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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.

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[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

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[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.

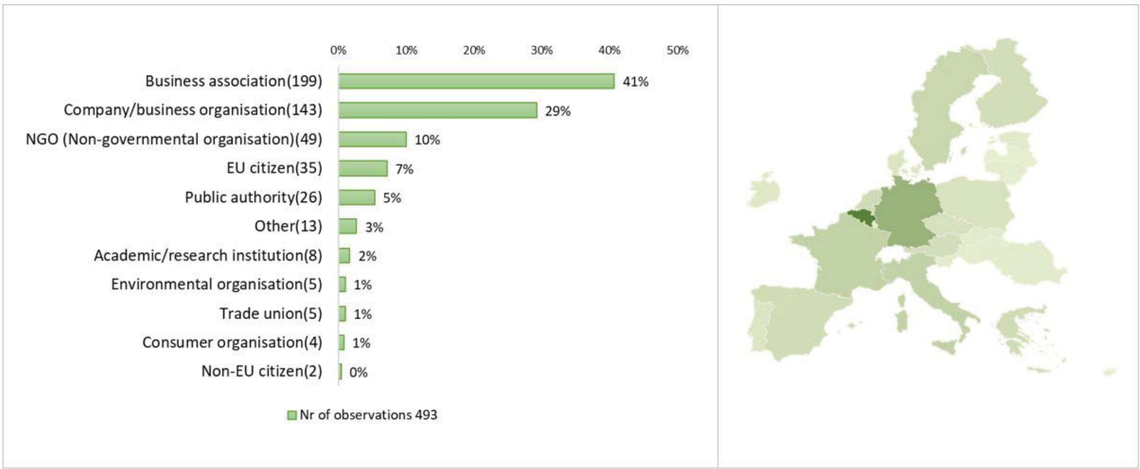
Additional position papers could be provided in response to the OPC. In total, 145 papers were received. Based on a preliminary review and a selection (e.g., exclusion of duplicates), 129 papers were thoroughly analysed. About half of the papers originated from business associations, 27% from companies 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					Admin costs for the European Commission **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 <u>Compliances costs for regulated entities</u> If the ETS extension is applied to intra-EEA emissions, the estimated ETS payment would represent an amount of	<u>at EUR 0.5 to 1.5 million per period for all national competent authorities):</u> • Preparation and implementation of national legislation and guidelines, • Information and communication tasks. • ETS specific communication <u>Admin costs for the European Commission</u> • Updating the IT system behind the EU maritime transport MRV	<u>at EUR 0.5 to 6.4 million per year for all national competent authorities):</u> • Approval of monitoring plans and review of verified emission reports • Registry operations • Monitor compliance and enforcement actions <u>Admin costs for the European Commission</u> • 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.

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[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

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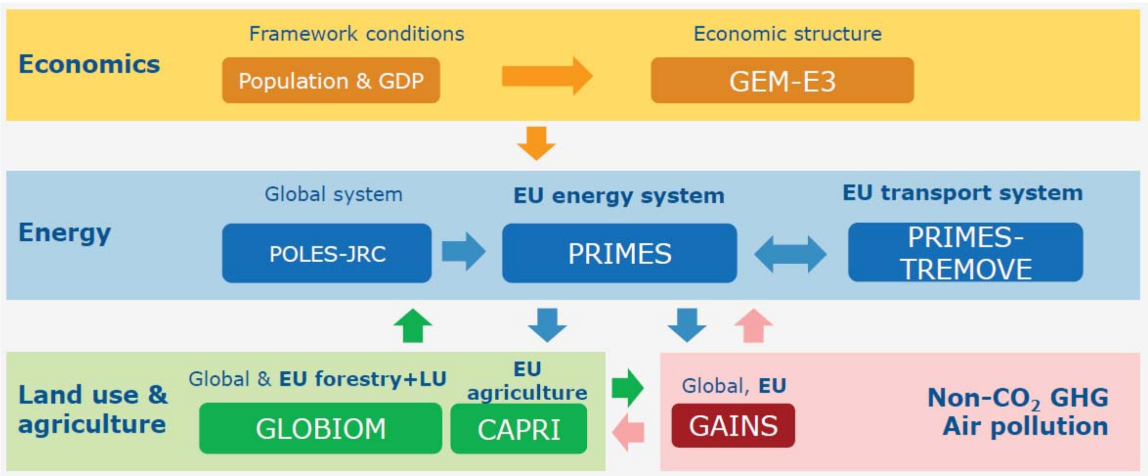
[24] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176
[25] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331
[26] https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf
[27] While cross-border trade is possible, the 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/

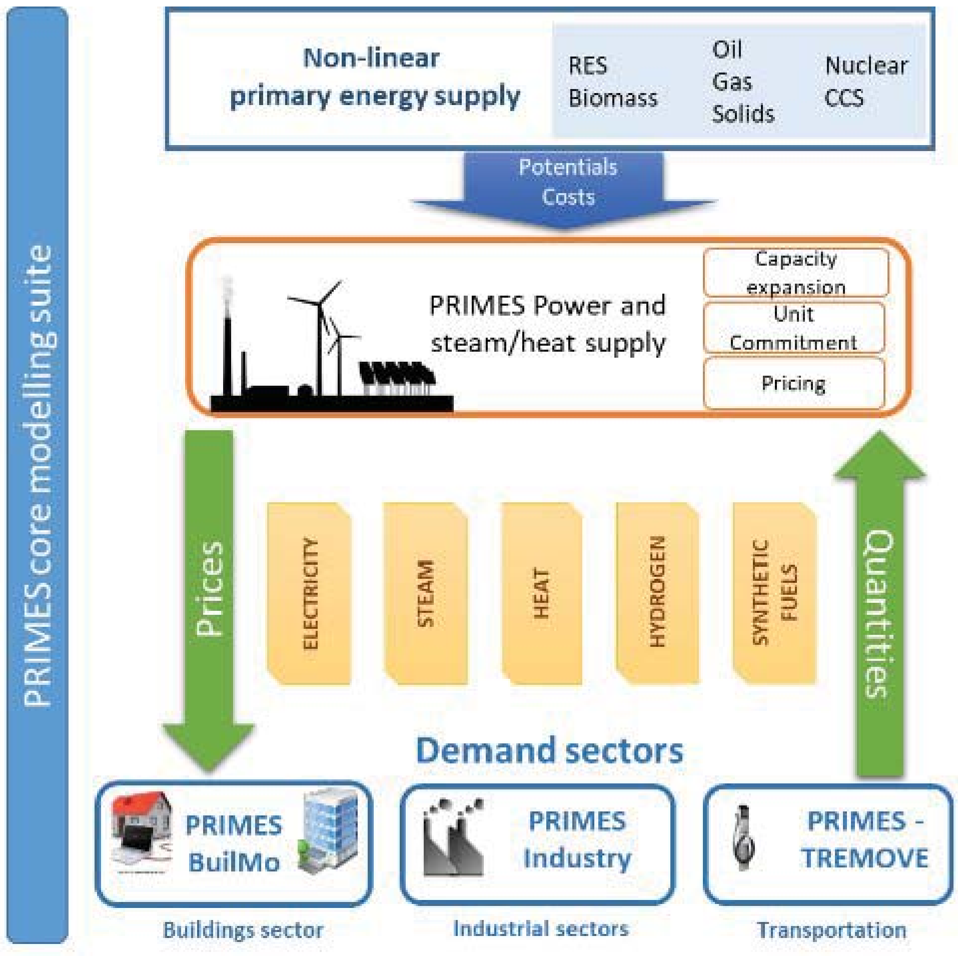
The model covers the horizon up to 2070 in 5-year interval periods and includes all Member States of the EU individually, as well as neighbouring and candidate countries.

