, which add an additional cost burden. Given this, they have some concerns that a cost increase in maritime transport associated with the proposed policy options may result in carbon leakage in industrial sectors and transport routes, as well as a transition to land transport where possible, due to the sensitivity of the region to increasing maritime sector costs.

According to information transmitted by Finnish stakeholders, ice-strengthened ships may consume 20% to 60% more fuel depending on their route when sailing in ice covered waters in the Baltic Sea area, in comparison to sailing in the same area under open water conditions. In addition, due to their hull form and propeller being less optimal for operation in open water, ice-strengthened vessels may on average consume approximately 2-5% more fuel in open water conditions than ships designed solely for sailing in open water. Ice strengthening also reduces a ships capacity, meaning they are capable of transporting less freight per voyage than a ship of similar size which has not be ice-strengthened.[28] However, data in the literature about the effect of ice class vessels on energy consumption is limited, with diverging results.

Based on a recent analysis (Ricardo 2021), carbon pricing would result in minor additional commodity prices for goods transported in ice-strengthened vessels, assuming 6 months of ice-navigation per year and a range of ad valorem transport costs between 1% and 15%. In this sense, the competitiveness of industry sectors reliant on maritime transport in Nordic and Arctic regions is not expected to be significantly affected in general terms.

According to data from the EU maritime transport MRV regulation, 17% of the monitored ships voluntarily reported Ice Class in 2019, compared to 16% in 2018. More than half of these ships have ice class IA, which means that they are capable of navigating in difficult ice conditions, with the assistance of icebreakers when necessary.

Figure 84: Distribution of reported ice class in the EU maritime transport MRV regulation (Inner-circle 2018, Outer-circle 2019)



Source: EMSA, data from the EU maritime transport MRV Regulation

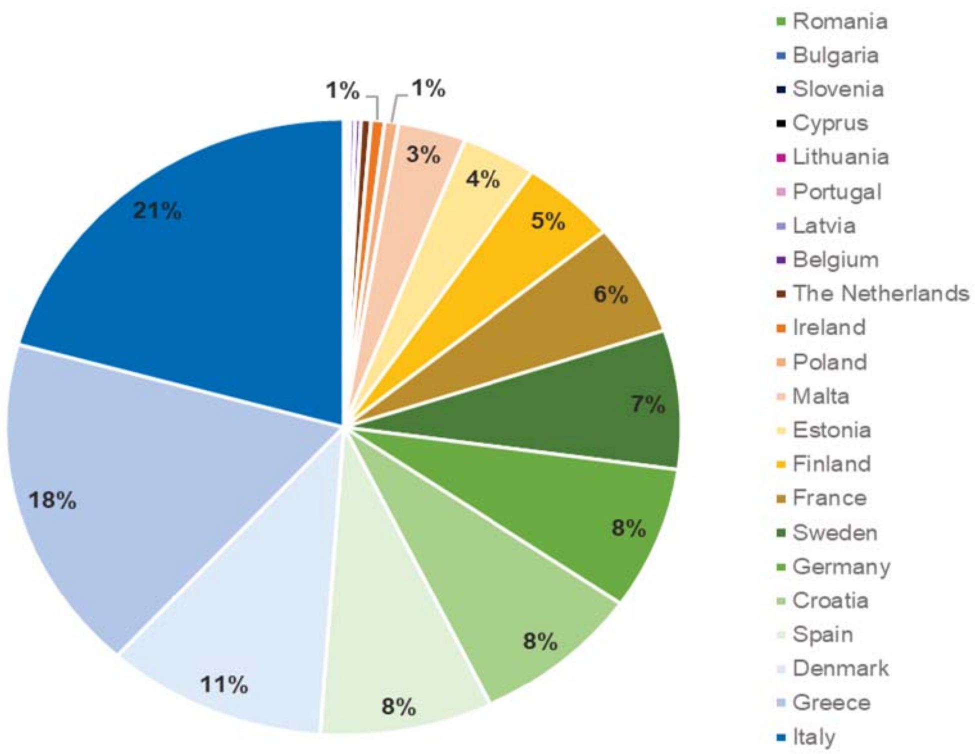
[28] Besides fuel consumption, shipping in Arctic regions requires additional investments in hull construction, specialised seafarers and additional insurance to cover for risks associated with icebergs and ice sheets, resulting in higher capital, labour costs and insurance costs than normal (Solakivi, Kiiski, & Ojala, 2018) (Solakivi, Kiiski, & Ojala, 2019). However, these additional costs would not be affected by the carbon price and have not been considered.

In addition, the EU maritime transport MRV regulation gives the possibility to companies to report on a voluntary basis the distance travelled and the time spent at sea when navigating through ice. However, in 2018 and 2019, less than 0.01% of the reported distance travelled was categorised as "distance travelled through ice".

Sea passengers

In addition to freight ships, passenger ships (e.g. ferries and cruise ships) will also be affected by all policy options under consideration. In 2019, 419 million passengers embarked and disembarked in EU-27 ports. Italy and Greece are the focus of this activity, together accounting for 38% of all passengers. This is followed by North Sea countries (Denmark, Sweden and Germany), as well as Spain and Croatia. These figures indicate the prominent role of these countries as sea passenger hubs in Europe, pointing to the economic importance of passenger shipping to their economies.

Figure 85: Passengers embarked and disembarked in all port

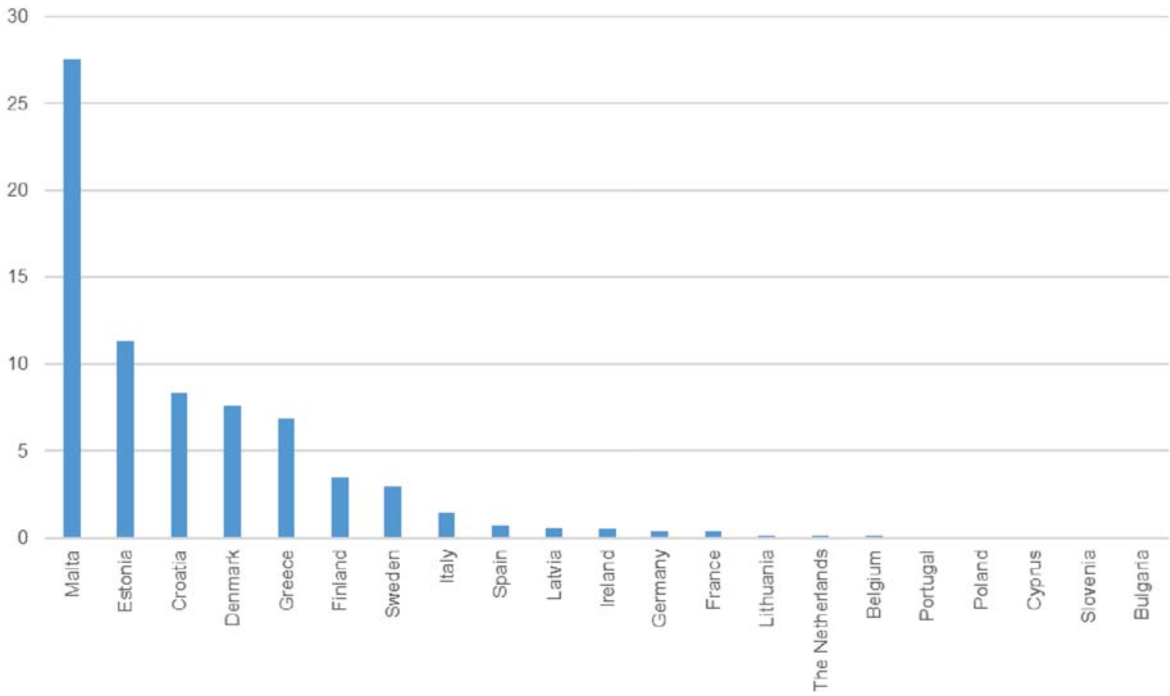


Source: Eurostat, 2020

A number of countries in the Mediterranean region, as well as in the Baltic regions have passenger transport linked to maritime tourism. Maritime tourism is the biggest maritime sector in terms of gross value added and employment (European Commission, 2020).

The number of passengers per inhabitant is particularly high in Malta, Estonia, Croatia, Denmark and Greece. This indicates that these countries are more reliant upon sea passenger traffic activity than other MS. This is likely to be linked to tourism, as maritime passenger travel is largely used by tourists. These MS, their maritime tourism industries, and their maritime passengers (should costs be passed on) are likely to be more sensitive to a change in the cost of maritime travel associated with the proposed policy options, than other MS.

Figure 86: Number of passengers embarked and disembarked per inhabitant, in 2019



Source: Eurostat, 2020

33.5 Economic impacts on imports/exports and sectors heavily dependent on shipping and ports

An increase in the maritime transportation costs associated with the payments of ETS allowances or carbon taxes along with the cost of abatement measures (e.g. alternative fuels) has different effects for upstream and downstream economic sectors in the EU. The impact on downstream sectors is driven by the direct effect of increasing the transportation costs of the final product and by the indirect effects of increasing the production costs of intermediate inputs.

Overall, all policy options will have greater impacts on the primary (e.g. agriculture and fishing) and secondary (e.g. manufacturing) sectors rather than the (tertiary) service sector, as most shipping activity is for the transport of goods and raw materials. Aside from services related to the shipping industry, the main service sector which may directly benefit from measures is tourism through the changes in the cost of operating cruise ships and ferries.

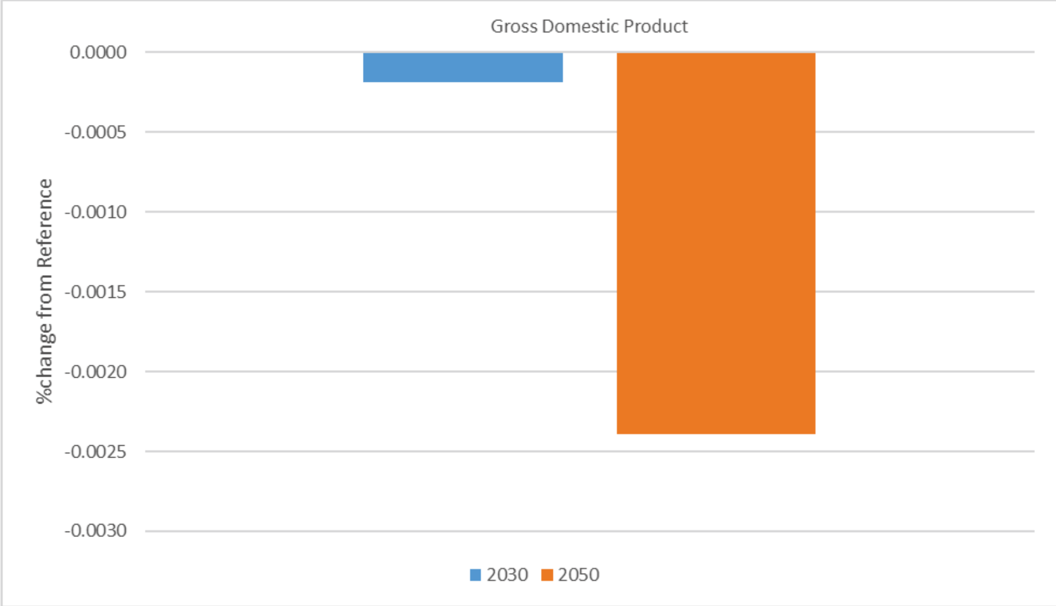
For the affected sectors, changes in commodity prices as a result of increased maritime transport costs that are estimated to range between 0.2% to 0.8% in 2030 and even changes up to 2% expected for 2050 are not expected to be noticeable by the consumer to the extent so as to drive significant changes in their behaviour. Usually, these price changes are within the expected price volatility of a commodity that is driven by non-structural or permanent changes. In this study, to assess the potential macroeconomic effect of carbon pricing measures, it is assumed that economic agents are fully informed, and the outcome depends on behavioural features and technological and income constraints. The response of EU firms and consumers to higher maritime transportation costs has been quantified through the large scale applied CGE model GEM-E3. This estimates the impact of changes in maritime transportation costs on EU Gross Domestic Product (GDP), sectoral production and employment.

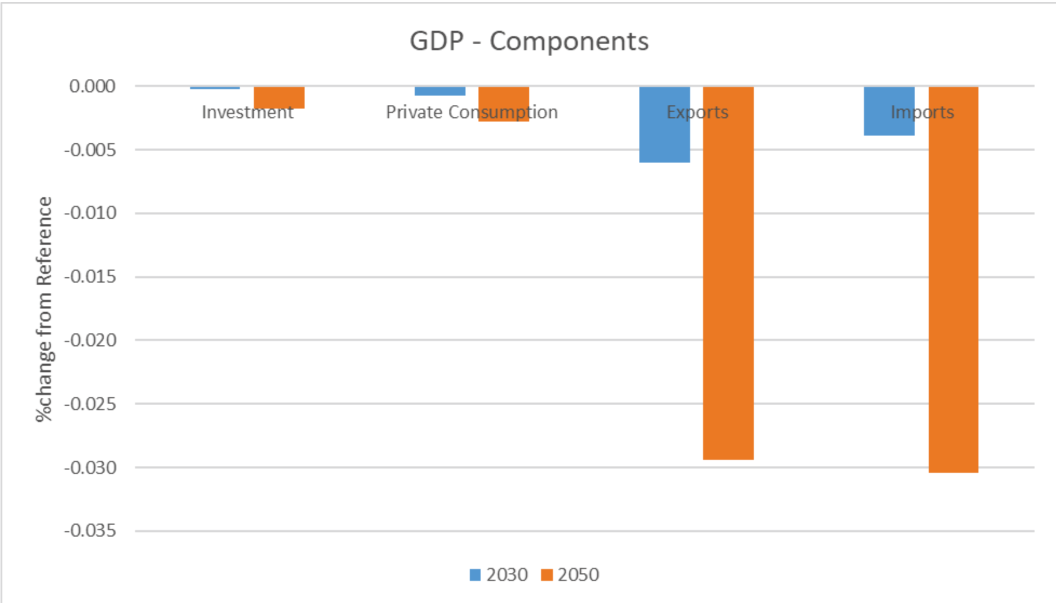
The overall net impact on the EU-27 Gross Domestic Product (GDP) as a result of increased maritime transport costs is expected to be marginal (see figure below). In 2030 the GDP is expected to decrease by 0.0002%, while, in 2050 the drop would be larger at 0.002%. This would represent a loss of GDP in absolute terms in 2050 of around €1 bn.

Increasing transportation costs for goods exported to the EU acts in favour of EU domestic production. As a result, imports into the EU would decrease as consumers increase their demand for domestically produced goods. Exports would decrease both due to higher maritime transportation costs and due to higher domestic production costs, as more expensive imports would increase the production costs in the EU indirectly. The shift to more expensive domestically produced and imported goods would increase production costs and decrease households' disposable incomes, which lowers private consumption. The expected changes in imports (€2.2 bn loss in 2050) and exports (€2.4 bn loss in 2050) approximately cancel out each other, hence the overall impact on GDP is even smaller. The results are in line with empirical findings regarding the responsiveness of demand and economic growth to changes in freight rates (Michail, 2020).

It should be noted that the analysis does not take into account the positive impact to the economy that any potential recycling of the ETS or carbon tax revenues would have. Many studies have shown the benefits of ETS recycling schemes, which tend to generate a double dividend.

