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REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement

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1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1. Overall Policy context

The European Green Deal[1] aims to transform the EU into a fairer and more prosperous society with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases by 2050 and where economic growth is decoupled from resource use. The climate neutrality objective has been endorsed by the European Council[2] and Parliament[3] and is laid down in a legally binding manner in the European Climate Law[4]. At the same time, the transition must be just and inclusive.

The European Green Deal also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts.

The necessity and value of the European Green Deal have only grown in light of the very severe effects of the COVID-19 pandemic on our health and economic well-being. Unprecedented near term investments will be needed to reverse the negative impacts of the COVID-19 crisis on jobs, incomes and businesses. In this regard, the agreed Next Generation EU recovery instrument and its centerpiece, the Recovery and Resilience Facility, with a budget of EUR 672.5 billion, will strongly support the green and digital transitions, with at least 37% allocation to the first and 20% to the latter.

With its Communication on stepping up Europe's 2030 climate ambition (the 2030 Climate Target Plan)[5], the Commission proposes to raise the EU's ambition on reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030 in a responsible way. This is a substantial increase compared to the existing target of at least 40%. It is in line with the Paris Agreement[6] objective to keep the global temperature increase to well below 2°C and pursue efforts to keep it to 1.5°C.

The December 2020 European Council (hereafter referred to as European Council) confirmed this ambition level and the European Climate Law ensures that it is legally binding. The European Council asked for delivering the target collectively by the EU in the most cost-effective manner possible, preserving EU's competitiveness and taking account of Member States' different starting points, specific national circumstances and emission reduction potential. It gave further guidance on key elements for a 2030 Climate and Energy Policy Framework[7]. They invited the Commission to rapidly present

[1] European Green Deal, COM(2019)640
[2] European Council conclusions, 12 December 2019.
[3] European Parliament resolution of 14 March 2019 on climate change and resolution of 28 November 2019 on the 2019 UN Climate Change Conference in Madrid, Spain (COP 25).
[4] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243, 9.7.2021, p. 1)
[5] COM(2020)562 final and its impact assessment, SWD(2020)176
[6] http://unfccc.int/paris_agreement/items/9485.php
[7] European Council conclusions, 10 and 11 December 2020 1011-12-20-euco-conclusions-en.pdf (europa.eu)

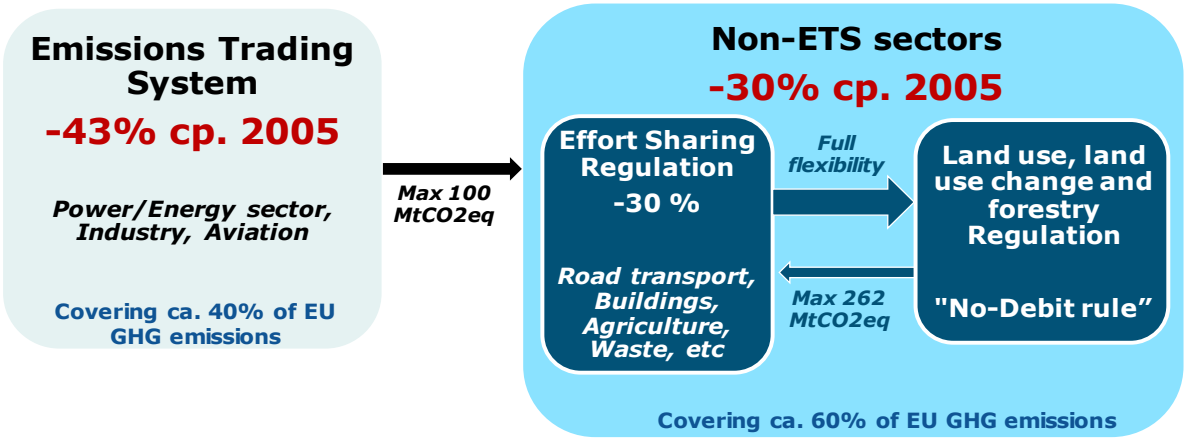
all the remaining relevant proposals to this end so as to swiftly inaugurate the legislative process. To this end, the Commission has started the next steps towards implementing these targets and will review the relevant climate-related policy instruments. To achieve 55% GHG reductions economy wide, the sectors under the Effort Sharing Regulation will need to step up efforts. The analysis supporting the Climate Target Plan indicated that overall reductions would need to increase by around 10 percentage points. The Climate Target Plan pointed out the need to review the ESR, decide on its scope and increase its ambition. The European Council conclusions in May 2021 reaffirmed the December 2020[8] conclusions.

1.2. The Effort Sharing Regulation within the overall Climate Policy architecture

The current economy-wide target of at least 40% GHG reduction in 2030 compared to 1990, is achieved through 3 distinct policy instruments, as represented in Figure 1:

- The EU Emission Trading System (ETS) covers large point sources in power and industry, as well as currently intra EU aviation, taken together representing approximately 40% of EU GHG emissions. The ETS will reduce GHG emissions in those sectors by 43% compared to 2005.
- The Effort Sharing Regulation covers the other 60% GHG emissions, notably in sectors such as road transport, heating in buildings, agriculture and other non-CO2 emissions (e.g. waste, F-gases). Overall, these sectors need to reduce emissions by 30% compared to 2005, which is a lower ambition than the ETS, notably due to the large cost-efficient emission reduction potential in the power sector in the ETS.
- Thirdly, the land use sector is presently required to meet the so-called "No-Debit" rule, which requires that the land use sink should not deteriorate compared to how the sink would evolve under current land use and forest management practices[9].

Figure 1: Current climate policy architecture to achieve -40% GHG reductions in 2030 compared to 1990



Source: Commission services

[8] Special meeting of the European Council, 24-25 May 2021 - Conclusions (europa.eu)

[9] The no debit rule corresponds to a net sink of 225 Mt CO2eq in 2030, which means that in 2030 the land use sector in the EU removes 225Mt of CO2 from the atmosphere

This impact assessment focusses on the implementation of the Climate Target Plan as regards the Regulation on binding annual greenhouse gas (GHG) reductions by Member States, the so-called Effort Sharing Regulation (ESR). The ESR primarily addresses Member States as institutional actors and thus in first instance affects national administrations.

The Effort Sharing Regulation (ESR) combines national accountability for achieving the common climate objectives (environmental integrity) with flexibility for Member States to implement the appropriate measures taking into account national circumstances (subsidiarity).

A range of European policies and measures play an important role to help Member States reduce emissions in the sectors covered by the ESR. The interaction between EU-level measures and Member States measures has been growing in importance and intensity. Examples are:

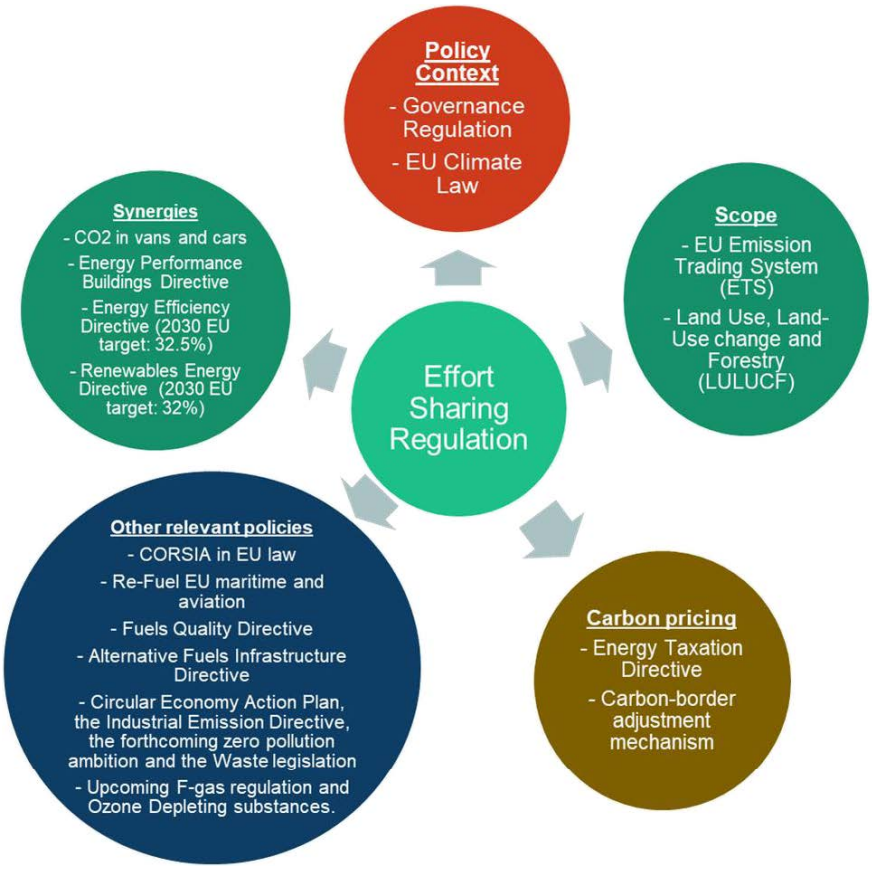
- The **Renewable Energy Directive** (RED) and the **Energy Efficiency Directive** (EED) drive the uptake of energy efficient and renewable technologies, helping reduce GHG emissions in all sectors.
- **CO_2 standards for new vehicles** (cars, vans, trucks) reduce GHG emissions in the road transport sector as the existing vehicle stock is gradually replaced by cleaner vehicles.
- The **Directive on Alternative Fuels Infrastructure** ensures the development of EU wide infrastructure that is required to allow the transport sector to switch to electricity or other low carbon fuels.
- The building sector will also see emission reductions following the implementation of the requirements of the **Energy Performance of Buildings Directive.**
- Strategic plans under the **Common Agriculture Policy** allow Member States to focus agriculture funding on improving GHG efficiency of its agriculture.
- **Waste legislation** aims to reduce landfilling of bio-waste and associated methane emissions.
- **F-gases**[10] are phased down by a set of EU regulations regulating their placing on the EU market, in conformity with the Montreal Protocol.

The Revision of Effort Sharing Regulation presented in this impact assessment thus must be in coherence with the updates of other 2030 climate, energy and transport policies (see Figure 2). Policies being updated that interact with the ESR are notably the EU Emissions Trading System (ETS) Directive and the Land Use, Land Use Change and Forestry (LULUCF) Regulation. Policies being updated that contribute to reducing emissions in the ESR are CO_2 Emissions Performance Standards for Cars and Vans, the

[10] Fluorinated gases (or "F-gases") are chemical substances with a very high global warming potential used in specific applications such as air-conditioning systems, switch gear and as chemical feed-stock

Renewable Energy Directive, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, the Energy Taxation Directive, the revision of the Directive on Deployment of Alternative Fuels Infrastructure and the new legislative initiatives to reduce methane emissions in the energy sector.

Figure 2: Overview of relevant interactions identified between different EU legislative instruments in relation to Effort Sharing



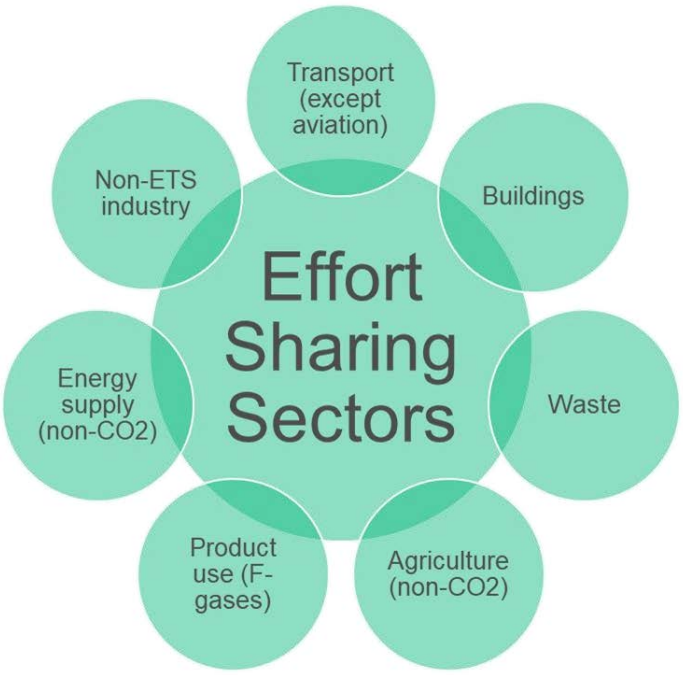
Source: Commission services

Further information on related policies and policy initiatives notably impacting the emissions from the energy system in the ESR is provided in annex 10.6.

1.3. Key aspects of the Effort Sharing Regulation

The ESR currently covers all GHG emissions included in the EU's target which are covered neither by the EU Emissions Trading System (ETS) nor by the Regulation on Land-Use, Land-Use Change and Forestry (LULUCF). It currently covers direct GHG emissions from transport (except aviation and non-domestic shipping), buildings, agriculture, industrial installations and gases not covered by the EU ETS and waste as well as non-combustion related emissions from energy and product use (see Figure 3). It includes both CO_2 emissions as well as a significant share of non-CO_2 emissions.

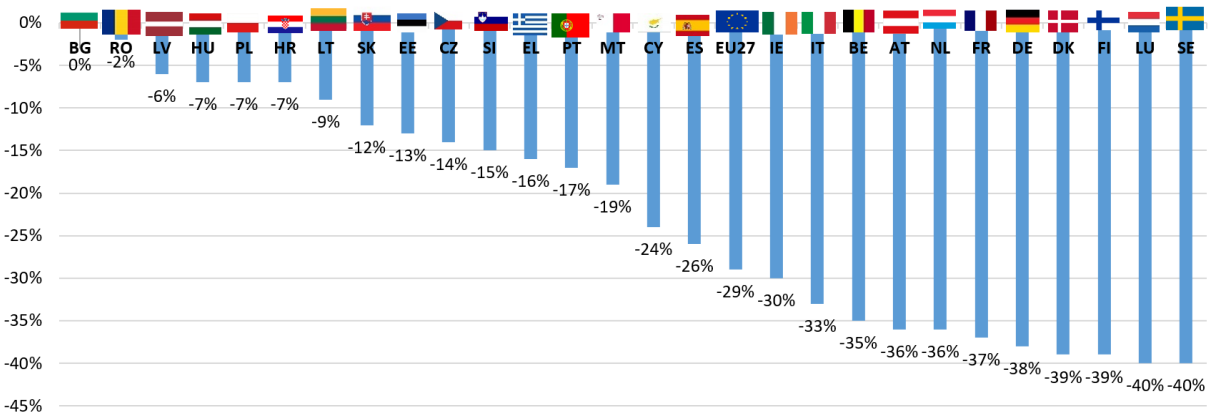
Figure 3: Overview of the sectors currently covered under Effort Sharing Regulation



Source: Commission services

The current ESR aims at reducing covered greenhouse gas emissions by 30 % below 2005 levels by 2030. It sets "minimum contributions" in the form of binding national emission reduction targets for each Member State for the period from 2021 to 2030 to reduce GHG emissions in the sectors covered by the Regulation, which for 2030 vary between 0% and -40% compared to 2005. The distribution key is based on economic capacity, i.e. GDP per capita, with some limited adjustments to reflect cost-efficiency in a fair and balanced manner. It also sets binding national emission trajectories from 2021 to 2030, starting from the average of 2016 to 2018 emissions.

Figure 4: Member State greenhouse gas emission reductions in 2030 in relation to their 2005 levels determined in Effort Sharing Regulation



Source: Commission services

In order to provide for flexibility for Member States in implementing their commitments and as a means to enhance the overall cost-efficiency of reaching the EU-wide 2030 target, the ESR provides a range of flexibility instruments:

- Emission allocations can be banked and borrowed with certain limitations.
- Transfers of allocations between Member States are possible. This flexibility instrument can make a major contribution to achieve the overall target in a cost-efficient way: it allows Member States to be rewarded for overachievement, while the transfer of allocations facilitates compliance for Member States with a more ambitious target at a lower cost.
- The ESR contains limited flexibilities with the existing ETS and LULUCF sectors. Member States that have access to the ETS flexibility had to communicate the intended use of the allocated maximum amount, and can then use it under the ESR. Each Member State has been allocated a maximum amount of flexibility with LULUCF, which can only be used if a Member State overachieves its LULUCF "No-Debit" commitment and if it needs it for ESR compliance.

There is a compliance check at five-year intervals, with non-financial penalties for non-compliance. This is a significant administrative simplification compared to the preceding Effort Sharing Decision[11], based on an annual compliance check. The Effort Sharing Regulation related planning, monitoring and reporting requirements, including the National Energy and Climate Plans, are set under the Regulation on the Governance of the Energy Union and Climate Action (Governance Regulation)[12]. Climate-related reporting obligations had already been streamlined under the preceding Monitoring Mechanism Regulation. The Governance Regulation provides a further step by integrating these with streamlined energy related reporting obligations, which were before set in different sectoral laws.

Achievement of the targets under the ESR is therefore linked with adequate and effectively implemented National Climate and Energy Plans (NECPs), with a range of national policies and measures, many of them needing to be implemented at national level for reasons of subsidiarity. The ESR leaves it to Member States to decide through which measures they achieve their targets, although a number of EU policies contribute in all Member States to emission reductions. In the context of the Governance Regulation, all Member States have established NECPs, outlining their existing and planned policies and measures, including energy efficiency and renewable energy targets and measures. Under the Governance Regulation, Commission recommendations can guide Member States in the establishment of ambition and the implementation of the

[11] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.
[12] 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.

necessary policies and measures. Overall this approach is based on subsidiarity, and allows Member States to develop the measures that are best suited for their own national circumstances.

The Climate Target Plan concluded that all key climate and energy policies need to be reviewed, increased in ambition and that this should be done in a coherent manner. It listed a number of policy options for the ESR in this context, with a focus on what the scope of the ESR could be in relation to notably a new Emission Trading System for sector presently included in the ESR. Therefore this impact assessment mainly focusses on:

- Scope of ESR and resulting EU wide target.
- Member State targets and trajectories keeping fairness and cost efficiency as key principles for the Effort Sharing Regulation.
- Use of existing flexibilities to enhance cost efficiency (trade, banking and borrowing, LULUCF and ETS flexibilities), respecting two principles: environmental integrity and preserving the balance of efforts among all sectors of the economy.

2. PROBLEM DEFINITION

2.1. What are the problems and their drivers?

Higher 2030 climate ambition is imperative to ensure the EU is set on a gradual and balanced trajectory to reach climate neutrality by 2050. As part of the Green Deal to increase the climate ambition from at least -40% to at least -55%, the Commission will present proposals to revise most of the EU measures presented in section 1.2, with a view to meeting the new target and to improve further the interactions between different measures, at whatever level these are adopted and implemented.

The general problem is that with current national targets agreed for 2030 (a EU-27 reduction of 29%[13] compared to 2005) and existing and planned policies, GHG emissions in ESR sectors are not expected to sufficiently decrease by 2030 to achieve the contribution of these sectors to the new overall EU target of at least 55%.

The Climate Target Plan indicated the need to review the ESR, decide on its scope and increase ambition with a view of stepping up efforts by the sectors under the Effort Sharing Regulation. The Climate Target Plan and its Impact Assessment indicated that as part of the overall step up from at least -40% to at least -55% GHG reductions for all sectors, the overall reductions in the Effort Sharing sectors would need to increase approximately by 10 percentage points.

[13] The ESR EU target with the United Kingdom (i.e. EU-28) was set at 30%. Without the UK in the EU (i.e. EU-27), this target is equivalent to 29% GHG reductions below 2005 levels.

This needs to be further considered within an overall coherent revision of the regulatory framework that ensures environmental integrity, including the revision of the ambition undertaken in the existing Emissions Trading System and the revision of the Land Use, Land Use Change and Forestry Regulation.

This Impact Assessment assesses also options that set targets at lower ambition in the ESR and assesses if in combination with the achievement of other policies, this would still allow to reach a combined effect of at least 55% GHG emissions economy wide by 2030.

The Climate Target Plan concluded that all key climate and energy policies need to be reviewed, increased in ambition and that this should be done in a coherent manner. To ensure this, all impact assessments build on the same set of coherent modelling scenarios. The modelling is based on an updated baseline, i.e. the Reference scenario that incorporates existing policies as represented in the National Energy and Climate Plans.

In the EU Reference scenario (see section 5.1)[14], reflecting current trends and the foreseen implementation of NECP's, emissions covered by the ESR are projected to decrease by around 32% in 2030, thereby overachieving the current ESR target, while the Impact assessment of the Climate Target Plan projects a substantially higher contribution in those sectors of around 39%-40% to be consistent with the overall EU target of at least 55%.

Scope of the ESR

So far, the ETS, the ESR and the LULUCF Regulation together have covered the GHG emissions of different parts of the economy, as shown in Figure 1, each of them defining the contribution of the covered sectors to the overall target. Specific questions arise from the possible extension of carbon pricing, an important tool to combat greenhouse gas emissions, to new sectors.

The possible extension of the ETS warrants the consideration of the scope of the Effort Sharing Regulation itself, taking into account the effectiveness, cost-efficiency and fairness of the instrument and the climate policy architecture as a whole. Similarly a change in scope of the LULUCF Regulation towards a Land Use instrument[15] could also impact the ESR scope. Concretely, in case emission trading, and/or a Land Use instrument, is set up for certain sectors covered by the current ESR, different options for the scope of the ESR need to be considered, notably whether or not a sector is included both in the ESR and in one of the other instruments.

[14] The EU Reference scenario assumes the full implementation of existing climate, energy, transport and energy policies and is based on the National Energy and Climate Plans by the Regulation on the Governance of the Energy Union and Climate Action, prioritising the achievement of the energy efficiency and renewable energy targets as included in these plans and the legislative framework as it currently exists for 2030 (achieving at least -40% GHG emission reductions compared to 2005).

The consequences of these options need to be compared in terms of the overall effectiveness, fairness and cost-efficiency of each option for the policy architecture.

For instance the potential application of emissions trading to sectors such as buildings and road transport would cover around half of the emissions of today's Effort Sharing Regulation. As with the current ETS, such a system would integrate the price of CO2 in economic and financial decisions and would be an important tool to incentivise cost effective action by business and consumers in these sectors across all Member States.

At the same time, a carbon price on its own would not deliver the required transformation in the sectors concerned in an efficient manner. The Climate Target Plan concluded that there is a clear need for complementary and targeted policies. These can address market failures and split incentives, accelerate technological change and develop the required infrastructure in a coordinated way (e.g. for building renovation, electrification and hydrogen technology for industry).

Distribution of targets

For each of the options for a different scope of a revised ESR, a further question concerns how the overall EU level effort in the ESR sectors should be distributed among Member States.

ESR target setting needs to be considered within an overall coherent revision of the regulatory framework that ensures environmental integrity, including the revision of the ambition undertaken in the existing Emissions Trading System and the revision of the Land Use, Land Use Change and Forestry Regulation.

Fairness and cost efficiency remain key principles for the Effort Sharing Regulation. This includes a target setting approach that takes into account differences in capacity to act while considering adjustments to take into account specific national circumstances. In this respect, European Council conclusions of December 2020[16] provided clear guidance and those of May 2020 reaffirmed them[17].

The current ESR addressed the differences in economic capacity by differentiating national targets according to relative differences in GDP per capita. However, setting targets based solely on GDP per capita may result in large differences in the costs per ton reduced emissions between Member States if the reductions have to be achieved domestically, and might induce very costly efforts for those higher income Member States with more limited remaining mitigation potentials. For this reason, in the current ESR, the targets for Member States with a GDP per capita above the EU average have been relatively adjusted to reflect cost-efficiency in a fair and balanced manner. This issue needs to be reassessed in the context of the higher ambition, and in the context of a potentially revised scope of the ESR.

[16] European Council conclusions, 10 and 11 December 2020 - 1011-12-20-euco-conclusions-en.pdf (europa.eu)
[17] Special meeting of the European Council, 24-25 May 2021 - Conclusions (europa.eu)

Flexibility instruments to enhance cost-efficiency

Flexibility between Member States to reward overachievement and allow for cost efficient attainment of the collective target will also remain important with increased ambition. Limited and appropriate flexibilities will need to respect environmental integrity and preserve the balance of efforts among all sectors of the economy, as outlined in the 2030 Climate Target Plan.

The flexibility requirements that are currently foreseen in the ESR contribute to achieving overall cost-efficiency in reaching the EU's GHG emission reduction target, while respecting environmental integrity. The access to and use of flexibilities will need to be reassessed taking into account the different options for the scope of a revised ESR.

The ESR provides for temporal flexibility (within certain boundaries to keep environmental integrity) around the target trajectory through banking and borrowing. An important but so far not frequently used element of the current Effort Sharing legislation, is the possibility of AEA (annual emission allocations) transfers across Member States, whereby a Member State overachieving its target can transfer these AEA's to a country that is not meeting its target domestically (geographical flexibility).

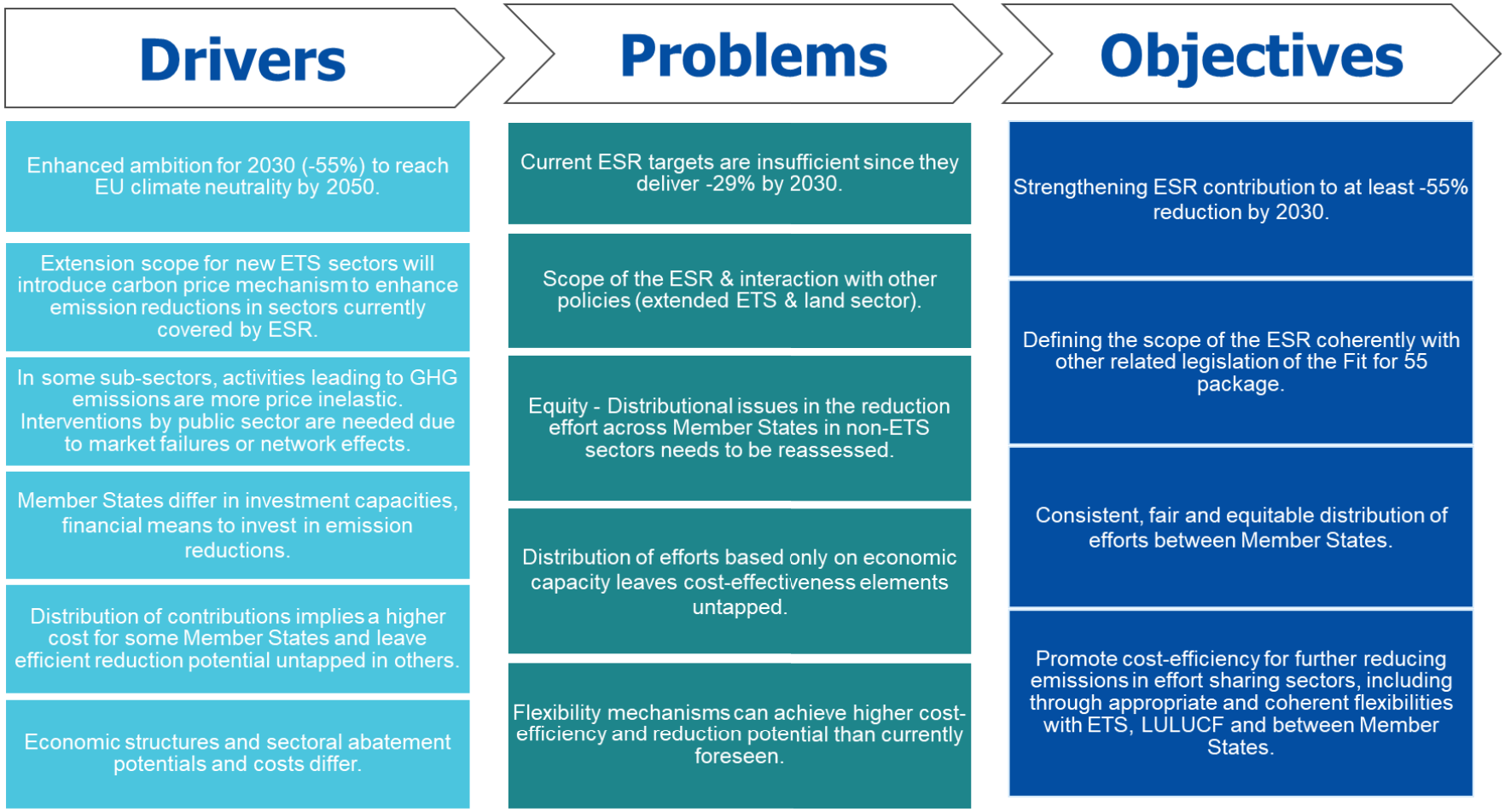
Member States have currently also the possibility to transfer a limited amount of credit generated under the LULUCF legislation for compliance in the ESR. This so called LULUCF flexibility can only be used to cover for own deficits and cannot be transferred to other Member States.

However this flexibility is impacted by the agreement under the Climate Law that the contribution of net removals to the at least -55% net GHG reduction target should be limited to 225 $MtCO_{2\text{-}eq}$. While this provision in the Climate Law is without prejudice to the revision of Union legislation, the impact of any continued use of the LULUCF flexibility within the ESR on the likelihood or not to meet this requirement under the Climate Law will also be assessed in this impact assessment.