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 16 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.

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[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

[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 34 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.

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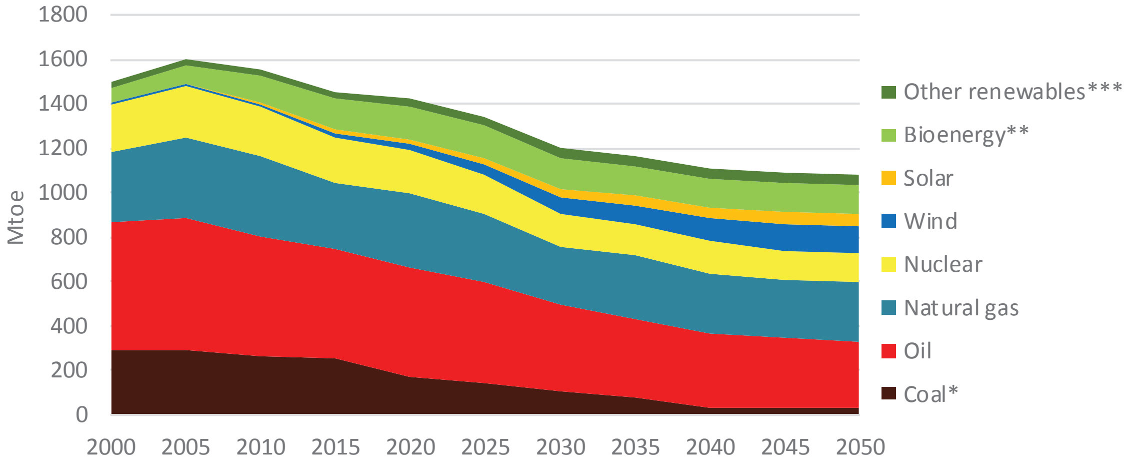
[66] Energy system costs for the entire energy system include capital costs (for energy installations such as power plants and energy infrastructure, energy using equipment, appliances and energy related costs of transport), energy purchase costs (fuels + electricity + steam) and direct efficiency investment 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.

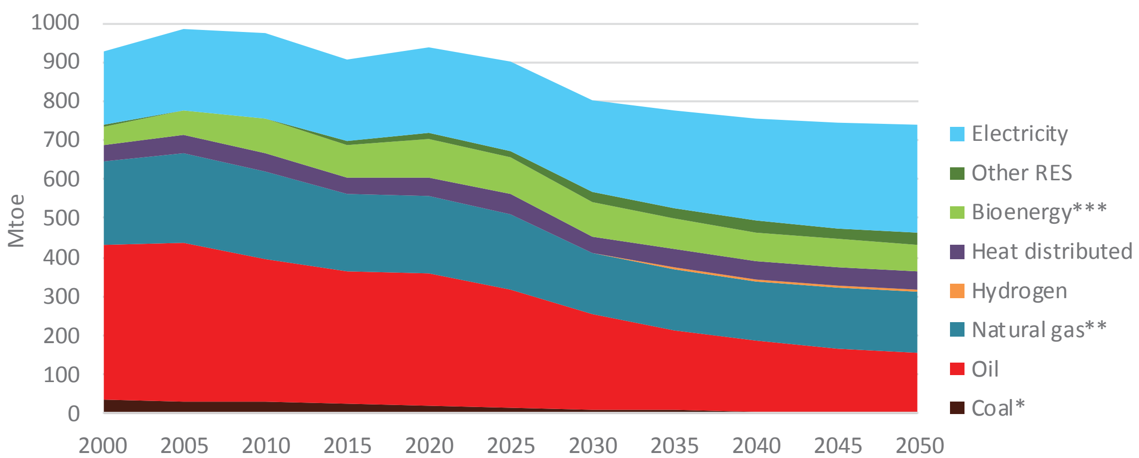
Focusing on the energy system, REF2020 shows that in 2030 fuel mix would still be dominated by fossil fuels. While the renewables grow and fossil fuels decline by 2050, the substitution is not sufficient for carbon neutrality. It also has to be noted that there is no deployment of e-fuels that are crucial 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



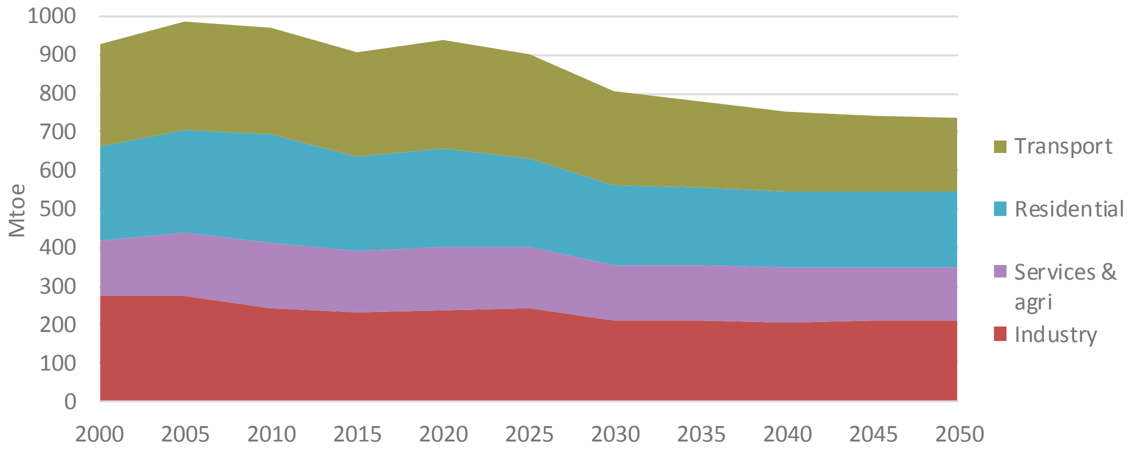
*Note: * includes peat and oil shale; ** includes manufactured gases, *** includes waste*

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.