Figure 87: Impact on a) EU 27 GDP and b) GDP components in 2030 and 2050 as a result of the measure compared to the baseline

a) 

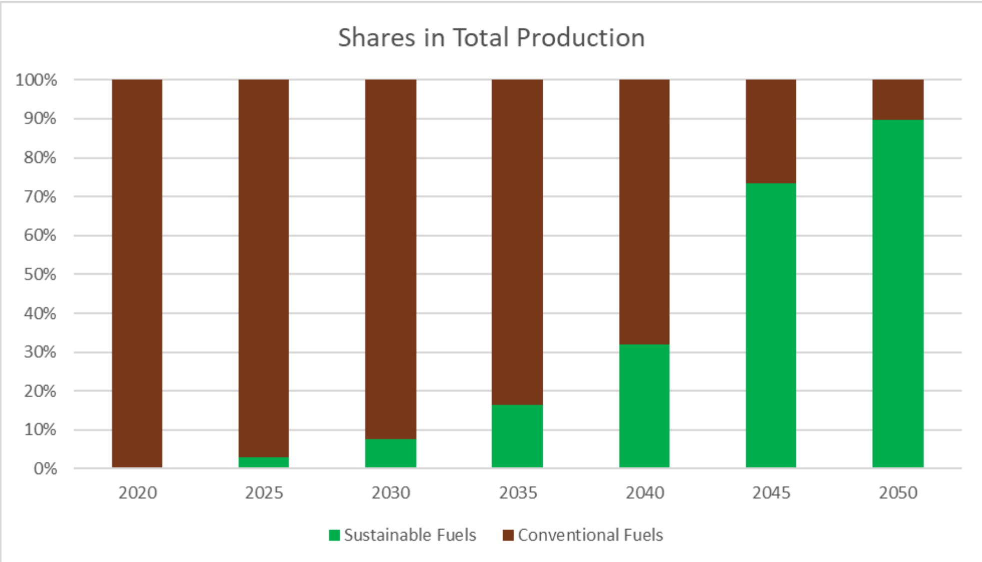
b) 

Source: GEM-E3, E3Modelling

The impact on sectoral production (sales by industry) is also generally rather small, but it varies substantially across sectors. Sectors related to the fuel supply chain are expected to reduce their production more than any other sector as carbon pricing drives fuel substitution and energy efficiency improvements on the maritime sector and to a lesser extent due to increasing transportation costs. Goods produced in the EU that are sold within the EU market are favoured by the imposition of a carbon price on maritime GHG emissions as this essentially increases the transportation costs for imported goods leading to higher substitution towards EU production. As the energy intensive industries of the EU are already under the EU ETS and have assimilated the carbon price in their cost structure, the additional cost from transportation increases their overall costs only marginally (i.e. the change in relative prices is larger for imported goods that do not reflect any carbon pricing in the costs structures). In particular the pulp & paper, chemicals and iron & steel sectors that operate under the EU ETS would gain a comparative advantage if the transportation costs of competing imported goods rise. The exports of these goods would not be affected as much because the ETS carbon price has already been assimilated in their cost structures and the additional effect from maritime emissions carbon pricing is relatively small.

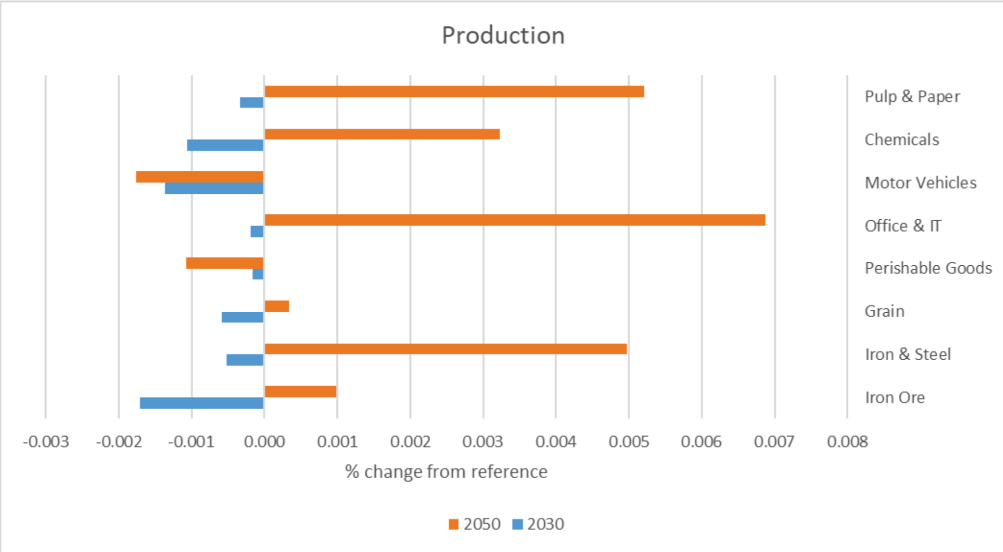
For downstream products, like motor vehicles and perishable goods, the indirect increase in their production costs would lead to lower EU domestic demand. In 2030 the impact on production is expected from the modelling to be virtually zero. In all sectors, very small reductions in all sectors are observed as changes in prices are not sizeable enough to lead to any substitutions and hence they mostly incur additional costs. It should be noted however that while the above discussion focuses on some key mechanisms and trends in production, the absolute impact is negligible.

Figure 88: Evolution in the production of fuels for the maritime sector



Source: GEM-E3, E3Modelling

Figure 89: Impacts on the production of affected sectors as a result of the measure compared to the baseline in 2030 and 2050 in the EU 27



Source: GEM-E3, E3Modelling

Ports play an essential role in reducing GHG emissions from shipping and many ports in the EU have already developed specific programmes to reduce their carbon footprint (ESPO, 2020). At the same time, the competitiveness of some EU ports vis-à-vis non-EU neighbouring ports may be affected by the introduction of the measure.

As per their response to the Inception Impact Assessment, the European ports organisation ESPO expects that transhipment ports, especially Mediterranean ports and ports in the North Sea would be most impacted by the introduction of the measure. Mediterranean transhipment ports (e.g. Algeciras, Valencia) face the competition of ports in North Africa, which would not be subject to the carbon pricing measure. From their side, ports in the North Sea undertaking transhipment operations (e.g. Rotterdam, Antwerp) may increasingly face competition from British ports after UK's withdrawal from the EU as these are no longer subject to the measure. As described in detail in the transhipment case study for Algeciras, transhipment operations are very cost-sensitive and largely depend on the commercial policies of ports in competition (i.e. port fees), available capacity and economies of scale of transhipment operations.

The extension of the measure to extra-EU journeys is expected to cause a higher impact on the competitiveness of EU transhipment ports as international routes calling at EU ports for transhipment operations would be more severely affected and may opt to switch to neighbouring non-EU ports for their large scale transhipment operations.

As regards shipbuilding, although the EU's market share in terms of volumes has declined over the years, the EU has succeeded in retaining a position by building more complex ships with a relatively higher value added, while the production of more standard mass production ships moved to other countries, especially in Asia. The EU also has a relatively strong position in the ship repair market and in the marine equipment sector which supplies ship construction.

At the European level, it still remains an important source of jobs and economic activity in the regions where it does take place. The main concentrations of large ship yards are in Germany, Croatia and Romania, followed by Finland and Spain.

A measure to address GHG emissions of ships will lead to an increase of demand of retrofitting, as well as of high value marine equipment. Therefore, any policy option should lead to net benefits for regions and sectors dependent on shipbuilding. The highest net benefits would be provided by policy options with the highest in-sector emission reduction required.

34 CUMULATIVE REVENUES GENERATED OVER THE PERIOD 2020-2050

For the period 2020-2050, cumulative additional revenues for public authorities are estimated in the table below. Despite higher carbon prices in the long-term, the carbon costs and therefore the revenues would tend to decrease over the years due to lower CO_2 emissions.

Table 59: Cumulative additional total revenues generated 2020 - 2050 by policy options (billion Euro 2015)

POLICY OPTIONS	ETS/ tax revenues in the period 2020-2050 (billion EUR 2015)
MAR1 –MINTRA	37 b EUR
MAR1 _MEXTRA50	74 b EUR
MAR1-MEXTRA100	111 b EUR
MAR2 or MAR3 - MINTRA	124 b EUR
MAR4_-MEXTRA50	74 b EUR

Source: PRIMES Maritime module

35 IMPACTS ON INNOVATION, POTENTIAL TO STIMULATE THE UPTAKE OF ALTERNATIVE FUELS AND INNOVATIVE TECHNOLOGIES

The uptake of innovative technologies and sustainable alternative fuels is key to enable the transition towards a zero-emission waterborne transport, as recognised by the vast majority of stakeholders from the sector.

In general, carbon pricing can contribute to innovation by making innovative solutions more cost-effective compared to conventional technologies and by using possible revenues to finance dedicated research and innovation activities.

In this context, it is expected that all policy options would drive innovation in energy efficiency technologies and support the deployment of solutions such as hybridisation, wind assistance propulsion, air lubrication or waste heat recovery as their marginal abatement cost would become negative on the short-to mid-term[29]. In addition, all policy options would further accelerate the uptake of renewable and low-carbon fuel, in particular MAR2 and MAR3.

All policy options would also trigger a significant amount of revenues that could contribute to support innovation, in particular through the Innovation Fund for the ETS options.

The ability of all policy options to trigger innovation is illustrated in the model by an acceleration of hydrogen and electric ships by 2050 compared to the baseline.

36 IMPACTS AT GLOBAL LEVEL

36.1 Impacts on trade

The implementation of a maritime carbon pricing measure at EU level on maritime transport emissions may have an impact on trade flows with third countries. However it is only expected to impact commodities with very low weight to value ratio (i.e. commodities with high weight and low value). The table below presents the top global trade partners, their proportion of trade with the EU and the value to weight ratio of their main trade flows. The majority of the main global trade partners have a significant share of their export and import trade flows with the EU, but only those where the main export products have a low value to weight ratio (i.e. Russia, China, India) may be affected.

[29] According to the 4th IMO GHG Study, the marginal abatement cost of these solutions are estimated between 6 to 105 USD/tonne CO_2

Table 60: Top global trade partners (in value) and share of imports and exports values from and to the EU in 2019, including all freight transport modes

Trade partner	Imports		Exports	
	% Imports from EU 2019	Value to weight ratio of main imports from EU	% Exports to EU 2019	Value to weight ratio of main exports to EU
China	13%	High	15%	Medium-high
United States of America	18%	High	16%	High
Japan	11%	High	10%	High
United Kingdom	49%	High	46%	High
Hong Kong	5%	High	7%	High
Korea, Republic of	10%	High	9%	High
Mexico	10%	High	4%	High
Canada	11%	High	5%	High
India	9%	High	15%	Medium-high
Singapore	10%	High	8%	High
Russian Federation	9%	High	42%	Low

Source: Ricardo analysis based on UNCTAD trade data

Typically, maritime routes, especially container traffic, are organised in multiple port calls, which means that even if the measure is only applied to intra-EEA journeys, trade flows with third countries could be potentially affected by the EU measure if there are more than one port call in the EEA. However, the impact on third countries will be very limited. The inclusion of extra-EEA journeys in the scope of the measure would increase the possible impacts on trade flows with third countries in case carbon pricing leads to a substantial increase in international transport costs.

36.2 **Impact on global climate actions.**

While the IMO often needs up to seven years or more between the decision to develop a new mandatory IMO instrument and its entry into force (Kachi, Mooldijk, & Warnecke, 2019), the adoption of EU measures could potentially impact the IMO discussions on mid and long term measures to address GHG emissions. The position of IMO Members could change in two different ways:

- **Support the adoption of a global market-based measure**: The EU adoption of a regional carbon pricing scheme could accelerate the adoption of candidate measures of the IMO Initial Strategy and, particularly, a global market-based measure led by the IMO. This is because the existence of a feasible regional carbon pricing mechanism may improve the situation of those who want to price shipping emissions, while simultaneously reducing the pay-offs for those that are against the measure (Dominioni, Heine, & Martinez Romera, 2018). The example of the aviation sector demonstrates that adoption of regional measures such as inclusion of aviation in the EU ETS accelerated global agreements such as the adoption of CORSIA by ICAO in 2016. Similarly, the adoption of the maritime transport EU MRV Regulation has accelerated the implementation of an equivalent fuel consumption reporting scheme at global level, the IMO DCS.

- **Refrain from implementing a global market-based measure and support the development of multiple regional market-based measures:** The introduction of carbon pricing measures in the EU for the maritime sector could discourage some third countries to push for global measures and it could encourage others to establish their own regional measure. However, there are numerous examples of EU initiatives leading to the adoption of IMO measures rather than multiple regional measures and the risk of having a patchwork of uncoordinated regional regulations would also be discouraged by the maritime transport industry. The European Commission also aims to advance discussions on market-based instruments as a medium-term measure at IMO, as explained in the Sustainable and Smart Mobility Strategy[30].

A general principle from economic contract theory is that for negotiations based on unanimity, parties will prevent the achievement if the pay-off is lower in the agreement than in the current status quo (Dominioni, Heine, & Martinez Romera, 2018). The supporting study from RICARDO compared the pay-off of supporting a global measure or pursuing a separate regional measure under the status quo and under the EU action for the following clusters of countries: main global trading partners, oil exporters, neighbouring countries and developing countries. This political economy analysis suggests that most of the analysed clusters are more likely to agree on a global market-based measure once the regional measure at EU level is implemented. The only exemption being neighbouring countries, which may benefit from potential spill overs of the regional approach. The incentives to achieve an international agreement are greater

[30] COM(2020) 789 - Sustainable and Smart Mobility Strategy – putting European transport on track for the future.

the larger the GHG emissions coverage of the EU measure (Dominioni, Heine, & Martinez Romera, 2018).

If a global market-based measure is adopted after the European one, there are a number of scenarios on how they could interact (this was also considered for aviation[31]). The EU could decide to amend its measure upon implementation of the global measure to avoid double regulation. The European Commission for instance proposed to amend the EU maritime transport MRV regulation to align it with the data collection system developed by the IMO where appropriate. The two measures could cover different scopes. For instance, the IMO measure could be applied at global level but exempt the emissions covered under the EU system. Other linking approaches could be envisaged. In the case of a cap-and-trade scheme, which has obvious similarities with the ETS, emissions allowances could be possibly made fully fungible or there could be limited fungibility (e.g. up to a certain amount or only one-way). In the case of an emissions tax or levy, the link would be harder. Still, the instruments could be coordinated, e.g. by exempting EU related emissions from all or part of the global emissions tax, by using free allowances or by aligning the rate of the global emissions tax with the allowance price in the EU ETS.

36.3 **Impacts on LDC and SIDS**

Overall, the EU amounts to 11% of the value of imports into SIDS and LDCs. Imports into SIDS and LDCs from Europe tend to be for oil products, food or machinery. The table below shows the top ten LDCs and SIDS in terms of import share from the EU. Cabo Verde and São Tomé and Principe, which are designated as SIDS, have a large dependency on European imports, with more than 60% of their imports coming from the EU. Countries designated as LDC and mostly located in Africa have also more than one third of their imports with origin in the EU and may also be affected by the measure.

Table 61: Main LDC and SIDS importers from the EU

Country	SIDS/LDC status	% Share of imports from the EU
Cabo Verde	SIDS	76%
São Tomé and Principe	SIDS and LDC	60%
Guinea-Bissau	SIDS and LDC	47%
Senegal	LDC	40%
Central African Republic	LDC	40%
Chad	LDC	37%
Niger	LDC	36%

[31] SWD(2017) 31

Cuba	SIDS	33%
Togo	LDC	33%
Guinea	LDC	33%

Source: UNCTAD trade data 2019

A similar behaviour is found for exports, with 12% of overall exports from SIDS and LDCs being shipped to the EU-27. As shown in the next table, some LDCs and SIDS have a significant share of their exports to the EU, which means that their exports could be affected if the increased cost of shipping leads to lower demand levels in the EU or where they are being priced out in comparison to other exporters with lower shipping costs (e.g. closer to the EU market). Cabo Verde and São Tomé and Principe have also a large dependency with the EU in terms of exports, which makes them particularly vulnerable to changes in shipping costs to and from the EU. Open registry states like the Marshall Islands, Liberia and the Bahamas are also among the top exporters to the EU.