Finally, the limited flexibility from the existing ETS towards the ESR, for Members States with targets above the EU average target and above their own cost-efficient reduction potential, needs to be reassessed in the context of the higher ambition and in the context of a potentially revised scope of the ESR.

Figure 5 sets out the intervention logic. It summarises the described problems specific to the revision of the Effort Sharing Regulation, the relevant problem drivers, and outlines possible approaches to address them, setting them in relation with the objectives to pursue and the available policy options. The latter two elements are described in section 4 and 5.

Figure 5: Overview of the intervention logic of Effort Sharing Regulation review to define the scope and contribution of the Effort Sharing Regulation including drivers, problems and objectives.



2.2. How will the problem evolve?

The need to revisit the scope of the Effort Sharing Regulation and/or the ambition level of its 2030 target and the distribution of the effort among Member States is a consequence of the proposal by the Commission endorsed by the European Council and confirmed by the co-legislators in the Climate Law, to step up the ambition of the climate target 2030 to at least -55 %. The existing framework of the ESR is projected to deliver by 2030 an overall reduction of greenhouse gases in the effort sharing sectors of 32 % compared to 2005[18]. Leaving both the scope and ambition level of the Effort Sharing Regulation unchanged would put the entire additional burden of faster decarbonisation onto the Emissions Trading System and LULUCF sectors, as well as on the strengthening of the other instruments relevant for these sectors, and the Energy Efficiency Directive, the Renewable Energy Directive and the Energy Performance Buildings Directive in particular. This could potentially have high economic costs, especially in the sectors included in the ETS. It would also leave untapped the potential of the ESR to hold national governments accountable for decarbonisation and to allow for country specific policy approaches.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The legal basis of this initiative is to be found in the Treaty on the Functioning of the European Union (TFEU). According to Article 11 of TFEU, environmental protection requirements must be integrated into the Union's policies and activities, in particular with a view to promoting sustainable development. Articles 191, 192 and 193 of TFEU further clarify that Union policy preserves, protects, and improves the quality of the environment; protects human health; and promotes measures at the international level to deal with regional or worldwide environmental problems. Article 191 mentions climate change as one such problem in particular. Article 192(1) of TFEU empowers the European Parliament and the Council to decide what action is to be taken by the Union to combat climate change, as an objective of the Union policy per article 191(1) TFEU.

3.2. Necessity (why EU action) and subsidiarity (why EU action instead of Member States)

Climate change is a trans-boundary problem where coordinated EU action can supplement and reinforce national and local action effectively. Thus, individual action is unlikely to lead to optimal outcomes and action at EU level is therefore indispensable. The EU has worked since the UNFCCC was established to develop joint solutions and

[18] At the same time, implementing policies foreseen in Member States' national energy and climate plans would deliver a greenhouse gas emissions reduction of 32% relative to 2005 in the effort sharing sectors.

drive forward a European approach to fight climate change. Coordinated EU action can effectively supplement and reinforce national and local action. Coordination at the European level enhances climate action and EU action is thus justified on grounds of subsidiarity in line with Article 191 of the Treaty on the Functioning of the European Union.

The reduction of greenhouse gas emissions across the European Union benefits from coordination at the EU level given the EU's single market. An increase in the 2030 target for EU GHG reductions will impact all sectors included under the current Effort Sharing Regulation.

Action at the EU level is therefore indispensable and coordinated EU policies have a much bigger chance of leading to a true transformation towards a climate neutral economy by 2050, while avoiding fragmentation of the internal market. Coordinated action at the EU level furthermore facilitates the full consideration of the different capabilities to act among Member States. The EU single market moreover acts as a strong driver for cost-efficient change.

The impacts of such ambition increase and related policies on growth and jobs creation, fairness and cost-effectiveness are examples of elements that can be better considered at the EU level.

Coordinated EU policies have a much bigger chance of leading to a true transformation, particularly in light of the global dimension of the challenge. This approach must take into account different mitigation potential between Member States, as well as the EU single market as a strong driver for cost-efficient change and upward convergence.

Coordinated EU action is therefore needed to achieve the EU-wide 55% net GHG reductions for 2030, in particular to ensure a cost-efficient and fair distribution of efforts across the EU and its Member States. Also Norway and Iceland have committed to the same GHG ambition levels as the EU and in 2019 joined the EU's effort sharing[19].

Nevertheless, the role of Member State action is crucial to achieve the increased overall EU ambition, in particular in areas where the competence for specific policies and measures lies mainly with Member States for reasons of subsidiarity. The responsibility for continued progress up to 2030 will have to be shared, as is already the case in current climate and energy package, which lays down EU and Member State obligations until 2030, including an EU governance system with their National Energy and Climate Plans[20]. The legally binding national targets under the Effort Sharing Regulation leave it to Member States to decide how to achieve them allowing for certain flexibilities between Member States and other legislative instruments, such as LULUCF and ETS, fully respecting the principle of subsidiarity.

[19] Decision of the EEA Joint Committee 269/2019 of 25 October 2019.
[20] https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting_en

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives

The general objectives of this initiative is to reach at least 55% net greenhouse gas emission reductions by 2030 compared to 1990, in line with the 2030 Climate Target Plan, with a view to achieving climate neutrality (i.e. net zero GHG emissions) by 2050 in a gradual and balanced way. This articulation of targets and objectives requires a coherent strengthening of the policy architecture, including the Effort Sharing Regulation.

4.2. Specific objectives

There are three specific objectives for the review of the Effort Sharing Regulation:

The first specific objective is to define the scope of the ESR so that it remains coherent with other related and proposed legislation of the Fit for 55 package, as well with the overall architecture incentivising a cost-efficient contribution of all sectors to meet the overall objective. This is of particular importance in view of the interactions of ESR scope and ambition with the possible ETS extension and of considerations on a joint instrument for agricultural and LULUCF emissions (Land Use instrument), taking into account also linkages with other instruments in the 2030 Climate and Energy package (the Energy Efficiency Directive, the Renewable Energy Directive, the Energy Taxation Directive and the Regulation on the Governance of the Energy Union and Climate Action – amongst others).

The second specific objective is that additional efforts should be shared in a consistent, fair and equitable manner between Member States. Fairness is a core principle of the effort sharing legislation. A key element in this kind of legislation so far has been to correlate the ambition level of national targets with national economic capacity, and there is clear guidance from the European Council that this correlation ought to be maintained. The ambition should also be consistent with the national energy and climate plans for 2030 as starting point for additional efforts, reflecting national circumstances as called for by the European Council.

The third specific objective is to promote cost-efficient solutions for further reducing emissions in effort sharing sectors. In the current ESR this is done by some target adjustments and the appropriate design of targeted flexibilities. This implies:

- Ensuring that the set targets are achievable with reasonable efforts, taking into account differences in cost-efficient mitigation potentials between Member States,
- Providing sufficient flexibility over time and across Member States in the attainment of ESR targets,
- Providing appropriate flexibility between ETS, LULUCF and ESR sectors.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1. What is the baseline from which options are assessed?

The baseline for this initiative is the continuation of the current Effort Sharing Regulation (EU) 2018/842 (ESR) as adopted in 2018, without any changes. In modelling terms, this is reflected in the EU Reference Scenario 2020.

The Reference scenario assumes the full implementation of existing climate, energy, transport and energy policies[21]. For climate it includes the revised ETS Directive[22], the Effort Sharing Regulation[23], and the LULUCF Regulation[24], and it assumes the achievement of the target of at least 40% GHG reductions by 2030. For energy it includes the Energy Efficiency Directive and the Renewable Energy Directive[25]. For a detailed description of the Reference scenario see Annex 10.4[26].

In this respect, it is important to note that the Reference scenario is based on the implementation of existing EU measures as well as the National Energy and Climate Plans ("NECPs") foreseen by the Regulation on the Governance of the Energy Union and Climate Action[27]. The Reference scenario focusses on a bottom up representation of these national contributions to achieve the national renewable energy and energy efficiency policies and targets, as these are set out in the NECPs as well as existing policies related to non-CO2 emissions.

While the Reference scenario projects a limited overachievement of the EU 32% target for renewable energy, it also projects an underachievement of around 3 percentage points for the 32.5% energy efficiency target. At EU level, it projects for the ESR, an overall reduction of emissions of 32% by 2030 as compared to 2005. This is in line with the aggregation of the Member States' NECPs which estimates the EU wide aggregate reduction of emissions for ESR sectors at -32%[28]. Thereby full implementation of current policies see a collectively overachievement of the EU-27 wide target of -29% as outlined in the ESR[29]. Nevertheless, it must be noted that while the projections in the Reference scenario achieve broadly the national renewable energy and energy efficiency ambition of the NECPs, they do not always match fully the GHG reductions at Member States' level referred to in the NECPs.

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[21] This includes measures from the "Mobility Packages" published in 2017-2018 such as the CO2 standards for cars and vans, as well as trucks, the Alternative Fuels Infrastructure Directive, the Clean Vehicles Directive, and the Euro vignette Directive. Regarding non-CO2 emissions measures included of importance are the F-gas Regulation, the waste legislation including the Landfill Directive, the Nitrate Directive as well as the Common Agricultural Policy.
[22] As amended by Directive (EU) 2018/410
[23] Regulation (EU) 2018/842
[24] Regulation (EU) 2018/841
[25] Directive (EU) 2018/2001
[26] The EU Reference Scenario projects the impact of combined measures with the PRIMES – CAPRI - GAINS – GLOBIOM modelling tools. This allows to see economy-wide interactions in a coherent manner.
[27] Regulation (EU) 2018/1999
[28] COM(2020)564 final
[29] The ESR EU target with the United Kingdom (i.e. EU-28) was set at 30%. Without the UK in the EU (i.e. EU-27), this target is fixed at 29%.

5.2. What policy scenarios are assessed?

This impact assessment uses a number of policy scenarios that achieve net 55% GHG emission reductions economy wide by 2030 compared to 1990. They were developed to ensure coherence across the different impact assessments of the "Fit for 55 Package". For more information regarding the policy scenarios, see annex 10.4[30].

These core policy scenarios (MIX, MIX CP, and REG) build further upon the logic of the MIX and REG scenarios as included in the impact assessment supporting the 2030 Climate Target Plan[31], but are based on the updated Reference scenario as baseline.

The central policy scenario used in this impact assessment is the MIX scenario, which assumes an extended emissions trading system in buildings and road transport, combined with additional, medium to high ambition, renewable energy and energy efficiency policies. In the MIX scenario the emission trading system for new sectors is assumed to be separate from the existing ETS, but its parameters are supposed to be set at a level of ambition that would lead to carbon prices similar to those projected for the existing ETS.

The MIX CP scenario also assumes that a separate ETS is implemented for buildings and road transport. In the MIX-CP scenario energy policies are less ambitious resulting in higher carbon prices in the new ETS sectors than the existing ETS. The REG scenario instead assumes no extension of emission trading to new sectors, but delivers increased ambition in the non-ETS sectors by other regulatory interventions and incentives, notably related to very ambitious energy efficiency and renewable energy policies.

Finally a scenario, referred to as 'MIX-NECP-plus' is developed. Whereas the Reference scenario mimics national energy efficiency and renewable energy targets, it sometimes overshoots or undershoots emission reductions in the ESR compared to individual Member States estimates in the NECP. For those Member States where the Reference does not project the achievement of the NECPs ambition in the ESR, the MIX-NECP-plus scenario assumes the achievement of additional reductions compared to the MIX scenario, equal to half of the gap between the Reference and the NECPs. Conversely, for those Member States where the Reference overshoots the NECPs estimates, the MIX-NECP-plus scenario assumes less reductions compared to the MIX scenario equal to half of this gap. This is an alternative manner to recognise better national assumed starting points in the ESR with respect to emission reductions, while still recognising the reduction potential seen in the modelling based on the energy mix goals of the NECPs.

5.3. Description of the policy options

As outlined in the Climate Target Plan, the potential extension of the scope of the ETS to sectors that are currently covered by the ESR, and the potential set-up of a Land Use instrument, warrants an analysis whether the scope of the ESR needs to be changed. This

[30] The EU Reference Scenario projects the impact of combined measures with the PRIMES – CAPRI - GAINS – GLOBIOM modelling tools. This allows to see economy-wide interactions in a coherent manner.
[31] SWD(2020) 177

can have a profound impact on the role of the ESR in the overall climate policy architecture. The main options of this impact assessment therefore relate to potential changes to the scope of the ESR. However, the assessment also allows to draw conclusions on how the ESR can be updated in case of no extension of ETS scope, with the results of the REG scenario representing EU wide cost efficient projections without an extension of the ETS to new sectors.

In addition, the main features of the ESR, in terms of the distribution of targets (based on fairness), and in terms of flexibilities (based on cost-efficiency) vis-à-vis the ETS and LULUCF sectors and across Member States, require the definition of different sub-options, within the different main options for the scope.

5.3.1. Option 1: Keep current ESR sectoral scope in parallel to extending emissions trading

In this option, the scope of the Effort Sharing Regulation is kept unchanged. Impacts of increasing the target in the ESR are assessed through a high and a low ambition level increase.

Furthermore, this option is assessed in terms of what the interactions can be with an expanded Emissions Trading System. This means that some sectors would be covered by both instruments.

The sectors which lend themselves to the extension of the Emissions Trading System most straightforwardly, not least for reasons of the volume of the associated greenhouse gas emissions, are road transport and buildings. The introduction of EU-wide emissions trading for these sectors is being analysed in the impact assessment on the amendment of the Emissions Trading System[32].

Issues to analyse are the distribution of effort across Member States, balancing fairness and solidarity with cost-efficiency, taking into account national circumstances as well as the environmental integrity of the instrument.

Flexibility mechanisms are further instruments to attain this balance.

Lastly, the implications of the two policy variants on the ESR targets on the Governance Regulation, and Member States' NECPs and related reporting and monitoring, also warrant consideration.

<u>Option 1.1: Parallel coverage ETS/ESR, strong increase in ESR ambition</u>

A strong increase in overall ESR target is analysed under this option. This corresponds to the cost-efficient contribution of the relevant sectors – the current ESR sectors within an unchanged scope – to the 55% overall net GHG emissions reduction target.

[32] It is assumed in this Impact assessment that in the emission trading system for the new sectors is kept separate from the current ETS (no link or gate-way).

This option implies a reduction of emissions in these sectors by 39% to 40% relative to 2005, which is an increase of 10 to 11 percentage points relative to the baseline.

For the distribution of the increased ambition in the ESR the following sub-options are considered:

- **Target option 1.1.1**: baseline, where the distribution of targets is purely based on an update of the GDP/capita data methodology used under fairness target setting (see 5.1).
- **Target option 1.1.2**: based on the same GDP/capita data methodology but with additional adjustments to reflect cost-efficiency concerns

The appropriateness of the current flexibility mechanisms is particularly relevant. For the EU-27, the current energy and climate framework allows for a limited ESR-ETS flexibility of up to 100 million tonnes, and up to 262 million tonnes are available for ESR-LULUCF flexibility for Member States who overachieve their LULUCF commitment. As regards the LULUCF flexibility, this will need to be assessed also in the light of the requirements foreseen under the Climate Law.

For both target options it will be assessed what the impact would be of continuing or discontinuing the current ETS and LULUCF flexibility. In the case of continuing them, the assessment considers what could be changed, also taking into account considerations following the Climate Law.

Option 1.2: Parallel coverage ETS/ESR, limited increase in ESR ambition and in flexibilities

The introduction of a new expanded ETS has raised the question if this should lead to a reduced ambition update in the ESR.

This option considers the impact of setting a target equivalent to emission reductions of around 35% relative to 2005 in the effort sharing sectors. This would set the target in the ESR at a level lower than what the projections see fit as contribution by the sectors to the overall economy wide GHG target.

The assessment will focus notably on how the ESR would interact with an expanded EU ETS that has a target set at a level in-line with cost efficient emission reduction projections, given the significant synergies between the two systems.

5.3.2. Option 2: Maintain in the ESR only the sectors not covered by emissions trading

A second option is a scope reduction of the Effort Sharing Regulation mirroring the extension of the EU Emissions Trading System to road transport and buildings, keeping these two instruments separate.

In this context it will be assessed what the impact would be of keeping the ESR targets at current level, but applied to this reduced scope, or to increase them in line with cost-efficient projections.

For both variants, in view of differences in the role of the sectors shifted to the ETS, the distribution of effort across Member States needs to be revisited, with particular attention to differences between fairness and cost-efficiency and the role and impact of existing LULUCF and ETS flexibility.

Option 2.1: ESR reduced scope without buildings and transport, targets increased to cost-efficient ESR ambition level

The first variant studies the cost-efficient ambition level for the reduced-scope effort sharing sectors for the overall 2030 target of -55 % relative to 1990. This is projected to be around -35 % relative to 2005.

Option 2.2: ESR reduced scope without buildings and transport, current ESR targets maintained

The second variant is to keep the current national ESR targets unchanged. In the reduced ESR scope the application of national targets reduces the scale of required reductions to -27 % relative to 2005 for the EU-27.

The assessment will also look in a more limited manner at what would happen if the scope of the ESR is further reduced with all fossil fuel combustion emissions being removed from the ESR scope (and thus assuming that all these sectors would be covered in an expanded ETS). In this case the ESR would be left to cover agricultural and energy-related non-CO2 emissions, some industrial process emissions – not related to fuel combustions –, F-gases and waste and wastewater related methane emissions, covering to date about one third of the present effort sharing sector emissions. Some instruments put strong constraints on some of these emissions to date (solid waste and F-gases) while for other emissions (energy, agriculture and waste water) there are no sector specific policies that put effective caps on their non-CO_2 emissions.

5.2.3. Option 3: Phase out of the Effort Sharing Regulation and replacement by other policy instruments

This option foresees a phase-out of the ESR following on the one hand an extension of the ETS to all fossil fuel combustion emissions and, on the other hand, covering agriculture and the LULUCF sector with a single climate policy instrument with its own objectives and rules.

A repeal or phase-out of the Effort Sharing Regulation would necessitate appropriate regulation for the remaining limited greenhouse gas emissions not covered by either the extended ETS or the new land instrument. This applies in particular to emissions from waste water treatment installations, and methane emissions from fossil fuel based energy installations.

5.4. Effort Sharing Regulation options discarded at an early stage

The following options have been discarded at an early stage:

- ESR ambition levels which go beyond cost-efficient projected contributions given that this would not facilitate a cost-efficient sharing of efforts between Member States and between sectors. It is to be noted that Member States have the option to aim for more ambition beyond the binding national targets as enshrined in the ESR. The policy scenarios as used for this impact assessment do typically show for a number of Member States overachievement of their target if policies are implemented cost efficiently across the EU.
- An ESR scope that is reduced by more than the sectors that are covered by an ETS extension as envisaged in the climate target plan, i.e. where the ESR scope would be reduced to cover only non-CO2 emissions other than agriculture. This is seen as a scope not viable for a full ESR system, and the option assessed (see option 3) is rather to phase-out the ESR in this case.
- In case of the policy option to include maritime transport in the EU ETS, which includes also part of the domestic navigation emissions, the option to remove domestic navigation emissions from the ESR scope was discarded at an early stage.

In its current form, the Effort Sharing Regulation covers emissions from domestic navigation. This includes emissions from fuels used by vessels that depart and arrive in the same country[33]. In 2018, domestic navigation emissions represented around 16.6 MtCO2eq, i.e. around 11% of all international and domestic navigation emissions as reported in the EU GHG inventory.

The possible extension of emissions trading to at least intra-EU maritime transport, as called in the Climate Target Plan communication, could have some implications on the scope of the ESR. Different options could be envisaged.

If, on one hand, the scope of the ESR were to be maintained, it would create an overlap between the domestic navigation emissions covered by the EU ETS and the ESR. It would provide an opportunity for Member States to continue taking subsidiary action to reduce emissions from domestic shipping. In addition, the overlap would only be partial as a substantial part of these domestic navigation emissions might not actually fall under the emissions trading system, if this one is based on the EU maritime transport MRV regulation that neither cover inland shipping, nor emissions from ships below 5 000 gross tonnage such as small ferries, motor boats or workboats, nor ship movements and activities not serving the purpose of transporting cargo or passengers for commercial purposes, such as dredging, ice-breaking, pipe laying or offshore installation activities. According to the EU maritime transport Regulation, the ships below 5 000 gross tonnage are estimated to represent 45% of all ships calling into EU ports and around 10 % of all

[33] Domestic navigation does not include emissions from fishing vessels, which are included in the ESR under the inventory category agriculture/forestry/fisheries.

maritime transport related emissions. A large share of these ships are assumed to be involved in domestic navigation.

Alternatively, another option would be to reduce the scope of the ESR by only deducting the domestic emissions that are covered by the ETS. Such an option would be difficult to implement in practice as the EU maritime transport MRV regulation considers domestic emissions as intra-EEA emissions and because it does not allow disaggregating navigation emissions per EEA countries.

It is therefore assumed that emissions from domestic navigation would continue being covered under the ESR.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1. Option package 1: Keep current ESR sectoral scope unchanged

Option 1 is the option where the ESR sectoral scope is kept unchanged and where emission trading is potentially introduced in new sectors, notably the building and road transport sectors, at the same time.

Two options are assessed. Under option 1.1 where the collective target at the EU level is increased in-line with cost efficient projections resulting in an increase from around 29% currently to 40% emissions reductions by 2030 compared to 2005. A second intermediate option, 1.2, sees an intermediate target increase of 35%.

The majority of stakeholders' views in the public consultation wanted to maintain the current scope of the ESR. NGO's in particular did not see a new ETS as a policy tool that should replace the ESR or result in a reduced scope for the ESR. This was also the main message stemming from the social media campaign launched to reply to the ESR open public consultation, to which 45,500 EU citizens contributed. A number of Member States rather indicated that they wanted to see how an extended ETS would work before deciding to reduce the scope of the ESR. Business replies were more diverse. A significant share of stakeholders representing the energy sector supported that the ESR scope could be reduced if an ETS were expanded in the future. A majority of stakeholders was in favour of continuing to include agricultural non-CO2 emissions under the ESR. No stakeholders, nor Member States asked to expand the ESR to existing ETS sectors (see section 10.2.2).

As regards ambition, 94% of stakeholders (229) agreed with increasing the ESR ambition level in line with Member States stepping-up their efforts and pursuing more ambitious targets. This is the case because stakeholders such as citizens, NGOs, public authorities and private actors indicated that keeping a stable framework and increasing targets would keep national governments accountable for the climate actions and also in line with the Climate Target Plan. A very limited number of stakeholders from the energy sector (4) did not agree to Member States' increased ambition. They stated that ESR would not need to reflect an increase ambition but rather ETS as a market price driver would be the

driver for bringing down emissions in relevant sectors (including transferring those of building and transport from ETS to ESR).

6.1.1. Efficiency and environmental impacts of the 2030 targets in the ESR

In option 1.1, the ESR target would be set up at 40% reduction of emissions by 2030 compared to 2005. This is an increase relative to the baseline of 11 percentage points. This is fully in line with cost efficient projections across different scenarios.

Table 1: GHG reductions in ESR sectors 2030 compared to 2005 in option 1.1

GHG reductions in ESR sectors in 2030 compared to 2005 (PRIMES base year data for 2005)			
	REG	MIX	MIX CP
EU	-40.6%	-39.9%	-39.0%

Source: Commission Services

If a separate ETS for road transport and buildings is implemented, it would cover a bit more than 50% of total ESR emissions and contribute around 50% of the additional emission reductions required in the coming decade in the ESR sectors. As such it would provide additional means to achieve environmental integrity of the overall ESR target.

If the extension of emission trading would include all fossil fuel CO_2 emissions, the scope would cover around 2/3rd of all ESR emission in the EU, with a similar share of cost-efficient ESR emission reductions projected over the coming decade.

Clearly, the larger the scope of an ETS with a cap set at the level of cost-efficient reduction projections economy-wide, the more the ETS would contribute in achieving the ESR target.

Conversely, the achievement of the ESR cannot be assumed to be only driven by the ETS. Firstly, it does not cover all emissions in the ESR. Secondly, the ESR-driven incentive to undertake action at government level should not be limited to the sectors not covered by the new ETS. In fact, for the sectors covered by a separate ETS, there is no certainty for all Member States that the private sector would deliver an emission profile in these sectors that meets the fairness-based differentiated targets under the ESR. There will thus be a need for those Member States to take national action also in sectors to be covered by the new ETS, or to acquire annual emission allocations (AEAs).

This is an important feature for sectors like buildings and road transport, where alongside efficient pricing incentives, other policies are also important to achieve highly ambitious greenhouse gas emission reductions. Examples are providing the necessary infrastructure, addressing the lack of alternatives (e.g. the development of zero emission cars) and the correction of split incentives. Such policies in turn will reduce the impact of carbon pricing on individual consumers, providing an incentive to all Member States to provide a conducive regulatory framework.

In option 1.2, a lower ambition increase would consider emission reductions of 35% relative to 2005 in the effort sharing sectors.

This option clearly has risks related to environmental integrity. On the one hand one still could expect a separate ETS to drive emission reductions in a significant part of the ESR. On the other hand, even in this case, still around half of the ESR emissions need to be reduced by other regulatory actions. Assuming the new ETS sectors meet their cap, the ESR as a whole may not achieve their required reduction potential (-40%), if the other ESR sectors not included in the new ETS do not see additional reductions. If these other sectors were to simply meet their Reference projections, overall the ESR would achieve -36% emission reductions, which would be compliant with the -35% ESR target but clearly not in line with the required reduction of -40%.

If the ETS scope extension is increased to all fossil fuels, and if these achieve cost efficient reduction projections, and other ESR emissions are kept as projected in the Reference scenario, then the ESR overall would achieve -37% emission reductions, which would be compliant with the -35% ESR target but clearly not in line with the required reduction of -40%. Indeed, missing the ESR target by 2 to 3 percentage points is equivalent to missing the EU wide target of net -55% compared to 1990 by around 1 to 1.5 percentage points.

With all fossil fuels covered by an ETS, most remaining emissions in the ESR would be non-CO2 emissions, representing around 1/3 of the whole ESR currently. Achieving the ESR contribution to the overall -55% target in option 1.2 would thus require significant policy initiatives that, next to existing policies in waste and F-gas emissions, would also limit agriculture non-CO2 and methane leakage in the energy system. Strengthened EU policies related to methane leakage from the energy system as well a revision of the F-gas legislation that may contribute to closing any potential gap in this situation are in fact under preparation.

Conversely, in the largest remaining non-ETS sector, that is, agriculture, achievability of further reductions will depend strongly on the implementation of ambitious CAP strategic plans by Member States. Member States action in this regard clearly would be further encouraged by setting high ambition goals in the ESR in line with option 1.1 rather than option 1.2.

It could be considered to put stopgaps in place in other regulatory instruments that would ensure overall achievement of the net 55% greenhouse gas reduction target. Increasing targets beyond cost-efficient reductions in the existing ETS and the new ETS could increase environmental integrity. This would however imply a risk of higher corresponding economic impacts and an uneven distribution of effort between “ETS covered” and “not ETS covered” ESR sectors.

Finally, by limiting the assessment in this section to the year 2030 only, it does not take into account the potential accumulation of surpluses early in the period resulting from emissions that are lower than the annual emission allocation in early years. These

surpluses can then be used to offset deficits in later years when emissions may be higher than the annual emission allocation. The accumulation of surpluses early in the period could thus reduce also later in the period the incentives to act. This clearly results in bigger environmental risks over time in option 1.2 than option 1.1. This will be assessed in more detail in section 6.1.3.

Conclusion:

From a perspective of efficiency and environmental integrity, option 1.1 clearly gives the strongest incentive to Member States to adopt additional policies to achieve their national target and can facilitate a cost efficient combination of EU and national measures. In this context, it is important to note that many measures for ESR sectors (buildings, road transport, waste, agriculture) are taken at national level for reasons of subsidiarity, and that a significant part of the ESR would not be covered anyway by a new ETS for building and road transport. Option 1.1 is therefore characterised by a combination of carbon pricing, EU measures and national measures, which enhances the ability to deliver targets, and therefore enhances environmental integrity. From an economic perspective, this combination of measures can be important to enhance cost-efficiency of the overall policy because (1) some cost-efficient solutions can only be taken at national or subnational level and (2) such policies can help to unlock the full potential of cost-efficient measures taken at EU level, including the carbon pricing incentive from an extended emission trading to building and road transport.

Option 1.2 does not have the same environmental integrity, and clearly risks missing the required reductions in the ESR sectors. A larger scope of a new ETS to road transport and building sectors, and a higher target in this new ETS, would lower this risk. Similarly, setting higher ambition in the existing ETS or the LULUCF sector, beyond what is needed under the cost-efficient projections, may compensate for this risk, but may create new issues in terms of environmental integrity or cost in those sectors.

6.1.2. National targets and distributional impacts in the ESR

The national targets under the Effort Sharing Regulation for 2030 adding up for EU-27 to -29% compared to 2005 emissions are based on differentiation of efforts depending on relative GDP per capita for 2013 with GDP measured at market prices within a range from 0% to -40% compared to 2005 emission levels.