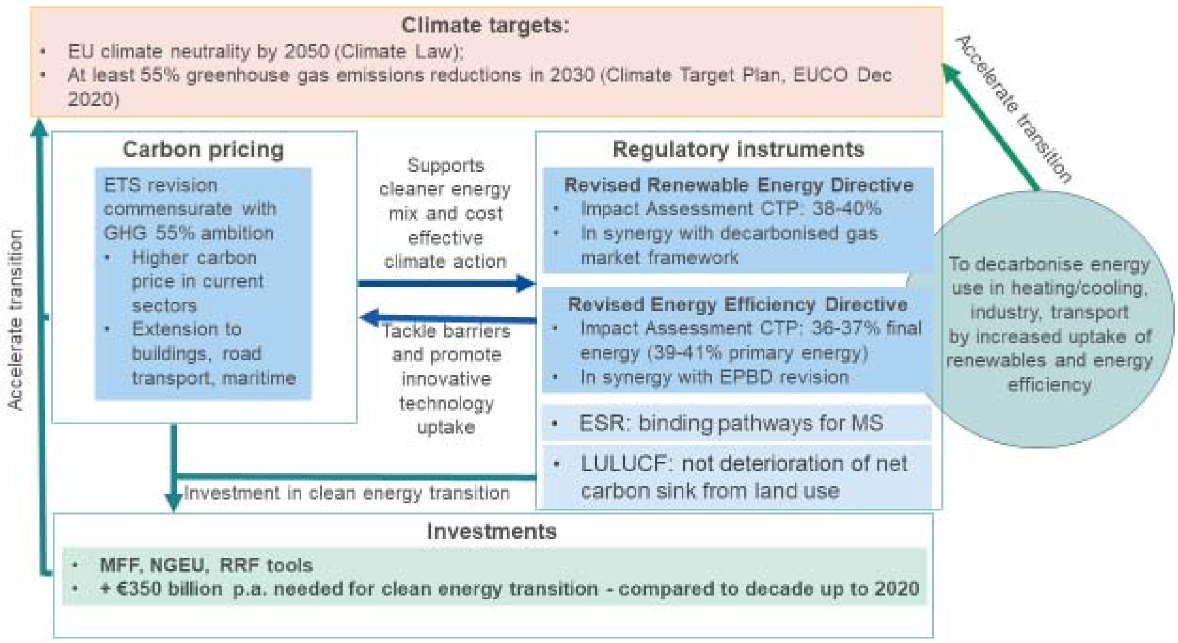
The second key lesson was that even though policy tools chosen in the CTP scenarios were different - illustrating in particular the fundamental interplay between the strength of the carbon pricing and intensity of regulatory measures - **the results achieved were convergent**. All CTP policy scenarios 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 35 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">By 2030: 2 ETS systems:
- one “current+” ETS (current extended to intra-EU maritime)
- one “new” ETS applied to buildings and road transport

After 2030: 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 35), 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

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[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:

$$\min_{\{e_\tau\}_{\tau=t}^{t+h}} \sum_{\tau=t}^{t+h} \beta^{\tau-t} C_\tau(\hat{u}_\tau^t - e_\tau)$$

$$\text{subject to} \quad 0 \leq e_\tau \leq \hat{u}_\tau^t, \qquad \text{and} \quad b_\tau = b_{\tau-1} + \hat{f}_\tau^t + \hat{a}_\tau^t + \hat{o}_\tau^t - e_\tau \geq -\hat{f}_{\tau+1}^t$$

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:

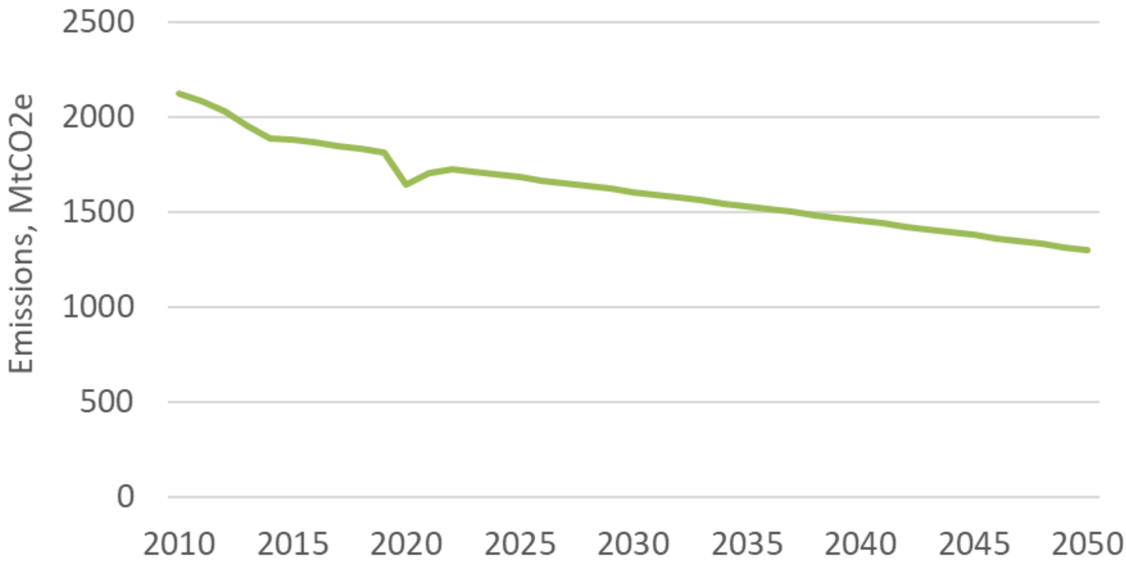
- The COVID-19 pandemic has already had a significant impact on the realised emissions in 2020, so these estimated impacts are included in the baseline. To model the magnitude of the effect on baseline emissions the updated model draws on data from the Price-Induced Market Equilibrium System (PRIMES) 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 21 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 41.

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 42).

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.

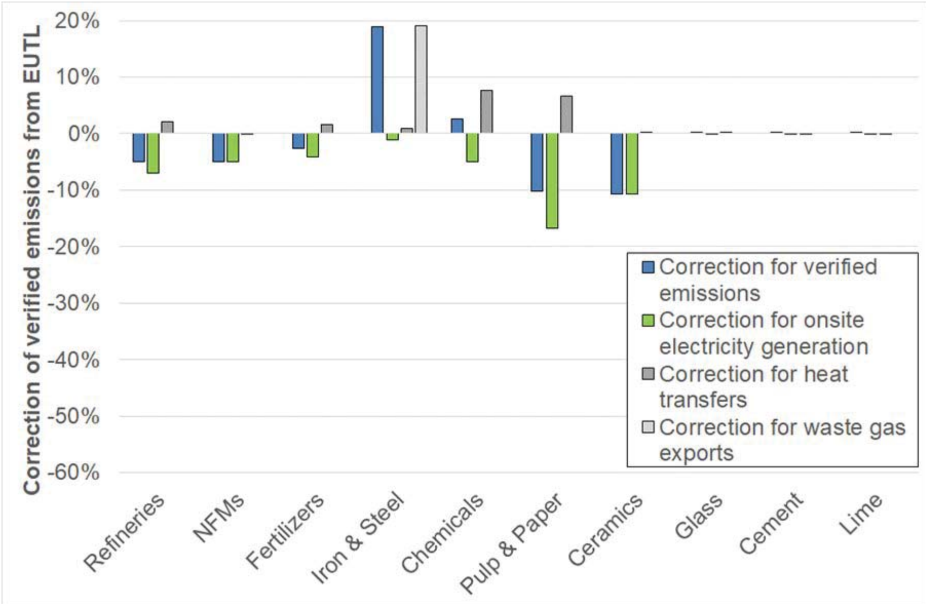
As opposed to the rule for electricity, installations do receive free allocation for heat produced within the same installation but also if imported from other ETS installations and/or exported for district heating purposes or non-ETS entities. Therefore, emissions related to heat flows that are relevant 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 22).

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 43 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 44.

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 45 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 **Error! Reference source not found.** 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.