Table 62: Main LDC and SIDS exporters to the EU

Country	SIDS/LDC status	% Share of exports to the EU
Cabo Verde	SIDS	83%
São Tomé and Principe	SIDS and LDC	70%
Marshall Islands	SIDS	62%
Liberia	LDC	57%
Antigua and Barbuda	SIDS	50%
Bangladesh	LDC	46%
Guyana	SIDS	46%
Comoros	SIDS and LDC	46%
Bahamas	SIDS	39%
Malawi	LDC	38%

Source: UNCTAD trade data 2019

However, these export and import data doesn't differentiate direct voyages from voyages with intermediary ports calls. In the cases of indirect export or imports (with an intermediary port call), the carbon pricing would be limited to a portion of the emissions, therefore limiting the impacts on these trades. A recent study indicated that for the MEXTRA50 scope under actual carbon prices the transport cost for containers for a voyage between Spain and Singapore will be increased by 0,5 to 1%[32].

Third countries could also be indirectly affected by the measure if their trade flows with non-EU countries use EU ports as transhipment hubs. For containerised cargo, 12% of the total traffic in TEUs moving between EU countries and non-EU countries transits

[32] T&E study 2020 : all aboard!

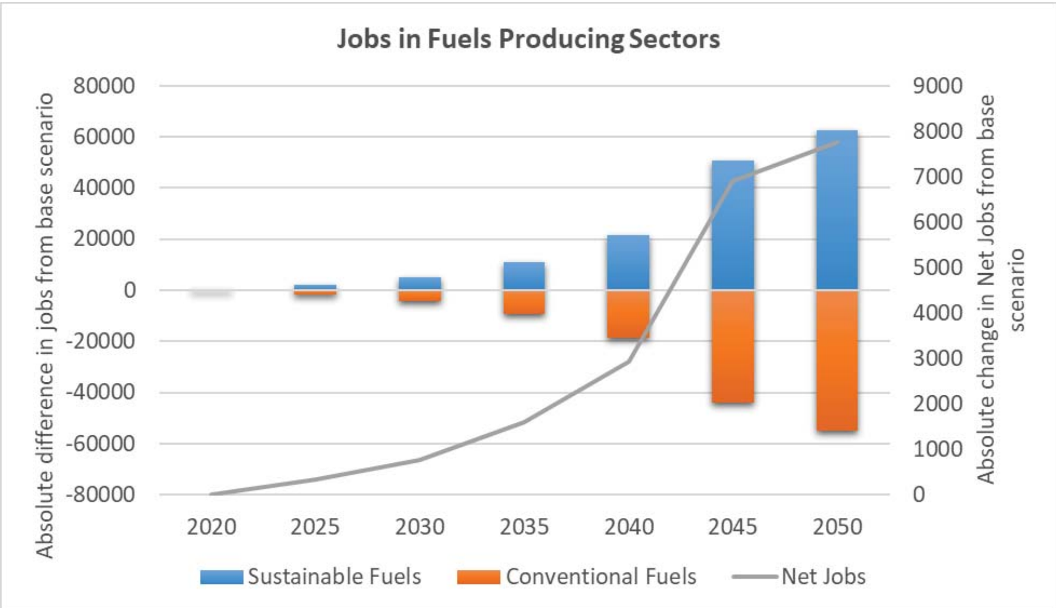
through EU ports but neither originating from EU countries nor destined for EU countries (World Shipping Council, 2020). Containerised products however tends to have a relatively high value, the effect on the final price of the commodity for imports and exports with non-EU partners transiting via EU ports is expected to be marginal. A portion of these shipments would originate from or be destined for LDCs, especially in North and West African locations, which are more likely to be connected through feeder services to EU ports due to their proximity. In that case the MINTRA scope would also have impacts on trade between SIDS and LDCS with non-EU countries, but these are considered rather limited. Impact on SIDS and LDCs will increase with the geographic scope, as with the carbon price. MAR2 and 3 are expected to have more impacts than MAR1 and 4.

37 Social impacts

37.1 Impacts on employment

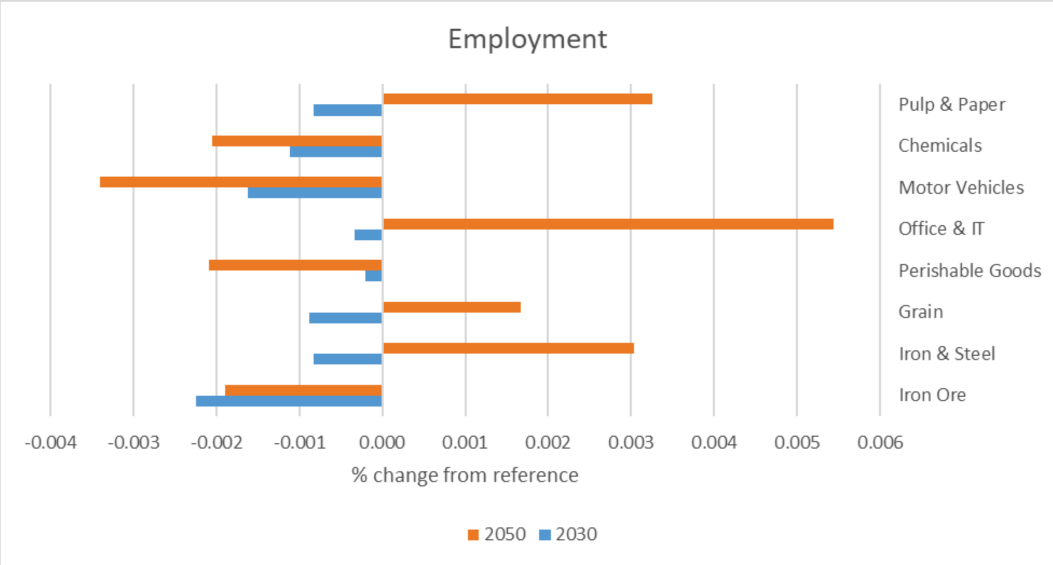
As described in Section 6.2.3.1, the changes in employment for fuel suppliers and other sectors which rely on shipping for trade are limited, as shown below (based on the MAR1 MEXTRA50 option).

Figure 90: Impacts on the employment of fuel suppliers as a result of the measure compared to the baseline in 2030 and 2050 in the EU 27



Source: RICARDO 2021

Figure 91: Impacts on the employment of non-energy sectors as a result of the measure compared to the baseline in 2030 and 2050 in the EU 27



Source: RICARDO 2021

As demonstrated above, the net impact of employment on the energy sector is positive over the period 2025-2050 as the fossil fuels are substituted by sustainable fuels, which are expected to be mostly produced within the EU.

With regard to all other sectors, impacts on employment will be negligible or slightly negative by 2030 and positive by 2050 for all but two sectors. The motor vehicles and perishable goods sectors will likely suffer the greatest negative impacts on employment by 2050, but again this impact will be very small, from about -0.002 to -0.004%.

37.2 **Impact on vulnerable households**

To assess the impact on vulnerable households, a differentiation has been made by household income class depending on the consumption pattern and sources of income of each class. The GEM-E3 model identifies income classes by deciles.

- **Income effect:** The skillset and the different sources of income (i.e. wages, dividends, rentals etc.) for each household class determine the size of impact. Changes in the sectoral production and employment affect household income. Low income classes derive their income mainly from wages while high income classes both from wages and dividends.
- **Price effect: higher prices reduces consumers' disposable income.** Depending on the consumption patterns the increase in prices of different commodities affects differently each income class.

The overall impact on welfare is negative but small as it can be seen in the table below.

Table 63: Change in Welfare by Income Decile (EU-27 – Hicksian Equivalent Variation – D1 is the lowest income decile)

	In €m		% of Income	
1	-1.3	-82.1	-0.0003%	-0.015%
2	-2.9	-109.2	-0.0005%	-0.015%
3	-4.0	-134.0	-0.0005%	-0.013%
4	-5.8	-168.5	-0.0005%	-0.013%
5	-8.3	-191.0	-0.0006%	-0.012%
6	-7.8	-247.8	-0.0005%	-0.013%
7	-10.0	-289.2	-0.0005%	-0.012%
8	-11.5	-343.0	-0.0005%	-0.012%
9	-11.0	-431.7	-0.0004%	-0.011%
10	-14.5	-924.4	-0.0002%	-0.011%

Source: RICARDO 2021

38 CASE STUDIES EXPLORING THE POTENTIAL RISK OF CARBON LEAKAGE LINKED TO THE MARITIME POLICY OPTIONS

Objectives and scope

Three detailed case studies building upon the support study carried out for this impact assessment (E3M/ Ricardo forthcoming) explored the possible impacts of the maritime policy options on selected regions, routes and vessel types, in particular as regards the potential risks of policy evasion (through evasive port calls, or transhipment at non-EU hubs) and policy avoidance (through modal shift).

In order to explore the potential impacts for specific regions and routes, the following case studies have been selected:

- A **modal shift** case study: assessing the potential for shifting from short-sea shipping (SSS) to road transport between the port of Barcelona (Spain) and the port of Civitavecchia (Italy);

- A **transhipment** case study: assessing the potential for container ships to use Tanger Med (Morocco) as an alternative transhipment hub to the port of Algeciras (Spain);

- An **evasive port call** case study: assessing the potential for shipping operators to engage in evasive non-EU port calls along routes ending at the port of Piraeus (Greece), port of Algeciras and the port of Rotterdam (the Netherlands).

38.1 **Methodology**

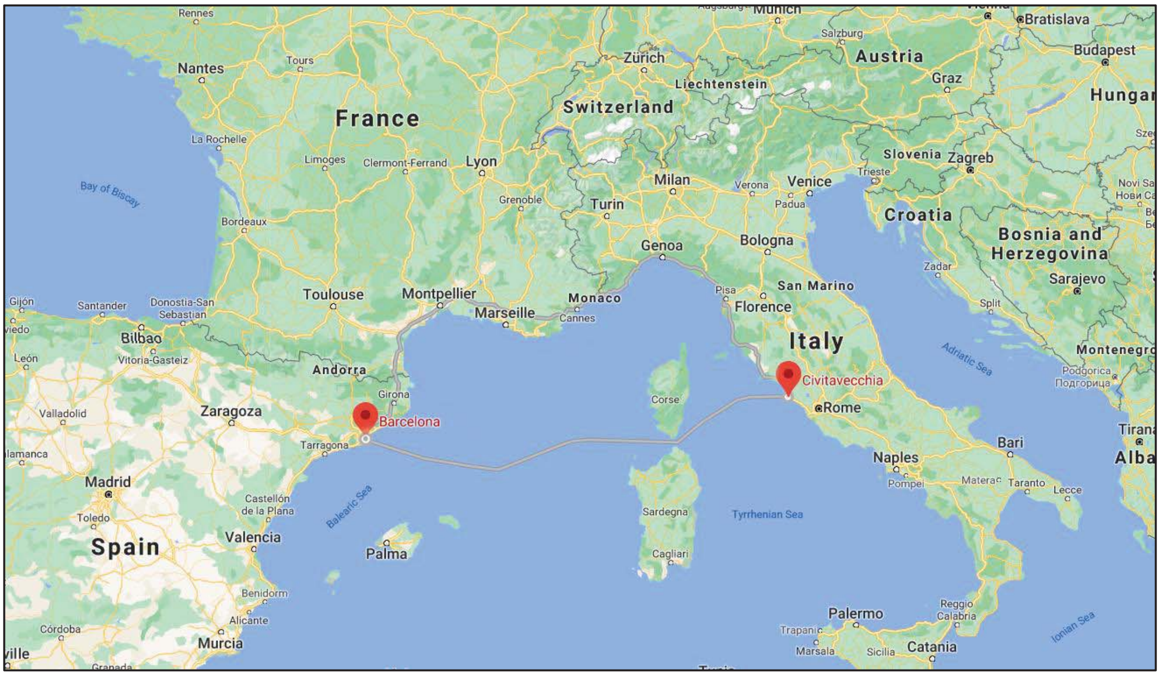
The methodology followed for undertaking the cases studies draws upon the analysis undertaken in the main impact assessment support study, and reflects the approach taken in the 2013 Impact Assessment supporting study[33]. Where specific input data were available on the routes considered, such as distance travelled and speed of vessels, these have been integrated into the calculations. Where possible, assumptions have been refined, through use of more specific data. A thorough review of the relevant literature was conducted, focusing on the potential for modal shift, transhipment and evasive port calls, as well as the specific regions and routes considered. The literature has informed the assumptions and results presented in the respective case studies.

38.2 **Modal shift case study**

This case study focused on assessing the risk of modal shift away from Short Sea Shipping (SSS) freight transport to road freight, as a result of introducing policy measures to control maritime GHG emissions in Europe and in the case road transport is not covered by similar carbon pricing. The Ro-Pax service between Barcelona and Civitavecchia provides a suitable example where maritime transport is in competition with road freight transport, with the existing service running six days a week and taking approximately 20 hours. In addition, to promote maritime transport and due to expected growth along the route, CEF funding aims to support the infrastructure associated with the respective ports in order to drive Ro-Pax traffic further.

[33] Support for the impact assessment of a proposal to address maritime transport greenhouse gas emissions https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/ghg_maritime_report_en.pdf

Figure 92: Barcelona – Civitavecchia route



The resulting cost for the open ETS and closed ETS scenarios for this route and the increase in total costs is presented in the table below, assuming no administrative costs for the operator associated with complying with the policy option. The carbon price is assumed to be respectively 45.5 EUR/ton CO_2 and 268 EUR/ton CO_2. The fuel price is estimated at 480EUR per ton of fuel and the consumption per trip of 106 tons of fuel. For the selected route and vessel, the average speed travelled is 21 knots and the gross tonnage is 50.000.

Table 64: Total cost per trip for shipping operators

Parameter	Unit	Value
Total cost of trip without carbon pricing	€m	€ 0.14
Total cost of trip with open ETS	€m	€ 0.15
Total cost of trip with closed ETS	€m	€ 0.19
Increase in total cost of trip with open ETS	**%**	**7**
Increase in total cost of trip with closed ETS	**%**	**36**

Source: RICARDO 2021

An increase in the total cost of the trip could result in an increase in the modal share of road transport. In line with the Comi and Polimeni (2020) study, a 10% cost increase would cause a 3.1% increase in the modal share of road transport, a 7% increase in total costs would result in a potential 2% increase in road modal share, and a 36% increase in total costs would result in a 11% increase in road modal share.

However, modal choice for freight transport depends on a range of factors, including transit time, cost, and flexibility. Although there is the potential for road transport to offer an alternative to SSS along this route, practical obstacles could limit the shift from SSS. Freight operators are already likely to have invested in the use of the SSS route, and would face sunk costs from returning to the use of road transport. In addition, it is necessary for road hauliers to comply with EU legislation, including HGV speed limits and daily driving limits. These legislative measures limit the potential time and cost savings which could be associated with switching back to road transport, as it is likely that either two drivers would be required to complete the route, or a single driver would need to complete the trip over two days.