The view of the majority of stakeholders is that the ambition increase at the EU level of the instrument should be in line with the cost effective reduction potential (such as described in the impact assessment of the 2030 Climate Target Plan). A majority of respondents of the open public consultation supported fairness (i.e. GDP per capita) and cost-efficiency as the key parameters for setting national targets in the ESR, taking into account specific national circumstances. Indeed, 56% of respondents (154) believed fairness is a right criteria, mainly EU citizens, NGOs and business associations. The energy sector expressed mixed views, since while being the most positive sector of activity in favour of fairness criteria (27) it was, at the same time, the relatively larger

sector against (6). As regards cost-effectiveness, a majority of 51% rated it as a positive or very positive criterion, with EU citizens (46) and business associations (47) representing the largest groups in favour. NGOs rated cost-efficiency negatively (17 against and only 6 in favour) as they claimed all Member States should do their best to reduce emissions even if it comes at a higher abatement costs. Public authorities were mostly in favour of this criteria (except 2) since they consider cost-effectiveness a useful and valid distribution key for those countries with higher abatement costs. Most representatives from the energy sector rated positive or very positive this cost-effectiveness criteria, together with building & housing and manufacturing sectors. They considered that cost-effectiveness criteria is valuable when it comes to reflect real abatement costs for GHG emission reductions.

The starting point for calculating the 2030 targets to reach up to 40% reductions in the ESR compared to 2005 emissions is to apply all elements of the previous 2030 methodology with the same differentiation in efforts depending on GDP per capita[34]. In terms of the EU target, the GHG emission limits will have to be reduced by 11 percentage points in the first option 1.1 with high ambition in the ESR and by 6 percentage points in the second option 1.2 with more limited ambition, delivering respectively -40% and -35% (compared to 2005 emissions) as the collective EU target.

It is opted to continue limiting the overall spread in targets in the EU to a range of 40 percentage points (pp) with reductions in option 1 varying in the range of -10% to -50% and in option 2 in the range of -5% to 45%. This is in itself a measure that addresses cost efficiency concerns, as it notably caps the required emission reduction efforts for some high income Member States compared to a situation that only the GDP per capita formula is applied and contributes as such to convergence of efforts across the EU.

Furthermore, updating the target ambition also allows to include more recent data for GDP per capita to better reflect capacity to act. This section includes therefore an update from the 2013 data to more recent and stable 2017-2019 data. By taking a more recent base year for target calculation the capacity to act is most representative of the updated timeframe and by averaging it out over 3 year one avoids annual variability issues, which can be seen as an improvement of the applied methodology.

Table 2 below represents the current national emission reduction targets in 2030 for the ESR. It furthermore includes the increase required to achieve an overall 40% target and 35% target in the ESR based an update of the GDP per capita formula only. In brackets the unbound result of the formula is represented (before applying the range). The approach includes also limited deviations for Greece, Latvia and Slovenia as included in the 2020 targets under the Effort Sharing Decision to address specific Member State concerns and as maintained in the target setting approach under the current Effort Sharing Regulation.[35] Figure 6 and Figure 7 below represent the same information

[34] SWD/2016/0247 final
[35] Slovenia, Latvia and Greece receive a target correction of respectively 3 pp, 2 pp and 1 pp.

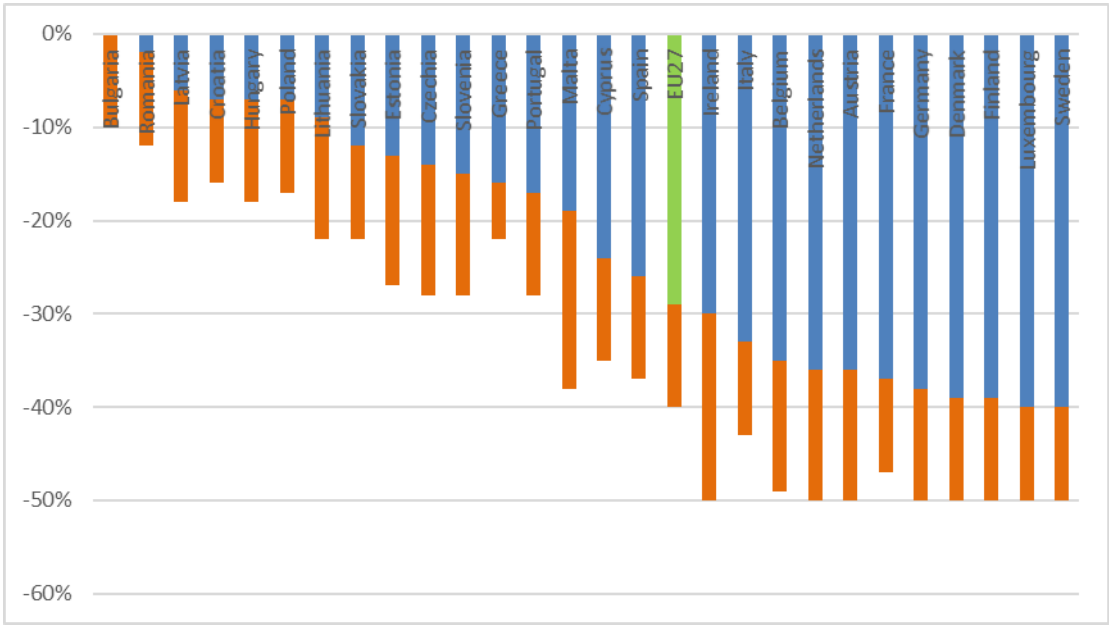
respectively for a step up in ambition to -40% and -35% compared to 2005 emissions. From this assessment, Ireland and Malta are the two Member States with the highest target increase (in percentage points) compared to the existing 2030 targets.

Table 2: Comparison of current emission reduction targets in 2030 delivering -29% and targets based on GDP/cap formula using 2017-2019 data delivering -40% (option 1.1.) and delivering -35% (option 1.2.)

EU-27 / Member State	Current ESR 2030 target	ESR Review 2030 target delivering -40% (option 1.1.)	ESR Review 2030 target delivering -35% (option 1.2.)
		Target based on GDP/capita formula update, bound to a range of -10% to -50% [unbound target]	Target based on GDP/capita formula update, bound to a range of -5% to -45% [unbound target]
EU-27	**-29%**	**-40%**	**-35%**
Belgium	-35%	-49%	-44%
Bulgaria	0%	-10% [-8%]	-5% [-3%]
Czechia	-14%	-28%	-22%
Denmark	-39%	-50% [-55%]	-45% [-50%]
Germany	-38%	-50%	-44%
Estonia	-13%	-27%	-22%
Ireland	-30%	-50% [-62%]	-45% [-57%]
Greece	-16%	-22%	-17%
Spain	-26%	-37%	-32%
France	-37%	-47%	-42%
Croatia	-7%	-16%	-11%
Italy	-33%	-43%	-38%
Cyprus	-24%	-35%	-30%
Latvia	-6%	-18%	-13%
Lithuania	-9%	-22%	-17%
Luxembourg	-40%	-50% [-77%]	-45% [-72%]
Hungary	-7%	-18%	-13%
Malta	-19%	-38%	-33%
Netherlands	-36%	-50% [-52%]	-45% [-47%]
Austria	-36%	-50% [-51%]	-45% [-46%]
Poland	-7%	-17%	-11%
Portugal	-17%	-28%	-23%
Romania	-2%	-12%	-7%
Slovenia	-15%	-28%	-23%
Slovakia	-12%	-22%	-17%
Finland	-39%	-50%	-45%
Sweden	-40%	-50% [-53%]	-45% [-47%]

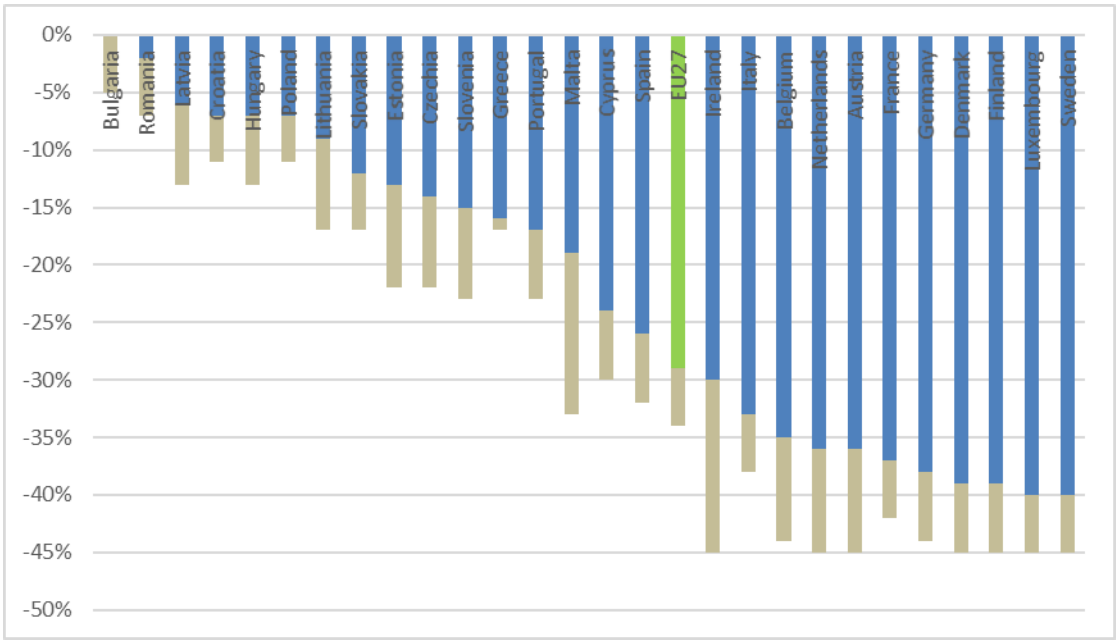
Source: Commission Services using EUROSTAT data on GDP per capita[36]

Figure 6: Option 1.1. national targets based on GDP/cap formula using 2017-2019 data under option 1.1 delivering -40% GHG reductions in ESR (in orange) as compared to current legislative ESR target (in blue)



Source: Commission Services using EUROSTAT data on GDP per capita for 2017-2019

Figure 7: Option 1.2. National targets based on GDP/cap under option 1.2 delivering -35% GHG reductions (in grey) as compared to current legislative ESR target (in blue)



[36] See in Annex 10.5.2 for the data used from Eurostat.

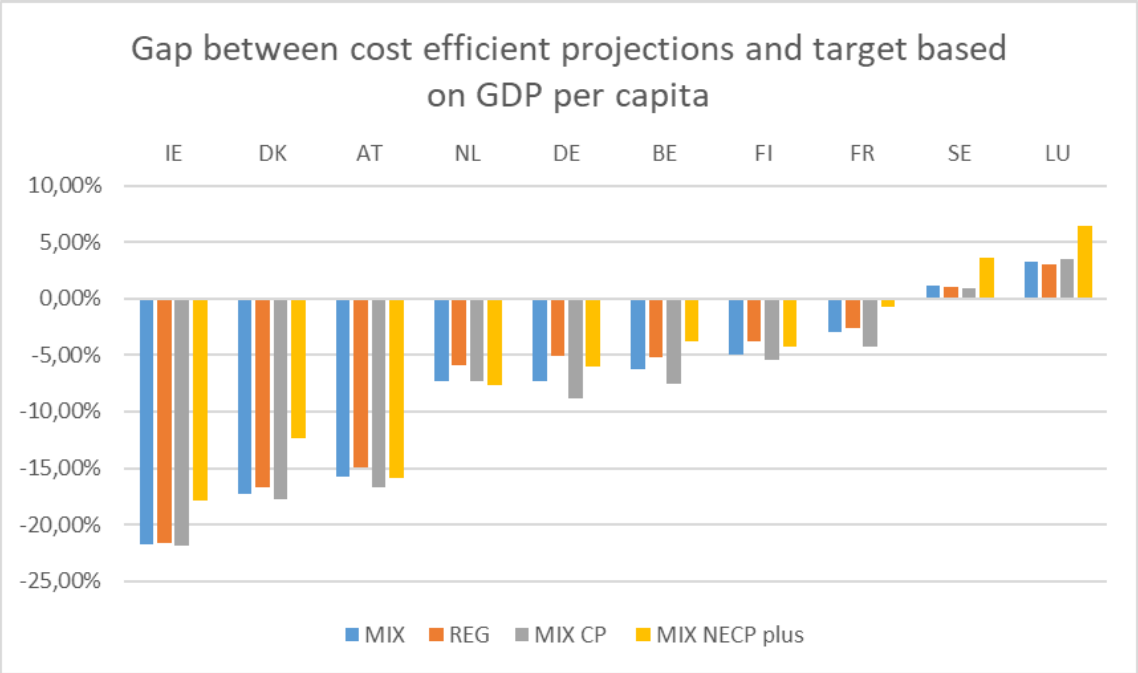
Source: Commission Services using EUROSTAT data on GDP per capita for 2017-2019

Cost efficiency adjustments

The current ESR targets are based on GDP per capita data but also include specific adjustments to take into account that for certain high income Member States a target based purely on GDP is substantially more ambitious than the cost-efficient contribution. High income Member States are Member States with a GDP per capita above the EU-27 average.[37]

Figure 8 below represents the gap, for high income Member States, between a target based only on the GDP per capita formula and cost efficient emissions projections in the ESR from the updated MIX scenario as well as a number of different emission reduction scenarios that also achieve economy wide 55% GHG reductions in the EU.

Figure 8: Gap in 2030 between GDP per capita -based targets and cost-efficient EU emission reductions for high income Member States (as pp of 2005 emissions) to achieve overall -40% GHG reductions in the ESR



Source: Commission Services

[37] The group of high income Member States applied in this impact assessment are those Member States that have a GDP per capita above the EU-27 GDP per capita calculated as the average over the years 2017, 2018, and 2019.

Without adjustments, high income Member States would be expected to reduce emissions more than their respective cost efficient reduction potential. These results are structurally similar to those obtained in 2016 for high income Member States.

Within the group of high income Member States, the following main sub-groups could be distinguished (Table 3):

Table 3: Grouping of high income Member States according to gap between cost efficient projections and GDP per capita (avg. 2017-2019) based targets achieving -40% GHG reductions in the ESR

High Income Member States			
Group 1 No or very low cost efficiency gap (well below 5 pp)	**Group 2 Low cost efficiency gap (well below 10 pp)**	**Group 3 High cost efficiency gap (around 15 pp)**	**Group 4 Very high cost efficiency gap (above 20 pp)**
LU, SE, FR	DE, NL, FI, BE	AT, DK	IE

Source: Commission services (based on MIX scenario)

Sweden and Luxembourg have no gap, even with high reduction targets. Ireland instead shows the largest gap, in part driven by the large share of agriculture non-CO_2 emissions in their emission profile. For all high income Member States, except Austria and the Netherlands, the MIX NECP plus scenario outperforms the MIX scenario. This indicates that typically our reference projection is conservative compared to what higher income Member States have planned in their NECPs regarding the ESR emissions. It shows that high income Member States in current NECPs are ready to take action and reduce emissions beyond cost-efficient levels.

In order to reflect high income Member States' differences between their cost-efficient reduction potential and targets based on GDP per capita only, a limited cost efficiency adjustment to the GDP based targets can be made, similar to what was done for the current 2030 ESR targets. The aim is to smoothen part of the differences between high income Member States, based on a cost efficiency reflective adjustment: group 1 contributes with 0.5 pp of additional reductions (but capped at -50%); group 2 stays with the targets defined by their GDP per capita; and groups 3 and 4 receive a less ambition target (for group 3 this adjustment is set at the same level as for the current target redistribution for cost efficiency reasons, that is, a decrease by 3 pp in the 2030 point target).

Ireland is a specific case as the cost efficiency gap for Ireland is particularly high. The target for Ireland has increased significantly due to the update in GDP per capita data from 2013 data to average 2017-2019 data. Ireland has seen strong upward revisions in its GDP since 2013 resulting in a target increase based on the GDP per capita formula of 23pp. Even with a target correction of 9 pp., as is currently made for Ireland in the ESR,

Ireland would still have a 50% target, 20 pp higher than their current 2030 target, which was set at 30% after target correction. What is specific about Ireland is that its GDP is already significantly higher than its GNI, and its GNI grew at a lower rate. Would targets be calculated based on GNI, then the target based formula would give Ireland a -55% target, which would result in a -46% target with a 9 pp target correction. Due to the exceptionally large cost efficiency gap in Ireland, the currently applied 9 pp. target correction for Ireland will be assessed for a target based on GNI. Table 4 gives the resulting target corrections.

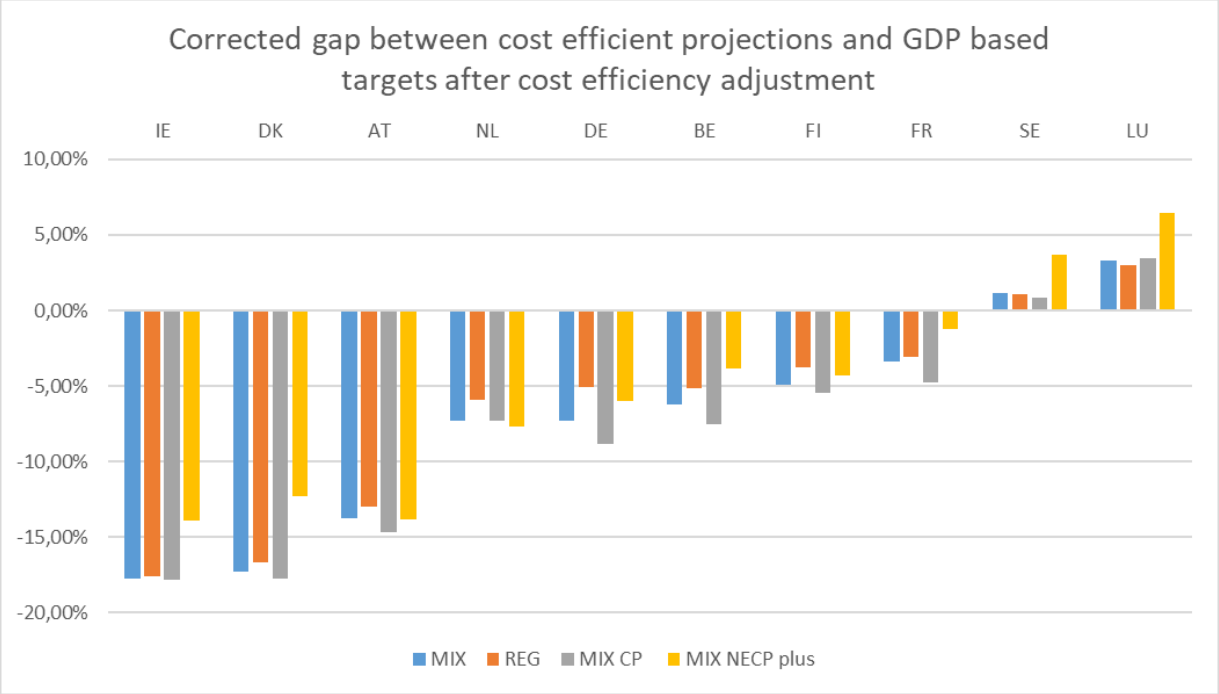
Table 4: Target correction for high income Member States under option 1.1

	Target correction	ESR Review 2030 target delivering -40% (option 1.1)	
		Target based on GDP/capita formula update, bound to a range of -10% to -50% [unbound target]	After target correction
Austria	3 pp	-50% [-51%]	-48%
Belgium	0 pp	-49%	-49%
Denmark	3 pp	-50% [-55%]	-50%
Finland	0 pp	-50%	-50%
France	-0,5 pp	-47%	-47,5%
Germany	0 pp	-50%	-50%
Ireland	9 pp GNI based	-50% [-62%]	-46%
Luxembourg	-0.5 pp	-50% [-76%]	-50%
Netherlands	0 pp	-50% [-51%]	-50%
Sweden	-0.5 pp	-50% [-53%]	-50%

Source: Commission services

As can be seen from Figure 9 below, the differences in gaps between Member States are reduced with such a gap correction, though not to such an extent that the relative rankings change much.

Figure 9: Gap in 2030 between GDP per capita -based targets with a limited target correction and cost-efficient EU emission reductions for high income Member States (as a % of 2005 emissions) to achieve overall -40% GHG reductions in the ESR



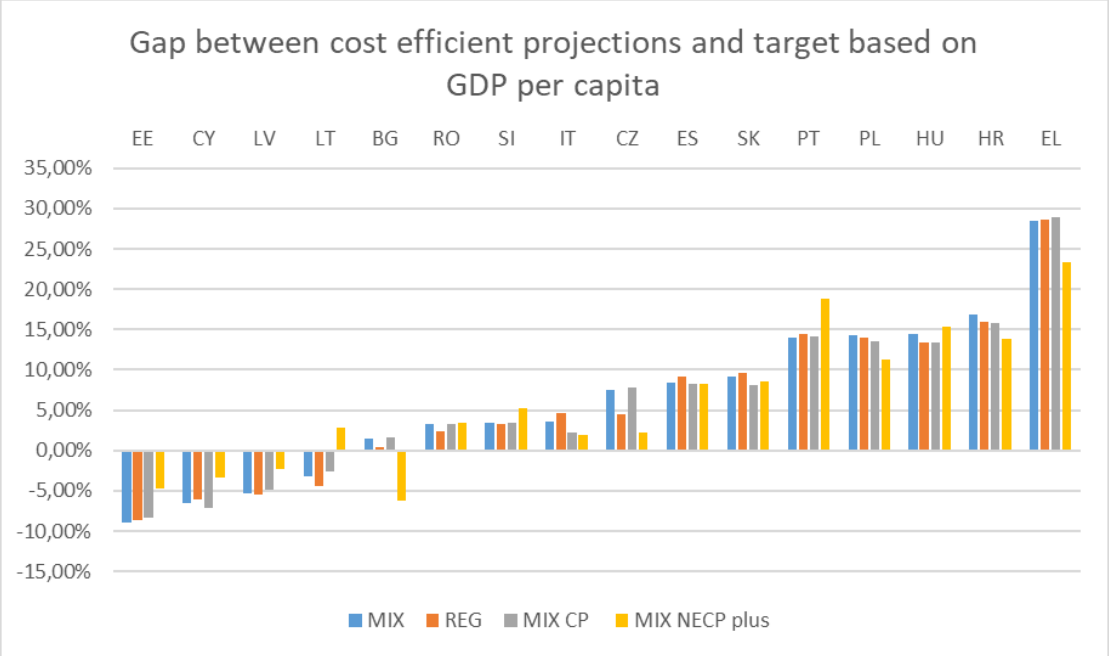
Source: Commission Services

Figure 10 below represents the gap in low and middle income Member States between a GDP per capita target based only on the GDP per capita formula and cost efficient emissions projections in the ESR.

Generally, low and middle income Member States, i.e. Member States with a GDP below the EU average, see emissions decrease more when achieving their cost efficient reduction potential than the target they would receive.

Figure 10: Gap (-) in 2030 between GDP per capita-based targets and cost-efficient EU emission reductions for low and middle income Member States (as pp of 2005 emissions) to achieve overall -40% GHG reductions in the ESR[38]

[38] The most significant exception, and not represented in the figure is Malta. This Member State has a gap of around 69 pp between its GDP based emission reduction target and its cost-efficient emission reductions in modelling based on the most recent Reference scenario. This is because of particular developments related for instance to population development, build-up of housing stock and F-gas emissions from air conditioning systems. The projections are also in-line with Malta's own 'with additional measures scenario' that still sees emissions increase by 41% compared to 2005 emissions by 2030.



Source: Commission Services

For many low and middle income Member States, the MIX NECP plus scenario underperforms compared to the MIX scenario. This indicates that typically our reference projection is optimistic compared to what lower income Member States have planned in their NECPs regarding the ESR emissions. But even taking into account the more pessimistic starting point of the NECPs in the MIX NECP plus scenario, overall the picture remains the same.

Estonia, Cyprus, Latvia and Lithuania face a negative gap between their GDP based target and their cost efficient emission reductions, which is however more modest than for those high income Member States that receive a target correction. Instead, the gap for Malta, using the latest projections is of the order of magnitude of 55 pp.

A target correction for Estonia and Cyprus of 3 pp and Lithuania and Latvia of 1 pp would reduce their gap but not eliminate it. Important in this context is also to assess what the potential role may be of notably the LULUCF flexibility, which under the existing ESR is also available to this group of countries (see section 6.1.4).

Given this level of target correction is small (at levels less or up to the correction applied in the group 3 of the high income Member States) and due to the size of these countries, this would not majorly negatively impact the overall environmental integrity at the EU level.

For Malta the large gap between its calculated GDP based target and its projected cost-efficient emissions merits considering an approach with a higher target correction. With the gap running into levels of around 55 pp., even a GDP based target reduction of 19 pp. (to a level of -19%, which is equal to its current target) would still result in a gap of around 36%.

Convergence of targets

The distribution of efforts among Member States based on the continued application of the formula based approach as used for the existing Effort Sharing Regulation, together with an update based on most recent GDP per capita data, has as a consequence that while at the EU level the collective target increase compared to the existing 2030 target is 11 pp, a number of Member States see significantly higher increases in their individual targets. This is not beneficial to improve convergence of targets between Member States. Assuming Member States will try to meet targets domestically, higher target increases may be more challenging to implement and lead to higher cost concerns.

Therefore, in order to contain target increases closer to the increase in the collective target, an additional correction is assessed: no Member States should see its target increase by more than 12 pp. The application of this cap limits the target (further) for a few high, middle or lower income Member States. Taking into account the potential target corrections as discussed above, it would correct the target of Ireland by a further 4 pp, the targets for Belgium, Czechia, and the Netherlands by 2 pp and the target for Slovenia by 1 pp. It is further noted that Austria, Estonia, Lithuania and Malta are already within the 12 pp cap due to the potential cost efficiency adjustments explained above. If these correction for cost efficiency would not have been introduced, they would have benefited also from this 12 pp limitation in target increase.

This type of target correction would of course require an increase in target of other Member States to ensure environmental integrity. This should not be expected from Member States that have a gap when comparing cost efficient projections with updated target, that already have contributed to a target correction or that are already at the boundaries of the target range. Thus in order not to jeopardise environmental integrity, the targets for Member States with no gap, i.e. Croatia, Greece, Hungary, Italia, Poland, Portugal, Romania, Slovakia, and Spain, are increased by 0.7 pp to ensure the ESR delivers on a -40% emission reduction compared to 2005.

The result of the 12 pp cap on the target increase can thus address cost efficiency concerns and leads to more reduced variance (and thus improved convergence) of Member States' targets compared to a target setting approach that has no such cap on target increase.

Table 5: Overview of potential target corrections and resulting targets under option 1

Overview of potential target corrections Member States under option 1.1.EU-27 / Member State	Target based on GDP/capita formula update, bound to a range of -10% to -50% [unbound target]	Cost Efficiency correction based on gap assessment [applied on unbound target]	Correction for 12 pp cap [applied after cost efficiency correction and after bounded target]	Target after corrections
EU-27	**-40%**			**-40%**

Belgium	-49%		2 pp	-47%
Bulgaria	-10% [-8%]			-10%
Czechia	-28%		2 pp	-26%
Denmark	-50% [-55%]	3 pp		-50%
Germany	-50%			-50%
Estonia	-27%	3 pp		-24%
Ireland	-50% [-62%]	9 pp (GNI based)	4 pp	-42%
Greece	-22%		-0.7 pp	-22.7%
Spain	-37%		-0.7 pp	-37.7%
France	-47%	-0.5 pp		-47.5%
Croatia	-16%		-0.7 pp	-16.7%
Italy	-43%		-0.7 pp	-43.7%
Cyprus	-35%	3 pp		-32%
Latvia	-18%	1 pp		-17%
Lithuania	-22%	1 pp		-21%
Luxembourg	-50% [-77%]	-0.5 pp		-50%
Hungary	-18%		-0.7 pp	-18.7%
Malta	-38%	19 pp		-19%
Netherlands	-50% [-52%]		2 pp	-48%
Austria	-50% [-51%]	3 pp		-48%
Poland	-17%		-0.7 pp	-17.7%
Portugal	-28%		-0.7 pp	-28.7%
Romania	-12%		-0.7 pp	-12.7%
Slovenia	-28%		1 pp	-27%
Slovakia	-22%		-0.7 pp	-22.7%
Finland	-50%			-50%
Sweden	-50% [-53%]	-0.5 pp		-50%

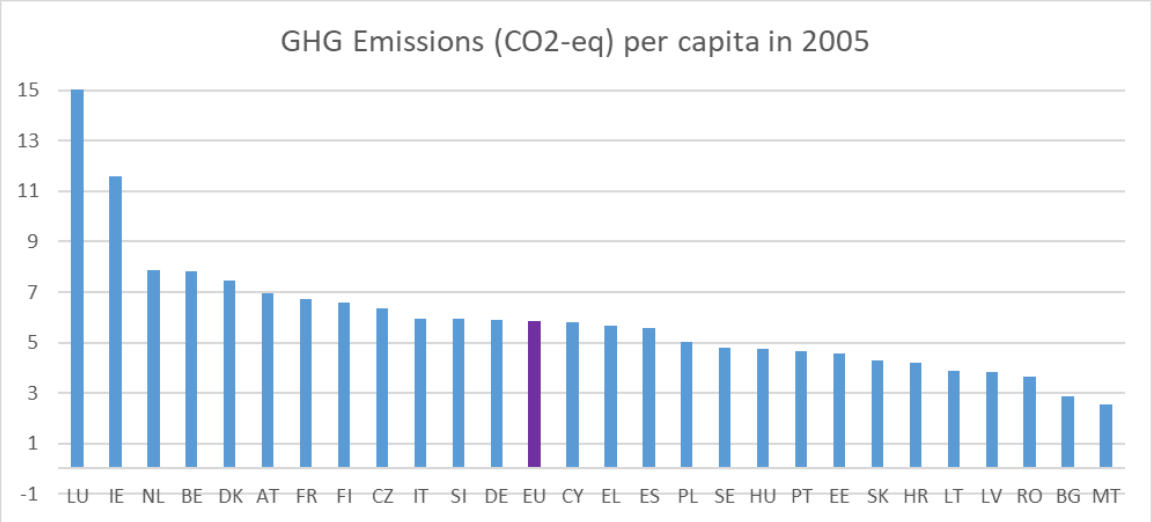
Clearly, for option 1.2 with the more limited GDP based target setting at -35% as compared to -40%, any gaps between the (lower) GDP based target in option 1.2 and the cost-efficient emissions projections (unchanged from option 1.1) would correspondingly be smaller. For more detail on the corresponding potential gap and surplus estimates, see annex 10.5.1.