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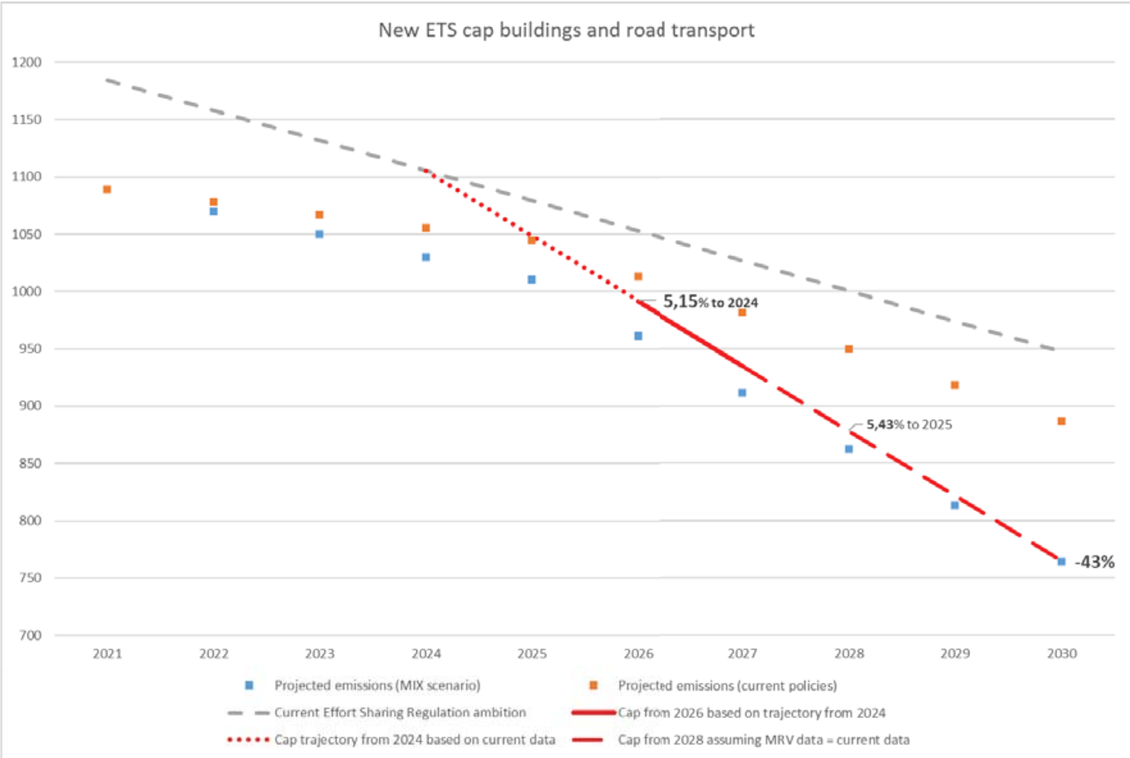
[89] According to Article 7(1)(k) of Regulation (EU) No 525/2013 implemented by Article 10 and Annex V of Commission Implementing Regulation (EU) No 749/2014, all Member States have reported on consistency of reported emissions with data from the emissions trading system where relevant, including for 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 46.

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.

[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.

[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

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[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 45 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

[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].

[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.

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[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

[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

[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

[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.

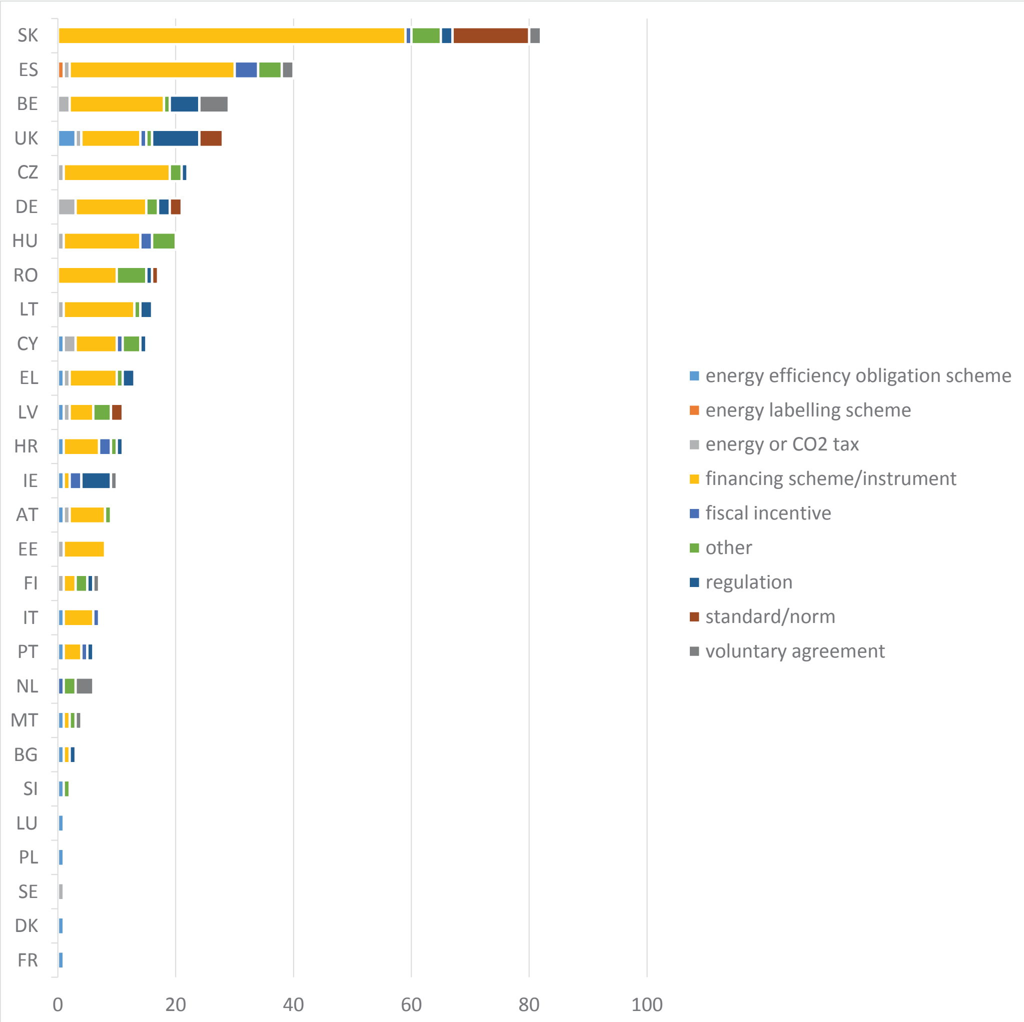
Regarding the obligation period 2014-2020, some MS notified only one policy measure, all of them but one implemented an EEOS. Sweden notified for instance only a taxation measure. Six countries reported more than 25 policy measures. All countries with more than 10 policy measures reported a mix of at 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