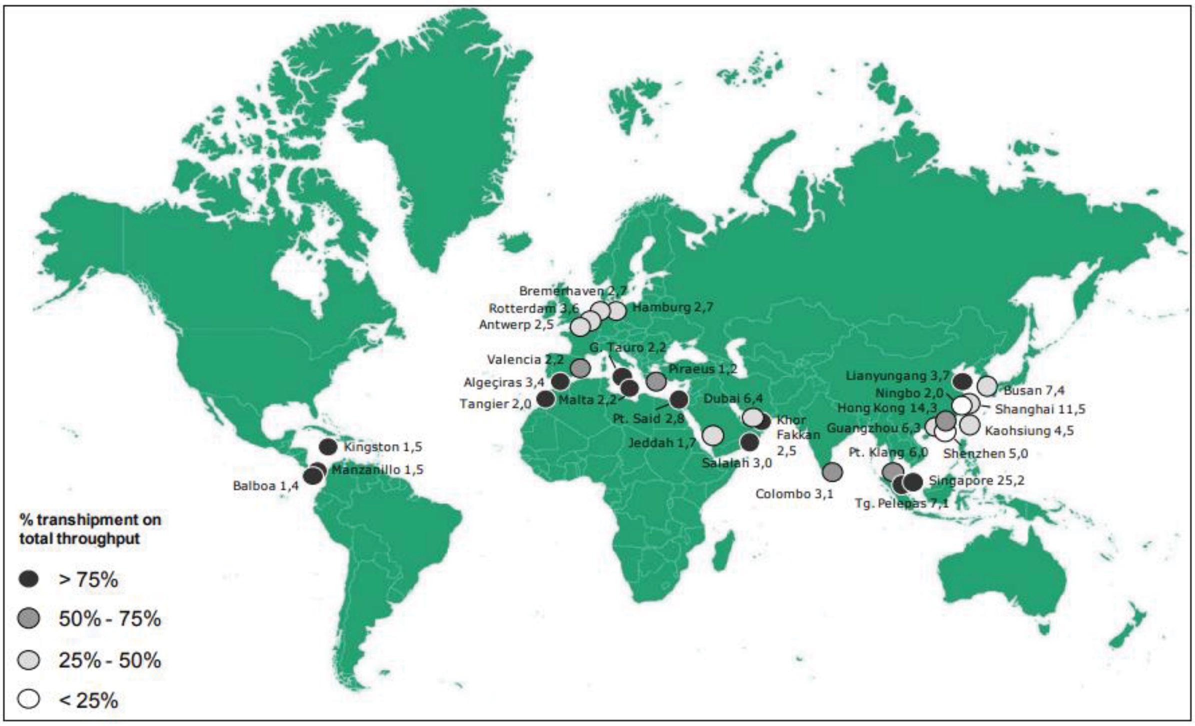
In addition to these operational obstacles associated with the potential shift back to road transport, the use of the Ro-Pax route aligns more closely with the EU's strategic objectives to encourage the use of alternative modes. The cost associated with SSS is also of primary significance in regard to modal choice. As shown before, there is potential for the policy options to have an impact on fuel costs, and hence on the total costs associated with SSS. However, assuming a cross elasticity of 0.31 for shifting from SSS to road, the impact of the increase in total costs of SSS is likely to have a small impact on road modal share along the route in the case of an open ETS (MAR1 or MAR4), and a more significant impact in the case of a closed ETS or a tax (MAR2 and MAR3).

38.3 **Transhipment case study**

Transhipment is the *'unloading of goods from one ship and its loading into another to complete a journey to a further destination'* (Eurostat, 2016). The emergence of containerisation since the 1960s has resulted in the **development of new port connection structures**, such as transhipment, which emerged to optimise resources and benefit from economies of scale (Grifoll, Karlis, & Ortego, 2018)

In line with this, container shipping lines are increasingly sending their vessels to intermediate locations, between the origin and destination, where containers are transhipped. According to Ducruet and Notteboom (2012), on average, a container was handled 3.5 times between the first and final port of call in 2008, indicating the significance of transhipment in the container shipping network. Container shipping lines have been the key players in setting up liner services centred around transhipment hubs, with transhipped containers representing 28% of global container port throughput in 2012 (Notteboom, Parola, & Satta, Partim transshipment volumes, 2014). Therefore, due to the significance of transhipment to container traffic, this case study focuses on transhipped container traffic.

Figure 93: Main transhipment hubs worldwide: container volumes transhipped, 2011



Source: Notteboom, et al., 2014

This case study focused on assessing the likelihood of freight operators shifting from the use of an EU transhipment hub to a non-EU transhipment hub, as a result of introducing policy measures to control maritime GHG emissions. Tanger Med offers an attractive alternative to Algeciras as a transhipment port, in regard to its close proximity and infrastructural capacity. In addition, recent investments in the port have enhanced the quality of port services.

The practical feasibility of changing transhipment hub depends on a range of important factors, including port location, berth availability, transit time, cost, frequency and service quality. Although cost is an important factor, port location and proximity to primary routes, cities and ports, are key factors which influence transhipment hub choice in Europe.

However, it is also important to consider the costs associated with transhipment, which have the potential to have a significant impact depending on the variation between ports. In the case of Algeciras and Tanger Med, a significant difference in transhipment costs already exists between the two ports. In addition to port fees, it is also essential to consider other operational costs, and the costs associated with fuel, ETS/carbon levy payments and capital costs. Fuel costs in particular comprise a significant share of the total port costs.

Therefore, the potential for shipping operators to use non-EU transhipment ports, as a result of the policy options, will depend both on the operational factors influencing transhipment port choice, and the transhipment costs associated with proximal non-EU transhipment hubs.

Table 65: Percentage cost difference of transhipment operations in Algeciras under the proposed policy options illustrated for two different distances from the port of origin to the transhipment port

Year	Option	Carbon price (€/tCO_2)	Geographical scope	Total cost increase linked to transhipment operations in Algeciras (%)	
				1,000 nautical miles from the port of origin	10,000 nautical miles from the port of origin
2030	MAR 1 MEXTRA50	45.5	Intra-EU + 50% Extra-EU	3	6
	MAR2 MEXTRA50	268	Intra-EU + 50% Extra-EU	16	33
	MAR 1 MEXTRA100	45.5	Intra-EU + 100% Extra-EU	5	11

Source: RICARDO 2021

The analysis looked at the increase in cost for calls to Algeciras linked to the different options. The results are showed in the table above. The estimated total cost increase linked to transhipment operations in Algeciras is one of the factors that could exacerbate evasive behaviour in favour of Tanger Med, in particular for MAR2.

38.4 **Evasive port call case study**

This analysis studies the likelihood of freight operators to engage in evasive port calls at non-EU ports, as a result of introducing policy measures to control maritime GHG emissions. All of the considered non-EU ports offer potential additional port calls, due to their relatively close proximity to the destination EU ports. In addition, the EU MS selected are considered to be subject to a relatively high level of exposure, due to their close proximity to non-EU ports.

The port of Algeciras, with an evasive port call at Tanger Med

In regard to adding an additional port call at Tanger Med, a T&E (2020) study estimated that there is no risk of policy evasion at a CO_2 price of €30/tonne, but a 9% risk at a CO_2 price of €50/tonne. There is potential for a GHG emissions policy to lead to congestion at Tanger Med, which would result in reducing significantly the risk of policy evasion at a CO_2 price of €100/tonne. For the trips travelling to or from Oceania, all trips covered would be motivated to evade at a CO_2 price of €45/tonne. However, none of the 1,194 voyages sailing to or from the UK and Svalbard would be encouraged to evade at CO_2 prices below €215/tonne.

Two evasion cases were assessed in more detail (see next table). The two cases assess the potential for evasion at Tanger Med, along the route ending at the Port of Algeciras. The cases consider container vessels and dry bulk carriers, and draw upon the opportunity costs and additional time incurred in the evasion scenarios presented by the T&E (2020) study. As further inputs of this analysis, results from the PRIMES Maritime module on shipping costs (fuel, operating and capital costs), carbon prices and emission reduction for the different policy scenarios are considered.

Table 67: Port evasion case: Algeciras- Tanger Med

	Evasion case 1	**Evasion case 2**
EU port	Algeciras	Algeciras
Evasion port	Tanger Med	Tanger Med
Type of vessel	Containers	Dry bulk carriers
Additional distance in evasion scenario (nautical miles)	32	32
Additional time in evasion scenario (days)	0.5	2.5
Evasive port fees (€)	31 368	16 582

Source: RICARDO 2021

The next table presents the distance turning points above which shipping operators would be incentivised to add an additional port call, as a result of the proposed policy options. For distances exceeding 12 000 nautical miles, it is assumed that evasion does not occur, as this is higher than the travel distance to the equivalent point halfway around the Earth's circumference following a straight line.

Table 68: Distance turning points across the proposed policy options for routes to the port of Algeciras with potential evasive port calls in Tanger Med

Year	**Option**	**Carbon price**	**Distance turning point (nautical miles)**	
			Evasion case 1	**Evasion case 2**
2030	MAR1 MEXTRA50	45.5	No evasion	11 300
	MAR2 MEXTRA50	268	2 900	2 200
	MAR1 MEXTRA100	45.5	8 300	6 000

Source: RICARDO 2021

The port of Piraeus, with an evasive port call at the port of Haydarpaşa

The analysis undertaken by T&E (2020) suggests that it would not be financially attractive for ships to evade policy by calling at the port of Haydarpaşa prior to the port of Piraeus if the CO_2 price was below €30/tonne. The analysis suggests that even a higher CO_2 price of €100/tonne would only result in policy evasion occurring for 0.5% of all journeys. This is due to the additional port, fuel, operational and opportunity costs (and the remaining CO_2 costs), which outweigh the costs associated with policy compliance (T&E, 2020).

The port of Rotterdam with an evasive port call at the port of Southampton

The T&E (2020) study concluded that there is no risk of policy evasion for shipping operators completing their journey at Rotterdam, for CO_2 prices under €100/tonne. The study found that the opportunity costs of oil tankers increase at a much slower rate than all other cost types, as the size of the vessel increases. As a result, the opportunity costs represent a proportionately larger share of the total costs of the smallest oil tankers (2%), relative to the largest oil tankers (1%). However, the port of Southampton charges very high port fees, particularly for larger vessels. Policy evasion would result in port costs equating to 30% of total costs for large oil tankers. Large oil tankers would require a higher ETS price to evade policy through a stop in Southampton.

Other cases

The study estimated that all 125 voyages travelling to or from North and South America would consider evading policy at CO_2 prices between €100/tonne and €255/tonne. However, this differed for the trips travelling from Russia or Ukraine, where none of the voyages would be motivated to evade policy at a CO_2 price under €300/tonne. Furthermore, for CO_2 prices below €100/tonne, only six voyages would consider evading policy, and all of these journeys involved ships travelling to or from Asia. These results highlight the importance of the distance travelled in regard to the likelihood to evade policy (T&E, 2020).

Summary

The practical feasibility associated with an evasive port call has the potential to impact the decision of the shipping operator to engage in an evasive port call. For example, it is necessary for shipping operators to already have business at a port to allow them to call at a port, and load or unload cargo. Therefore, shipping operators without existing business in non-EU countries would be required to develop new business activities, to enable them to call at non-EU ports in an attempt to evade policy. This would involve a relatively high level of administrative burden.

It is essential to remain attuned to the significance of port costs on the potential for evasive port calls, as it is possible that proximal non-EU ports will lower their port fees to further attract shipping operators. This would in turn impact the turning point, and therefore, directly influence the number of ships likely to evade policy. However, port fees also comprise a much smaller share of total costs for large container vessels, relative to fuel costs.

It is important to note that it is difficult to make assumptions regarding the response of shipping operators to the uncertainty associated with the proposed policy options. However, it can be concluded that the potential for shipping operators to engage in evasive port calls, as a result of the proposed policy options, will depend both on the practical feasibility of engaging in shipping activity, and the costs associated with engaging in evasive port calls.

Table 69: Summary of risk of evasive port call for policy options in 2030

Year	Option	Risk of evasive port call
2030	MAR1 MEXTRA50	Very low
	MAR4 MEXTRA50	Very low
	MAR2 MEXTRA50	High
	MAR1 MEXTRA100	Medium

Source: RICARDO 2021

Annex 11: Detailed analysis on the Innovation Fund

39 Types of projects that can be supported by the Innovation Fund

Based on the applications to the first call for large-scale projects under the current Innovation Fund, there were applications from all eligible sectors for projects to be located in all EU MS, Iceland and Norway. As the evaluation is still ongoing, it is not known which projects will actually be funded, so the analysis is based on the applications received. Nevertheless, even only the analysis of the applications indubitably shows the potential of the Innovation Fund to play a pivotal role as a key instrument for decarbonising Europe through clean tech solutions.

The analysis of the proposals received reveals multiple technological pathways, applicable across multiple industries and sectors of the economy, which can help reduce emissions both in ETS but also in other sectors such as transport, buildings and agriculture. For instance, there is significant interest from projects related to clean transport – for instance integrated hydrogen distribution and use to various transport modes, e.g. heavy-duty vehicles, buses, fuel cell and hydrogen vehicles, ships; use of carbon capture and use technologies for production of aviation and other fuels; use of bio-based solutions for the production of various fuels. There are also projects providing technological solutions in the renewable heating and cooling of buildings. The call for small-scale projects launched on 1 December 2020 and closed on 10 March is putting further emphasis on projects providing carbon neutrality solutions for buildings or construction products substituting carbon intensive ones.

When zooming into the proposals received for energy-intensive industries, three main pathways can be identified: hydrogen, carbon capture and utilisation/storage (CCU/CCS), and bio-based decarbonisation pathways, with a certain overlap between hydrogen and CCU/CCS proposals. Other pathways include circular economy solutions such as recycling (e.g. scrap metal, plastics), pyrolysis, and electrification.

A deeper analysis of the proposals concerning hydrogen technologies (hydrogen involved as a final or intermediary product), shows that more proposals (12% of the total number of received proposals) can be considered green hydrogen, i.e. they either intend to produce their own renewable electricity or conclude power purchase agreement to secure additional renewable electricity. About 7% of the hydrogen proposals concern blue hydrogen (hydrogen produced from natural gas combined with CCS), and another 7% concern integrated hydrogen distribution and use to various transport modes, while the rest covers different varieties that have not clearly indicated the source of electricity.

A deeper look into the applications concerning carbon capture (a fifth of the total proposals received) shows that most focus on one part of the CCU/CCS value chain, only some proposals integrate all aspects of the value chain from CO_2 capture to utilisation or storage and 7% have the potential for net-carbon removals (negative emissions, net-carbon removals. CO_2 is captured from various sources: bio-refineries, ferrous and non-ferrous metal production, cement and lime, refineries, chemicals, bio- and geothermal combined heat and power (CHP) plants, Waste to Energy or ambient air, showing the cross-cutting application of this technological pathway. The CCU/CCS proposals aim to result in the production of different products: electricity & heat, hydrogen, methanol, aviation fuels, methane, construction materials, other chemicals and other fuels

A deeper analysis of the proposals concerning bio-based products and technologies shows that these amount to about a fifth of the total and they consider various biomass feedstock, mostly waste and residues, while their products are various biofuels, different bio-based chemicals, or combining chemicals and fuels.

In the renewable energy sector, there are proposals employing all types of on- and offshore wind, floating and ground-based foundations, concentrated solar power (CSP), photovoltaics (PV), production facilities for PV cells and modules, as well as tidal, wave, salinity gradient and hydro energy, and deep geothermal energy. Many renewable energy proposals combine different renewable energy technologies (CSP and PV, CSP and biomass, wind and PV) an often variable renewable energy sources are combined with battery or thermal storage or the production of hydrogen.

In the energy storage sector, many proposals aim to find solutions for the inter-daily electricity storage, while others include other storage types (batteries, compressed or liquid air storage, thermal, hydrogen, and hydro storage). Some proposals cover demand-side measures by applying smart grids or virtual power plant solutions and others concern production facilities for batteries.

The wide variety of project applications received for the first call under the Innovation Fund shows that companies are willing to invest in a multitude of technological solutions to decarbonise Europe, and are looking for public funding. This advocates for increasing the size of the Innovation Fund to address this need and to help industry play its role in EU transition to carbon neutrality.

40 LEVEL OF SUPPORT FOR PROJECTS UNDER THE INNOVATION FUND

As outlined above, the oversubscription of the first call for large-scale proposals under the Innovation Fund demonstrates significant interest of companies in investing in low-carbon technologies and the already high capacity for the market to absorb such funds. The Commission impact assessment accompanying the delegated regulation on the Innovation Fund was underpinned by a market study which estimates the potential investment volume to EUR 55 to 68 billion for demonstration projects in the relevant sectors for the period 2021-2030 (a conservative estimate as potential investments may be higher especially in cross-cutting technologies)[34].