Convergence to low emissions per capita

The long-term aim to achieve low emissions would require over time a convergence of the per capita emissions to levels that are overall lower than today. Figure 12 shows that with targets set at a level representing the right column in Table 5, strong convergence is expected by 2030. By 2030, 21 Member States have an allocated emissions level per

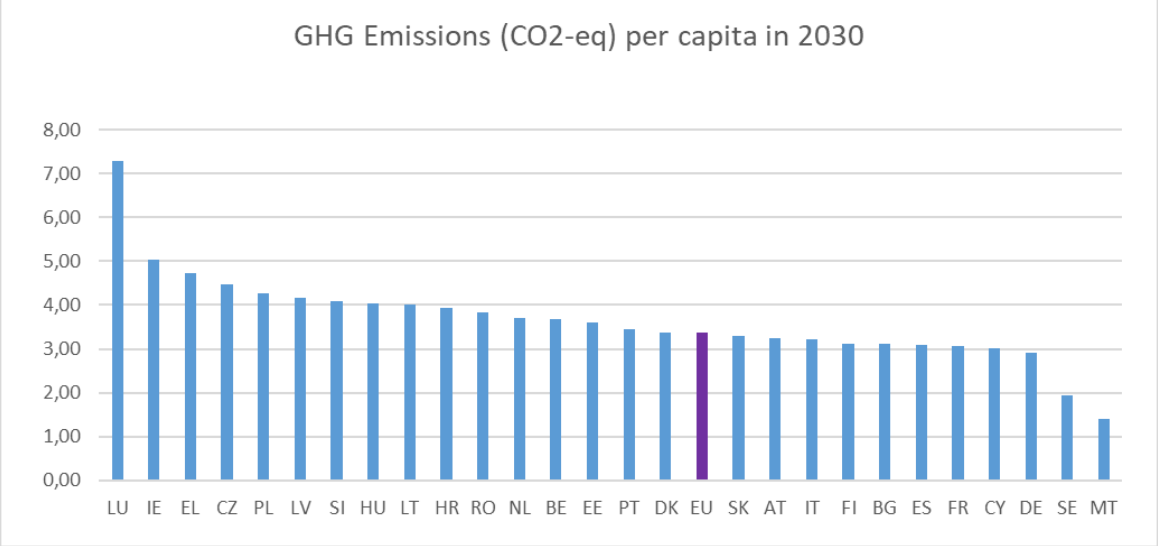
capita within a range of 1 ton around EU average, as opposed to 10 in 2005 (see Figure 11). Two higher income Member States (Luxembourg, Ireland) and two lower income Member State (Czechia, Greece) have allocated emissions per capita above this range. Sweden and Malta have allocated emissions per capita below this range. This convergence is also significant compared to the existing 2030 targets. In reality, actual emissions per capita can deviate in 2030 depending on the extent to which flexibilities are used.

Figure 11 GHG emissions ($CO2_{equivalent}$) per capita in 2005 for each Member State and the EU



Note: the actual figure for Luxembourg is 21,93 which is not visible from the chart.

Figure 12 GHG emissions ($CO2_{equivalent}$) per capita in 2030 for each Member State and the EU



Source: MIX scenario

Conclusion:

In general the GDP/cap approach remains a valid approach in order to distribute the effort among Member States in a fair way reflecting different economic capacity. The choice of the 2017-2019 average reference period for GDP per capita ensures this is based on the most recent, stable economic data.

A detailed comparison with the MIX scenario that achieves a cost-efficient contribution makes clear that for selected high and low or middle-income countries, a limited adjustment gives a fairer distribution of effort. For 2 countries, i.e. Ireland and Malta, a more extensive adjustment is warranted to take into account very specific national circumstances.

In order to avoid a too high target increase for Member States any increase in Member States' targets could be capped. A small target increase for Member States with no gap would ensure the ESR delivers still on a 40% emission reduction compared to 2005.

In addition, the above overall approach would imply that GHG emissions per capita converge strongly by 2030.

6.1.3. Starting point and trajectory in the ESR and environmental integrity

The present set of annual emission allocations (AEA) for the EU-27 Member States draws a trajectory of allowed emissions in the period 2021-2030. In 2030 it translates in a point target equal to 29% reductions by 2030 compared to 2005. The sum of annual allocations over the period provides for an AEA budget in that decade of 19,944 Mt CO_2eq, close to 20 Gt.

In the reference scenario, Member States' aggregate emissions are projected to cumulate in 2021-2030 to 19346 Mt CO_2eq. This reflects a limited 2030 target overachievement planned in the NECPs (-31% reductions achieved in the ESR) and the significant impact of COVID-19 reducing emissions in 2020[39].

With policy changes to promote faster decarbonisation as modelled in the MIX scenario, EU-27 greenhouse gas emissions are projected to decrease cumulative by around 1.1 Gt compared to the Reference scenario.

The MIX scenario foresees a fair degree of progress with decarbonisation already in the first half of the next decade. But there is high uncertainty what the impact or COVID will

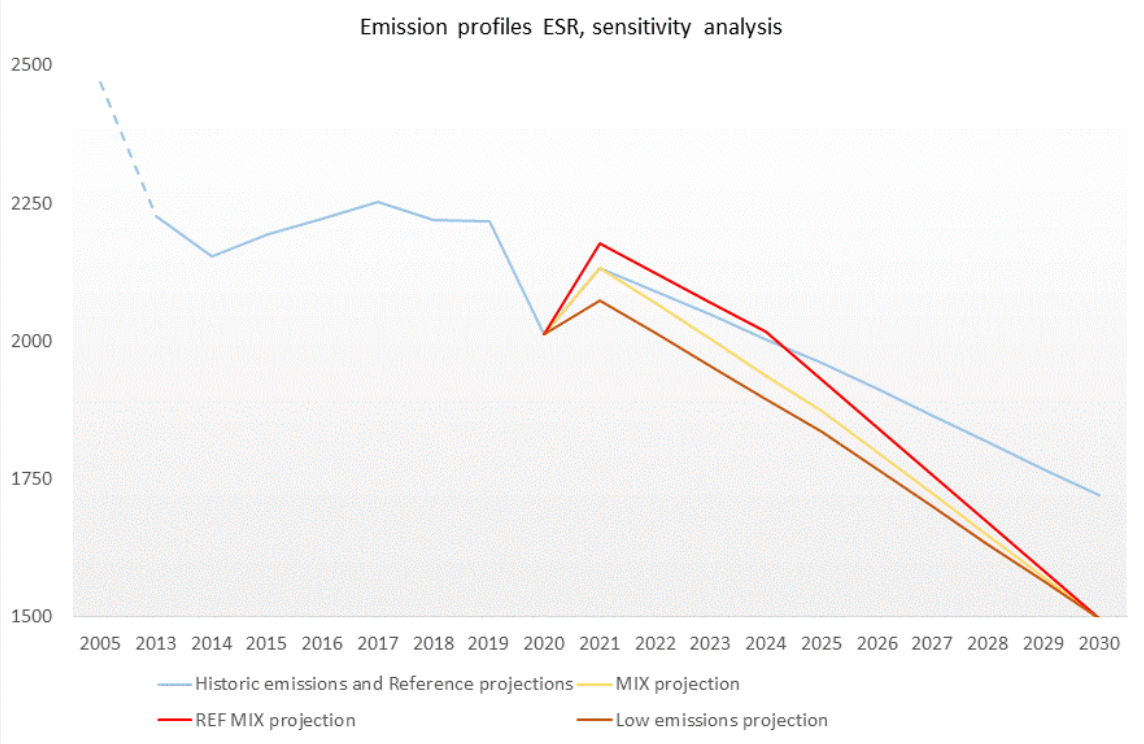
[39] The PRIMES-GAINS modelling tool, provides point year estimates for emission for each five years. Values for the years in between have been derived by linear interpolation. It includes an estimate of the impact on 2020 emissions following the COVID-19 crisis; for the Reference and the MIX scenarios the value for 2021 emissions has been adjusted upward, proportional to projected GDP growth assumptions for 2021 as used in the Reference projection; the values 2022-2024 have been then derived by linear interpolation between 2021 and 2025.

be in the coming years. For this assessment of the impact of trajectory over time, and given the uncertainties related to the COVID-19 pandemic recovery, two sensitivity scenarios are introduced. One with an emission profile that is more conservative than MIX and one with higher emission reductions than MIX.

The more conservative profile is referred to as REF-MIX. This scenario sees a higher rebound in emissions in 2021 than assumed in Reference and MIX, and an emission profile between 2021 and 2024 going towards the 2025 Reference projection, only declining faster from there to the 2030 level of the MIX scenario. Cumulative emissions under this outlook are around 0.4 Gt more than in the MIX scenario, but still around 0.7 Gt less than the Reference scenario.

Instead the Low Emissions scenario would see a very low rebound in 2021, with emissions straight onwards on a decreasing trajectory towards the 2030 level of the MIX scenario, with emissions already in 2025 below the MIX scenario. Cumulative emissions under this outlook are around 0.3 Gt lower than in the MIX scenario, and 1.4 Gt less than the Reference scenario.

Figure 13: Emission profiles for ESR, sensitivity analysis



Alternative AEA trajectories that achieve -40% GHG reductions

The 2030 endpoints of alternative AEA trajectories are set at the point targets as defined by options 1.1 and 1.2, i.e. a reduction of respectively 40% and 35% respectively

compared to 2005[40]. But regarding the overall trajectory of the target, the following issues warrant consideration:

- The starting point and value for a new linear AEA trajectory. At present, the AEA trajectory for the period 2021-2030 starts at five twelfths of the point between 2019 and 2020, with the average of the emissions 2016-2018.[41]

- The entry into force of the new AEAs in lieu of those in force currently.

- The question if unused AEAs should be carried over into the time period with updated AEAs, or if banking (as specified in Art. 5(3) of the Effort Sharing Regulation) should be discontinued or at least constrained and resulting in a tightening instead.

On these grounds, for both options 1.1 and 1.2 each, a number of options for AEA trajectories are assessed. For a representation regarding AEA trajectories for option 1.1 see Figure 14 with the blue dotted lines representing different possible emission profiles as presented in Figure 13 and the yellow, green and red lines showing possible new target trajectories. Up until the year of entry into force of the updated ESR scheme, the trajectory currently in force achieving -29% by 2030 (red line) would apply:

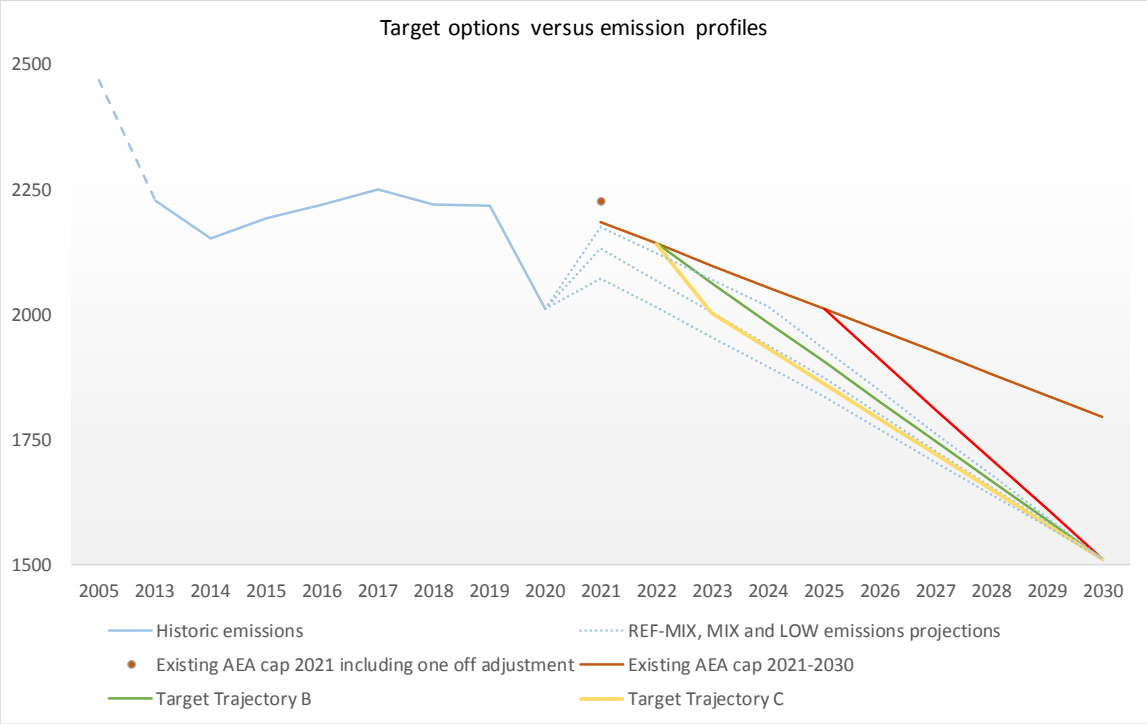
- Trajectory A: AEAs remain unchanged compared to existing legislation until 2025, and are reduced faster as of 2026, in a linear manner to reach the increased 2030 ambition. For the -40% target this results in an AEA budget over 10 years of 19.1 billion (one AEA being 1 ton of CO_{2eq}).

- Trajectory B: AEAs remain unchanged in 2021 and 2022; steeper reductions are mandated as of 2023, assuming a fast legislative process, to reach the increased 2030 ambition targets. The early tightening allows for more gradual year-by-year reductions but delivers an overall smaller budget. For the -40% target this results in an AEA budget over 10 years of 18.7 billion.

- Trajectory C: the starting point and method for the calculation for the annual emission allocations and their linear decreasing trajectory spelled out in Art. 4 ESR is maintained, including the starting point of the calculation (i.e. at five twelfths of the distance between the points for 2019 and 2020), but now taking into account the new 2030 target. New AEAs are applied as of 2023. With this approach, a step change would arise in 2023. For the 40% target this results in an AEA budget over 10 years of 18.4 billion.

[40] For the assessment in this section, 2030 emissions at EU level are assumed to be exactly equal to the ESR target at EU level.
[41] See Art. 4(2) of the Effort Sharing Regulation.

Figure 14: Options A, B and C related to target trajectory updated ESR with increased ambition to achieve -40% GHG reductions (option 1.1)



Source: Commission services

For the AEA trajectories as described above, the following impacts need to be assessed:

(1) Would the transition to a more ambitious trajectory allow for AEA transfers among Member States in line with article 5 (4) ESR to smoothly operate? The tighter the system overall, the less likely that those Member States that have a gap will be able to find Member States willing to sell any surplus generated.

(2) Is the AEA budget defined by the new trajectory tight enough, so as not to corrupt the credibility of the 2030 target? The more lenient the trajectory, the higher the risk that early on large surpluses are built up that may provide a reduced incentive to take action later on in-line with the actual target trajectory.

Assessing impacts of different AEA trajectories that achieve -40% GHG reductions

For option 1.1 relevant characteristics of the alternative AEA trajectories and implied budgets are summarized in Table 6 below and compared to the possible emission profiles of the MIX, REF-MIX and LOW scenarios. In annex 10.7 similar information is provided for option 1.2.

Table 6: Characteristic of alternative AEA trajectories A, B and C for option 1.1

	Option 1.1: Possible new AEA trajectories		
	A	B	C
Current trajectory	2021-2025	2021-22	2021-22
New trajectory			
Period	2026-2030	2023-2030	2023-2030
Trajectory starting value	Current AEA 2025	Current AEA 2023	2016-18 emissions

Trajectory starting time	2025	2022	2019+5/12
Total AEAs (Mt CO2-eq)	19090	18664	18421
AEAs Current trajectory	10534	4368	4368
AEAs New trajectory	8556	14295	14052
Evaluation with REF-MIX projection, Unused (surplus) or gap of AEAs, annual average, Mt CO2-eq.			
2021-2030	37	-5	-30
% of 2005 ESR base year	1.5%	-0.2%	-1.2%
Current trajectory	43	35	35
% of 2005 ESR base year	1.7%	1.4%	1.4%
New trajectory	32	-15	-46
% of 2005 ESR base year	1.3%	-0.6%	-1.8%
Evaluation with MIX projection, Unused (surplus) or gap of AEAs, annual average, Mt CO2-eq.			
2021-2030	79	37	12
% of 2005 ESR base year	3.2%	1.5%	0.5%
Current trajectory	103	83	83
% of 2005 ESR base year	4.1%	3.3%	3.3%
New trajectory	55	25	-5
% of 2005 ESR base year	2.2%	1.0%	-0.2%
Evaluation with LOW projection, Unused (surplus) or gap of AEAs, annual average, Mt CO2-eq.			
2021-2030	111	69	44
% of 2005 ESR base year	4.4%	2.7%	1.8%
Current trajectory	152	141	141
% of 2005 ESR base year	6.1%	5.6%	5.6%
New trajectory	70	51	20
% of 2005 ESR base year	2.8%	2.0%	0.8%

For option 1.1, achieving 40% GHG reductions in the ESR by 2030, the target trajectories considered result in total stocks of AEAs that are 4.3% to 7.6% smaller than the one defined by the AEAs presently in force.

Under the MIX emission profile, target trajectory C would leave the overall budget very tight, with only the equivalent of 0.5% of 2005 base year emissions left unused. Target trajectory A instead would be generous, resulting in a surplus of unused carbon budget equivalent to 3.2% of 2005 base year emissions. Target trajectory B is in the middle, with a surplus of unused carbon budget equivalent to 1.5% of 2005 base year emissions.

Target trajectory C is the tightest trajectory. For the REF-MIX emission profile target trajectory C would result in a deficit over the whole period of -1.2%. For the MIX scenario, if excess AEAs from the beginning of the period are not admitted for further banking from 2023 onwards, this results for target trajectory C that is tighter than the MIX emission profile with a resulting gap of -0.6 % under the updated target trajectory. Even with banking in case of the MIX emission profile, the market is tight. This will increase the risks that there are not enough Member States willing to enter into transfers to allow those with deficits to compensate for them. Overall target trajectory C seems too tight.

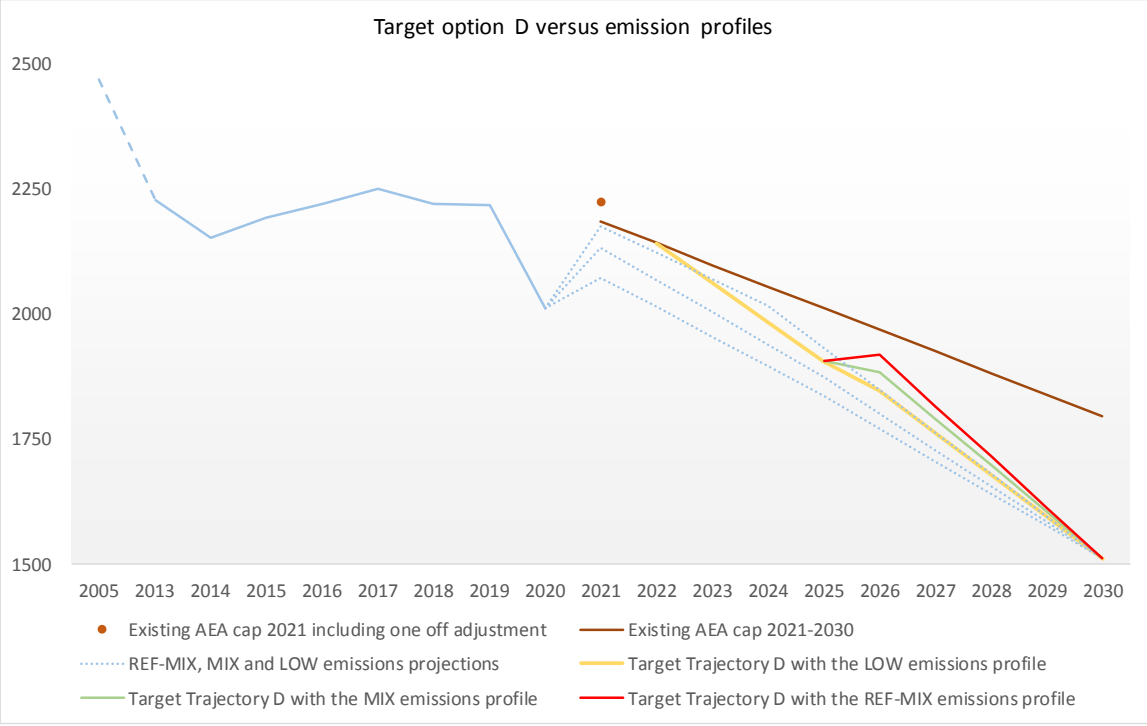
Instead target trajectory A is the most generous. It results in all emission profiles in significant surplus, increase to as much as 4.4% of base year emissions in case of the LOW emission profile. Not allowing to bank unused AEAs into the period 2026-2030 when the target trajectory is updated, does reduce the surplus significantly in case of the LOW emission profile.

Target trajectory B is in the middle. It generates a surplus of unused AEAs equivalent to 1.5% of base year emissions in the MIX scenario. The target trajectory has the disadvantage that with a high rebound of emissions and/or a delayed start of reductions early in this decade, as represented in the REF-MIX scenario, it results in an overall deficit over the period of -0.2%, aggravated if no banking would be allowed once the target trajectory update comes in place in 2023.

With the COVID crisis unfolding, there is high uncertainty of the rebound and thus the emission profile early on in the period. To take this into account a fourth target trajectory option D is assessed. In this option the first 5 years the target trajectory follows target trajectory B. But in 2026 and update is implemented. In practical terms, in 2025, information on actual emissions for the years 2021-2023 will be available. The average of these will be taken to start a new trajectory as of 2024, to arrive at the 2030 target of -40% relative to 2005 in 2030.

Figure 15 below represents option D. The update of the target trajectory is dependent on the level of emissions in 2021-2023, and thus different target trajectories can be drawn depending on the emission profile that will develop.

Figure 15: Option D related to target trajectory updated ESR with increased ambition to achieve -40% GHG reductions (option 1.1)



For option 1.1 relevant characteristics of the target trajectory D is summarized in Table 7 below. Clearly trajectory D has the benefit that even in case of a high rebound, or a delay in the increase of reductions, the emission profile would be updated, allowing for a deficit that may have build-up early, to be compensated. This may be crucial to allow a market to develop early on, where Member States are willing to transfer AEAs to other Member States with deficits already in the period 2021-2025. Without it, the compliance cycle for the period 2021-2025 may become more difficult in case of higher emission profiles early on.

On the other hand, if emission are low early on, the update will remain limited. In the example employed it remains close to the initial target trajectory B, and can go below if emissions would be even lower in 2021-2023 than assumed in the LOW emission profile. Overall surplus build up is similar to target trajectory B. While the surplus is significant, it also can only develop if the system is on an emission pathway that is already early on more in-line with what is required to achieve the 2030 targets. If necessary, and only in case of such low emission profiles, one could see purpose in limiting partly the banking from the one period into the other.

Table 7: Characteristic of alternative AEA trajectory D for option 1.1

	Option 1.1: Target trajectory D		
Current trajectory	2021-22		
New trajectory			
Period	2023-2025 like trajectory B		
	2026-2030		
Trajectory starting value	2021-23 emissions		
Trajectory starting time	2024		
Emission profile	**LOW**	**MIX**	**REF-MIX**
Total AEAs (Mt CO2-eq)	18.713	18.804	18.895
AEAs 2021-2025	10321	10321	10321
AEAs 2026-2030	8392	8483	8574
Unused (surplus) or gap of AEAs, annual average, Mt CO2-eq.			
2021-2030 % of 2005 ESR base year	74 2.9%	51 2.0%	18 0.7%
2021-2025 % of 2005 ESR base year	110 4.4%	61 2.4%	0 0.0%
2026-2030 % of 2005 ESR base year	38 1.5%	41 1.6%	35 1.4%

In summary, for option 1.1 trajectories A would appear generous. Trajectories C appears too tight. Instead trajectory B seems acceptable except in case of a high rebound in emissions early on, then it also results in a deficit. To address this it can be useful to update the target trajectory in 2026. In case of a very low emission profile early on, there might be merit in considering limiting partly banking into the period with the updated target trajectory.

Assessing impacts of different AEA trajectories that achieve -35% GHG reductions

Target trajectories, similar to options A to C for option 1.1 have also been developed for option 1.2 that is set at 35 % of emissions reductions relative to 2005 in the effort sharing sectors. For all detail on target trajectories and resulting impacts, see annex 10.7. Overall, they are of course more generous than those of option 1.1, by about 1.5 to 2.5 percentage points over time. They provide for overall emission allocations between 19.1 to 19.5 Gt CO2eq for the decade, on average 540 Mt more than those for option 1.1. In case emissions do reduce up to -40% (which would represent the achievement of the environmental objective), under the MIX scenario, they would leave 3.1 % to 4.6 % of overall emission allocations 2021-2030 unused.

With banking allowed only within periods with current and new AEAs respectively, the target and emissions trajectories would leave a large amount of 3.0 % to 5.1 % of the new AEAs unused. In fact trajectories A and B, the surplus of unused AEAs in the second period is larger than in the first period, as the path of projected emissions is reducing faster than the AEA trajectories.

Under a less favourable outlook of emissions declining more slowly, the amount of excess allowances would be about 1.7 percentage points lower than in the more optimistic case. Again, in the period with new AEAs, more unused AEAs would accrue, from 1.4 % to 4.1 % of the overall amount in that period, respectively.

What is clear is that the build-up of significant surpluses of AEAs over time is a realistic outcome with emissions profiles that would effectively be on a pathway to achieve -40% GHG reductions. This in turn means that towards the second part of the decade, there is less and less incentive coming from the ESR to actually achieve emission profiles in line with a 40% reduction, and theoretically emissions reductions could actually reverse and end up with emissions reductions of less than 35% by 2030. This would magnify risks of too little action in those sectors not covered by a new ETS, and thereby endanger the attainment of the net zero objective for 2050.

6.1.4. Assessing the impact of the existing ETS and LULUCF flexibilities over the period 2021-2030

The current ESR has specific flexibilities that allow Member States to achieve their sector commitments using corresponding emission reductions in other sectors.

First, a limited number of high income Member States may use a limited amount of ETS allowances for compliance purposes in the ESR. This reduces these Member States' auctioning volumes in the existing ETS, reducing the cap and increasing the overall stringency of the ETS. The Member States having access to the flexibility were those that were deemed at risk of a gap between their cost-efficient reductions and their GDP-based

target[42]. Furthermore, this ETS flexibility was also granted for Member States that have no free allocation in the current ETS, i.e. Malta.

The maximum amount of the ETS flexibility is expressed as a % of 2005 ESR emissions, or equivalent to around 10 million allocations that are received annually, with flexibility as to when to use it over the 10 year period 2021-2030. The total maximum volume is thus equivalent to around 100 million allocations over ten years.

Table 8: Member States having access to the ETS flexibility under the current Effort Sharing Regulation

	Maximum annual ETS flexibility under current ESR (expressed as a share of 2005 ESR emissions)
Ireland	4%
Luxembourg	4%
Austria	2%
Belgium	2%
Finland	2%
Denmark	2%
Netherlands	2%
Sweden	2%
Malta	2%

Source: Commission Services

Member States had to indicate by the end of 2019 the extent to which they want to use this flexibility, which can be reviewed downwards in 2023 and 2025. Belgium, Denmark, Ireland, Luxembourg, Malta, Austria and Finland have indicated that they will make use of the ETS Flexibility, amounting to maximum 65.2 million allocations, a volume which can still be reviewed downwards twice. The Netherlands and Sweden did not take the opportunity to use ETS flexibility.