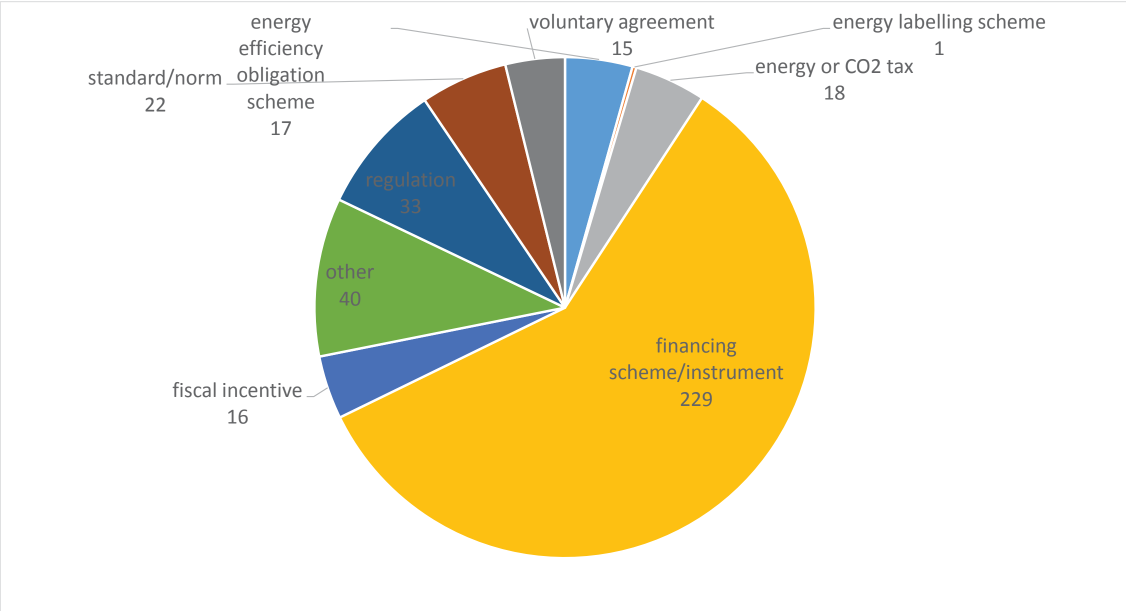


Source: Assessment of Commission services supported by technical assistance

The majority of the reported policy measures are financing schemes/instruments. The remaining of notified policy measures refers to other instrument types.

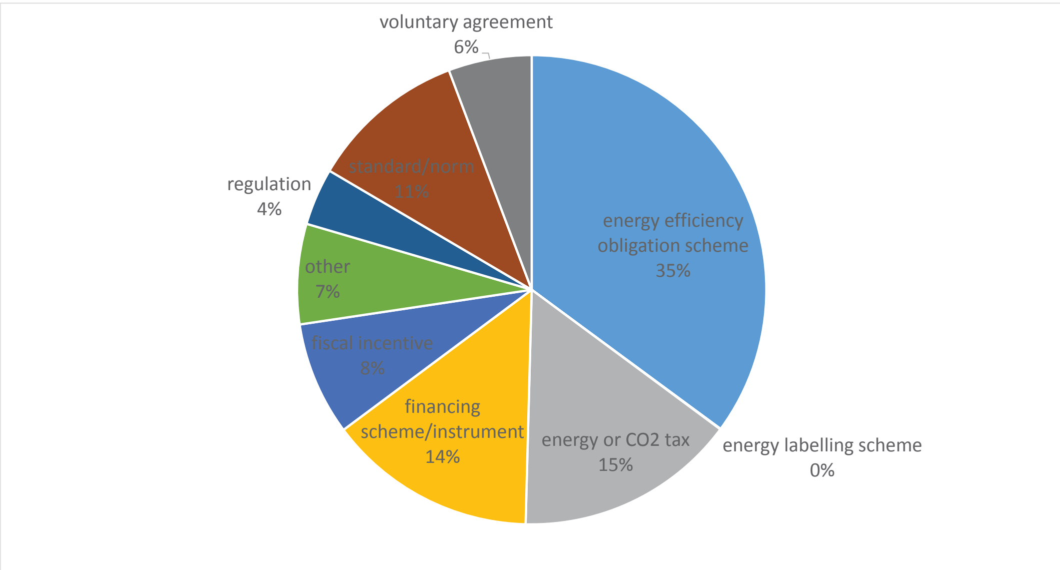
More than a third of the reported energy savings (around 35%) result from energy efficiency obligation schemes, whereas financial schemes contribute with 12% to the overall energy savings. Energy and CO_2 taxes contribute with 16%.

Figure 26: Number of reported policy measures by Member State, as of November 2020



Source: assessed by Commission services with technical support

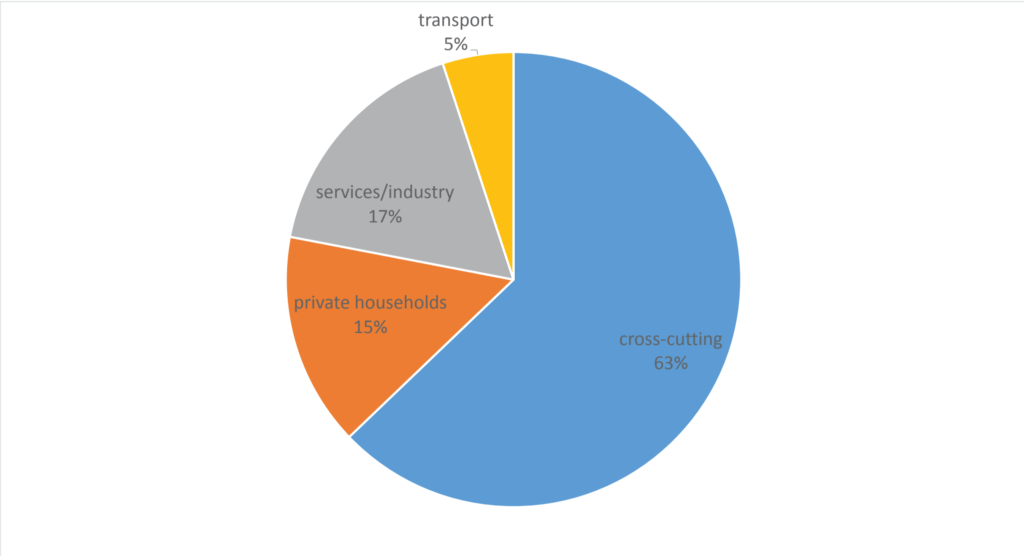
Figure 27: Share of reported energy savings by policy measure type on EU level, as of November 2020



Source: Commission services based on technical assistance

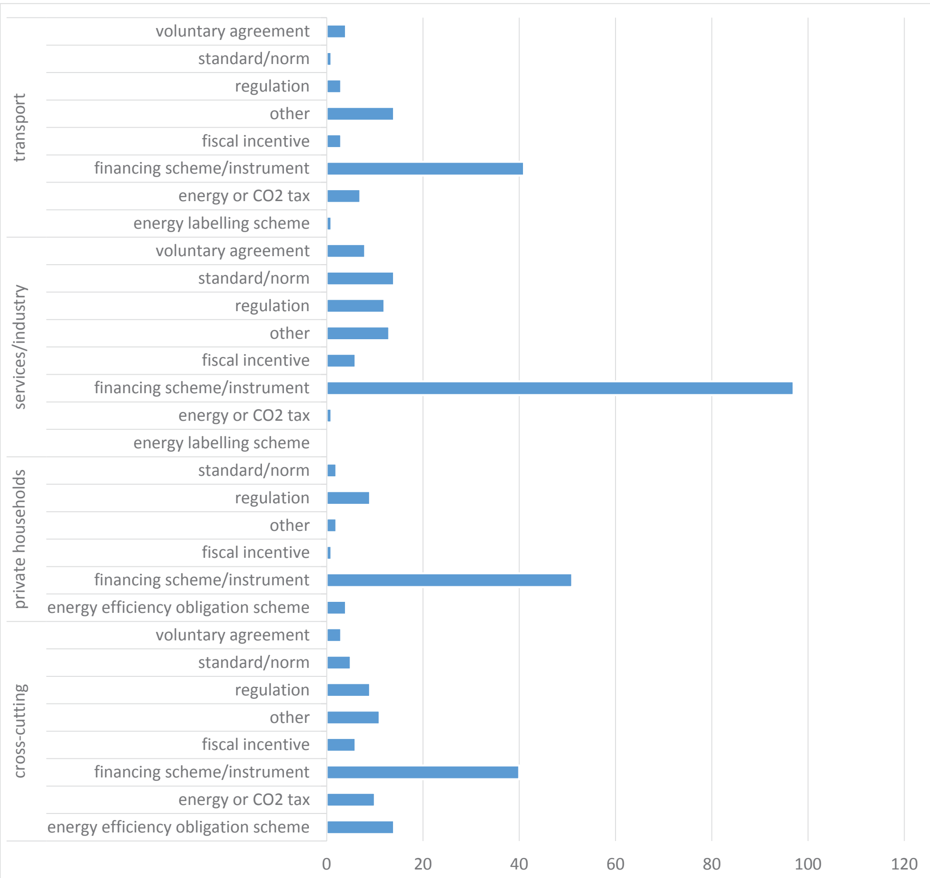
Regarding the sectors targeted by the policy measures under Article 7 EED, the major share of energy savings results from cross cutting measures, which cannot be attributed to a single sector. The two main instrument types in terms of energy savings, energy efficiency obligation schemes and taxation 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