Currently, the project costs that can be funded by the Innovation Fund are defined as the additional costs of the innovation and are much lower than the total project costs. Furthermore, the current funding rate of the Innovation Fund is set at maximum 60% of the relevant costs, thus leaving a significant part of the total project costs to be covered by the project proponent or other public and private investors. This financial gap can be very big in absolute terms when it comes to large-scale industrial projects. This may be challenging and compromise the bankability and financial viability of an otherwise promising clean tech projects in terms of emission reductions. The Impact Assessment accompanying the Innovation Fund delegated regulation and academic literature converge on the conclusion that the carbon price on its own is not expected to trigger sufficient investment in many important breakthrough technologies in industry and energy (e.g. CCS, low-carbon technologies for cement, green hydrogen-based steel making, recycling and circular economy solutions).

Therefore, increased level of support under the Innovation Fund is clearly warranted. It can be done in two ways which can be deployed together and address different needs and specificities:

- *a direct increase of the maximum funding rate,*

By increasing the funding rate, the relative and absolute size of the funds that have to be provided by the project sponsor is reduced, thus the financial viability of the project and its bankability are improved. A higher funding rate would allow upscaling technologies that have already reduced their technology risks (thanks to early demonstration) by addressing the remaining market failure, stemming for revenue risk (where the innovative products cannot be fully remunerated on the basis of market prices, as these have not yet internalised the environmental benefits of clean solutions).

- *a complementary mechanism, such as Carbon Contract for Difference (CCFD)*

Such instruments can be based on competitive tendering, and take into account the CO_2 price when determining the actual support, thereby minimising the required amount of funding and optimising the use of the available amount of allowances. This would allow upscaling technologies that have already reduced their technology risks (thanks to early demonstration) by addressing the remaining market failure, stemming for revenue risk

[34] https://ec.europa.eu/clima/sites/clima/files/innovation-fund/swd_2019_85_en.pdf

(where the innovative products cannot be fully remunerated on the basis of market prices, as these have not yet internalised the environmental benefits of clean solutions).

41 CARBON CONTRACT FOR DIFFERENCE

In the context of the Green Deal, several policy documents have highlighted the importance of innovation in carbon/energy intensive sectors, including envisaging dedicated policy initiatives:

- **Green Deal Communication** (annex) : "*initiatives to stimulate lead markets for climate neutral and circular products in energy intensive industrial sectors (from 2020)*"
- **A new Industrial strategy for Europe**: "*the European Green Deal sets the objective of creating new markets for climate neutral and circular products, such as steel, cement and basic chemicals. To lead this change, Europe needs novel industrial processes and more clean technologies to reduce costs and improve market readiness"*
- **Hydrogen strategy**: "*Develop a pilot scheme – preferably at EU level – for a Carbon Contracts for Difference programme, in particular to support the production of low carbon and circular steel, and basic chemicals*.'
- **European Council conclusions (Dec 2020)**: '*The Commission is invited to consider (...) proposing measures that enable energy-intensive industries to **develop and deploy** innovative climate-neutral technologies while maintaining their industrial competitiveness'*

In the coming years, it can be expected that the Innovation Fund will finance a considerable number of first-of-a-kind demonstration projects, which will enhance the market-readiness of break-through technologies in a range of sectors. This is clearly demonstrated by the success of the first call.

The ETS revision is therefore an opportunity to widen the portfolio of financing instruments. Notably, Carbon Contracts for Difference (CCFD) could be developed as a complementary instrument (next to the existing grant and loan instruments) within the Innovation Fund. Such a new window is well suited for commercial second, or third of a kind projects, to be deployed in the second half of this decade. The operational modalities of this instrument can be further developed later in implementing legislation.

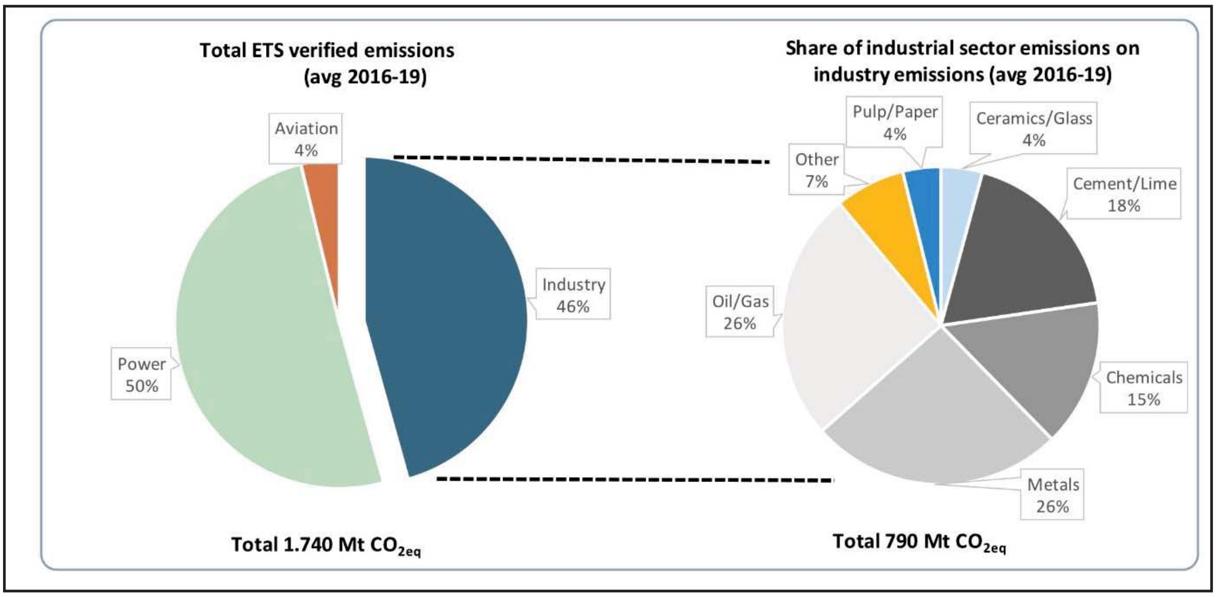
In principle, CCfDs could be applied to the entire range of sectors and technologies that are covered by the Innovation Fund, and broader or more focused approach can be taken, focusing on maximum added value. For instance, a pilot CCFD could focus on a technological pathway bringing GHG reductions across multiple sectors such as for example the production of green hydrogen. In order to ensure that only innovative technologies enabling deep decarbonisation are funded (not for instance incremental investments), all projects should comply with a certain emission performance.

41.1 **Problem definition and rationale**

41.1.1 GHG emissions of energy-intensive sectors

Decarbonising basic materials is crucial to achieving the goal of climate neutrality by 2050. In Europe, their production accounts for 18% of total GHG emissions (around 750 Mt CO_2-eq a year) and have kept relatively stable over the last years. The bulk of these emissions come from just a few multi-purpose products (mainly cement, iron&steel) and few chemical feedstocks (such as ethylene, propylene, hydrogen, methanol).

Figure 94: Share of specific sectors of total ETS emissions – EU-28 (based on the average emissions over the period 2016-19)



41.2 **Why additional policy instruments for early deployment?**

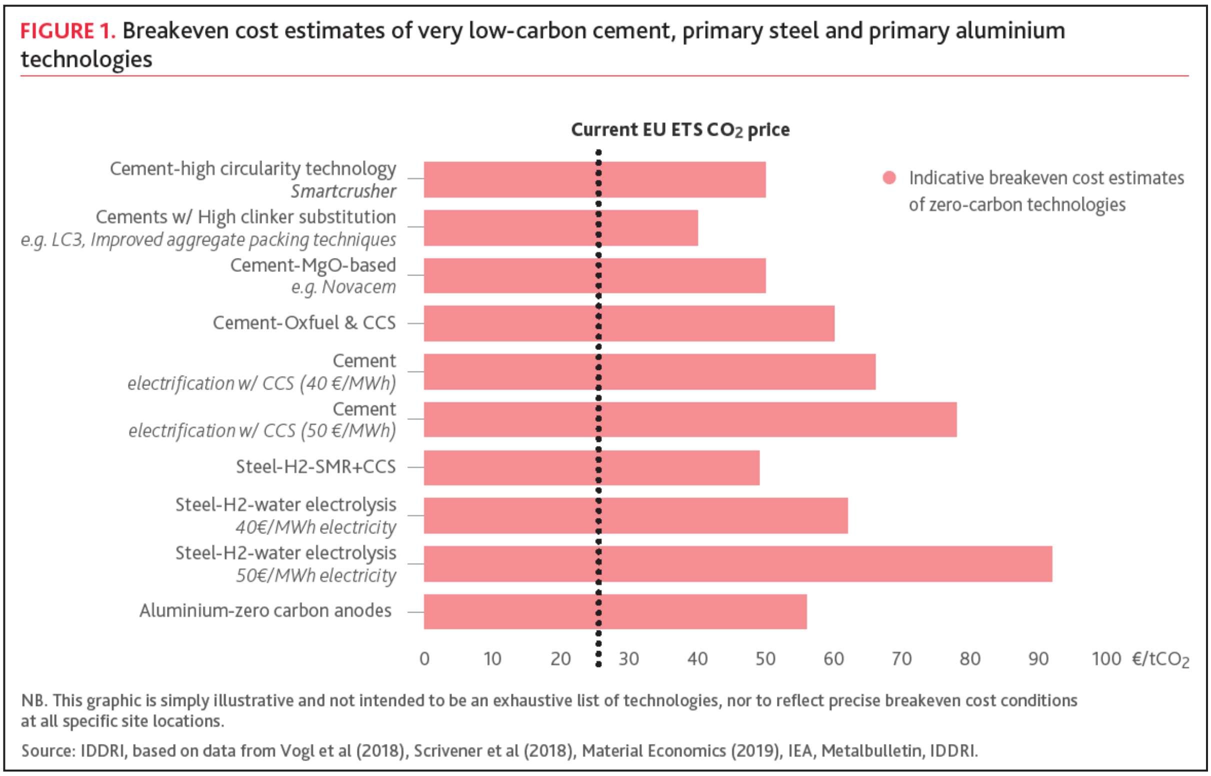
Achieving ambitious emissions reductions targets for 2030 and 2050 will necessarily entail addressing the emissions from basic materials. As 2050 is basically one investment cycle away, major investments in energy intensive industry will still be operational in 2050. It is therefore important to kick-start deployment of such solutions sooner rather than later.

In recent years, limited GHG emissions reductions in the production of basic materials have been achieved, mainly by implementing incremental improvements of the efficiency of production processes and/ or fuel switch.

Nevertheless, a substantial number of industrial break-through technologies have been identified and researched, see e.g. 'Industrial Transformation 2050, Pathways to Net-Zero Emissions from EU Heavy Industry'[35]. However, very few technologies have been scaled beyond the pilot phase.

The prime reason is that current abatement costs for most technologies are today substantially above current ETS prices. The figures below gives break-even cost estimates of low carbon cement, primary steel, primary aluminium, green hydrogen, and basic chemicals. These estimates include increases arising from both investment (CAPEX) and operational costs (OPEX) as compared to conventional production techniques.

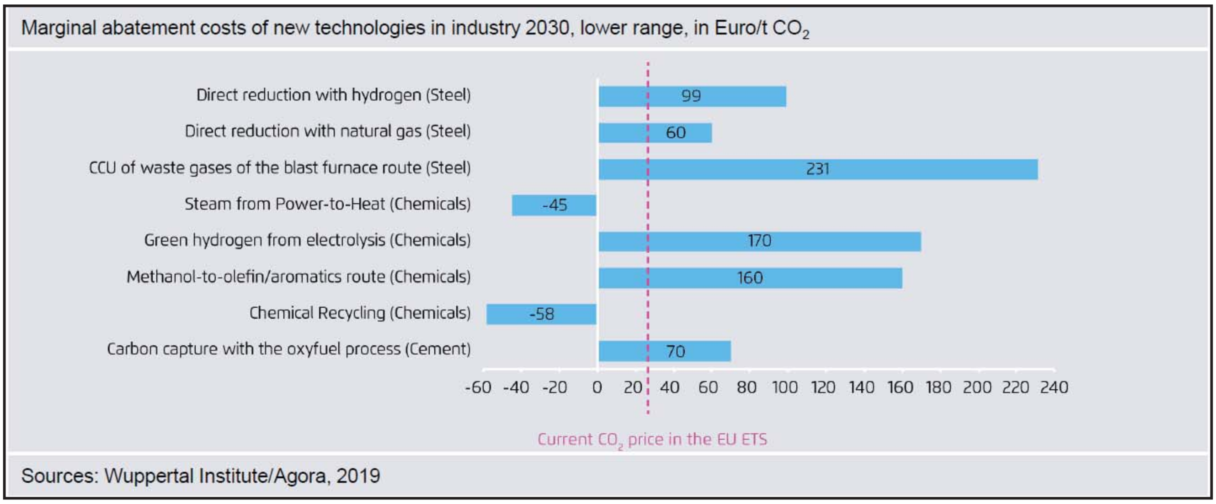
Figure 95: Breakeven cost estimates



[35] Material Economics et al, 2019

Considering the lack of experience with large-scale applications, there remains a substantial uncertainty on such estimates, and certainly the first investments may face even higher abatement costs. The policy experience with renewable energy has shown that policy induced market deployment and learning by doing can be a powerful tool for cost reduction, although such effects cannot always be transferred from one sector to another on a one-to-one basis.

Figure 96: Marginal abatement costs of new technologies



While the ETS provides an incentive to reduce GHG emissions in those sectors, and this incentive is expected to increase over time (including through a revised ETS in accordance with a strengthened 55% overall target), the uncertainty over sustained increased CO_2 prices over longer periods also implies that the commercial viability is uncertain. As a result the bankability (willingness by third parties to finance such projects) is expected to remain low (too high commercial risk) and investments may not materialize.

In conclusion, achieving deep decarbonisation by 2050 will require the first industrial scale alternatives to be deployed during the coming decade. Complementary policies to the ETS, to create lead markets for low carbon materials, seem justified because of,

(1) the current high abatement costs of these technologies compared to the CO_2 price,

(2) uncertainty as regards CO_2 price developments over the next decade(s) (and associated investment and financing risks) and

(3) the need to first lower costs through learning by doing, industrialization and economies of scale.

41.3 Carbon Contracts for difference (CCfD's)

CCfDs are a policy instrument which can be used to develop lead markets for basic materials and hydrogen by creating contracts for difference on the CO_2 price. Such a long-term contract with a public counterpart functions in a similar way as current tendering systems for renewable power, but instead of paying the difference between the electricity strike price and the electricity market price, the public authority would pay the difference between the CO_2 strike price and the actual CO_2 price in the ETS.

The CCfDs are suited for 2nd or 3rd of a kind projects, making them ready for the market in analogy to the support for renewables to make them market competitive and would allow upscaling technologies that have already reduced their technology risks (thanks to early demonstration) by addressing the remaining market failure, stemming for revenue risk (where the innovative products cannot be fully remunerated on the basis of market prices, as these have not yet internalised the environmental benefits of clean solutions).

It bridges in an explicit way the gap in costs (linked to the GHG abatement cost of the technology) between conventional and low carbon alternative technologies in a technology neutral way[36]. A CCfD is therefore compensating the investor for both additional CAPEX and OPEX, covering the entire cost difference between a low carbon product and a conventional product.