Second, there is a bi-directional flexibility to and from the LULUCF sector. If Member States outperform their regulatory commitment set out in the current LULUCF Regulation, they can generate LULUCF credits, for use in the ESR or for trading with other Member States in the LULUCF sector. If they underperform against the regulatory commitment, they need to compensate for the gap in the LULUCF sector: and although this can be done through acquiring LULUCF credits from other Member States, it can also be achieved by a Member State using ESR AEAs.

[42] Ireland and Luxembourg faced a large gap between their GDP target and cost-efficient emissions reduction. Austria, Belgium, Denmark and the Netherlands also faced a gap but smaller than Ireland and Luxembourg, which resulted in a lower level of ETS flexibility. Finland and Sweden were granted ETS flexibility as a matter of precaution in case the smaller gap from more recent projects would not materialise (See section 5.3, SWD(2016) 247 final).

Of direct relevance to this impact assessment is the situation where Member States do not meet their ESR target, and they can use their own LULUCF credits. This LULUCF flexibility for compliance with the ESR has as a premise the lower mitigation potential in the agricultural sector. It is therefore limited in size, and the quantity of LULUCF credits that Member States can use for ESR compliance (annually, with flexibility over the period) varies according to the relative size of their agricultural emissions, expressed as an annual percentage[43] of the average 2008-2012 agriculture emissions. Summed at EU level, this LULUCF flexibility is set currently to a maximum amount of LULUCF credits equivalent to 262 MtCO2 over the 10 year period. Moreover, Member States can only use LULUCF credits to cover for an ESR deficit, if the LULUCF credits are generated on their own territory – in other words, they cannot be traded for compliance purposes in the ESR.

Stakeholder's views as regards the role of flexibilities as collected in the open public consultation (see section 10.2.2) showed that, for ETS flexibility, half of the respondents agreed that should only be applicable for ETS allowances originating from the ETS, and not for allowances from sectors joining the new ETS. As regards LULUCF flexibility, all public authorities agreed that if ESR targets were increased, the maximum allowed number of credits should be increased to strengthen incentives for carbon removals. At the same time, all NGOs but 3 were against the use of LULUCF credits by Member States to achieve their ESR targets and even in more disagreement in case of increase of LULUCF credits if targets were increased. The reason argued is that targets should be met in isolation without additional flexibilities or credits from other elements of the climate policy framework since this national target should be reflected in concrete national initiatives and investments. The agriculture sector representatives were also mainly against (6 against and 2 in favour). On the role of the flexibilities, the energy sector was neutral, not showing strong preference or role for the flexibilities that ESR allows. For the ETS flexibility, NGOs were largely against its extension to all Member States (20 against and 3 in favour) while business associations and citizens showed mixed views. In this regard, the NGOs argument was similar to the one used for LULUCF credits, in the sense that national ESR targets should be reached in isolation and with a relevant set of measures and policies to reduce emissions in ESR sectors without allowing and extension to all Member States. Per sector of activity, the energy sector was to a large extent against, together with agriculture, trade, manufacturing and chemicals. For the latter, ETS and ESR should work in isolation without interactions that would reduce the expected contribution/effort of each legislative instrument.

Both the existing ETS and LULUCF flexibilities can contribute to reduce the cost-efficiency gap in countries with a projected gap between cost efficient reductions and target. Consequently this may result in a situation in which Member States are in

[43] For the group with highest shares of agriculture emissions this is equal to 15% (IE, LT ,DK ,LV), for a second group this share is equal to 7.5% (RO, BG, FR, EE, FI, ES, SE, CY, EL, PT, NL, SI, PL) and for the remaining Member States this share is equal to 3.75%.

compliance with their ESR obligation while emissions are higher than the target trajectory in the ESR. This can impact how the EU achieves its target of at least 55% net greenhouse gas reductions.

The Climate Law foresees that in order to ensure that sufficient mitigation efforts are deployed until 2030, the contribution of net removals to the at least net 55% GHG reduction target in 2030 shall be limited to 225 Mt $CO_{2\text{-eq.}}$ This provision in the Climate Law is without prejudice to the revision of Union legislation, and thus it does not preclude the continued use of the LULUCF flexibility under the ESR. Nevertheless it needs to be assessed to which extent the potential use of the LULUCF flexibility can increase the risk of not meeting the ambition as foreseen under the Climate Law.

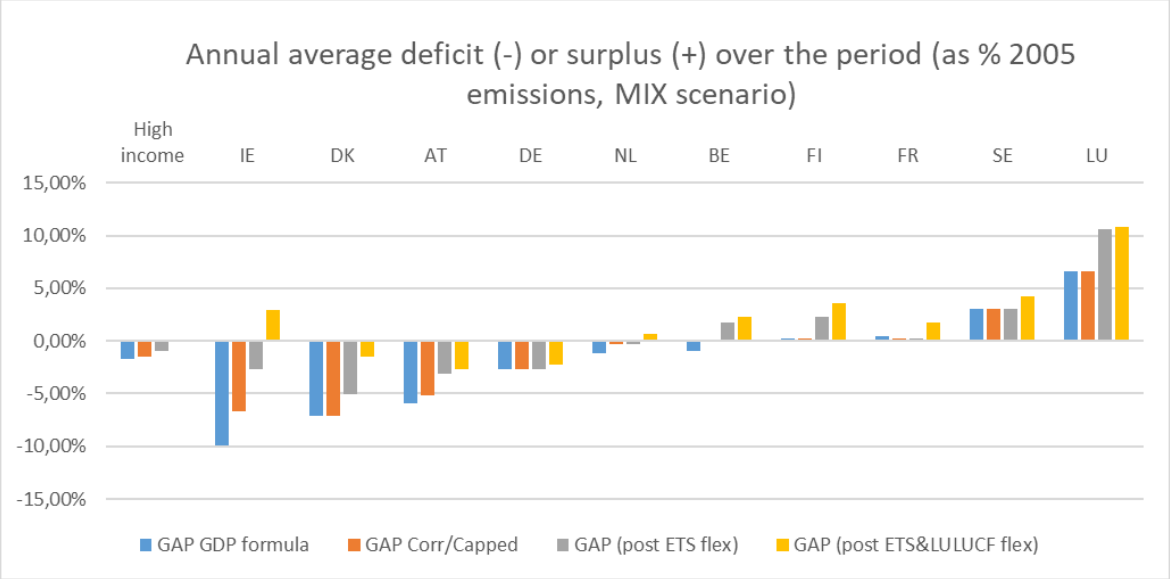
Both ETS and LULUCF flexibilities can currently be used over the 2021-2030 period insofar as the ETS flexibility was selected and insofar as there was effective overcompliance in the LULUCF sector in a given Member State. To assess how this annual flexibility impacts the gap or surplus between cost-efficient emission reductions and target in Member States one needs to look at this gap or surplus over the period, and not just in the point year. This in turn will depend on the trajectory of the target over time and the achieved emission profile over time (see section 6.1.3). In the assessment as presented in Figure 16 and Figure 17 the average annual gap or surplus is estimated over the period of 10 years, using the MIX scenario, the target trajectory I and II (as presented in Table 7) and assuming an equal use per annum of the LULUCF and ETS flexibility.

For those Member States with a gap by 2030, the gap is typically not existent, or smaller at the beginning of the period (e.g. 2021) than in 2030. Therefore, for these Member States, a smaller gap (or larger surplus) can be expected over the period than at the 2030 end-point. Member States should pro-actively plan for how to manage their gap over time. It is important to note that the projections used, from the MIX scenario, imply a cost-efficient increase in reduction efforts compared to the reference scenario. This does not prevent high-income Member States to step up efforts and go beyond cost-efficient reductions, requiring potentially less transfers between those Member States with surpluses and those with a gap.

Applying both a limited target correction (see Section 6.1.2) and assuming the ‘full use’ of ETS flexibility leads to a significant reduction of the gap in most high income Member States. These are clearly the most readily available flexibilities to use by Member States. The possibility to use the LULUCF flexibility is more uncertain, and will depend on action in the LULUCF sector.

Both Sweden and Luxembourg seem less in need of the additional flexibilities, which raises the question if it is still fully appropriate to maintain the ETS flexibility for them.

Figure 16: Annual average gap or surplus over the period, high income Member States

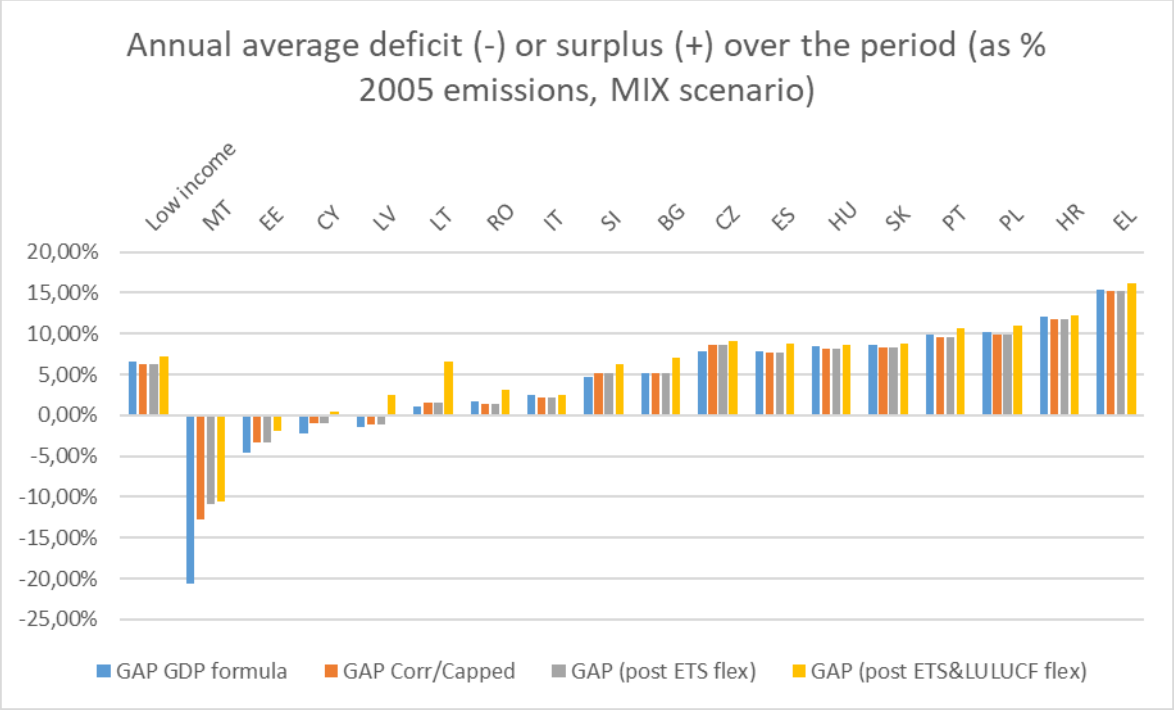


Source: Commission services

For low-income Member States, the use of LULUCF credits could provide for flexibility, notably for countries that have actually a gap in 2030 in a cost-efficient projection. Both Cyprus and Latvia see their gap turn into a surplus if the LULUCF flexibility would be used to the fullest, while for Estonia the gap would significantly reduce. The possibility to use the LULUCF flexibility is however more uncertain, and will depend on additional action in the LULUCF sector, so as to increase the national LULUCF net removals beyond the increased targets in the LULUCF Regulation.

Only one low-income Member State benefits from the ETS flexibility, Malta, who is expected to remain in significant deficit over the period even with the existing 2% ETS flexibility. For Malta it could be considered for instance to increase this flexibility for instance by 5 pp. which, due to the size of its ESR emissions, would only have a very small impact on the total size of the ETS flexibility.

Figure 17: Annual average gap or surplus over the period, low income Member States



Source: Commission services

This impact assessment uses a projection that achieves around -40% GHG reductions in the ESR compared to 2005 (see Table 1). Combined with efforts in the ETS this would result in GHG reductions of the sectors covered, but excluding LULUCF of around -53% in 2030 compared to 1990. In principle any use of LULUCF flexibilities may result in lesser reductions in the ESR. Instead the ETS flexibility will in principle reduce the cap in the ETS and increase corresponding efforts, thus not impacting total GHG reductions excluding LULUCF.

The lower the use of LULUCF credits in the ESR, the more likely it is that the requirement of the Climate Law will be met to limit the contribution of net removals to the at least net 55% GHG reduction target in 2030 to 225 Mt $CO_{2\text{-eq.}}$. At the same time, where LULUCF credits are used, the emission reductions in the ESR could still meet its ambition of -40% if for instance other Member States overachieve their ESR target but do not engage in transfers to other Member States. Also any overachievement in the ETS could contribute to meeting the requirements in the Climate Law, even with use of LULUCF credits in the ESR. Finally the transfer of ESR credits into the LULUCF sector for compliance purposes with the LULUCF target could increase overall ambition in the ESR.

The effective use of the LULUCF flexibility in the ESR is dependent on what gap may remain after Member States have undertaken their own reduction efforts in the ESR and after use of the other flexibilities foreseen in the ESR.

If the LULUCF flexibility towards the ESR would be split over two periods, with half available up to 2025 and the other half for the period 2026-2030, then the potential use in the ESR sector would be reduced significantly. This would restrict the maximum use of

LULUCF credits to 131 million in the period 2026-2030 with a view to achieving the 2030 ambition.

Furthermore the effective use can only materialise if Member States overachieve their obligations under the LULUCF regulation. An increase in climate ambition in the LULUCF regulation for the period 2026-2030 would reduce the likelihood of generating significant amounts of LULUCF credits for compliance use in the ESR.

For instance option 1.2. of the LULUCF IA, which increases the LULUCF target from 2026 onwards to achieve by 2030 the equivalent of -310 Mt CO_2 will make it harder to generate LULUCF credits than under the present LULUCF regulation.

Estimates using the GLOBIOM model show that when introducing an incentive in the LULUCF sector equivalent to €10 per ton of CO2, abatement could increase net removals to -324 Mt CO2 in 2030. This could generate LULUCF credits equivalent to 240 Mt CO2 over the period 2026-2030 in a group of Member States while generating a gap equivalent to 153 Mt CO2 in the other Member States. Assuming perfect trade between Member States in the LULUCF sectors for compliance purposes, this would result in a net amount of credits equivalent to 87 Mt CO2 over 5 years being available to compensate excess emissions in the ESR sectors[44]. It is important to note that the assumption of perfect trade is unrealistic. Therefore, the impact on the ESR would likely be more limited, given that a number of Member States may need to transfer AEAs from the ESR to their own LULUCF sectors for compliance purposes.

Of the Member States that effectively generate LULUCF credits, some would overachieve their maximum allowed limit of LULUCF credits for use in their own ESR, while others would potentially generate more limited credits or none at all in the period 2026-2030. If no trading of LULUCF credits would be allowed for compliance purposes in the ESR, those with remaining surpluses could not transfer them to other Member States for compliance in the ESR.

In case that the LULUCF flexibility is split over two periods, and assuming Member States cannot trade LULUCF credits for compliance purposes in the ESR, the projections with the GLOBIOM model indicate that of the LULUCF credits generated, in total 68 million ton, can effectively be used as LULUCF flexibility in the ESR or on average 13.6 million credits per annum in the period 2026 -2030.

When reducing the incentive in the LULUCF sector from €10 per ton of CO2 to €5, the overall ambition level in the LULUCF sectors would still be met, with a sink as large as -314 Mt CO2 in 2030. But the availability of LULUCF credits that can be transferred would further reduce. In this case, with the LULUCF flexibility split over two periods and assuming Member States cannot trade LULUCF credits for compliance purposes in the ESR, the projections indicate that of the LULUCF credits generated, in total only a

[44] This amount would be lower if the sink would not overachieve the ambition level of 310 Mt CO_2.

net 44 million ton[45] can effectively be used as LULUCF flexibility in the ESR or on average around 9 million credits per annum in the period 2026 - 2030.

Instead Member States with a gap in the LULUCF sector would need to acquire LULUCF credits or transfer AEA units from the ESR into their LULUCF sector for compliance, increasing scarcity in the ESR. If AEA units from the ESR are used for compliance in the LULUCF sector, it would have the opposite effect and potentially allow for overachievement of the overall ESR target.

Finally not all Member States that can generate credits in the LULUCF sector will effectively need them in the ESR, further reducing this risk of the LULUCF flexibility undermining the requirements of the Climate Law. For the Member States with a high agriculture share in their ESR emissions, the LULUCF flexibility is of particular importance. Not all are projected to be generating LULUCF credits. Target increases in the LULUCF sector thus will reduce the likelihood of this flexibility being used, even if retained. Presently, only a few Member States have declared in their NECPs an intention to make use of the LULUCF flexibility in order to comply with their current ESR targets.

An option for increased used of LULUCF credits that does not impact the likelihood or not of meeting the requirements of the Climate Law is the creation of a reserve for unused LULUCF credits. This additional reserve can only be accessed ex post, provided that compliance with the requirements of the Climate Law has been established, to allow Member States to use LULUCF flexibility for compliance purposes in the ESR. Such a reserve would operate in a similar manner as the already existing safety reserve in the ESR.

6.1.5. The role of existing flexibilities in the ESR (transfers, banking, borrowing)

Flexibility instruments do not jeopardise environmental integrity since they allow tighter GHG emission reduction targets overall, enhance cost-efficiency and further contribute to a fair distribution of effort. They should be transparent, predictable and easy to operate. An important question is to what extent the existing set of rules could be enhanced without limiting Member States' freedom of choice with respect to using the flexibilities.

The current Effort Sharing Regulation provides a range of flexibility instruments:

- Own annual emission allocations can be banked and borrowed with certain limitations.

In this regard, a Member State has the flexibility to borrow a quantity of up to 10 % from its annual emission allocation for the following year for the period 2021-2025 and up to 5% for the period 2026-2030. Keeping the limits for the period 2026-2030 reduces the

[45] The projections indicate that 66 Mt of LULUCF credits would be available in a number of Member States that can be transferred into the ESR for compliance purpose. If this would occur then there would also be Member States with a deficit in the LULUCF sector that cannot be compensated by trade anymore within the LULUCF sector. These would then need to transfer the equivalent of 22 Mt from the ESR into the LULUCF for compliance purposes, resulting in a net inflow of LULUCF credits into the ESR of 44 Mt.

risk for non-compliance, as it limits any incentives to delay the introduction of new policies. It also limits the risk that Member States will not be able to cover any deficit created for future years either from domestic mitigation, or by securing Annual Emission Allocations (AEAs) from other countries.

As regards environmental integrity, if aggregate surpluses are available, this flexibility mechanism can help Member States to effectively deliver the target, reducing the risk of overall non-compliance. On the other hand, too many surpluses may compromise the overall attainment of the target. This is considered in the economic impact section.

- Transfers of allocations between Member States are possible.

This flexibility instrument can make a major contribution to achieve the overall target in a cost-efficient way: it allows Member States with a lower target to be rewarded for overachievement, while the transfer of allocations facilitates compliance for Member States with a higher target.

The transfer of allocation between Member States does not impact the achievement of the overall EU-wide ESR target, but increases the cost-efficiency of reaching that overall target. Depending on their GDP-based GHG emission reduction targets, relative to their potential for cost-efficient reductions in the effort sharing sectors, Member States may either be suppliers or recipients of such transfers (see Table 9).

Table 9: Potential sellers and buyers of allocations for option 1.1 and 1.2

	Option 1.1 (40% target)	**Option 1.2 (35% target)**
Member States with cost-efficient target below GDP target (potential buyers)	Belgium, Denmark, Germany, Estonia, Ireland, France, Cyprus, Latvia, Lithuania, Malta, the Netherlands, Austria, Finland	Belgium, Cyprus, Denmark, Germany, Estonia, Latvia, Ireland, France, Lithuania, Malta, the Netherlands, Austria,
Member States with cost-efficient target above GDP target (potential sellers)	Bulgaria, Czechia, Greece, Spain, Croatia, Hungary, Italy, Luxembourg, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden	Bulgaria, Czechia, Greece, Spain, Croatia, Finland, Italy, Luxembourg, Hungary, Poland, Portugal, Romania, Slovenia, Slovakia, Sweden

Source: Commission Services

Potential sellers are virtually all lower income Member States, but not only these. Notably, Sweden and Luxembourg also have a higher cost-efficient reduction potential than their target resulting from the application of the GDP method. A transfer of allocations can therefore reduce higher income Member States' costs to achieve their GDP based targets and tap into the potential for cost-efficient emission reductions beyond their target in lower-income Member States.

This raises a number of important questions in how the ESR interacts with other instruments, notably a new emission trading to new sectors. In principle, an increase in

the overall target in the ESR will steer an increased demand in transfers of AEA between Member States. Member States with a projected gap are likely to be concerned as to whether the supply of such AEAs will effectively materialise, because it would require in particular low-income Member States to overachieve their target and reduce their emissions towards cost efficient levels. In this context, the introduction of a new ETS for road transport and buildings would provide for increased incentives to effectively achieve this cost efficient abatement level and increase the likelihood that surpluses of AEAs will be available.

With regards to flexibility mechanisms in the ESR and stakeholders' views, they showed a preference for flexibility between countries and flexibility over time either through banking or borrowing (see section 10.2.2).

6.1.6. Administrative impacts of the current compliance rules for option 1

For option 1 there would be some administrative impacts resulting from the ETS coverage of certain sectors, while maintaining them in the ESR at the same time. First, ESR administrative rules would continue to apply. However they are generic and the administrative costs related to 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[46]. It is relevant to bear in mind that the 2016 impact assessment for the Effort Sharing Regulation[47] already showed that the administrative costs related to implementing the regulation were limited.

Impacts of double coverage on monitoring and accounting

In a nutshell, there is no change envisaged compared to current ESR monitoring and compliance architecture. The ESR inventory will be determined by subtracting from the UNFCCC inventory the existing ETS inventory covering. One does not need to subtract the new ETS sector from this. The monitoring of the new ETS system, separate from the monitoring of the existing ETS system, will overlap, but not impact, the ESR inventory.

The new ETS would be a fully independent instrument from the ESR. Therefore transfers under the ESR do not have to be met with transfers under the new ETS and vice versa.

However, given the relative size of the new ETS sectors within the ESR, the behaviour of these new ETS sectors also impacts Member States own likelihood related to the need or not to engage in transfers in AEAs.

For instance, if a Member State's new ETS sectors would not decrease emissions in an ambitious manner, and rather decide to acquire ETS allowances, then it is also more likely that the Member State itself will be confronted with an emission profile in the ESR that does not match its target, and thus that it will need to acquire AEAs or use other flexibilities.

[46] See section 6.3.4. of ETS Impact Assessment SWD (2021) 601.
[47] SWD (2016) 247 final.

The opposite is also through. If a Member State's new ETS sectors collectively would reduce emissions in a very ambitious manner, and thus acquire relative less ETS allowances, it is also more likely that the Member States will be confronted with an emission profile in the ESR that matches or goes beyond its target in the ESR and thus that it may transfer its surplus AEAs if it would like to do so. While this clearly also depends on how the Member State undertakes action in its ESR sectors not covered by the new ETS, such outcome is more likely if the Member State undertakes itself supportive policies to reduce emissions in the new ETS sectors. By doing so it would reduce both the pressure on its entities in the new ETS to acquire ETS allowances, as well as reduce the likelihood it has to acquire itself AEAs for compliance under the ESR.

The ESR and new ETS thus have independent monitoring systems which do not increase complexity since they target different groups (national authorities for ESR and specific sector actors for the new ETS for building and road transport). The impacts on monitoring and evaluation are further assesed in section 9.

There will be differences in emission calculation in the methods under the new ETS and the ESR inventory that will need to be assessed if they turn out significant. But they will not directly impact the functioning of the ESR.

In summary for option 1, there is no change envisaged compared to current ESR monitoring and compliance architecture. The current compliance cycle is fit for purpose and addresses appropriately the risks of Member States not being in compliance, thanks to annual emissions reporting and to a close follow-up by the Commission on Member States' progress towards their targets. This option does not increase administrative burdens in the Member States' reporting mechanism. Member States 'progress towards their 2030 targets would also continue to be monitored every year as part of the progress report published by the Commission[48]. This procedure complements the compliance checks by providing early warning in case Member States are lagging behind with their obligations every 5 years.

6.2. Option 2: Reduced scope ESR in line with the extended ETS scope to building and road transport

Option 2, in which the ESR sectoral scope would be reduced and not have any overlap with a new ETS, is assessed in this section. The first variant (option 2.1.) would exclude buildings and road transportation from the ESR scope, and the ESR (with its remaining scope) would have a target of -35% in 2030 compared to 2005, in line with cost efficient projections. The second variant (option 2.2.) would not include buildings and road transportation in the ESR either, and the national targets for 2030 would be kept as they stands currently, but applied to the reduced scope ESR. Furthermore the section briefly assesses what would potentially happen to the ESR if all fossil fuel would move into a new ETS and a corresponding reduction in the ESR's scope would also occur.

[48] Climate Action Progress Report 2020: https://ec.europa.eu/clima/sites/clima/files/strategies/progress/docs/com_2020_777_en.pdf

6.2.1. *Efficiency and environmental impacts of the 2030 point targets in a reduced scope ESR*

The first variant of option 2 (option 2.1.) would exclude buildings and road transportation. The reductions to be achieved in cost efficient projections in this reduced scope setting would be around -35% (see Table 10). This is the target that will be assessed in respect of this option.

Table 10: GHG reductions in a reduced scope ESR (excluding road transport and buildings) in 2030 compared to 2005

GHG reductions in ESR sectors in 2030 compared to 2005, reduced scope, excluding road transport and buildings (PRIMES base year data for 2005)			
	MIX	REG	MIX CP
EU	-36.3%	-36.4%	-36.3%

Source: Commission services

Option 2.2 would keep the current ambition in place with Member States' targets as in today's ESR, but apply this to the reduced scope, excluding buildings and road transportation from the ESR scope. Due to a different relative distribution of emissions in the ESR, with low income Member States taking a relatively larger share of emissions in this reduced scope ESR, the combined target would not reduce emissions by 29% as in the full scope of today's ESR, but only by 27% compared to 2030.

For option 2.1 the EU point target is set at the level -35%, around cost-efficient projections (for the sectors remaining in a new ESR) which would thus deliver the required ESR contribution to achieve the overall -55% EU-wide target. Assuming a similar cap setting in the new ETS, then the 'current ESR sectors as a whole' (i.e. the remaining ESR sectors and the road transport and buildings in the new emission trading) would match a reduction of 40% GHG compared to 2030 and thus there would be no environmental risk related to the point target in principle. However, overall there will be no incentive from the ESR to take national measures in the sectors that will be covered by the new ETS for instance related to the availability of infrastructure in the road transport sector or split incentives in the building sector, increasing the risk of too little policy intervention in these sectors.

For option 2.2 the point target in 2030 is set at -27%, which is clearly less ambitious than the required -35%, assuming other sectors would not receive targets going beyond cost efficient projections. Actually in the Reference scenario, the reduced scope ETS is projected to reduce emissions by -27%. It should be noted that while the Reference projections indicate that the EU as a whole would achieve the option 2.2 target, mostly high income Member States would still not meet their own target through domestic action alone. Given that perfect trade is unlikely, and thus extra efforts would still be needed in those Member States not achieving their targets domestically, this should in principle allow for some overachievement of the 27% target.

On the other hand, by limiting the assessment to the year 2030 only, one does not take into account the potential accumulation of surpluses early in the period, which could reduce the incentives to act later in the period and which therefore results in bigger environmental risks over time in option 2.2.

Assuming the point target in option 2.2. would ensure that the sector would meet Reference projections, this would still pose an environmental risk, equivalent to 8% of reduced scope ESR base year emissions or around 90 million ton $CO_{2\text{-eq}}$, equivalent to missing the EU wide target of net -55% compared to 1990 by almost 2 percentage points.

Conclusion:

Considering a reduced scope without road transport and buildings, purely from a perspective of efficiency and environmental integrity, option 2.1 compared to option 2.2 gives the strongest incentive for Member States to adopt additional policies in the remaining sectors in the ESR with many measures taken at national level for reasons of subsidiarity.

It is important to note though, that the ESR in this case will not support any action in the sectors covered by a new ETS and vice versa, the new emission trading to building and roads transport will not support action in the remaining ESR.

Option 2.2 clearly has strong environmental risks in this context, with no incentives coming from the separate ETS and a target setting approach that puts the collective effort too low.

6.2.2. National targets and distributional impacts in a reduced scope ESR

For this assessment, the same methodology as in Section 6.1 is applied for target increases, based on updated GDP per capita data for the years 2017-2019. Table 11 provides an overview of the additional target effort Member States would have to deliver by 2030 in a reduced ESR scope without buildings and road transportation but increased ambition to -35% overall for ESR, as well as of the current ESR targets (which would reduce total emissions in the reduced scope ESR by only -27%.)

Table 11: Overview of emission reduction targets in 2030 for ESR with reduced scope, excluding buildings and road transportation under options 2.1 and 2.2.