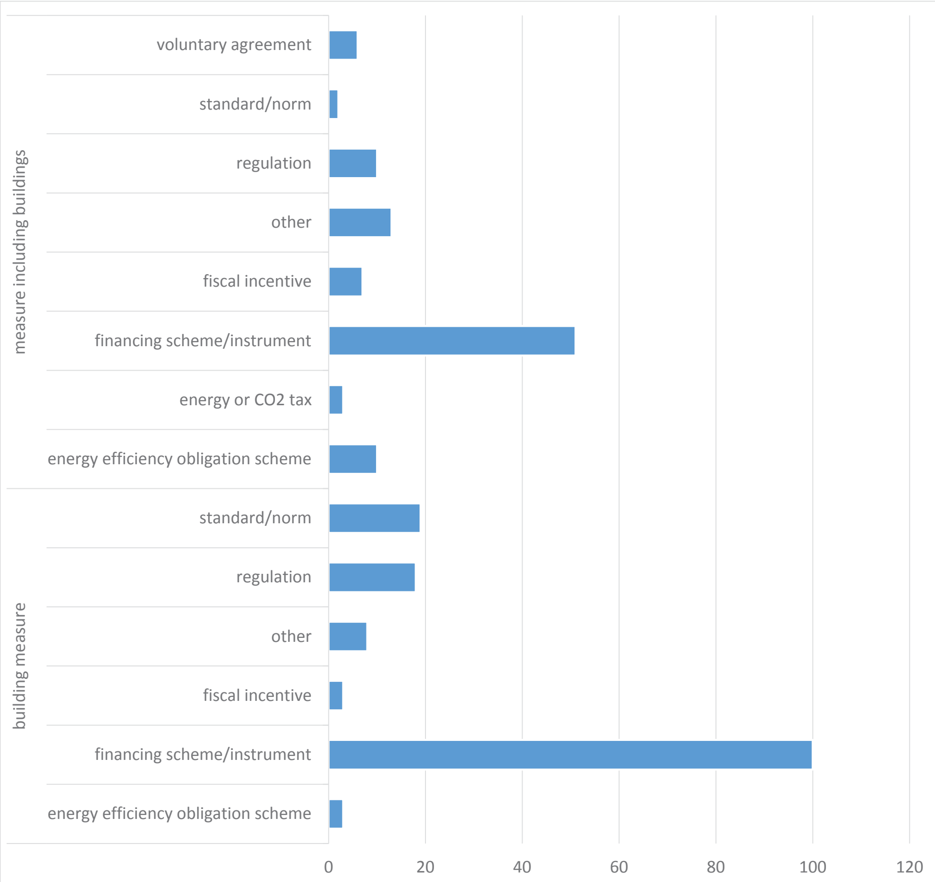
Figure 29: Number of policy measures by instrument type for targeted sector on EU level, as of November 2020



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

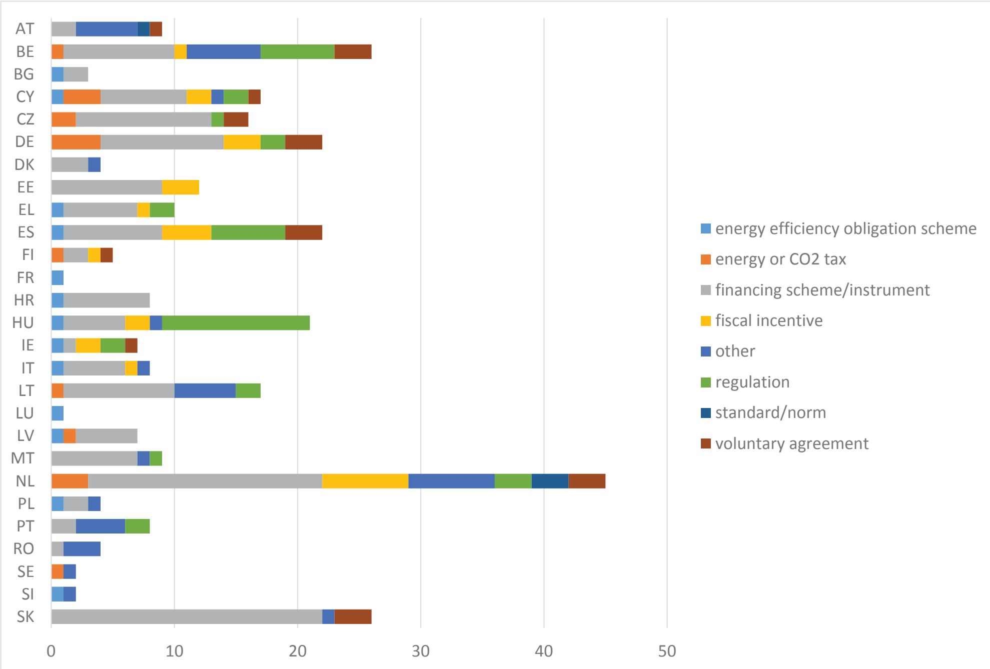


Source: Assessment of Commission services based on technical assistance

Several MS already implemented policy measures to achieve energy savings in the buildings sector in the period 2014-2020.

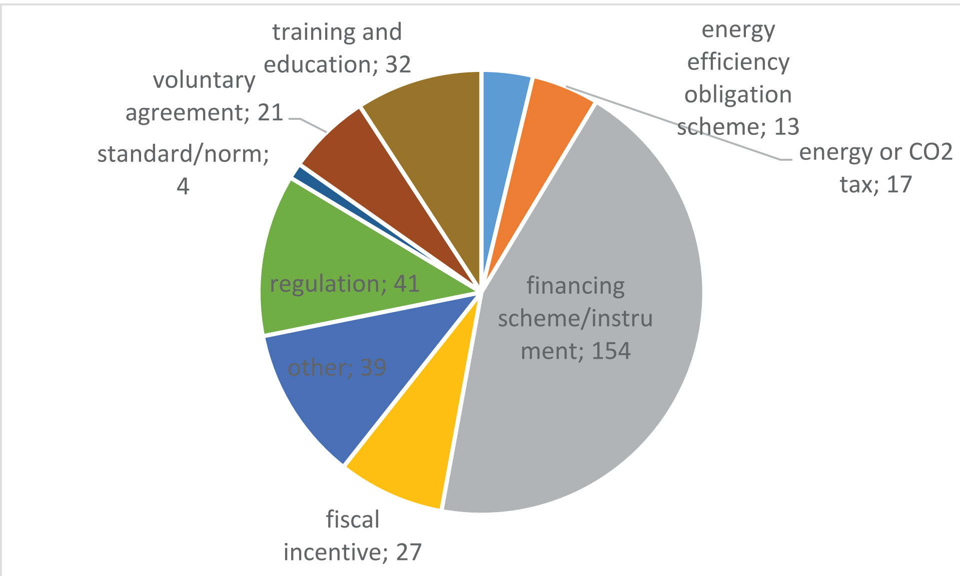
Regarding the obligation period 2021 to 2030, MS submitted with their first National Energy and Climate Plans the policy measures they intend to implement to achieve the required energy savings by 2030. The structure of the reported policy measures by type are very similar as for the obligation period 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