Specific advantages of CCfD's are:

- Builds on the ETS, but guaranteeing an investable carbon price to spur early deployment
- Can be allocated through cost-effective, competitive and (if preferred) technology neutral tendering processes whereby different projects submit a bid reflecting the strike price they need to make their technology competitive
- Reduces regulatory risk for investor,
- Enhances bankability, reduces financing cost (lower interest rate for financing)

In terms of implementation, CCfDs involve a contract between a public entity (e.g. national government, European institution) and a producer of basic materials. The contract needs to specify a "strike price" in terms of €/t CO_2-eq and a period of duration to be specified in the tender specifications. In each year over that period, the public entity would pay the producer the difference between the strike price and the realized average allowance price for every ton of avoided CO_2-eq, in accordance with following formula:

Yearly support = (strike price- av. ETS price)*(ETS benchmark - actual em.) * annual production

For instance (see Figure 91), with a strike price of 100 €/t CO_2-eq and an average allowance price of 50 €/t CO_2-eq over a particular year, the producer would be able to sell the surplus allocated allowances that it no longer needs for 50€/t CO_2-eq and receives an additional 50 €/t avoided CO_2-eq from the public entity. The amount of CO_2-eq avoided each year is calculated as the difference between the amount of GHG emissions in accordance with the relevant ETS benchmark and the actual emissions, multiplied by the annual production. This support is paid during a number of years agreed in advance.

Figure 97: Illustration of the policy mechanism of the Carbon Contract for Difference

Illustration of the policy mechanism of the Carbon Contract for Difference

Source: Agora Energiewende, 2019

Annex 12 Modernisation Fund

42 Overall context

The Modernisation Fund (MF) is a dedicated funding programme to support 10 lower-income EU MS (BG, HR, CZ, EE, HU, LV, LT, PL, RO and SK) in their transition to climate neutrality by helping to modernise their energy systems and improve energy efficiency.

The size of the Fund, its beneficiaries and the sharing of allowances among them and the types of investment that it can finance are regulated in the ETS Directive.

The table below shows the size of the Modernisation Fund in terms of allowances.

Table 70: Size and distribution of the Modernisation Fund in terms of allowances

Member State	Share (Annex IIb)	Allowances (Article 10(1))	Transfers (Article 10(2)(b)& 10c)	Total	Annual amounts
Bulgaria	5,84%	16.095.825	0	16.095.825	1.609.583
Czechia	15,59%	42.968.135	150.184.557	193.152.692	19.315.269
Estonia	2,78%	7.662.054	0	7.662.054	766.205
Croatia	3,14%	8.654.262	5.978.852	14.633.114	1.463.311
Latvia	1,44%	3.968.834	0	3.968.834	396.883
Lithuania	2,57%	7.083.265	8.696.818	15.780.083	1.578.008
Hungary	7,12%	19.623.677	0	19.623.677	1.962.368
Poland	43,41%	119.643.793	0	119.643.793	11.964.379
Romania	11,98%	33.018.490	167.747.579	200.766.069	20.076.607
Slovakia	6,13%	16.895.104	35.011.645	51.906.749	5.190.675
Total	**100,00%**	**275.613.439**	**367.619.451**	**643.232.890**	**64.323.289**

The biggest four beneficiaries (RO, CZ, PL and SK) hold around 87% of the Fund. Half the beneficiary MS decided to transfer additional allowances to the MF, demonstrating their preference for this instrument compared to solidarity or Article 10c derogation.

The table below shows the monetary size of the current Modernisation Fund with different carbon prices and rounded to million EUR. For the period 2021-2030, it pools together a very significant monetary volume ranging from some 19,3 billion EUR with a 30 EUR carbon price to some 25,73 billion EUR with a 40 EUR carbon price. These amounts are significantly above the expectations when the MF was agreed in 2017.

Table 71: Size and distribution of the Modernisation Fund in monetary terms

Member State	Total 2021-2030	With 30 EUR CO2 price (mio EUR)	With 35 EUR CO2 price (mio EUR)	With 40 EUR CO2 price (mio EUR)
Bulgaria	16.095.825	483mio €	563 mio €	644 mio €
Czechia	193.152.692	5.795 mio €	6.760 mio €	7.726 mio €
Estonia	7.662.054	230 mio €	268 mio €	306 mio €
Croatia	14.633.114	439 mio €	512 mio €	585 mio €
Latvia	3.968.834	119 mio €	139 mio €	159 mio €
Lithuania	15.780.083	473 mio €	552 mio €	631 mio €
Hungary	19.623.677	589 mio €	687 mio €	785 mio €
Poland	119.643.793	3.589 mio €	4.188 mio €	4.786 mio €
Romania	200.766.069	6.023 mio €	7.027 mio €	8.031 mio €
Slovakia	51.906.749	1.557 mio €	1.817 mio €	2.076 mio €
Total	**643.232.890**	**19.297 mio €**	**22.513 mio €**	**25.729 mio €**

43 INVESTMENTS TO BE SUPPORTED

A clear majority of respondents to the OPC (74%) supported the streamlining of the Modernisation Fund and the enhancement of its coherence with the Green Deal. About one third of respondents each were in favour to restrict financing to non-fossil fuel based heating and cooling systems (33%) and to remove the exception for financing coal-fired district heating in certain MS (32%). Less respondents favoured that the fund should only finance priority projects to simplify the administration (8%).

43.1 Priority investments

As priority investments defined in Article 10d(2) of the ETS Directive, the Modernisation Fund supports investments in:

- Generation and use of energy from renewable sources
- Energy efficiency
- Energy storage
- Modernisation of energy networks, including district heating, pipelines and grids
- Just transition in carbon-dependent regions: redeployment, re-skilling and upskilling of workers, education, job-seeking initiatives and start-ups

At least 70% of the resources of the MF have to be spent on such priority investments. In the territories covered by a Territorial Just Transition Plan, the just transition investments supported by the Modernisation Fund need to be consistent with these plans designed by beneficiary MS and they have a narrower scope compared to Just Transition Fund as they focus only on the human dimension. So far no beneficiary MS has indicated interest in financing such investments from the Modernisation Fund.

Some examples of priority investments were included in an assessment guidance document developed by the EIB and published[37].

43.2 Non-Priority investments

The ETS Directive sets strong limits for solid fossil fuel investments - no support from the Modernisation Fund shall be provided to energy generation facilities that use solid fossil fuels, other than efficient and sustainable district heating in Bulgaria and Romania. It also defines the priority investments as explained above.

There is a 'grey zone' of investments eligible for MF, but are not priority, and these are considered non-priority investments. Such projects could be for instance investments in gas power plants, natural gas infrastructure, industrial gas-fired electricity generators, nuclear power generation projects. The contribution of such investments to the aims of the Modernisation Fund and their potential to reduce emissions needs to be clearly proven, and they are subject to a more complex governance. The main difference with priority investments is that for non-priority investments the EIB conducts a detailed technical and financial due diligence assessment to establish its financial viability and added value to decarbonisation, based on which the Investment Committee assesses the proposal and makes its recommendation on its financing. Therefore, the category of non-priority investments poses some implementation difficulties and administrative burden (different submission and reporting requirements, more detailed assessment, different deadlines etc.)

44 GOVERNANCE

The governance of the Modernisation Fund is adapted to the nature of the investments, whereby MS are in the driving seat.

The **Beneficiary MS** are responsible for selecting and submitting investment proposals for Modernisation Fund support, paying off the support to the project proponents or scheme managing authority(ies) upon the disbursement decision of the Commission, participating in the Investment Committee, monitoring and submitting annual reports on the implementation of the Modernisation Fund investments, auditing the project proponents or scheme managing authorities and taking appropriate measures to ensure

[37] https://modernisationfund.eu/documents/

that the financial interests of the Modernisation Fund are protected, including recovery actions.

The **Investment Committee** is the main governing body of the Modernisation Fund. It is chaired by the Commission, and composed of the EIB (which also acts as its secretariat), 10 beneficiary MS, 3 non-beneficiaries (NL, DE, SE were elected for the first five year period). It is indispensable for endorsing non-priority investments, and is the main forum to discuss any matter pertinent to the Modernisation Fund.

The **EIB** plays a significant role in the implementation of the Modernisation Fund and is responsible for, auctioning the allowances which provide the resources of the Modernisation Fund in accordance with the Auctioning Regulation, confirming whether an investment is a priority or a non-priority one, conducting financial and technical due diligence of non-priority investments, including an assessment of the expected emission reductions, managing the assets of the Modernisation Fund, transferring the respective resources to the beneficiary MS following the disbursement decision of the Commission, and keeping track of the use of MS resources and providing the secretariat of the Investment Committee.

The **European Commission** is responsible for ensuring State aid control over the Modernisation Fund investments, taking the disbursement decision once an investment has been confirmed by the EIB or recommended for financing by the Investment Committee, chairing the Investment Committee and ensuring compliance with the ETS Directive and the implementing act on the Modernisation Fund.

Overall, the governance structure is efficient and simple for priority investments, and significantly more complex and time consuming for non-priority ones.

Annex 13: Auctioning revenues and distributional issues between Member States

45 Overview of possible ETS revenues

The level of ETS revenues varies across the policy options and its total size is determined by both the volume of allowances for auctioning and the allowance price. The below table provides for different policy options an estimate of possible yearly (average) revenues in billion EUR[38] including regular auctioning regardless for which purpose (distribution to MS, solidarity/redistribution, EU own resources) and excludes the allowances set aside in the existing ETS for both Modernisation and Innovation Funds (i.e. Modernisation Fund of 2% of the cap, and Innovation Fund of 450 million allowances, IF0). It does not prejudge potential increases in the use of funds (Innovation and Modernisation Funds, including potential contribution of the new ETS).

For the existing ETS, Table 62 presents estimates for the combination of the four different ETS cap ambition options (AMB1, 2a, 2b, 3) retained for interaction analysis with other options, with different options on the design of the Market Stability Reserve (MSR0+, MSR1, 2). For maritime transport, the focus is on the options covering an ETS extension to maritime considering the three possible geographical scopes (MINTRA, MEXTRA50 and MEXTRA100 for EU 27). For the possible extension to other sectors, results for both scope options (EXT1 and EXT2) are presented.

Future ETS carbon prices are by design uncertain. The carbon price assumptions (expressed in €2020) used are consistent with the central carbon price assumptions for periods described in Section 5.2.1, using a carbon price of EUR 45 for the period 2021-2025 and EUR 55 for the period 2026-30. In that section, also the underpinning ranges of scenario results and related uncertainties are described.

The figures below provide for the assumed carbon prices the **maximum** auction revenues under each option as determined by the following auction shares assumed: 57% for existing ETS[39], 100% for maritime transport and for buildings and transport, and up to 100% for all fossil fuel combustion. In the latter scope, a certain amount of allowances would need to be used for free allocation or other forms of compensation to protect small industry in a similar way against the risk of carbon leakage. For reasons of simplicity and avoidance of prejudgement of political choices, revenues estimated in Table 62, do not

[38] A range is provided where options are grouped, e.g. MSR1 to MSR3 in existing ETS cap options.

[39] The 3% free allocation buffer, sourced from the auction share, is considered to be used for free allocation, which is in line with the analysis on the risk of triggering the cross sectoral correction factor.

consider any split of the total revenues in MS between regular auctions, own resources, Innovation Fund use or solidarity mechanisms including the Modernisation Fund.

Table 72: Estimates of ETS auction revenues available for MS regular auctions, Own Resources and MS solidarity/redistribution per ETS sector (in bn EUR)

Option	**Sector**	**Annual average 2021-2025**	**Annual average 2026-2030**
Existing ETS – stationary[40,41]			
AMB1 +MSR0-2, IF0	Power and industry	[20 - 22]	[14 - 19]
AMB2a +MSR0-2, IF0	Power and industry	[19 - 21]	[14 - 21]
AMB2b +MSR0-2, IF0	Power and industry	[18 - 20]	[16 - 22]
AMB3 +MSR0-2, IF0	Power and industry	[20 - 22]	[16 - 20]
Maritime transport extension[42]			
MAR1, MAR4	Maritime	[0.4 – 1.4]	[1.5 – 4.9]
Extension to buildings and transport or all fossil fuel combustion			
EXT1, IF0	Buildings, transport		[47]
EXT2, IF0	Buildings, transport, other fossil fuel CO2		[up to 57]

The following sections illustrate distributional impacts on MS of the ETS revision and current solidarity/redistribution provisions which use a part of ETS revenues to address such impacts, first for the existing ETS in a strengthening context and then illustrating them in the context of the new ETS. The final section provides an overview of aviation and maritime specific aspects.

[40] The range of estimates is consistent with the MSR modelling exercise for the combination of AMB options with MSR options 0+ to 2 and with analysing the AMB options combined with MSR0+ based on PRIMES MIX modelling results.

[41] Aviation which is also part of the existing ETS is subject to a specific Impact Assessment where options on the sector cap reference and its split between auctioning and free allocation are assessed and auction revenue estimates are presented in a consistent way with this impact assessment.

[42] Assuming a phase-in approach in the period 2023-2025. Options MAR2 and MAR3 with maritime specific ETS or levy are projected to lead to significantly higher carbon prices and therefore significantly higher revenues, i.e. around EUR 6.5 bn of annual average revenues in the period 2026-2030 for MINTRA scope.

46 MEMBER STATE DISTRIBUTIONAL IMPACTS OF STRENGTHENING THE EXISTING ETS

While 90% of auctioning revenues are distributed between MS based on the established auction key, the ETS Directive for the period 2021-30 prolongs the solidarity provision consisting of the redistribution of 10% of the auctioned allowances to 16 low-income MS[43] and introduced the Modernisation Fund for those countries with GDP per capita below 60% of EU average (2013 reference)[44]. While these do not apply to exactly the same countries, it can be estimated that the overall solidarity provisions to low income MS amount to around 7% of the current cap or almost 1 billion allowances (over the 2021-30 period).

Currently, all auction revenues under the solidarity provision and at least 50% of total auctioning revenues distributed to MS should be used for targeted climate purposes. These include measures to provide financial support in order to address social aspects in lower- and middle-income households and measures to promote skill formation and reallocation of labour in order to contribute to a just transition to a low carbon economy, in particular in regions most affected by the transition of jobs, in close coordination with the social partners.

The importance of the Modernisation Fund in addressing distributional concerns was also highlighted by the European Council conclusions of 11 December 2020.

The Modernisation Fund is currently financed with 2% of total allowances (calculated on the basis of the ETS cap). Each beneficiary MS can also decide to top up its own share of the MF with allowances under Article 10c (derogation for free allocation to power generation) and Article 10(2)(b) (solidarity allowances). The top up by MS who have chosen to do so (CZ, HR, LT, RO, SK) amount to 367 million allowances compared to the 275 million allowances initial size of the Fund (see also Annex 12). This indicates that several MS are in favour of streamlining the support instruments available.

In the following we illustrate the MS impacts of the current legislation**:** Solidarity provisions are kept at a proportion of about 7% of the revised ETS cap, (Modernisation Fund of 2% of the cap and solidarity redistribution of 10% of auctioned allowances).

[43] Eligible MSs: BG; CZ; EE; EL; ES; HR; LT; CY; LV; HU; MT; PL; PT; RO; SI; SK
[44] Eligible MSs: BG; CZ; EE; HR; LT; LV; HU; PL; RO; SK

Given that so far beneficiary MS have shown trust in the Modernisation Fund by transferring additional allowances to it, and bearing in mind the benefits of avoiding a multiplication of support systems, an increase of the size of the Modernisation Fund could be one option to consider. This could be accompanied by a simplification of its governance structure by focusing only on priority investments.

Table 63 compares MS' projected ETS emissions under the REF scenario (with current ETS policy framework) with the MIX scenario (with -55% overall ambition level). The results show that in the scenarios with increased ambition, MS emissions are generally lower than in the reference scenario. This is valid for the 2021-30 period but also for each of the 5 year periods 2021-25 and 2026-30. Table 61 provides the overview of the MS' emission profile for the period 2013-19 (measured as the change of verified emissions (VE) between 2013 and 2019) and their projected changes of emissions for the period 2021-30 under different model scenarios. Comprehensive MS scenario data is presented in the separately published technical note[45].

[45] See the "Technical Note on the Results of the "Fit for 55" core scenarios for the EU Member States".

Table 73: Verified emissions ("VE") 2013 to 2019, projected emissions 2020 to 2030 and projected differences in emissions between the REF scenario (with current ETS policy framework) and the MIX scenario per Member State– scope is power and industry.