EU-27 / Member State	ESR reduced scope (excl. buildings & road transportation) delivering -35% (option 2.1)	ESR reduced scope (excl. buildings & road transportation) delivering -27% (option 2.2)

	Target based on GDP/capita formula update, bound to a range of -5% to -45% [unbound target]	Targets equal to existing ESR targets
EU-27	**-35%**	**-27%**
Belgium	-45% [-47%]	-35%
Bulgaria	-6%	0%
Czechia	-25%	-14%
Denmark	-45% [-53%]	-39%
Germany	-45% [-47%]	-38%
Estonia	-25%	-13%
Ireland	-45% [-60%]	-30%
Greece	-20%	-16%
Spain	-35%	-26%
France	-45%	-37%
Croatia	-14%	-7%
Italy	-41%	-33%
Cyprus	-33%	-24%
Latvia	-16%	-6%
Lithuania	-20%	-9%
Luxembourg	-45% [-75%]	-40%
Hungary	-16%	-7%
Malta	-36%	-19%
Netherlands	-45% [-49%]	-36%
Austria	-45% [49%]	-36%
Poland	-14%	-7%
Portugal	-26%	-17%
Romania	-10%	-2%
Slovenia	-26%	-15%
Slovakia	-20%	-12%
Finland	-45% [-48%]	-39%
Sweden	-45% [-50%]	-40%

Source: Commission Services

In option 2.1 a similar pattern as under option 1.1 emerges regarding the gap between cost-efficient emission reductions and targets set on the basis of GDP per capita. High income Member States typically have a GDP based target that is higher than their cost-efficient emissions projections, while low income Member States typically have a GDP based target that is lower than their cost-efficient emissions projections.

This gap actually increases for high income Member States. While in full scope ESR in the MIX scenario the gap (weighted average) was almost 7%, it would be increased to over 10% in the reduced scope ESR.

Figure 18 below includes the gap assessment for high income Member States. Next to a reduced scope ESR excluding buildings and road transport the figure also includes for

illustration the assessment of the gap if non-CO2 emissions only covered by a reduced scope ESR[49].[50]

A strong driver regarding the change in gap for high income Member States is the fact that non-CO2 emissions in high income Member States tend to decrease less in the coming decade than CO2 emissions in road transport and buildings, with waste policy already having captured the low hanging fruit regarding non-CO2 waste emissions and agriculture non-CO_2 emissions having more limited mitigation potential. The size of the agriculture sector impacts the picture, with Ireland in particular seeing a serious increase of its gap in relative terms compared to option 1. Similarly, also Member States that have exceptionally high reductions in road transport and building, such as Luxembourg for road transport, see their gap increase due to a reduced scope in the ESR.

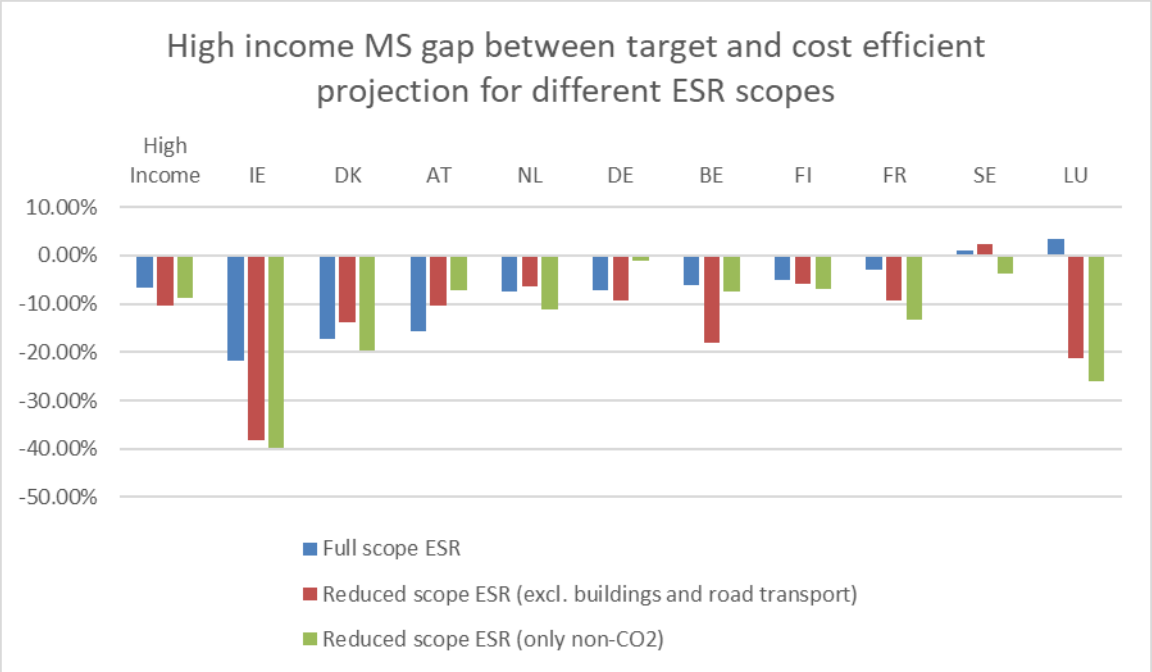
Overall, a reduced scope would impact a potential target redistribution in high income Member States and would lead to different conclusions than the target correction assessed in section 6.1.2. In the extreme case of a reduced ESR scope that would include only non-CO_2 emissions Luxembourg would instead become a candidate for a target correction.

At the same time, it is also important to assess the impact of both ETS and LULUCF flexibilities (see section 6.2.4), given that their relative impact, and especially that of the LULUCF flexibility, would increase with a reduced scope ESR.

[49] The targets are set for the EU to achieve cost efficient reductions, i.e. 33.5% reduction, applying the GDP per capita formula with updated 2017-2019 data, and bounding targets in a range between -4% and -44%.

[50] The assessed scope of a reduced scope ESR is too limited in this example. In practice, even if the ETS extension would include all fossil fuels, it would still result in a reduced scope ESR that covers cover any process or fugitive CO_2 emissions not covered by the existing or new ETS which would remain in the reduced scope ESR. Overall these emission are limited in size.

Figure 18: Impact of reduced scope on gap between target (based on the GDP per capita formula only) and cost efficient projections for high income Member States.



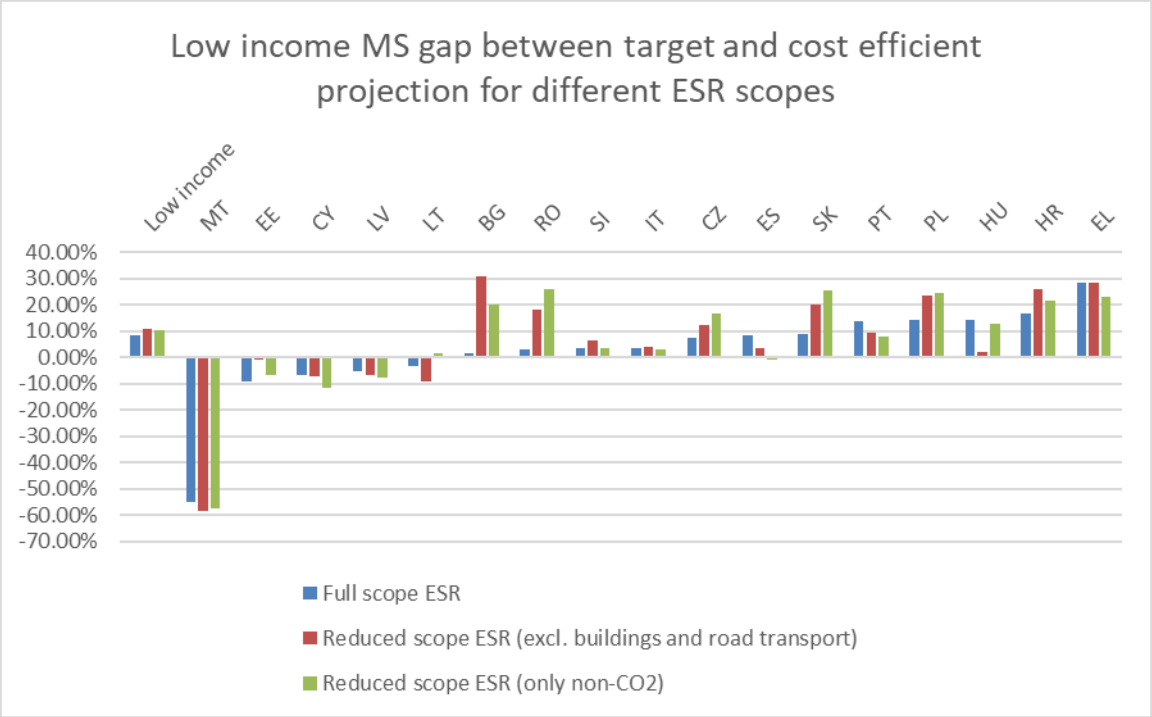
Source: Commission services

For low income Member States the reverse trend can be seen (see Figure 19). In full scope, in the MIX scenario, the surplus (weighted average) was close to 9%, whereas it would increase to close to 11% in the reduced scope ESR. By and large this group would reduce their emissions in small industry, waste, agriculture and non-CO_2 from energy at similar rates than in buildings and road transport, as compared with 2005 emissions.

Within the group of low income Member States, Eastern European Member States[51] typically would see fewer reductions in buildings and transport and relatively higher reductions in non-CO2 emissions, as compared with 2005. The size of the agriculture sector matters, and a larger share of agriculture emissions tends to reduce the size of overall non-CO2 emission reductions. These Member States also still can benefit from a significant reduction through the implementation of waste policy as well as the impact of reductions in coal mining on methane emissions. The impact from a move to a reduced ESR scope on the gap between the GDP target and the projected cost-efficient emissions reduction may therefore not only depend on the relative size of the agriculture sector but also other non-CO2 emitting sectors can play a role.

[51] Assumed here to be the 13 Member States that joined in the EU since 2004.

Figure 19: Impact of reduced scope on surplus (gap) between target and cost efficient projections for low income Member States



Source: Commission services

6.2.3. Starting point and trajectory in the ESR in a reduced scope

Emission allocations from alternative AEA trajectories

In Table 32 and Table 33 in annex 10.7, similar trajectories A, B, and C are assessed for options 2.1 and 2.2 as for options 1.1 and 1.2 (see section 6.1.3).

The complication for options 2.1 and 2.2 is the change in scope over the 2021-2030 period. The current scope would prevail up until the entry into force of new AEAs. Hence, in the assessment the period 2021-2030 is split into two parts: in the first part, the AEAs are related to the emissions projections under the scenarios explained above in their present scope. In the second part, the emissions projections relate to the remaining sectors in the ESR.

The impact of the scope correction on the availability of AEAs is significant. For option 2.1, trajectory A, which only applies a new AEA trajectory from 2026 onwards, provides for an overall stock of AEAs of 14.8 Gt of CO2eq. Trajectories B and C only allocate AEAs equivalent to 11.4 and 11.1 Gt of CO2eq respectively, because they apply the scope adjustment already from 2023 onwards.

The stock of AEAs in force in trajectory A for 2021-2025 equals to 10.5 Gt CO2eq, while the updated AEAs for the next five years add 4.2 Gt. For trajectories B and C, the stock of current AEAs is limited to 4.4 Gt in the years 2021-2022, and another 7.1 and 6.8 Gt new scope AEAs respectively are available for the rest of the period.

Overall the assessment in Table 32 and Table 33 is similar to section 6.1.3.

For option 2.1, under a scenario with a slower decline in emissions (REFMIX), trajectory option C is not viable. Even with banking into the new system option B remains tight. Conversely option A sees a large a surplus build up, which is not solved by not allowing banking into the new system. This is in part because the deviation in trajectory starts too late (from 2026 onwards), and sets a 2026 AEA cap that is too high compared to plausible cost efficient emission scenarios.

The main limitation of the assessment as presented in Table 32 and Table 33 is that the data to calculate the starting point (be it the amount of current AEAs that would need to be attributed to reduced scope ESR sectors for options A and B, or the 2016-2018 emissions for option C) are not presently available. The exercise as presented in Table 32 and Table 33 is based on PRIMES-GAINS estimates of sectoral shares.

An approach to get around this could be to await until MRV data of the new ETS is available[52]. While this would give credibility to the data for the starting point, it would come late, certainly if multiple years are used. For instance if MRV data for an new scope ETS would be available from 2023 onwards, inventory data using average 2023-2025 data to define the starting point in 2026 would have to wait until 2027. Such approach, if used to define a new trajectory would require some ex post adjustments to the allocations.

In summary, trajectories using methodologies such as B and C may be too tight, while option A would be rather generous. A major limitation to any trajectory is that no exact data is available to define the reduced scope emissions. Any target trajectory will thus be based on inventory estimates which could then be reviewed when MRV data of the new ETS scope for building and road transport is available.

6.2.4. Assessing the impact of the existing ETS and LULUCF flexibilities over the period 2021-2030 in a reduced scope ESR

The ETS flexibility that is available for a limited number of high income Member States and Malta (see Table 8) can also be used to reduce the gap (between cost-efficient emission reductions and targets set on the basis of GDP per capita) under Option 2.1.

The analysis below is based on a target trajectory similar to trajectory D as presented in section 6.1.3. It is assumed that the current scope prevails in 2021-2022, and the reduced scope only applies from 2023 onwards. This is an important driver impacting on the gap or surplus over time compared to the assessment in section 6.2.2 of the gap or surplus in the year 2030, with the gap or surplus in 2021-2022 having a relative larger impact on the gap or surplus over time due to the reduced scope from 2023 onwards.

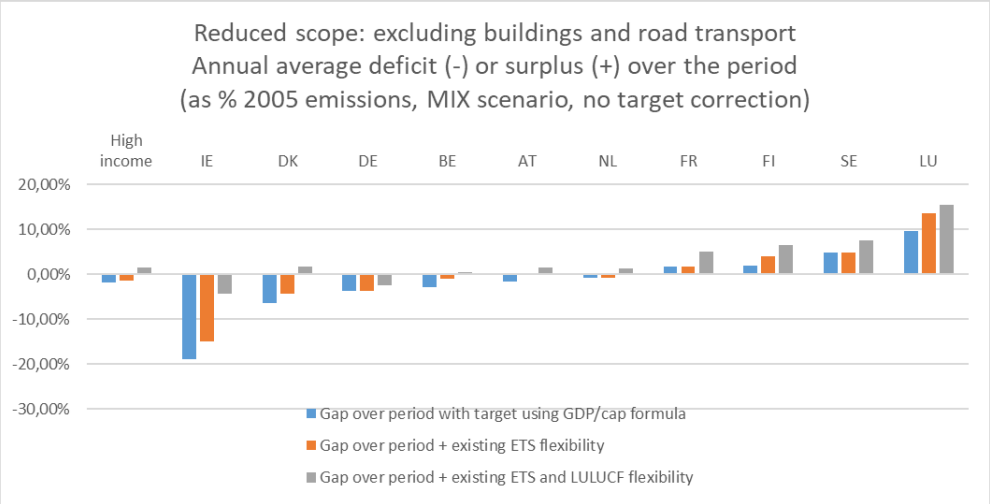
[52] Different options are available if limited data points are available. If only one inventory year is used as the starting point for a downward trajectory, the starting value could be somewhat increased compared to that inventory point to allow for a not too tight system early on. Another option is to use that inventory data as the starting value in a subsequent year with a similar outcome.

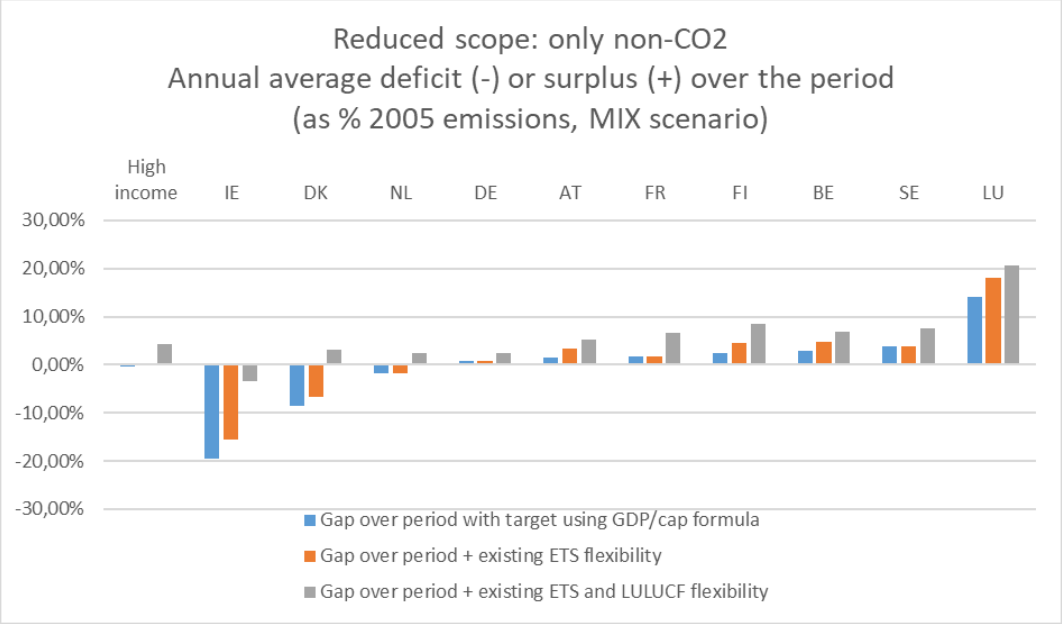
The ETS flexibility is expressed as a share of 2005 base year emissions of a shrinking scope ESR, and thus the absolute amount of the ETS flexibility is reduced. This roughly halves the ETS flexibility's absolute size in case of reduction of scope of the ESR to exclude buildings and road transport. If the ESR scope is reduced to non-CO2 only, then it would be reduced by around 2/3rd.

Instead, the LULUCF flexibility, which is there to allow alternative options to address difficult to abate non-CO2 emissions in the agriculture sector, is kept constant compared to full scope ESR, given that exactly these emissions remain part of also a reduced scope ESR. This has the opposite effect. With full scope, the LULUCF flexibility represents the equivalent of around 1% of 2005 base year emission. If the scope excludes buildings and road transport, this LULUCF flexibility would represent the equivalent of over 2% of 2005 base year emission. If the scope were to include non-CO2 only, then the LULUCF flexibility would represent over 3% of 2005 base year emissions.

Overall both flexibilities provide for a strong correction for any gaps in high income Member States in case of a reduced scope ESR, even in case no target correction is applied (see Figure 20). This is an important finding. Target correction is thus less of an issue in case of reduced scope, given that flexibilities gain in importance, notably the LULUCF flexibility. On the other hand, the introduction of a much higher ambition in the LULUCF regulation, together with the possible split of the existing LULUCF flexibility into two periods would likely significantly reduce the availability of the LULUCF flexibility. See also section 6.1.4 which discusses also the relationship between this review and the Climate Law which requires a higher level of mitigation efforts.

Figure 20: Impact of ETS and LULUCF flexibilities on high income Member State gaps in case of a reduced scope ESR

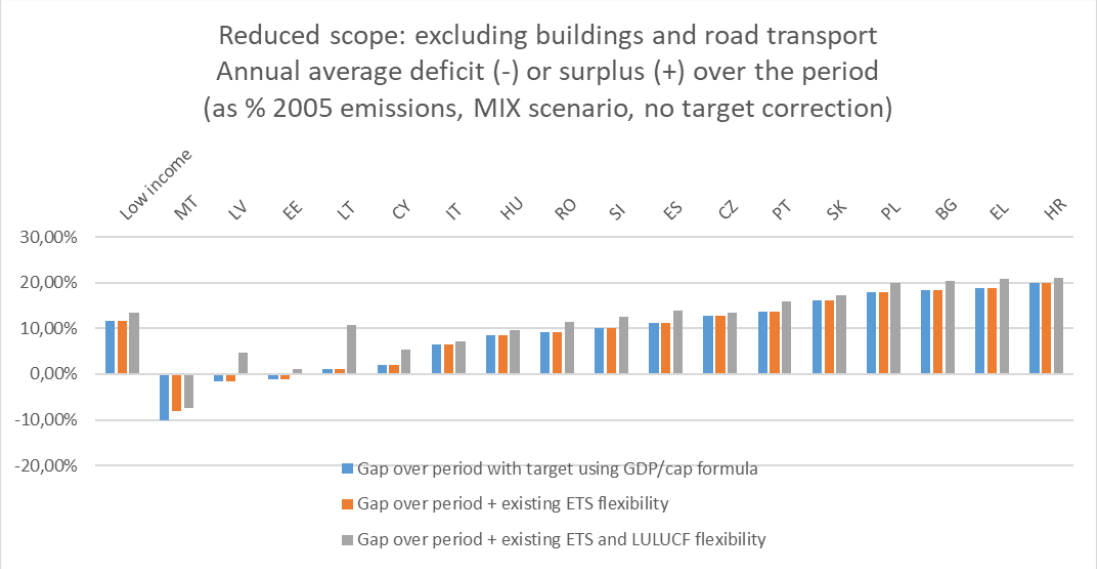


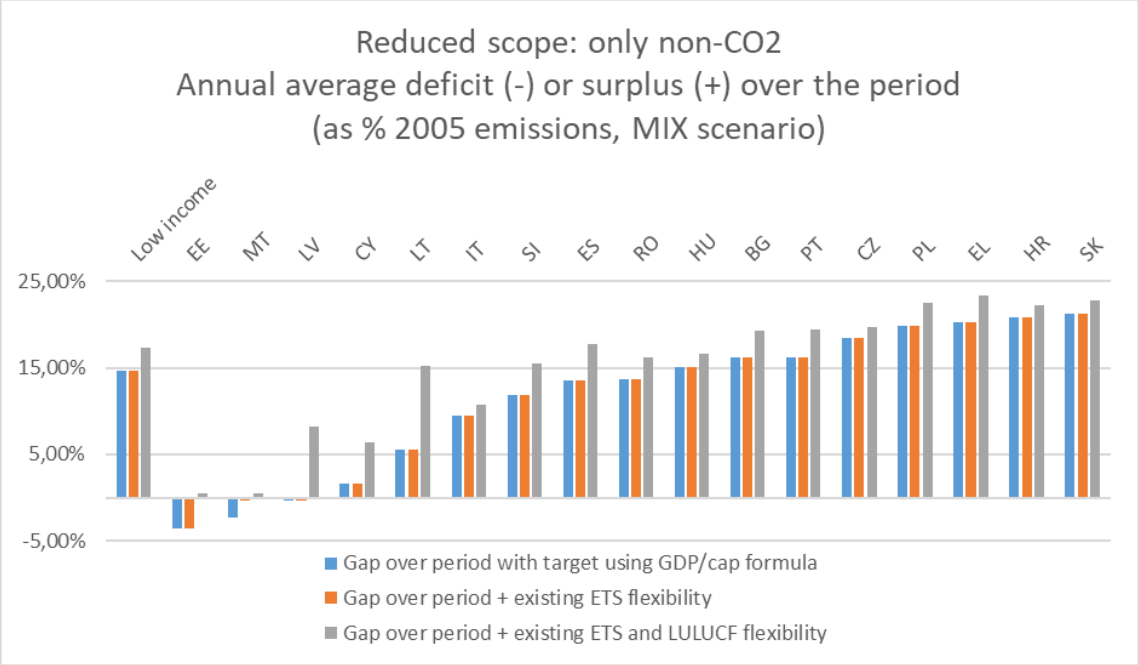


Source: Commission services

The one Member State that has a very high gap in 2030 between its cost efficient emission reduction potential and its target on the basis of GDP per capita is Malta (see Figure 19). But over period this reduces strongly, in part due to the surplus available in the year 2021, which in relative terms is large compared to the reduce scope from 2023 onwards. Also in a reduced ESR scope setting, Malta sees a significant deficit over period. In this case additional corrections could be contemplated, for instance in the form of a one off flexibility or to the ESR target itself. LULUCF is less of an option, given the limited mitigation potential in this area that Malta has.

Figure 21: Impact of ETS and LULUCF flexibilities on low income Member State surpluses and gaps in case of a reduced scope ESR





Source: Commission services

The following conclusion can be drawn:

Economic and environmental

A reduced scope of the ESR will not create any incentives towards greater national climate action in sectors excluded from the ESR. This could lead to suboptimal solutions in these sectors if, as a result, national actions are not undertaken that would be efficient in reducing emissions but are not triggered by carbon prices alone or other EU policies.

Within the ESR sectors in a reduced scope, the absolute demand for transfers and thus for government purchases of credits would decrease, but not its relative size compared to the target, with a consequently increasing gap on the side of high income Member States.

Social & Distributional

A reduced scope ESR would become less relevant as a tool to address fairness in the distribution of emission reduction efforts, since it would be impacting a lower share of emissions and thus incentivising fewer efforts in Member States, based on GDP per capita. Significant changes would occur as to where there would be gaps in emissions reduction by Member States as compared with their individual targets. The increased relative share of the LULUCF flexibility can potentially not materialise, due to the increased ambition in the LULUCF regulation itself and potential split of the LULUCF flexibility over 2 period (see also section 6.1.4 for a discussion on the LULUCF flexibility). Target corrections may thus be required, with Malta having the largest gap.

Environmental

Overall, a less ambitious target of 27% than the cost efficient projection in the reduced scope ESR would entail environmental integrity risks.

6.2.5. Administrative impacts of the current compliance rules for option 2

For option 2, impacts are as indicated for option 1, though the main difference would be that we would establish the ESR inventory, by not only subtracting the existing ETS reported emissions, but also the new ETS reported emissions. Therefore in the ESR there would be no additional administrative impact, though the system is of course dependent on the establishment of the new ETS monitoring and reporting system. While compliance cycle of ESR would be reduced in emission scope, the ESR administrative rules would continue to apply for the remaining sectors. Here, the generic and the administrative costs related to ESR implementation are independent from the emission scope of the ESR. In this regard, the assessment depicted under option 1 would continue to be relevant and the administrative costs related to implementing the regulation would also be limited using a 5-year cycle in line with the Paris Agreement.

Regardless of the scope being reduced, the Commission would continue with its annual monitoring exercise described in the Climate Action Progress Reports and the reporting obligations by Member States presented as per current ESR 5-year compliance cycle. The Governance Regulation and related Implementing Regulations would still apply as regards ESR. It can thus be concluded that option 2 is not likely to have additional administrative impacts compared to the current ESR.

The complication under this option might be rather related to the exact specification of the EU and national target trajectories and how to adapt it to a reduced scope given that historic inventory data related to the exact scope of the new ETS might not be fully available.

6.3. Option 3: Phase out of the Effort Sharing Regulation and replacement by other policy instruments

Under this option, the large majority of GHG emissions that are currently covered by the ESR, would be regulated, on the one hand, by the extension of the scope of the ETS to all fossil fuel combustion emissions and, on the other hand, by covering agriculture and the LULUCF sector by a single climate policy instrument with own objectives and rules.

In that sense, the impacts of this option are primarily analysed in the impact assessments of amending the ETS[53] and the LULUCF Regulation[54], in particular the economic and distributional impacts.

[53] SWD (2021) 601.
[54] SWD (2021) 609.

6.3.1. Environmental and cost-efficiency impacts

From a perspective of the overall environmental integrity and cost-efficiency of the climate policy architecture, this option is similar to option 2 for the share of emissions covered by the mentioned extended instruments. In particular, it would reduce incentives for Member States to take cost-efficient measures at national level in the sectors that are covered by the new ETS only. Beyond the land instrument, there would be no EU determined GHG target guiding the update of the NECPs. On the side of the new land instrument[55] however, Member States would continue to have a strong incentive to consider specific measures.

The remaining GHG emissions that would not be covered by other instruments would amount to some 358Mt CO2eq., less than 1/6 of the scope of the ESR today. Table 12 and Table 13 below give an overview which GHG emissions that are not covered by the other two instruments, first in terms of type of gas and secondly, in terms of sector/activity.

Table 12: Size and type of gas in a reduced scope ESR as of 2020 (option 3.1 - all energy combustion emission fall under ETS and all agriculture emissions under a new land instrument)

Size (in Mt CO2eq.)	Type of gas
195 Mt	CH4 emissions
80 Mt.	F-gases
72 Mt.	CO2
10 Mt.	N2O

Source: Commission Services based on PRIMES and GAINS.

Table 13: Weight and type of sector in a reduced scope ESR as of 2020 (option 3.1 - all energy combustion emission fall under ETS and all agriculture emissions under a new land instrument)

% of total ESR emissions (option 3.1)	Type of sector
41	Waste and wastewater
23%	industrial process & product use emissions
16%	fugitive emissions from energy supply
16%	Non-CO2 from buildings
4%	Others

Source: Commission Services based on PRIMES and GAINS.