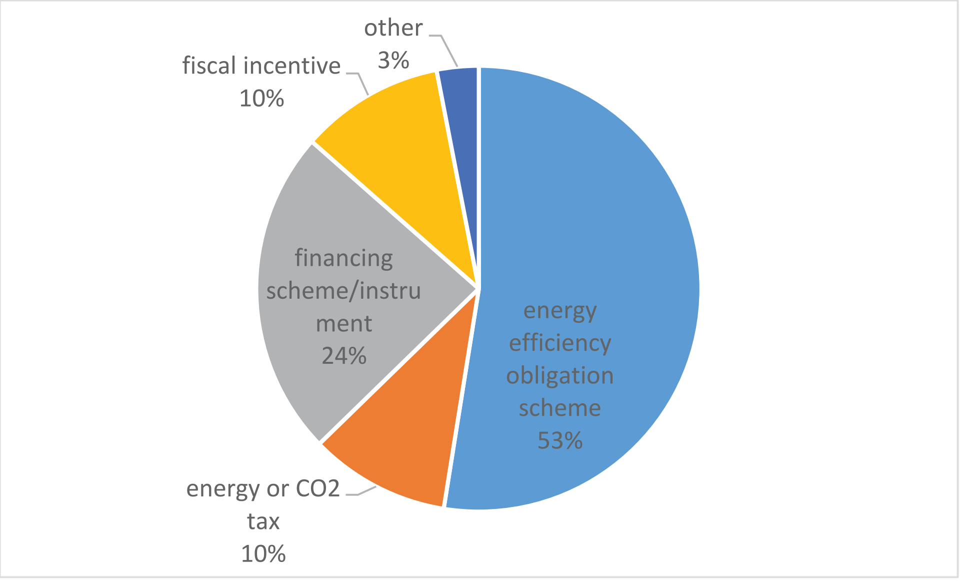
Source: Assessment of Commission services based on technical assistance

Figure 32: Number of policy measures by instrument type, as of November 2020



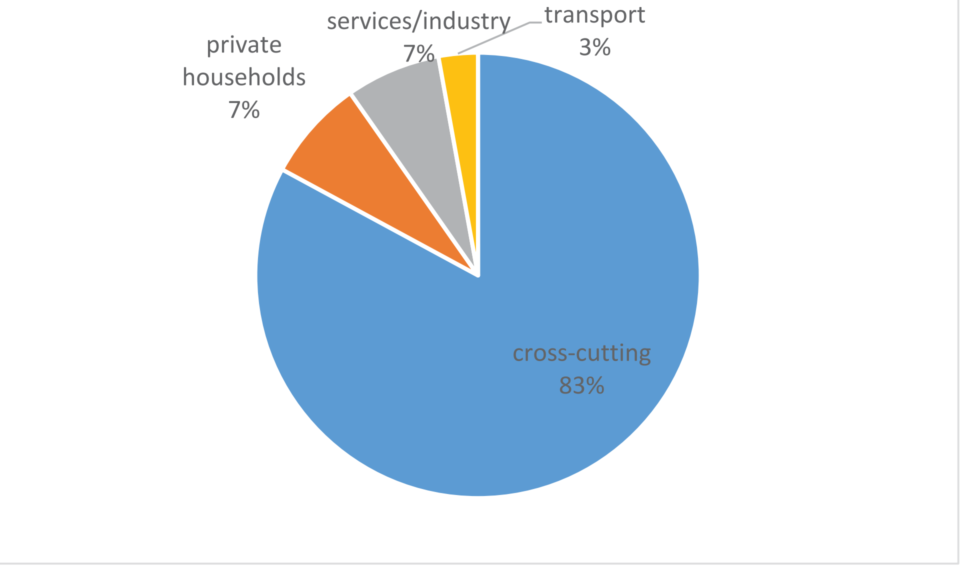
Source: Assessment of Commission services based on technical assistance

Figure 33: Share of cumulative energy savings 2021-2030 by instrument type, as of November 2020



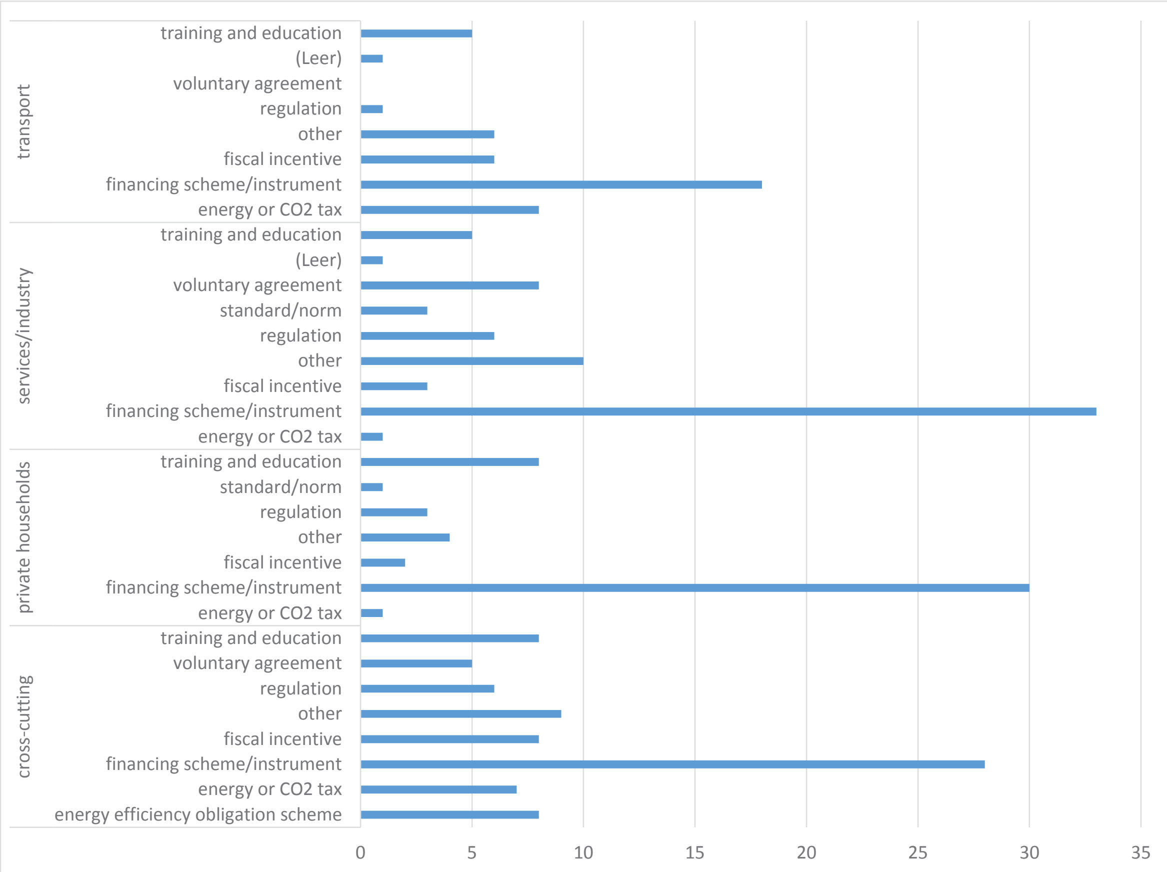
Source: Assessment of Commission services based on technical assistance

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.