				REF to MIX		
	VE change from 13 to 19	REF [2020-2030]	MIX [2020-2030]	2021-30	2021-25	2026-30
EU27	**-16%**	**-18%**	**-37%**	**-12%**	**-6%**	**-19%**
AT	-1%	-28%	-40%	-8%	-4%	-13%
BE	-1%	23%	19%	-3%	-2%	-4%
BG	-11%	-20%	-44%	-16%	-7%	-25%
CY	11%	-25%	-35%	-6%	-3%	-10%
CZ	-8%	-40%	-49%	-8%	-4%	-13%
DE	-25%	-15%	-36%	-14%	-7%	-21%
DK	-44%	-23%	-30%	-3%	-1%	-6%
EE	-47%	1%	-49%	-34%	-23%	-46%
EL	-31%	-39%	-35%	1%	-1%	3%
ES	-11%	-25%	-36%	-16%	-12%	-20%
FI	-26%	-29%	-49%	-9%	-3%	-17%
FR	-18%	-27%	-41%	-9%	-4%	-15%
HR	-14%	-30%	-42%	-10%	-6%	-16%
HU	2%	-22%	-29%	-3%	-1%	-5%
IE	-10%	-26%	-36%	-5%	-2%	-9%
IT	-14%	-15%	-45%	-11%	-1%	-22%
LT	-22%	-9%	-6%	-2%	-3%	0%
LU	-19%	-16%	-28%	-5%	-1%	-9%
LV	-6%	1%	-7%	8%	12%	4%
MT	-56%	-1%	-6%	8%	10%	5%
NL	-4%	-36%	-42%	-11%	-9%	-14%
PL	-11%	-2%	-36%	-17%	-8%	-27%
PT	-12%	-47%	-54%	-6%	-3%	-10%
RO	-14%	-11%	-40%	-21%	-13%	-30%
SE	-7%	-12%	-30%	-9%	-4%	-15%
SI	-15%	13%	-9%	-12%	-6%	-17%
SK	-9%	-25%	-40%	-9%	-3%	-15%

Legend: Negative values (red bar) indicate projected emissions decrease compared to reference, positive values (blue bar) indicate projected emissions increase compared to reference - first two columns compare 2030 to 2020 under each scenario; following columns compare REF to MIX where negative values (red bar) indicate MIX scenario emissions are X% lower than REF for the same period; positive values (blue bar) indicate MIX scenario emissions are X% higher than REF for the same period; MS highlighted are low income MS[46].

To account for differential impacts, since 2013 under the ETS some of its revenues have been redistributed to the lower income MS. The remainder of this section illustrates how the 16 MS that are currently beneficiaries of any such redistribution will be impacted by the different strengthening options.

The strengthening options impact the ETS cap by reducing the overall volume of allowances, which has an impact on the amount of allowances available for redistribution. Within the ETS framework the elements used for redistribution are in general set in relative terms to the cap, e.g. 10% redistribution of the auction revenues or the 2% of the total cap for the Modernisation Fund.

For the full impact on distribution of revenues between MS one has to look at all the elements that generate revenues, i.e. the redistribution elements and the regular auctioning share (currently 90% of the auctioned amount). Applying the current re-distributional elements results in an overall impact for the 16 MS mainly concerned that is proportionate to the reduction of the cap, i.e. those MS all get a relative reduction of their revenues.

The impact per MS thus depends on the allocation of auction revenue, and on how the solidarity elements are defined, such as the size of Modernisation Fund, and the size and eligibility of the "10% redistribution" solidarity[47]. Table 64 shows the results of applying current solidarity framework for different ambition options with the resulting MF size for the period from when the cap is updated. The ambition options are defined as AMB1: 6.24% LRF from 2026 without rebasing; AMB2a: 5,09% LRF from 2024 without rebasing; AMB2b: 3,90% LRF from 2024 with 163 million rebase; AMB2c: 4,22% LRF from 2024 with 119 million rebase; AMB3c: 4,57% LRF from 2026 with 163 million rebase. Because all solidarity provisions are defined as a share of the cap (e.g. MF is 2% of the cap) the relative difference at MS level between the solidarity allowances of different ambition options to the existing framework is equal to the difference of the total

[46] Low income MS defined as currently defined for Modernisation Fund eligibility (GDP per capita at market prices below 60 % of the Union average in 2013

[47] One additional solidarity element to consider is the share by which MS contribute to the Market Stability Reserve intake, i.e. until 2025, the "10% solidarity" share is not accounted to determine the MS contribution to the MSR intake.

cap (provided the same solidarity framework is used). The relative difference to existing framework/cap is referenced in each ambition option in square brackets.

Under the increased ambition scenarios, as the cap reduces and both solidarity elements are defined in proportion to the cap, the solidarity allocations reduce. Their value however could increase with the projected increase in carbon prices.

Table 74: Existing ETS total solidarity allowances, in million allowances (including 10% redistribution and Modernisation Fund), and changes under the different ETS strengthening options[48] –for period 2021-30

	Existing framework	AMB1 [-8,7%]	AMB2a [-12%]	AMB2b [-15%]	AMB2c [-14%]	AMB3c [-11%]
BG*	77	-9	-12	-11	-9	-9
CZ*	121	-14	-18	-17	-14	-13
EE*	24	-3	-4	-3	-3	-3
EL	36	-4	-5	-5	-4	-4
ES	70	-8	-11	-10	-8	-8
HR*	16	-2	-2	-2	-2	-2
CY	3	0	0	0	0	0
LV*	9	-1	-1	-1	-1	-1
LT*	16	-2	-2	-2	-2	-2
HU*	42	-5	-6	-6	-5	-5
MT	1	0	0	0	0	0
PL*	358	-41	-54	-51	-41	-40
PT	17	-2	-3	-2	-2	-2
RO*	142	-16	-21	-20	-16	-16
SI	5	-1	-1	-1	-1	-1
SK*	48	-5	-7	-7	-5	-5
Total solidarity	985	871	836	845	871	876
MF size for 2021-30	276	244	234	237	244	245
MF share	2%	2%	2%	2%	2%	2%

[48] Indicative figures before MSR application and applying the solidarity eligibility criteria in ETS current framework

47 Member State distributional impacts of a new ETS for buildings and road transport or all fossil fuels

The new ETS for buildings and transport will generate substantial auction revenues. Different uses are possible, including contributions to own resources, to the Innovation Fund as indicated in options IF1 and IF2, to the Modernisation Fund, to address social impacts, as well for a specific solidarity element in the distribution of auctioning revenues to MS. Any such use of revenues from the new ETS for solidarity purposes should be seen in the context of the specific impacts on citizens that the extension of ETS to new sectors (notably road transport and buildings) could bring about.

For any auctioning revenues that would accrue to MS, the questions of the distribution key is highly relevant, especially if one were to strengthen the link with enabling MS to address social impacts of carbon prices.

As it has been done for the existing ETS so far, a combination of a general element based on historical emissions and a specific solidarity element appears a reasonable starting point. Such a solidarity element for the new ETS could also be complemented and partly replaced by other instruments, e.g. due to the overlapping scope between instruments to address social impacts and instruments to address MS distributional issues.

Recent historical emissions could serve as proxy for different economic structures and different efficiencies of the capital stock of the sectors concerned. In the context of the new ETS, recent (2016-2018) MS shares of emissions in sectors covered under the new ETS could be used as basis for – or starting point for further considerations on – the general element of the distribution key for MS revenues. This data has been reported for the UNFCCC inventory and comprehensively reviewed as part of the implementation of the Effort Sharing Regulation. It has been used to define the starting point of the national ESR reduction trajectories defining current 2030 ambition related to the sectors covered by the new ETS.

If auctioning revenues were distributed to MS, it could also be considered that a certain share of the revenue in the new ETS would be earmarked for use for specific purposes such as those outlined in Table 4 in Section 5.2.5.

For the solidarity elements specific for the new ETS, the needs mentioned in Table 4 like the risk of energy poverty, the availability of finance for renovations and the availability of transport alternatives e.g. in rural areas would need to be reflected, in line with a just transition and the principle that no one is left behind. With no robust or agreed data to represent vulnerable groups directly, different ways to include GDP as indicator for a MS' capacity to address these appears to be a reasonable proxy for considerations on the solidarity element of the key.

The PRIMES modelling gives an indication of how additional emission reductions for reaching a total of -55% reductions by 2030 compared to 1990 in the relevant new ETS sectors differ between MS in different scenarios with carbon pricing. Table 65 illustrates this for EXT1.

Table 75: Additional reduction in percentage points between 2025 and 2030 in the transport and buildings sector together, per Member State, compared to the Reference scenario

	Reference	MIX (percentage points compared to Reference)
EU	-15%	-9%
AT	-9%	-5%
BE	-13%	-14%
BG	-4%	-5%
HR	-1%	-8%
CY	-14%	-10%
CZ	-10%	-6%
DK	-8%	-4%
EE	-4%	-5%
FI	-22%	-7%
FR	-18%	-11%
DE	-16%	-12%
EL	-16%	-9%
HU	-9%	-11%
IE	-26%	-2%
IT	-19%	-8%
LV	-13%	-4%
LT	-15%	-5%
LU	-19%	-8%
MT	-3%	-5%
NL	-11%	-4%
PL	-12%	-13%
PT	-17%	-4%
RO	-2%	-7%
SK	-2%	-6%
SI	-13%	-7%
ES	-17%	-5%
SE	-17%	-7%

If a new ETS is created for the road transport and/or buildings sector (EXT1), there ought to be full auctioning of allowances (see Section 5.2.4.3 and Annex 5). For option EXT2 auctioning would be by far the dominating allocation method with some free allocation likely to be needed.

By definition, no solidarity and support mechanisms exist today as it is a new system. This Impact Assessment illustrates the impacts if ETS revenues would be used in a similar manner to how revenues are used under the existing ETS. Nevertheless, the potential new sectors have very different characteristics from those in the existing ETS, and the policy choices to address potential impacts of extending the ETS to these sectors will have to take account of a broader set of considerations than the use of revenues generated by the ETS. In particular:

For the road transport sector, there may be less of a need for specific solidarity mechanisms, to the extent that higher-income citizens are likely to drive larger and less fuel efficient cars, and lower income citizens in cities are more likely to use public transport. However, this might not be universally valid, as higher income groups might find it easier to switch to electric vehicles, and some lower income groups live in areas with limited alternatives to the use of (older) cars. This suggests the need for a package of measures that offers citizens an alternative to shouldering the carbon price, for instance in the form of a competitive supply of zero carbon vehicles, access to finance, and adequate infrastructure.

For the buildings sector, the availability of finance for renovations is an issue, and especially the risk of energy poor and low income households who often live in worst performing buildings. ETS revenues can contribute to finance such investments and address energy poverty, notably in the context of the transition to a low carbon economy, although this is an issue which requires broader policies at both the Union and MS level.

Bearing in mind these considerations, the remainder of the analysis here will focus on how the revenues from the extension of the ETS could be distributed if an approach analogous to that of the existing ETS were to be adopted. The following considerations focus on option EXT1, but considerations for EXT2 are similar as the additional amount of emissions added is small.

As the new ETS will in particular impact on vulnerable groups, which exist in all MS but often with higher shares in lower income MS, it will be important how the auctioning distribution and in particular the solidarity provisions address this. With no robust data to represent vulnerable groups directly, such as energy poverty, a GDP/capita related element in the distribution of auction revenues could provide a reasonable proxy. How the MS distribute the revenues to vulnerable groups and apply national policies is crucial for succeeding in a fair and just effect of decarbonisation policies in general, and carbon pricing policies in particular.

Concerning road transport, lower income MS could see a continued faster increase in transport demand, as well as a car fleet more based on second hand cars, and therefore encounter greater difficulties in abating emissions from this sector. Higher income MS, instead, would likely see a faster electrification as well as less growth in transport demand. In the buildings sector, many aspects play a role in the impact, including the heating fuel mix, building types, the use of district heating and combined heat and power and the national policy mix in the Reference. Given the importance of access to finance for buildings investments, this will be a greater challenge for lower income MS.

Table 66 illustrates what the application of current instruments to use ETS revenues to address distributional purposes could mean for the new ETS combines a general element based on recent historical emissions, a 10% solidarity element based on GDP per capita, as in the existing ETS and a 2% contribution to the Modernisation Fund.

If 10% were to be distributed on the basis of a key with a strong GDP/capita element[49] to certain MS to address solidarity as it is in the methodology for the existing ETS, it would have important benefits for lower income MS, and provide them with additional resources to address potential impacts on vulnerable groups (in particular in relation to heating and cooling of buildings).

The amounts available for distribution could be significant, from the time the new ETS comes into operation. Between 2026 and 2030, total allocations for the buildings and road transport sectors could be around 4.4 Gton of allowances. Using 2% of the cap of the new ETS for a solidarity-based fund (like the Modernisation Fund) could generate some 88 million allowances. Using then 10% of the remainder for distributional purposes as in the existing ETS could imply that, in total, some 518million allowances would be available for solidarity purposes

Table 66 illustrates preliminary results under EXT1 the results of applying the solidarity elements of the first illustration, a 2% Modernisation Fund[50] and a solidarity-based 10% distribution based on the GDP/capita as in the existing ETS methodology for distribution would result in.

[49] Using only the GDP per capita component of the auction key formula of the existing ETS, updated with average 2016-2018 GDP, and applied only to member states with GDP/Capita below 90% of the EU average

[50] Assuming the same recipients and distribution key as in the existing ETS

Table 76: Illustration of applying current ETS solidarity elements to the new ETS for buildings and transport (EXT1)

	Distribution of 10% of auctioning revenues according to methodology based on GDP/Cap	Distribution of 2% of auctioning revenue according to current modernisation fund shares	2% of revenues to increase Modernisation Fund, then apply 10% solidarity share to remainder (EXT1)
EU	438.9	87.8	517.9
AT	0.0	0.0	0.0
BE	0.0	0.0	0.0
BG	23.7	5.2	28.4
HR	14.7	2.8	17.2
CY	0.9	0.0	0.8
CZ	28.8	13.8	42.0
DK	0.0	0.0	0.0
EE	2.7	2.5	5.1
FI	0.0	0.0	0.0
FR	0.0	0.0	0.0
DE	0.0	0.0	0.0
EL	23.9	0.0	23.4
HU	38.8	6.3	44.4
IE	0.0	0.0	0.0
IT	0.0	0.0	0.0
LV	6.0	1.2	7.2
LT	9.4	2.3	11.4
LU	0.0	0.0	0.0
MT	0.1	0.0	0.1
NL	0.0	0.0	0.0
PL	181.9	37.9	216.1
PT	17.5	0.0	17.2
RO	52.0	10.5	61.5
SK	15.2	5.4	20.3
SI	4.7	0.0	4.6
ES	18.8	0.0	18.4
SE	0.0	0.0	0.0

MS results illustrating a general element for a distribution key for auction revenues based on historical emissions similar as in the existing ETS (used in illustrations 1 and 2) are shown below for option EXT1 in the second column of Table 67 below, using for that average 2016-2018 emissions as used under the ESR.

The third column presents the above described solidarity share element of illustration 1 in a comparable way to the general element, i.e. as distribution key to MS, calculated based on a 10% redistribution under EXT1. As the comparison with column 2 indicates, such a key element would clearly favour low income MS.