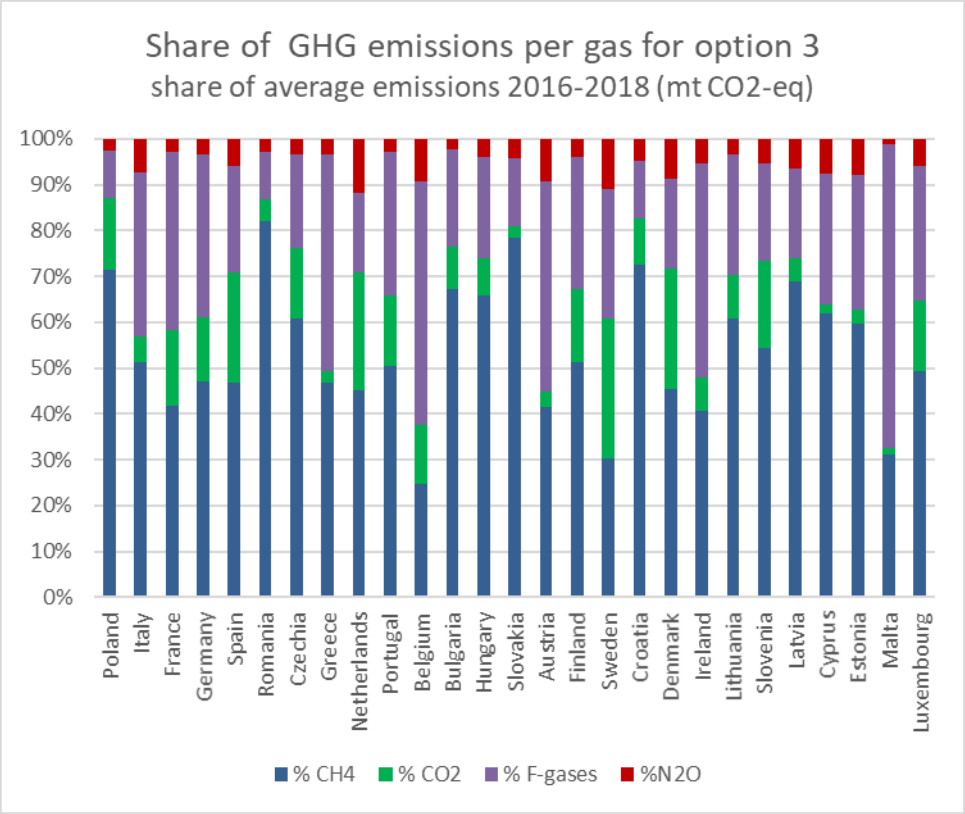
The distribution of these remaining emissions is very diverse across Member States, as shown in the graphs below. What is more, the remaining emission reduction potential and required instruments for the different sectors/activities are very diverse. For instance,

[55] LULUCF + agriculture, also referred to in option 3 in the LULUCF impact assessment.

the emission reduction potential in F-gases by 2030 is large, but F-gases are already regulated by the regulation to phase down their use and spur the use of alternative chemicals, and this legislation will be further updated (proposals scheduled for late 2021). The emission reduction potential for methane emissions in the sector of waste and waste water treatment is large, but this remaining potential is very dependent on national circumstances and on the progress that Member States have made in the implementation of waste regulation and waste water treatment practices and technology.

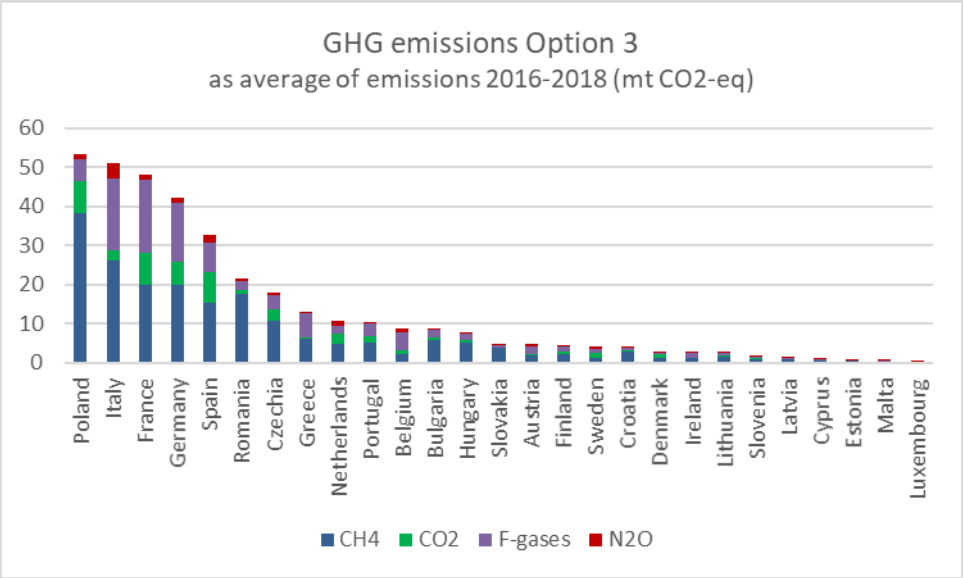
Figure 22 and Figure 23: All GHG emissions for the sectors under option 3 ("Buildings", "Waste and waste water", "Fugitive emissions from energy supply", "Industrial process and product use", and "other" sectors) in shares per gas in average 2016-2018 emissions from inventory data.

Figure 22: Member States' share of GHG emissions per gas for option 3



Source: Commission Services based on EEA

Figure 23: Member States' GHG emissions per gas in option 3



Source: Commission Services based on EEA

A GDP/cap approach is an appropriate parameter to distribute efforts in an equitable way only if a broad scope of sectors is covered, but this seems much less the case in these remaining sectors. As a result it does not seem appropriate to set-up a specific ESR instrument for these remaining emissions, because their mitigation potential is sector specific, with wide differences among Member States, and the overall size of the emissions is small in absolute terms..

Therefore, in practice the Effort Sharing Regulation as such would be phased out, and other instruments would have to make sure that emissions reductions (especially in non-CO2 gases) take place in respect of the remaining approximately 358 million tons CO2eq.

In the energy sector in particular, new policies would need to be put in place to activate a host of cost-efficient mitigation actions. These actions relate first and foremost to methane, and are linked to the methane strategy that the European Commission adopted in 2020. Mitigation actions include reductions of leakage in gas transmission and distribution networks, which are often tied to increased frequency of controls and to improved MRV capabilities. The Commission has already begun work on implementing key measures from the methane strategy[56]. Some cost-efficient mitigation potential also exists to reduce nitrous oxide emissions from power plants through the modification of fluidized bed combustion.

In the waste sector, increased enforcement of existing waste legislation such as on the sorting of organic waste is key for mitigating methane emissions. Such actions are equally foreseen under the methane strategy. Additional cost-efficient mitigation

[56] Inception impact assessment: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12581-Climate-change-new-rules-to-prevent-methane-leakage-in-the-energy-sector

potential still exists in wastewater for both domestic and industrial point sources. In both cases, optimized processes can reduce emissions of nitrous oxide cost-effectively, while the anaerobic treatment of wastewater streams with biogas recovery reduces methane emissions (with precise mitigation costs depending on local conditions).

Currently many Member States have national measure on F-gases in addition to the F-gas Regulation, e.g. in the form of taxes, additional leak reduction, record keeping and reporting measures. These measures tend to reduce F-gas emissions beyond the reduction that can be obtained by the measures at EU level. Without an obligation on each Member State to comply with an emission reduction target that includes F-gas emissions under the ESR, there is a risk that Member States have less incentive to continue with such complementary national measures in the medium term.

6.3.2. Administrative impacts of the current compliance rules for option 3

Option 3 would eliminate the administrative burden of ESR implementation as such for Member States. The monitoring and compliance cycle for the Effort Sharing Regulation would in fact no longer be required. However, achieving the required emission reductions would necessitate implementation of other EU or national policies.

Phasing-out of the ESR would also have implications for the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action (Governance Regulation)[57], as some planning, monitoring and reporting rules are linked with the existing ESR. Under option 3, many of the GHG emissions that are currently covered by the ESR would be regulated, on the one hand, by the extension of the scope of the ETS to all fossil combustion emissions and, on the other hand, by covering all agricultural emissions in the LULUCF. Therefore, while the ESR references in the Governance Regulation relate to a period to 2030 and not beyond, option 3 would require such amendments to reflect the material changes, as article 4 refers materially to ESR targets and related policies and annex I also does so for ESR reporting obligations under the general framework for integrated National Energy and Climate Plans. In a reduced scope scenario (option 2), the Governance Regulation would not require such amendments.

6.4. Other impacts

As presented in the Climate Target Plan (CTP) impact assessment[58], climate and energy policy have wide-ranging implications on the economy, including in terms of the sectoral composition of demand, output and employment, relative producer and consumer prices and the international competitiveness of domestic firms. The transition to climate neutral economies requires innovation and the reallocation of productive capital and the labour force across and within sectors. This is a gradual process that entails shifts in investment patterns. This in turn creates risks related to the retirement of productive assets before the

[57] 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.
[58] SWD/2020/176 final

end of their economic lifetime and potentially difficult adjustments in the labour market as a result of natural frictions and potential mismatches between skills available and the skills requirements of the economy. The speed at which the process transition has to take place increases the challenges related to resource reallocation. As the COVID-19 pandemic has made amply evident, however, many other factors affect the economy in multiple and at times significant manners, whether in terms of cyclical developments or structural changes.

The higher level of mitigation ambition will also affect sectoral investment significantly. As expected, investment in fossil fuels would drop sharply, in particular for coal. Similarly, the transition to clean power technologies and the electrification of the economy would imply a significant increase in investment in clean electricity supply. In industrial sectors, investment is affected by two contrasting trends: the need to invest for decarbonisation purposes and the evolution of output in the sector.

The CTP impact assessment also indicated that the impact of increased climate ambition on aggregate output by 2030 would be relatively limited, but that it could have repercussions at the sectoral level and thus affecting the related labour market. On the other hand, household income was also projected to increase. In that sense, the CTP impact assessment also developed appropriate analysis around the redistribution of carbon revenues that are part of the ETS impact assessment.

Finally, positive impacts could still be expected on air quality and human health as a result of reducing GHG emissions from combustion, correlated with other air pollutants. In particular the use of solid fuels for household heating and liquid fuels for road transport are a strong driver for regional air pollution. The shift to electrification, both in transport and building heating, actions in line with the achievement of the ESR targets, will allow for improved local air pollution impacts. Additional benefits deriving from energy efficiency policies, in particular the improved indoor environment, may have also a positive impact on health and worker productivity[59].

The combination of existing air pollution policies as well as ambitious climate policies results in additional reductions of air pollutants by 2030. This is due to the reduction in energy consumption as well as a general shift towards less polluting fuels. This results in strong benefits for air quality, human health and ecosystems impacts. In terms of health impacts, the reduction of GHG emissions is associated with lower emissions and concentrations of air pollutants, in particular fine particles with a diameter of 2.5 μg or less (PM2.5), nitrogen oxides (NO2) and sulphur dioxide (SO2). For instance, premature deaths from PM2.5 exposure decrease with around 16.8 thousands cases/year in 2030[60]. In addition, there are benefits such as a reduced number of lost working days resulting from avoided illnesses and reduced ecosystem impacts.

[59] Shnapp, S., Paci, D. and Bertoldi, P., Untapping multiple benefits: hidden values in environmental and building policies, EUR 30280 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19983-0, doi:10.2760/314081, JRC120683.
[60] The figures are based on the MIX scenario compared to REF scenario.

For further quantitative details, see annex 10.3.

6.5. Coherence with related legislation and other policy initiatives

Relevant aspects of links and coherence with the ETS Directive and the LULUCF Regulation have already been covered in prior sections.

Related policy initiatives that are relevant to all the options in this IA include the reviews of several initiatives summarised below:

- **The Renewable Energy Directive (RED II)** review will a) assess how far EU renewable energy rules (Directive 2018/2001/EU) can contribute to a higher EU climate ambition of 55% GHG reduction target by 2030 with a possible upward review of the minimum 32% target for renewable energy set at EU level and b) explore how to accelerate the transition to a more integrated energy system as outlined in the energy system integration & hydrogen strategies[61].
- **The Energy Efficiency Directive (EED)** main goal is to assess the basis of what needs to be streamlined and strengthened as regards EU's headline targets to increase energy efficiency by 20% for 2020 and by at least 32.5% for 2030 embedded in this Directive (EED)[62]. On this basis, it will a) address any remaining ambition gap, in case the national contributions in the final NECPs submitted by Member States do not add up to achieve the existing 2030 targets, and b) deliver on the potential contribution of energy efficiency to a higher greenhouse emissions reduction target by 2030 of -55%[63].
- The **Energy Performance of Buildings Directive (EPBD)** revision aims to strengthen the legal framework on energy performance of buildings. Together with the other actions from the Renovation Wave action plan (see below), it will aim to at least double the annual energy renovation rate of buildings by 2030, to foster deep energy renovation, and to contribute to the achievement of the EU climate ambition of 55% GHG reduction target by 2030 and the climate neutrality objective for 2050[64].
- The **Regulation setting CO2 standards for cars and vans'** main objective is to reduce CO2 emissions from cars and vans cost-effectively, in line with the European Green Deal, so as to: a) contribute to the objectives of the Communication on stepping up Europe's 2030 climate ambition and b) define a clear pathway towards zero-emission mobility, in the broader context of climate neutrality by 2050[65].
- The **Revision of the Alternative Fuels Infrastructure Directive**[66]'s main objective is to set requirements for greatly expanding the EU's network of

[61] Inception impact assessment - Ares(2020)4087053
[62] Directive 2012/27/EU.
[63] Inception impact assessment - Ares(2020)4101900
[64] Inception Impact assessment - Ares(2021)1397833
[65] Inception Impact assessment - Ares(2020)6081912
[66] Directive 2014/94/EU

recharging and refuelling stations for alternative vehicle fuels – mainly electric batteries and hydrogen. The goal is to install a sufficient number of points in all countries that are easy to access and use to encourage people to use low- and zero-emission vehicles in much greater numbers than currently – as a measure to ensure achievement of the EU climate ambition of 55% GHG reduction target by 2030 and the climate neutrality objective for 2050 as presented in the European Green Deal[67].

- Climate change mitigation is among the specific objectives of the Commission's proposal for the next **Common Agricultural Policy (CAP).** The CAP proposals require that the CAP Strategic Plans should contribute to the objectives of EU legislation concerning the environment and climate, including the Effort Sharing Regulation (which covers inter alia emissions from the agriculture sector) towards the achievement of the EU climate ambition presented in the European Green Deal.
- The **Farm to Fork strategy**[68] aims to accelerate the transition to a sustainable food system that should a) have a neutral or positive environmental impact; b) help to mitigate climate change and adapt to its impacts; c) reverse the loss of biodiversity; d) ensure food security, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food and e) preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade in line with the European Green Deal.
- The **Renovation Wave**[69] aims to double annual energy renovation rates in the next ten years. These renovations will enhance the quality of life for people living in and using the buildings, reduce Europe's greenhouse gas emissions, and create up to 160,000 additional green jobs in the construction sector.
- The **Circular Economy Action Plan**[70] aims at accelerating the transformational change required by the European Green Deal, while building on circular economy actions implemented since 2015. It sets the agenda of interrelated initiatives to establish a strong and coherent product policy framework to help contributing to GHG emission reduction in key sectors, such as buildings where material efficiency can save 80% of building emissions[71].
- The **Sustainable and Smart Mobility Strategy**[72] lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. As outlined in the European Green Deal, the result will be a 90% cut in emissions by 2050, delivered by a smart, competitive, safe, accessible and affordable transport system.

[67] Inception Impact assessment - Ares(2020)1948408
[68] Farm to Fork Strategy Communication: f2f_action-plan_2020_strategy-info_en.pdf (europa.eu)
[69] COM(2020)662
[70] COM/2020/98 final
[71] Hertwich, E., Lifset, R., Pauliuk, S., Heeren, N., IRP, (2020), *Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future.*
[72] COM/2020/789 final

- And the **Revision of Energy Tax Directive's (ETD)**[73] main objectives are: a) aligning taxation of energy products and electricity with EU energy and climate policies, to contribute to the EU 2030 energy targets and climate neutrality by 2050 and b) preserving the EU single market by updating the scope and the structure of tax rates, and rationalising the use of optional tax exemptions and reductions.

Other policies that drive improvements in the efficiency of the transport sector and greater use of sustainable transport modes will also contribute to the decarbonisation of the economy and sectors under ESR review and its option 1. The sectorial legislation for setting GHG emission targets under Urban Waste Water Treatment Directive (UWWTD)[74] is currently being assessed and could also further contribute to GHG emission reductions in sectors covered by the ESR.

Additionally, there are implications for the Governance Regulation[75], as the integrated national energy and climate progress reporting due in 2023 on biennial basis and related reporting and monitoring will require attention and perhaps adjustment to any changes to the current ESR, especially as these changes may impact the policies and measures Member States adopted or planned to reduce GHG in the ESR sectors. This would apply all the more to the phasing-out of ESR under option 3. This option would call for the amendment of the Governance Regulation to reflect the material changes of this option, as it both refers materially to ESR targets and related policies as well as to the ESR reporting obligation in Annex I. However, the ESR references in the Governance Regulation relate to a period to 2030 and not beyond.

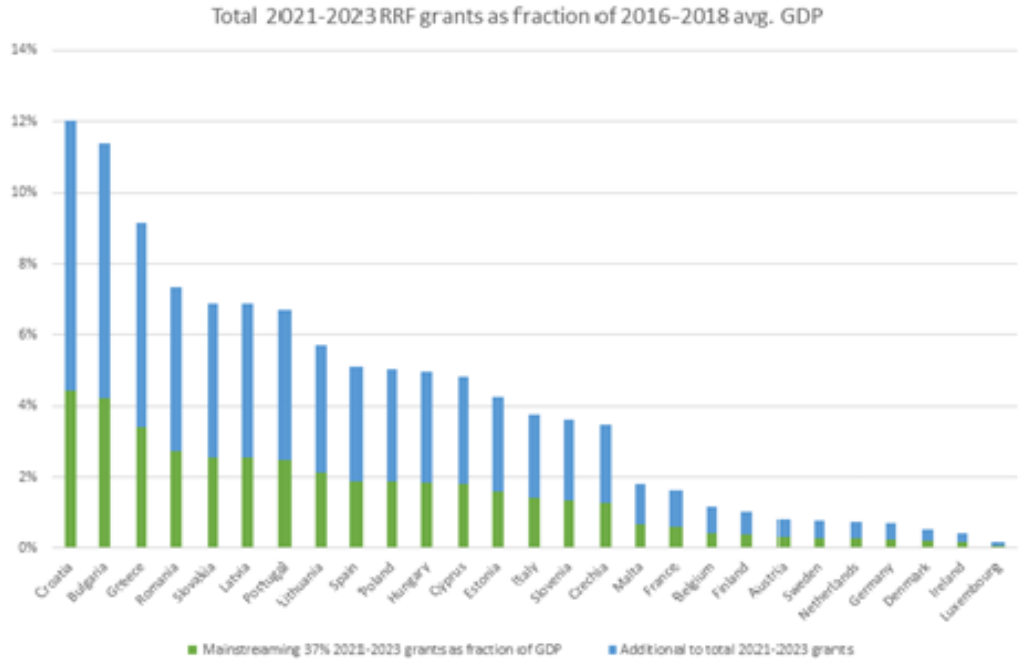
The National Energy and Climate Plans (NECPs) NECPs are both a policy tool and an investment agenda that provide business and investors a forward-looking framework. They constitute a strong basis for Member States to design their green recovery and resilience strategies and deliver on broader European Green Deal objectives from a clean and circular economy to a zero pollution ambition while ensuring energy security. Innovation and investment strategies, supported and triggered by public funds, will be required, both at the Member States and at the EU level, including in the context of the economic recovery from the current pandemic, by investing in energy efficiency, renovating buildings, deploying renewable energies and storage, sustainable mobility, modernising electricity grids and boosting innovation and securing supply chains in crucial technology areas such as renewable hydrogen and batteries.

To this end, the EU budget (Multiannual Financial framework – MFF- 2021-2027) together with the Next Generation EU package and the related proposed national recovery and resilience plans can be a strong driver for transformation and leverage

[73] Directive 2003/96/EC
[74] Inception Impact assessment: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12405-Revision-of-the-Urban-Wastewater-Treatment-Directive
[75] 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.

sustainable private and public investment. Overall, the EU budget (MFF) 2021-2027 and the Next Generation EU package will ensure a 30% climate mainstreaming expenditure target. As regards specifically the Resilience and Recovery Facility under Next Generation EU, each national recovery and resilience plan will have to include a minimum of 37% of expenditure related to climate investments. These funds can heavily support the investments and reforms identified in the NECPs[76].

Figure 24: EU Recovery and Resilience funds available per Member States in relation to GDP, 2021-2023



Source: Commission Services

In this respect, the Just Transition Mechanism (JTM) was announced as part of the European Green Deal Investment Plan Communication on 14 January 2020.

The resources will be leveraged through the three pillars of the mechanism: (i) a Just Transition Fund implemented under shared management; (ii) a dedicated scheme under Invest-EU; (iii) and a new public sector loan facility to mobilise investments benefiting the most affected regions.

The commitment 2021-2027 for the Just Transition Fund has an allocation of EUR 17.5 billion, of which EUR 7.5 billion from the new Multiannual Financial Framework and EUR 10 billion from the Recovery Instrument[77].

The negotiation of the JTF Regulation, although proposed quite late in the MFF package, in January 2020, has been completed end December 2020. The Just Transition

[76] According to the IEA, a sustainable recovery plan could add 1.1 percentage points to global economic growth each year. The effect on employment would be significant, saving or creating roughly 9 million jobs a year over the next three years (IEA's World Energy Outlook Special Report on Sustainable Recovery)

[77] Multiannual Financial Framework 2021-2027 (in commitments) – 2018 prices

Mechanism Regulation is currently discussed with the co-legislators in trilogues. The Just Transition Fund Regulation will enter into force along with the Cohesion policy legislative package most probably end of June. The InvestEU Regulation governing the second JTM pillar has been adopted in March 2021[78]. The Regulation governing the third pillar (i.e. a new public sector loan facility) is currently under discussion with the co-legislators and adoption is expected in July.

The aim is to mobilise investment over the 2021-2027 period to benefit the territories and people across Europe most affected by the transition to a climate-neutral economy in terms of impact on their economic structure and consequently the social impact. The Just Transition Mechanism focuses on those regions and sectors that are most affected by the transition given their dependence on fossil fuels, including coal, peat and oil shale or carbon-intensive industrial processes emitting greenhouse gases.

The Just Transition Fund will provide primarily grants to support the transition to a climate-neutral continent of the most impacted European regions; the dedicated transition scheme under Invest-EU will crowd-in private investments; and the partnership with the EIB will leverage public financing. The Just Transition Platform, a dedicated advisory and technical assistance for the regions and projects concerned will accompany these measures. The Just Transition Mechanism will include a strong governance framework centred on territorial just transition plans, the expected transition process set out in the plans should be aligned with the National Energy and Climate Plans (NECPs).

Table 14: EU Just Transition funds available per Member States, 2021-2027, EUR billion expressed in 2018 prices.

EUR m, 2018 prices	Allocation under the European Union Recovery Instrument	Allocations under the Investment for growth and jobs goal	**Total**	**Share**
BE	95	71	**166**	**0,9%**
BG	673	505	**1.178**	**6,7%**
CZ	853	640	**1.493**	**8,5%**
DK	46	35	**81**	**0,5%**
DE	1.288	966	**2.254**	**12,9%**
EE	184	138	**322**	**1,8%**
IE	44	33	**77**	**0,4%**
EL	431	324	**755**	**4,3%**
ES	452	339	**790**	**4,5%**
FR	535	402	**937**	**5,4%**
HR	97	72	**169**	**1,0%**
IT	535	401	**937**	**5,4%**
CY	53	39	**92**	**0,5%**
LV	100	75	**174**	**1,0%**
LT	142	107	**249**	**1,4%**
LU	5	4	**8**	**0,0%**
HU	136	102	**237**	**1,4%**

[78] Regulation (EU) 2021/523 of the European Parliament and of the Council of 24 March 2021 establishing the InvestEU Programme and amending Regulation (EU) 2015/1017.

MT	12	9	**21**	**0,1%**
NL	324	243	**567**	**3,2%**
AT	71	53	**124**	**0,7%**
PL	2.000	1.500	**3.500**	**20,0%**
PT	116	87	**204**	**1,2%**
RO	1.112	834	**1.947**	**11,1%**
SI	134	101	**235**	**1,3%**
SK	239	179	**418**	**2,4%**
FI	242	182	**424**	**2,4%**
SE	81	61	**142**	**0,8%**
EU-27	**10.000**	**7.500**	**17.500**	**100,0%**

Source: Annex I Just Transition Fund Regulation. All amounts reflect gross allocations, before transfers for technical assistance. Totals may not tally due to rounding.

7. HOW DO THE OPTIONS COMPARE?

In Sections 5 and 6 the different options are described and assessed in detail. This section offers a comparison between the policy options assessed in terms of the three specific objectives that the Effort Sharing Regulation review has at its core: (1) the potential to ensure environmental integrity, (2) allowing for a consistent, fair and equitable distribution of climate ambition efforts between Member States and (3) taking into account cost efficiency in such distribution. Consequently, the comparison has been designed around the following areas: scope, environmental integrity, distribution of efforts and flexibility.

Comparison as regards the scope (specific objective 1)

So far, the ESR, EU ETS and the LULUCF Regulation together have covered all GHG emissions in a mutually exclusive way, each of them defining the contribution of the covered sectors to the overall target. The assessed options consider two broad possibilities. On the one hand, an ESR with the current scope and the ESR and EU ETS both covering the buildings and road transport sectors (**Options 1.1 and 1.2**). On the other hand, an ESR with a reduced scope excluding the buildings and road transport sector which maintains the current mutually exclusive architecture of the ESR and EU ETS (**Options 2.1 and 2.2**).

From a perspective of effectiveness and environmental integrity, option 1.1 clearly gives the strongest incentive to Member States to adopt additional policies to achieve their national target. In this context, it is important to note that many measures for ESR sectors (buildings, road transport, waste, agriculture) are implemented at national level for reasons of subsidiarity, even if they are governed by EU legislation. Option 1.1 (and to lesser extent option 1.2) is therefore characterised by a combination of carbon pricing (in transport and buildings), EU measures and national measures, triggered by the individual accountability of Member States to comply with their national target. It enhances the individual and collective ability to deliver on targets, and therefore enhances the overall environmental integrity at EU level.

From an economic perspective, this combination of measures can be important to enhance cost-efficiency of the overall policy because (1) some cost-efficient solutions

can only be taken at national or subnational level and (2) such policies can unlock the full potential of cost-efficient measures taken at EU level, including the carbon pricing incentive from a new emission trading. As regards the second point, cost-efficiency through carbon pricing will work best if accompanied by national measures, for instance related to the availability of infrastructure, ensuring appropriate tax systems, the development of financing mechanisms for investments, and the removal of market barriers and failures (e.g. related to split incentives) and lack of information. At the same time, carbon pricing as well as other EU policies will facilitate the achievement of the targets under the ESR in all Member States.

In option 2.1 and 2.2 (reduced scope) and in Option 3, Member States have a much lower incentive to adopt national measures in the sectors covered by the new ETS to building and road transport, as they no longer have a national target for those sectors. In those sectors, there is a clear risk that the synergetic effects of both policy instruments will be much lower, potentially leading to carbon prices that are higher than needed, which also may have distributional effects at the level of lower income groups.

In Option 3, due to the small size of the remaining emissions (excluding all energy and agricultural emissions), the divergent abatement potential, and the regulatory approaches already in place for a significant part of these sectors, it does not seem appropriate to set-up a specific ESR instrument, nor would a GDP/cap based approach seem suitable. As the Effort Sharing Regulation would be phased out, other instruments to cover the remaining 358 MTCO2eq would have to make sure cost-efficient reductions in these sectors takes place.

As regards stakeholder's preference as detailed in section 6.1, a majority of respondents agreed that sectors covered in the future by the new ETS should also remain under the ESR (option 1) for a certain period of time after emissions trading has proved successful. As regards agricultural non-CO2 emissions, a majority was in favour of continuing to include agricultural non-CO2 emissions under the ESR (options 1 and 2).

Comparison as regards ambition level - Environmental integrity

Option 1 (maintaining the current scope of the ESR) has two main sub-options: either an ambitious target increase to 40% (**Option 1.1**) or a moderate target increase of 35% (**Option 1.2**). Option 1.1 sets an ambition level through ESR targets that creates clear incentives for Member States to implement national policies in all ESR sectors (both those covered and those not covered by the new ETS) that ensure environmental integrity in 2030. Option 1.2 clearly has risks related to environmental integrity in 2030 as the ESR target itself would not ensure achievement the overall ambition of -40% GHG reductions in the ESR and the carbon price signal (for the building and road transport sector) are not to deliver the additional efforts required in the ESR sectors not covered by the ETS, if not incentivised by an ambitious ESR target or other new policies. A larger scope of a new ETS, and a more ambitious target in the new ETS, would lower the risk. Similarly setting higher ambition in the existing ETS or the LULUCF sector, beyond

what is needed in the cost-efficient projections, may compensate for this risk, but may create new issues in terms of environmental integrity or cost in those sectors.

Taking into account the period up to 2030 and the potential accumulation of AEA surpluses early in the period, also points to a bigger environmental risks over time in Option 1.2 than Option 1.1. Under Option 1.2, it is a challenge to avoid a too generous AEA trajectory compared to emission profiles that could lead to -40% GHG reductions by 2030.