[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

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[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

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[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

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[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.

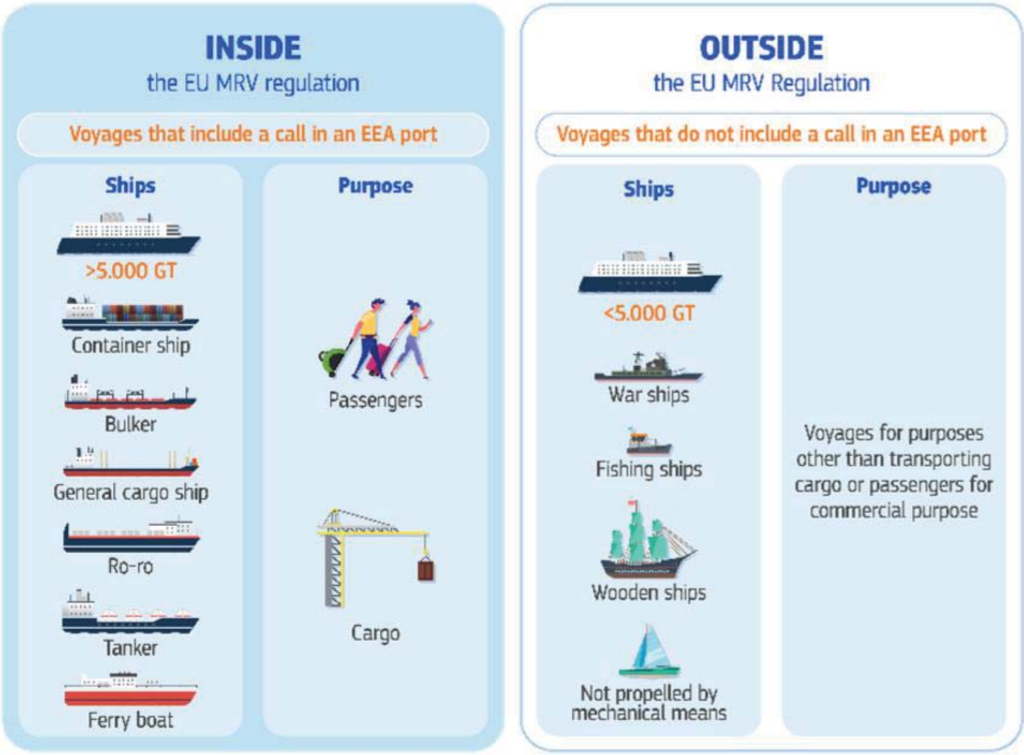
In terms of **costs pass-through**, some organisations have explained in their feedback why the use of commercial operators as regulated entities would help shipowners from the tramp shipping industry transfer the carbon pricing costs along the supply chain and ensure a level playing field. In general, 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.).

[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.

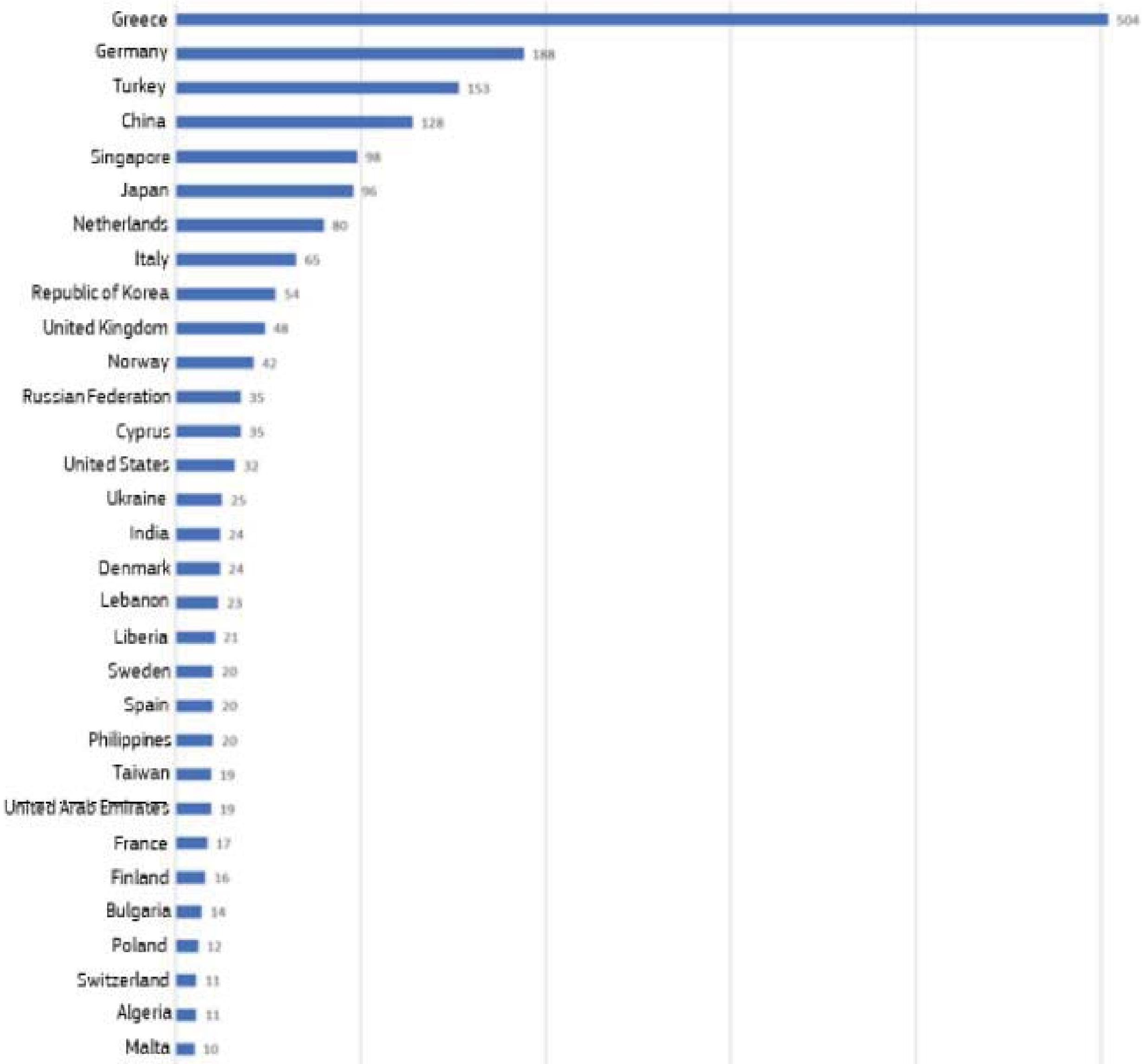
18.3 **Administering authority**

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

[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