Table 77: Illustration of applying different currently used distribution keys of allowances for the new ETS (buildings plus transport) across Member States,

	Distribution based on 2016 - 2018 average emissions	**Illustration 1: Solidarity distribution of auctioning revenues according to ETS methodology based on GDP/Cap**	**Illustration 2: ESR distribution 2016-2018 GDP-based ESR ambition based on 40% overall ESR target**
EU	100.0%	100.0%	100.0%
AT	2.5%	0.0%	2.0%
BE	3.9%	0.0%	2.9%
BG	0.8%	5.4%	1.3%
HR	0.7%	3.4%	1.0%
CY	0.2%	0.2%	0.2%
CZ	2.4%	6.6%	3.2%
DK	1.2%	0.0%	1.3%
EE	0.2%	0.6%	0.3%
FI	1.1%	0.0%	1.1%
FR	16.1%	0.0%	13.8%
DE	22.7%	0.0%	16.0%
EL	1.6%	5.4%	3.2%
HU	1.9%	8.8%	2.6%
IE	1.6%	0.0%	1.8%
IT	13.6%	0.0%	12.8%
LV	0.3%	1.4%	0.5%
LT	0.5%	2.1%	0.7%
LU	0.6%	0.0%	0.3%
MT	0.1%	0.0%	0.1%
NL	4.4%	0.0%	4.4%
PL	8.3%	41.4%	10.5%
PT	1.6%	4.0%	2.3%
RO	2.1%	11.9%	4.5%
SK	0.9%	3.5%	1.2%
SI	0.6%	1.1%	0.6%
ES	8.9%	4.3%	10.0%
SE	1.3%	0.0%	1.4%

A second illustration combines a general element based on recent historical emissions (second column), a solidarity element based on Effort Sharing targets for 2030 compared to 2005 applied to the new ETS sectors, and a 2% contribution to the Modernisation Fund (as in Table 66, column 3). The fourth column of Table 67 illustrates therefore a distribution key to MS which would result from a solidarity element as used under the Effort Sharing Regulation, proportional to 2030 ESR allocations[51], as calculated for a 40% reduction target, and which incorporate both historical emissions and a GDP/capita component[52]. As the comparison of column 4 and column 2 indicates, this would in general benefit MS with lower GDP per capita, as they receive lower decreases of 2030 allocations compared to 2005 as higher income MS. If it is distributed according to the ESR 2030 target formula for all MS as illustrated, all MS would receive allocations, unlike with a methodology like in the existing ETS.

It is to be noted that the distributive effect of the solidarity elements under illustrations 1 and 2 in column 3 and 4 cannot be directly compared. Illustration 1 is calculated based on a distribution key similar to the current 10% share ETS distribution. If one were to follow the ESR solidarity rationale used for illustration 2, the key would need to be applied to a significantly higher share of the total allowances to give benefits of similar order of magnitude for the lowest income MS as the key used under illustration 1. Under the existing ESR the 2030 element defines 50% of the target trajectory 2021 to 2030, with the other 50% defined by 2016-18 emissions, the general distribution key element illustrated in the second column.

For the residential sector, energy poverty issues are of special importance to investigate in view of possibly distributional impacts between MS but also household income groups. Below tables give an estimate of simple average rises by MS groups in terms of GDP per capita in total residential sector household expenditures as a percentage of consumption between Reference Scenario and the MIX and MIX-CP policy scenarios with a different role of carbon pricing in the policy mix. The expenditure components related to capital costs for investments and to fuel expenses have been presented in Section 6.3.2 and 6.3.3.

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[51] Assuming for comparability an ESR reduction target of 40% compared to 2005.
[52] Using 2005 emissions and average 2016-18 GDP as in the ESR review impact assessment.

The total expenditure rises presented in Table 68 are estimated for low, medium and high income groups as defined according to PRIMES modelling and provided as an average characterising different groups of MS: those with a GDP/ capita below 60% of the EU average, those with a GDP/ capita between 60% and 100% of the EU average, and those with a GDP/ capita above the EU average. The figures between the groups are not necessarily comparable, as the high, medium and low income groups are defined relative to the average income of a MS. Note that there are therefore uncertainties involved in the aggregation within the groups.

Total expenditures are likely to rise, due to a rise in annual capital costs.

Table 78: Average rise in total household expenditures in the residential sector, as a percentage of consumption per income group, average for Member States of a certain income level, MIX and MIX-CP percentage point difference compared to Reference

Total expenditures vs Reference in 2030		Lower income Households	Medium income Households	Higher income Households	All households
EU	MIX	1.16%	0.51%	0.33%	0.59%
	MIX-CP	0.76%	0.40%	0.31%	0.45%
MS < 60% GDP/capita	MIX	2.14%	0.96%	0.67%	1.09%
	MIX-CP	2.24%	1.03%	0.74%	1.17%
MS between 60-100% GDP/capita	MIX	1.50%	0.52%	0.27%	0.63%
	MIX-CP	0.39%	0.21%	0.17%	0.23%
MS > 100% GDP/capita	MIX	0.85%	0.42%	0.30%	0.48%
	MIX-CP	0.66%	0.36%	0.28%	0.40%

Source: PRIMES

48 Member State distributional impacts of Aviation and maritime ETS

In accordance with Article 3d(3) of the ETS Directive, the revenue from auctioning **aviation** allowances, for which a change to full auctioning is analysed in the aviation ETS impact assessment, is proportionate to the share of the total attributed aviation emissions for all MS for the reference year, which is the calendar year ending 24 months before the start of the trading period. MS with higher aviation activity have a higher share, without having regard to other economic aspects. For the fourth trading period of the ETS (which has begun on 1 January 2021) this means that the reference year for the distribution of aviation revenues is 2018. For the increased revenues from an increased share of auctions from the allocation of aviation allowances the same rule could apply, subject to considerations to use ETS revenues as own resources of the EU.

The transition to full auctioning would require the total quantity of allowances for aviation cap to be consolidated, moving from the current bottom-up approach (which defines the cap on the basis of free allocation, itself defined with the help of historical emissions). The cap represented by the total quantity of allowances for aviation and the application of the linear reduction factor on the cap have an obvious direct impact on the revenues. Because the defined cap would continue to be lower than the actual emissions from aviation (in 2019 it covered slightly more than half of the emissions), aviation would represent an additional demand for allowances from other sectors under the ETS. This demand, in practice, will depend to a considerable extent from the pace of the recovery of the sector from the COVID 19 crisis and from the method how the cap will be calculated.

Although **maritime** transport is essential to the competitiveness and economic functioning of the EU as a whole, shipping activity is concentrated in specific regions and countries. Ports attract a range of shipping-related activities, creating a cluster of businesses and jobs which in turn support the local economies, through encouraging expenditure on goods and services.

The parts of the EU-27 which are likely to be most affected by changes in the shipping sector include countries and regions which heavily rely on maritime transport: to import raw materials necessary for domestic industries; to import finished goods to meet the demand of domestic consumers; to export products and services (including tourism) to other parts of Europe; as a key mode of transport for commuters, industry and tourists; and as a significant source of employment and revenue. A detailed analysis of these activities and the extent to which they impact EU MS is presented in Annex 10.

Based on the above considerations, under all policy options, the countries and regions which are most exposed to possible changes in shipping activity are likely to be islands, countries with coastal areas and those which are particularly exposed economically to the shipping sector. These areas rely heavily on maritime transport to facilitate tourism, draw in export revenues and import the primary and secondary goods needed by their residents. Some of these countries are heavily dependent on international trade for their economic performance. A number of Mediterranean and Northern European countries and regions are also heavily dependent on maritime transport, due to the significance of tourism to these economies, including Malta, Denmark and Greece. The EU outermost regions[53] are also heavily dependent on maritime transport for territorial continuity, for

[53] Scattered across the Atlantic Ocean, the Caribbean sea, Latin America and the Indian Ocean, the nine EU outermost regions - Guadeloupe, French Guiana, Martinique, Mayotte, Reunion Island and Saint-Martin (France), the Azores and Madeira (Portugal) and Canary Islands (Spain) - face permanent

imports of raw materials, essential goods and other products, as well as for some exports. In addition, given their geographic location, (some) outermost regions rely on substantial maritime freight transport with neighbouring third countries. The geographical distribution of impacts will ultimately depend on the trade and economic characteristics of each individual country and region. Moreover, for countries where shipping is most important for extra-EU trade, a large geographical scope (MEXTRA50 or MEXTRA100) will have a higher impact compared to MINTRA only.

It might warrant further considerations how to address this, subject to considerations on using ETS revenues as own resources of the EU for repayment of the Recovery and Resilience Facility which also supports investments needed for the transition to climate.

If maritime auctioning revenues were to be distributed to MS, different climate purposes should be considered (e.g. for climate mitigation or adaptation measures, R&D investments or supporting developed countries). In the targeted stakeholders' consultation on the extension of EU emissions trading to maritime, the majority of stakeholders indicated that revenues from carbon pricing could support the decarbonisation of the sector, e.g. by supporting project development costs, reducing upfront costs or reducing the price gap between fossil fuels and sustainable alternative fuels.

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constraints due to their remoteness, small size, insularity, heavy dependence on air and maritime connections to the European continent for goods, access to services and territorial continuity. They have the highest EU unemployment rates and some of the lowest GDP rates. It is in this context that the Treaty on the Functioning of the European Union (Article 349 TFEU), provides for specific measures to support the outermost regions, including derogations on the application of EU law in these regions.

Annex 14: 2030 Climate Target Plan policy conclusions

49 2030 Climate Target Plan policy conclusions

The Communication on stepping up Europe's 2030 climate ambition - the Climate Target Plan (CTP)[54] and its underpinning impact assessment are the starting point for the initiatives under the Fit for 55 package.

The plan concluded on the feasibility - from a technical, economic and societal point of view - of increasing the EU climate target to 55% net reductions of greenhouse gases (GHG) emissions by 2030 compared to 1990. It also concluded that all sectors need to contribute to this target.

In particular, with energy supply and use responsible for 75% of emissions, the plan put forward ambition ranges for renewables and energy efficiency, which correspond in a cost-effective manner to the increased climate target. The climate target plan also established that this increase in climate and energy ambition will require a full update of the current climate and energy policy framework, undertaken in a coherent manner.

As under the current policy framework, the optimal policy mix should combine, at the EU and national levels, strengthened economic incentives (carbon pricing) with updated regulatory policies, notably in the field of renewables, energy efficiency and sectoral policies such as CO_2 standards for new light duty vehicles. It should also include the enabling framework (research and innovation policies, financial support, addressing social concerns).

While sometimes working in the same sectors, the policy tools vary in the way they enable the achievement of the increased climate target. The economic incentives provided by strengthened and expanded emissions trading will contribute to the cost-effective delivery of emissions reductions. The regulatory policies, such as the Renewable Energy Directive (RED), the Energy Efficiency Directive (EED), the Regulation on CO_2 standards for vehicles supported by the Directive on the alternative fuels infrastructure, and the Re(FuelEU) aviation and maritime initiatives, aim at addressing market failures and other barriers to decarbonisation, but also create an enabling framework for investment, which supports cost-effective achievement of climate target by reducing perceived risks, increasing the efficient use of public funding and helping to mobilise and leverage private capital. The regulatory policies also pave the way for the future transition needed to achieve the EU target of the climate neutrality.

[54] COM (2020) 562 final.

Such a sequential approach from the CTP to the Fit for 55 initiatives was necessary in order to ensure coherence among all initiatives and a collective delivery of the increased climate target.

With the "MIX" scenario, the impact assessment included a policy scenario that largely reflects the political orientations of the plan.

The final calibration between the different instruments is to be made depending, *inter alia* on the decision on the extension of emissions trading beyond the maritime sector and its terms.

The Table 78 below shows the summary of the key CTP findings:

Table 79: Key policy conclusions of the Climate Target Plan

POLICY CONCLUSIONS IN THE CTP	
GHG emissions reduction	• At least 55% net reduction (w.r.t. 1990) • Agreed by the European Council in December 2020 • Politically agreed by the European Council and the European Parliament in the Climate Law
ETS	• Corresponding targets need to be set in the EU ETS and the Effort Sharing Regulation to ensure that in total, the economy wide 2030 greenhouse gas emissions reduction target of at least 55% will be met. • Increased climate target requires strengthened cap of the existing EU ETS and revisiting the linear reduction factor. • Further expansion of scope is a possible policy option, which could include emissions from road transport and buildings, looking into covering all emissions of fossil fuel combustion. • EU should continue to regulate at least intra-EU aviation emissions in the EU ETS and include at least intra-EU maritime transport in the EU ETS. • For aviation, the Commission will propose to reduce the free allocation of allowances, increasing the effectiveness of the carbon price signal in this sector, while taking into account other policy measures.
ESR	• Corresponding targets need to be set in the Effort Sharing Regulation and under the EU ETS, to ensure that in total, the economy wide 2030 greenhouse gas emissions reduction target of at least 55% will be met.
LULUCF	• Sink needs to be enhanced. • Agriculture forestry and land use together have the potential to become rapidly climate-neutral by around 2035 and subsequently generate removals consistent with trajectory to become climate neutral by 2050.

CO2 standards for cars and vans	• Transport policies and standards will be revised and, where needed, new policies will be introduced. • The Commission will revisit and strengthen the CO_2 standards for cars and vans for 2030. • The Commission will assess what would be required in practice for this sector to contribute to achieving climate neutrality by 2050 and at what point in time internal combustion engines in cars should stop coming to the market.
Non-CO2 GHG emissions	• The energy sector has reduction potential by avoiding fugitive methane emissions. The waste sector is expected to strongly reduce its emissions already under existing policies. Turning waste into a resource is an essential part of a circular economy, as is prevention of waste, addressed by both Circular Economy and the Zero Pollution Action Plans. Under existing technology and management options, agriculture emissions cannot be eliminated fully but they can be significantly reduced while ensuring food security is maintained in the EU. Policy initiatives have been included in the Methane Strategy.
Renewables	• 38-40% share needed to achieve increased climate target cost-effectively. • Renewable energy policies and standards will be revised and, where needed, new policies will be introduced. • Relevant legislation will be reinforced and supported by the forthcoming Commission initiatives on a Renovation Wave, an Offshore Energy strategy, alternative fuels for aviation and maritime as well as a Sustainable and Smart Mobility Strategy. • EU action to focus on cost-effective planning and development of renewable energy technologies, eliminating market barriers and providing sufficient incentives for demand for renewable energy, particularly for end-use sectors such as heating and cooling or transport either through electrification or via the use of renewable and low-carbon fuels such as advanced biofuels or other sustainable alternative fuels. • The Commission to assess the nature and the level of the existing, indicative heating and cooling target, including the target for district heating and cooling, as well as the necessary measures and calculation framework to mainstream further renewable and low carbon based solutions, including electricity, in buildings and industry. • An updated methodology to promote, in accordance with their greenhouse gas performance, the use of renewable and low-carbon fuels in the transport sector set out in the Renewable Energy Directive. • A comprehensive terminology for all renewable and low-carbon fuels and a European system of certification of such fuels, based notably on full life cycle greenhouse gas emissions savings and sustainability criteria, and existing provisions for instance in the Renewable Energy Directive. • Increase the use of sustainably produced biomass and minimise the use of whole trees and food and feed-based crops to produce energy through inter alia reviewing and revisiting, as appropriate, the biomass sustainability criteria in the Renewable Energy Directive,

Energy Efficiency	• Energy efficiency policies and standards will be revised and, where needed, new policies will be introduced. • Energy efficiency improvements will need to be significantly stepped up to around 36-37% in terms of final energy consumption[55]. • Achievement of a more ambitious energy efficiency target and closure of the collective ambition gap of the national energy efficiency contributions in the NECPs will require actions on a variety of fronts. • Renovation Wave will launch a set of actions to increase the depth and the rate of renovations at single building and at district level, switch fuels towards renewable heating solutions, diffuse the most efficient products and appliances, uptake smart systems and building-related infrastructure for charging e-vehicles, and improve the building envelope (insulation and windows). • Action will be taken not only to better enforce the Energy Performance of Buildings Directive, but also to identify any need for targeted revisions. • Establishing mandatory requirements for the worst performing buildings and gradually tightening the minimum energy performance requirements will also considered.

[55] The Impact Assessment identifies a range of 35.5% - 36.7% depending on the overall design of policy measures underpinning the new 2030 target. This would correspond to a range of 39.2% - 40.6% in terms of primary energy consumption.