Option 2 (reducing the current scope of the ESR) also has two main sub-options, either a target increase to 35% (**Option 2.1**) or maintaining current targets (**Option 2.2**). While option 2.1 would set an ambition level that could ensure environmental integrity at least for the sectors remaining in the ESR, option 2.2 clearly has risks related to environmental integrity in 2030.

Option 2.1 sets an ambition level through ESR targets with clear incentives for Member States to implement national policies that ensure environmental integrity in 2030 in the remaining ESR sectors. However, it lacks accountability for Member States in the sectors covered by an extended ETS to building and road transport, and therefore lacks incentives for Member States to take cost-efficient measures in the new ETS sectors. Option 2.2 has similar risk characteristics as Option 1.2 related to environmental integrity in 2030 as the reduced scope ESR target together with an extended ETS to building and road transport would not ensure achievement the overall ambition of -40% in the current ESR sectors.

Option 3 has similar effects in terms of the overall environmental integrity as Option 2 in so far as it reduces incentives to take measures at national level in the sectors that are covered by the new ETS only. In sectors still covered in option 3 but not covered by the new ETS or a new land instrument[79], additional and updated policies would be required, but given its significantly reduced scope with remaining emissions of 358 MTCO2eq the overall environmental integrity concerns related to those specific sectors are more limited.

As indicated in section 6.1, the results of the ESR open public consultation showed that the great majority of respondents agreed that the regulated sectors should deliver additional reductions (options 1 and 2.1.). A very limited number of stakeholders from the energy sector (4) did not agree to Member States' increased ambition. The results of the campaign launched to provide feedback in the open public consultation resulting in more than 45,500 EU citizens asking to keep ESR scope and increasing national targets in line with the 55% GHG net reduction ambition for 2030 are reflected along the same lines (see 10.2.2).

Summarising the findings under **specific objective 1 (Define scope ensuring effectiveness and overall environmental integrity),** option 1.1. (i.e. an ESR with the

[79] LULUCF + agriculture, also referred to in option 3 in the LULUCF impact assessment.

current scope and the ESR and a new EU ETS both covering the buildings and road transport sectors) is shown as the most advantageous. This option clearly gives the strongest incentive to Member States to adopt additional policies to achieve their national target, respecting subsidiarity principle, indicated in Table 15. As (++) rating indicates, carbon pricing will work best if accompanied by national measures, for instance related to the availability of infrastructure, ensuring appropriate tax systems, the development of financing mechanisms for investments, and the removal of market barriers and failures (e.g. related to split incentives) and lack of information.

Additionally, option 1.1. scores the highest (++) as opposed to option 1.2. (0) on environmental integrity because in the latter case national targets would only increase to a limited extent, which would need to be matched by further ambition increases in other sectors, which would be very difficult to realise. Option 2.1. scores positive (+) in terms of environmental integrity, but lower than option 1.1, given the fact that synergies between national measures and carbon pricing would be lower. Finally, option 2.2. and 3 score negative in Table 15 (-) as the burden is diverted to other policy instruments, challenging the effectiveness and environmental integrity of the ESR itself.

Comparison as regards fairness (specific objective 2) and cost efficiency (specific objective 3)

The basic design of the current ESR to address the differences in economic capacity of Member States, as well as a relative adjustment to reflect the cost-efficiency in a fair and balanced manner is maintained under both options 1 and 2. Under **Options 1**, a distribution based on GDP per capita results typically in a gap between the GDP based target and the cost efficient abatement potential for high income Member States, while low income Member States receive targets that tend to be below the cost efficient reduction potential.

In order to smoothen part of these differences between high income Member States a continuation of a limited but updated adjustment of the GDP target between the high income Member States could be considered, as well as other elements, such continuation of the one-off ETS flexibility.

Some differences between the GDP based target and the cost efficient abatement potential can be observed also within the group of low and middle-income Member States, although most Member States in this group have targets which are set below the cost efficient reduction potential. This is fair, because achieving the full cost efficient potential may still require in relative terms larger efforts in these countries.

Among the low and middle-income Member States Malta faces a significantly higher cost-efficiency gap and a specific treatment could therefore be considered. This is already recognised in the current ESR, with Malta being the only low to middle income Member State having access to the ETS flexibility in the ESR. Also Cyprus, as small island state, and all the Baltic states have a cost-efficiency gap, though significantly smaller than MT. For these Member States limited corrective actions could be considered.

To improve convergence of targets between Member States for **Option 1.1** compared to a situation that only updates the targets according to the GDP per capita formula, a limit to the target increase could be introduce. This would then need to be compensated by increased efforts by those Member States that have no gap. Overall the target option consider, strongly converge GHG emissions per capita in the EU by 2030, also compared to the existing 2030 targets.

Under **Option 2.1**, a distribution of emissions reduction based on GDP per capita mainly results in different gaps between the GDP based target and the cost efficient abatement potential for each high income Member States. With a reduced scope, the impact of the LULUCF flexibility gains in relative importance.

Even with the (relatively small) adjustments for cost efficiency that have been described in this IA for **Option 1.1** , a gap between certain Member States' adjusted target and their cost-efficient abatement potential will remain. The flexibility requirements that are currently foreseen in the ESR contribute to achieving overall cost-efficiency in reaching the EU's GHG emission reduction target. The impact of these flexibilities for each of the options is summarised below.

Under **Option 3** the distribution of emissions that would not be covered by an ETS or a land instrument[80] is very diverse across Member States. This option would require EU specific legislation tackling current ESR sectors to provide incentives as regards fairness and cost-efficiency.

As regards stakeholder views, a majority of respondents of the open public consultation supported fairness and cost-efficiency as key parameters for setting national targets in the ESR, taking national circumstances into account.

As a summary of the findings focusing only on **specific objective 2 (fairness),** option 1 (i.e. an ESR with the current scope and the ESR and a new EU ETS both covering the buildings and road transport sectors) is the most favourable option, as depicted in Table 15 with rating (++). Under option 1, GDP/capita is main driver for target setting and Member States' specific potential is better taken into account. Options 2 scores positive too (++) given the fact that GDP/capita is kept as the main driver for target setting. Finally, option 3 scores neutral (0) since achievement of the fairness objective will solely depend on specific measures implemented in remaining sectors as indicated in Table 15.

A summary of the comparison of options under **specific objective 3 (cost-efficiency),** brings option 1.1.2. and option 1.2. to be rated the highest (++) in Table 15 because both options are based on GDP/capita with additional adjustments based on cost efficient abatement potential, not only in high-income Member States but also within the group of low and middle-income Member States. High income Member States could be considered eligible to a limited one-off ETS flexibility in some specific cases. This is the case for both Option 1.1 and Option 1.2. Target option 1.1.1. received only partial

[80] LULUCF + agriculture, also referred to in option 3 in the LULUCF impact assessment.

positive rating (+) because under this option target adjustments are not applied. As regards option 2, the assessment of the cost-efficiency specific objective is neutral (0) due to the fact that less cost-efficiency arises in meeting ambition in transport and buildings, which would not be part of ESR scope at all. Finally, option 3 receives a neutral rating (0) in Table 15 since cost-efficiency will depend on specific measures implemented in remaining sectors and not in ESR itself.

Comparison as regards flexibility mechanism

The impact of the current ETS flexibility is assessed for all options. The options do not materially change the logic for such flexibility set out in the current Regulation, as the gap between a fair target based on GDP per capita and the cost efficient abatement for high income Member States and for Malta is still largely in line with the analysis made in 2016. The ETS flexibility would continue to allow these Member States the ability to achieve their target more cost efficiently.

The current LULUCF flexibility provides the possibility for Member States to achieve their targets in the ESR in a more cost efficiently under all options. The Climate Law foresees that in order to ensure that sufficient mitigation efforts are deployed until 2030, the contribution of net removals to the at least net 55% GHG reduction target in 2030 shall be limited to 225 Mt $CO_{2\text{-eq.}}$ This provision in the Climate Law is without prejudice to the revision of Union legislation, and thus it does not preclude the continued use of the LULUCF flexibility under the ESR. Nevertheless it was assessed to which extent the potential use of the LULUCF flexibility can increase the risk of not meeting the ambition as foreseen under the Climate Law.

This risk will significantly reduce with a high ambition in the LULUCF sector itself, reducing the available credits and potentially even resulting in some demand in some Member States for ESR AEAs going towards the LULUCF sector for compliance. Furthermore if the LULUCF flexibility would split over the two compliance periods without banking over these period, this risk to not meet the requirements of the Climate Law would be further reduced.

Thus, both the existing ETS and LULUCF flexibility serve their purpose, contributing to some extent to reducing the gap in countries where this is most evident, though the role of the LULUCF flexibility will be reduced.

Due to the increased overall ambition, notably in option 1.1, it can be expected that flexibilities will be used in a more targeted manner. The dynamics of flexibilities have changed and additional, more restricted elements might arise, leading to a choice at Member State level on what actions to put in place. In that sense, the high income Member States as a group will need to make a choice to either increase abatement beyond cost efficient projections, or engage in trading in the ESR with those Member States that will overachieve their targets. In this regard, the carbon price of a new ETS will lead to additional abatement in low and middle income countries which increases the likelihood that surpluses of AEAs available in case of option 1.1.

Finally, similar to the existing safety reserve, a new reserve could be contemplated that allows for the use of unused LULUCF credits[81], once the environmental integrity of the Climate Law is secured at the end of the second compliance period (i.e. in case the EU overall has achieved sufficient mitigation) for those Member States in need of compliance credits. This reserve would also be dependent upon performance in the LULUCF sector.

With regards to flexibility mechanisms, stakeholders showed a preference for flexibility between countries and flexibility over time either through banking or borrowing. As regards ETS flexibility, half of the respondents agreed that should only be applicable for ETS allowances originating from the ETS, and not for allowances from sectors in transitional ETS arrangements (i.e. option 1 and 2). As regards LULUCF flexibility, all public authorities agreed that if ESR targets were increased, the maximum allowed number of credits should be increased to strengthen incentives for carbon removals.

In a nutshell, after **the assessment of the flexibility mechanism** for each option, option 1.1.2. and option 1.2. are rated the highest (++) in Table 15 under specific objective 3 which includes also flexibilities' assessment because both options ensured the continued role of flexibilities from current ESR. The combination of flexibilities could somehow help Member States to meet their target through a combination of domestic measures and available flexibilities, under all options.

Administrative and monitoring impacts

The Effort Sharing Regulation primarily addresses Member States as institutional actors and thus mostly affects their national administrations. The practical implications of this initiative as regards administrative and monitoring impacts are related to two areas: reporting and monitoring compliance under the ESR, and, indirectly, implementation of national policies and measures for GHG emission reductions or other mitigation actions.

As the Commission would continue with its monitoring exercise of the ESR emissions, and the reporting obligations by Member States presented in the Governance Regulation would still apply, the administrative and monitoring impact for **Options 1** and **Options 2** appear limited. Under Option 1 the impact is expected to be higher than under option 2 for the involved sectors, as ETS obligations will also apply to the buildings and road transport sector and some complexities may result from differences in emission calculation method between ESR and the new extended ETS.

Option 3 would reduce the administrative burden related to the ESR implementation for Member States. The monitoring and compliance cycle for the Effort Sharing Regulation would no longer be required as ESR would be redistributed in other climate legislative instruments. However, achieving the required emission reductions would necessitate implementation of other EU or national policies.

[81] Unused net removals are those not used in the current LULUCF flexibility of Article 7 ESR, and not used in the newly contemplated LULUCF safety reserve.

Finally, concerning the administrative burden, while Options 1 and 2 might only require minimum amendments to the Governance Regulation, Option 3 is likely to require a larger number of amendments to reflect the material changes of the phase-out of the Effort Sharing Regulation.

When asked about the role of the National Energy and Climate Plans (NECPs) embedded under Governance Regulation, stakeholders did not express strong views (neither positive nor negative) on the level of ambition presented in each NECP to distribute additional efforts (70 left the question blank and 56 were neutral, compared to 96 in favour and 53 against). The agricultural sector was mainly in favour of considering NECPs ambition when distributing additional efforts under ESR targets. However, as regards monitoring and compliance several NGOs were vocal about the necessity of establishing coherence between the EU instruments and the NECP framework.

In summary, **administrative and monitoring impacts would have a minimal impact for options 1 and 2.** Under option 1 which includes parallel coverage of transport and building sectors under ESR and a new ETS for both sectors, the impact is expected to be higher that under option 2, where parallel coverage is not included. In this regard, it is important to flag that the primary actors of ESR are national public administrations and Member States as institutional actors. Nonetheless, the reporting and compliance obligations would exist regardless of the scope of ESR. Option 3 would reduce the administrative burden in the ESR itself since it would no longer exist. However, it would increase the administrative burden in other legislative instruments in the phase-out transition. Achieving the required emission reductions would necessitate implementation of other EU or national policies.

Table 15: Comparison overview with all possible options

General objective: Reach at least 55% net greenhouse gas emission reductions by 2030 compared to 1990, in line with the 2030 Climate Target Plan.				
Policy option	**Main elements**	**Specific objective 1:** Define **scope** ensuring overall environmental integrity	**Specific objective 2: Fairness** reflecting national circumstances	**Specific objective 3:** Promote **cost-efficiency, including** with targeted adjustment and use of flexibilities
1. Unchanged Scope (Parallel coverage ETS/ESR)				
1.1. Parallel coverage ETS/ESR with high ESR ambition (-40%)	• ESR scope maintained • New ETS parallel to current ETS for ESR sectors: building & road transport • Targets revised in line with -55% • Role of flexibilities kept unchanged but reduced availability of the LULUCF flexibility.			
Target option 1.1.1: baseline, based purely based on GDP/cap		++	++	+
Target option 1.1.2: based on GDP/cap with additional adjustments		++	++	++
1.2. Parallel coverage ETS/ESR, limited increase in ESR ambition and in flexibilities	• ESR scope maintained • New ETS parallel to current ETS for ESR sectors: building and road transport • Limited increase of ambition (-35%), no adjustments for cost efficiency high income Member States • Role of flexibilities kept unchanged but reduced availability of the LULUCF flexibility.	0	++	++
• **Option 2: Reduced scope ESR (without transport & buildings sectors)**				
2.1. Reduced scope ESR, increase in ambition (i.e. -35% at EU level), unchanged role of flexibilities but reduced availability of the LULUCF flexibility		+	++	0
2.2. Reduced scope ESR, current ESR ambition maintained (i.e. -27% at EU level), unchanged role of flexibilities reduced availability of the LULUCF flexibility		-	+	0
Option 3: phasing-out ESR				
Phase out of the Effort Sharing Regulation and replacement by other policy instruments	• New ETS and new land instrument (LULUCF + agriculture) + relevant sectorial regulation to cover remaining ESR sectors.	-	0	

Note: (++) represents the highest possible rating for each specific objective; (+) represents a positive rating with areas for improvement for the respective specific objective; (0) represents a neutral assessment for the respective

specific objective, either because of not ESR intervention or because of lack of specific measures for suggested scope and the respective specific objective; (-) represents a negative effect for the respective each specific objective.

8. PREFERRED OPTION

When proposing its updated 2030 greenhouse gas emissions reduction target of at least 55%, the European Commission also described the actions across all sectors of the economy that would complement national efforts to achieve the increased ambition. A number of impact assessments have been prepared to support the envisaged revisions of key legislative instruments.

Against this background, this impact assessment has analysed the various options through which a revision of the Effort Sharing Regulation could effectively and efficiently contribute to the delivery of the updated target as part of a wider "Fit for 55" policy package.

Methodological approach

Drawing conclusions about preferred options from this analysis requires tackling two methodological issues.

First, as often the case in impact assessment analysis, ranking options may not be straightforward as it may not be possible to compare options through a single metric and no option may clearly dominate the others across relevant criteria. Ranking then requires an implicit weighting of the different criteria that can only be justifiably established at the political level. In such cases, an impact assessment should wean out as many inferior options as possible while transparently provide the information required for political decision-making. This is what this report does for the revision of the Effort Sharing regulation.

Secondly, the "Fit for 55" package involves a high number of interlinked initiatives underpinned by individual impact assessments. Therefore, there is a need to ensure coherence between the preferred options of various impact assessments.

Policy interactions

Given the complex interdependence across policy tools and the interplay with the methodological issue outlined above, no simultaneous determination of a preferred policy package is thus possible. A sequential approach was therefore necessary.

First, the common economic assessment, underpinning the "Communication on Stepping up Europe's 2030 climate ambition" looked at the feasibility of achieving a higher climate target and provided insights into the efforts that individual sectors would have to make. It could not, however, discuss precise sectoral ambitions or detailed policy tools. Rather, it looked at a range of possible pathways/scenarios to explore the delivery of the increased climate ambition. It noted particular benefits in deploying a broad mix of

policy instruments, including strengthened carbon pricing, increased regulatory policy ambition and the identification of the investments to step up the climate ambition.

An update of the pathway/scenario focusing on a combination of extended use of carbon pricing and medium intensification of regulatory measures in the economy, while also reflecting the COVID-19 pandemic and the National Energy and Climate Plans, confirmed these findings.

Taking this pathway and the Communication on Stepping up Europe's 2030 climate ambition as central reference, individual impact assessments for all "Fit for 55" initiatives were then developed with a view to provide the required evidence base for the final step of detailing an effective, efficient and coherent "Fit for 55" package.

At the aggregate level, these impact assessments provide considerable reassurances about the policy indications adopted by the Commission in the Communication on Stepping up Europe's 2030 climate ambition. This concerns notably a stronger and more comprehensive role of carbon pricing, energy efficiency and renewable energy policies, land sector, and the instruments supporting sustainable mobility and transport. These would be complemented by a carbon border adjustment mechanism and phasing out free allowances. This would allow to continue to address the risk of carbon leakage in an efficient manner. It would also preserve the full scope of the Effort Sharing Regulation for the achievement of the increased climate target.

Various elements of the analyses also suggest that parts of the revenues of a strengthened and new ETS should be used to counter any undesirable distributional impacts such a package would entail (between and within Member States). While the best way to do this is still to be determined, this would seem a superior alternative to foregoing the relevant measures altogether or simply disregarding the uneven nature of their distributional impacts. Under both these alternatives, the eventual success of any package proposed would be at risk.

Preferred policy options

Preliminarily assuming this fact and the analysis above as the framework for the aggregate "Fit for 55" package, the specific analysis carried out in this impact assessment comes to the main following conclusions and would suggest the following preferred policy options for the revision of the Effort Sharing Regulation.

The ESR currently regulates around 60% of the EU's greenhouse gas emissions by setting a collective target, as well as national targets that explicitly take into account fairness. Actual emission reductions in the ESR sectors will still require actions and policies at national level driven by Member States. In addition, the EU can support emission reductions within this framework with dedicated policies providing for:

- improved pricing instruments to reward low carbon solutions and efficiency (i.e. a strengthened Energy Tax Directive making energy taxation more coherent with the transition to climate neutrality and the further development of emission trading in sectors such as buildings and road transport);
- increased availability of technologies and infrastructure for end consumers that enable decarbonisation through a combination of regulatory instruments and investment incentives (e.g. CO2 and cars/vans legislation, Renewable Energy Directive, Alternative Fuels Infrastructure Directive, TEN-E and TEN-T);
- addressing market failures and improving information (e.g. the Energy Efficiency Directive, the Energy Performance of Buildings Directive, Eco-design standards and Energy labelling);
- improved means and access to finance that allows supporting increased investments required for decarbonisation (e.g. Connecting Europe Facility, the EU's Multiannual Financial Framework and Next Generation EU and re-distributional mechanisms related to auctioning in the emission trading system).

Given the strong role of subsidiarity in many of these sectoral EU policies, continuation of the ESR in its current scope is seen as the preferred option. This will ensure that Member States are accountable and have the right incentives to implement both national and EU policies in an ambitious manner, while providing the flexibility to take into account their national circumstances. This national accountability is accompanied by the Governance Regulation and National Energy and Climate Plans to further strengthen an integrated and pro-active approach to deliver on the national targets. The administrative burden is not increased by keeping ESR's current scope in the reporting mechanism by Member States.

The Impact Assessments clearly point towards the need for strong complementary policies to deliver emission reductions in conjunction with pricing instruments, as demonstrated in the MIX scenario. In such a context, the extension of emission trading to new sectors, is seen as contributing to the achievement of the ESR target, and not as a substitution of it.

The preferred option is to increase ambition in the ESR in line with the cost efficient projections to achieve the overall climate ambition for 2030 set out in the Climate Target Plan. Indeed, from an environmental integrity perspective, the option to propose only a limited increase in ambition in national targets under the ESR and instead to rely mainly on EU instruments, including an extended Emission Trading System to road transport and building sectors, carries a risk not to deliver the required emission reductions. Indeed, an extended Emission Trading System cannot be the only architectural pillar of these sectors but rather an additional support to ensure reaching the increased 2030 ambition.

Increasing the national targets under the ESR will require revisiting fairness and cost efficiency within the instrument. As regards fairness, the assessment concludes that an update of the target setting approach based on GDP per capita is still appropriate, while applying a limited amount of targeted corrections to address cost efficiency concerns. Overall this will drive towards convergence of per capita emissions in these sectors across the EU.

In view of ensuring maximum cost-efficiency, all existing flexibilities are expected to be used with the increased ambition, reflected in a 40% EU target for ESR. The flexibility instruments, both in their scale and functioning, are deemed to be appropriate to ensure enhanced cost efficiency of the overall policy.

The Climate Law foresees that in order to ensure that sufficient mitigation efforts are deployed until 2030, the contribution of net removals to the at least net 55% GHG reduction target in 2030 shall be limited to 225 Mt $CO_{2\text{-eq.}}$ This provision in the Climate Law is without prejudice to the revision of Union legislation. The proposed increase in ambition of the LULUCF regulation, together with splitting the existing LULUCF flexibility for use in each of the 5 year compliance periods, reduces the likelihood of not meeting the requirements of the Climate Law. Still, allowing for flexibility from the ESR sector into the LULUCF sectors and limited flexibility vice versa, is beneficial in order to enable Member States to comply effectively with their individual obligations.

The establishment of a new mechanism taking the form of an additional reserve could be considered. This reserve could be triggered only once the requirements of the Climate Law are achieved, for the purpose of national compliance with ESR targets by transferring any unused LULUCF credits[82] at the end of the second compliance period to those Member States in need. However, the use of this reserve will depend on over-performance in the LULUCF sector.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

As concluded in section 6.1.6 and 6.2.5 on administrative impacts of the current compliance rules, the monitoring and evaluation of the effects and impacts of the revised Effort Sharing Regulation would follow largely the same rules and procedures already established in the current ESR for the commitment period 2021-2030 for the preferred option. It would not increase the administrative burden of the reporting mechanism by Member States, as main actors targetted by the ESR.

A comprehensive framework of monitoring, reporting and verification is laid down partly in the ESR itself and partly in the Regulation (EU) 2018/1999 on the Governance of the

[82] Unused net removals are those not used in the current LULUCF flexibility of Article 7 ESR, and not used in the newly designed LULUCF safety reserve.

Energy Union and Climate Action (Governance Regulation)[83] and its implementing provisions[84]. Member States are obliged to annually report their greenhouse gas emissions to the Commission.

In a nutshell, the current framework reviews Member States' emissions as follows:

1. First, the data is requested to Member States to produce the annual inventory checks, with the support of the European Environment Agency. This include the UNFCCF inventory data as well as the inventory data of the existing ETS (for option 1) and the new ETS (for option 2).
2. Second, the Commission produces the evaluative annual progress reports.
3. Thirdly, the five-yearly comprehensive review is carried out before compliance checks, which, de facto, are formalised as ESR progress checks.

The Implementing Decision[85] adopted by the Commission in December 2020 sets out the annual emission allocations (AEAs) for each Member State for the years from 2021 to 2030 in terms of tonnes of CO_2 equivalent as laid down in the ESR[86]. A similar implementing decision would need to be adopted to set revised AEAs, unless it is decided to define them in ESR legislation already if the scope is not changed (under option 1).

The Commission annually evaluates Member States' progress in reducing GHG emissions, taking into account progress in Union policies and measures and information from Member States. Member States report their GHG emissions every year and their submitted greenhouse gas emissions inventories are subject to a quality assurance and quality control that includes checks of the transparency, accuracy, consistency, comparability and completeness of the submitted inventories. Every two years, Member States are obliged to report on national policies and measures and national systems of policies and measures implemented in order to achieve their targets under the ESR and on their emission projections.

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[83] 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

[84] Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014

[85] Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council.

[86] Idem.

In order to ensure efficient, transparent, cost-effective reporting and verification of GHG emissions and of other information necessary to assess progress with Member State's annual targets in 2021-2030, the requirements for annual reporting and evaluation under ESR integrated into the Governance Regulation would be kept as in current ESR (option 1 and option 2).

Under article 9 of the ESR, the control of Member States' compliance with their annual targets is carried out every 5 years. The Commission shall carry out two compliance controls of Member states' GHG emissions inventories; in 2027 (to check annual compliance for the years 2021-2025) and in 2032 (for the years 2026-2030). This procedure ensures that the compliance check is synchronised with accounting and compliance under the LULUCF Regulation[87], and allows for using any LULUCF credit for compliance with the non-ETS target. It also aligns the ESR compliance cycle in the 2021-2030 commitment period with the ambition cycle agreed under the Paris Agreement.

To ensure that the five yearly compliance check is based on accurate and verified data, the GHG emissions inventories submitted by Member States for the relevant years are subject to a comprehensive Union review co-ordinated by the European Environment Agency on behalf of the Commission as laid down in the Governance Regulation and its implementing legislation.

The compliance control is performed by the Commission by comparing the reported and reviewed emissions with the annual emission allocations. Before the compliance check, Member States can make use of the flexibility instruments (e.g., banking and borrowing, AEA transfers from other countries) to close any gap between their actual emissions and emission limits for a particular year.

If a Member State does not comply after applying the flexibility instruments, a deduction is applied from its emission allocation of the following year equal to the excess emissions (in tonnes of carbon dioxide equivalent) multiplied by an abatement factor of 1.08.

In addition to the compliance checks in 2027 and 2032, Member States' progress towards their 2030 targets are monitored every year and reported by the Commission in its annual climate action progress report[88]. Should the progress report show that a Member State is not on track for a specific year during the compliance period, it will have to submit to the Commission a corrective action plan including the actions to be taken by the Member

[87] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

[88] The report will present Member States' progress towards their obligations under the Energy Union and its governance system.

State in order to ensure compliance with its obligations together with the timetable for implementation. The Commission may issue an opinion on the corrective action plan.

Since the Effort Sharing emissions under option 1 are impacted by notably the availability of the ETS inventory data it is important to have a clear understanding of the implications of current data availability. Here it is relevant to mention that the existing ETS compliance cycle is defined as the annual procedure of monitoring, reporting and verification (MRV), together with all the associated processes. Every year, operators must submit an emissions report. An accredited verifier must verify the data for a given year by 31 March of the following year. Once verified, operators must surrender the equivalent number of allowances by 30 April of that year.

As regards the options presented in this impact assessment, option 1 implies keeping the current scope of the ESR and the existing monitoring, reporting and compliance system. If GHG inventories would continue to be used for all the sectors covered, consistency checks to explain differences between the emissions which would be covered double in GHG inventories and under a new ETS would be introduced into the GHG inventory reporting, similar as for current ETS emissions. If new ETS MRV data would be used for those sectors, then ESR emissions would be calculated as under option 2, and then verified new ETS emissions be added to calculate ESR emissions. Under option 2 which foresees a reduced scope of the current ESR, the scope of the ETS emissions deducted and based on a separate MRV system would now be larger, which would mean that AEAs and 2005 base years would need to be recalculated based on the reduced scope.

In conclusion, the existing monitoring, reporting and compliance check and as laid down in the current ESR and the Governance Regulation would be maintained in the Revision of the ESR proposal. An update of the AEAs would be needed in case of increased national targets. The two independent monitoring systems (for parallel coverage of transport and building sectors both under new ETS and ESR) do not increase the complexity since they target different reporting actors (national authorities for ESR and specific sectors for the new ETS).

10. ANNEXES

10.1. Procedural information

10.1.1. Lead DG, Decide Planning/CWP references

The Directorate-General (DG) for Climate Action was leading 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/2020/8680.

It is included in the 2021 Commission Work Programme under the policy objective "Fit for 55 Package"[89].

10.1.2. Organisation and timing

- The planned adoption date (Q2 2021) was included in the Commission Work Programme adopted on 19 October 2020.
- 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 (ISG), was established for preparing the climate-related "Fit for 55 Package" initiatives. Its members were: SG, LS, AGRI, BUDG, COMM, COMP, CNECT, DEFIS, DGT, DIGIT, EAC, ECFIN, ECHO, the EEAS, EMPL, ENER, ENV, ESTAT, FISMA, FPI, GROW, HOME, HR, IDEA, IAS, INTPA, JRC, JUST, MARE, MOVE, NEAR, OLAF, REFORM, REGIO, RTD, SANTE, TAXUD, and TRADE.
- The ISG met four times in the period from September until adoption in July 2021.

10.1.3. Consultation of the RSB

The RSB meeting on this initiative took place on 14 April 2021 with positive opinion with reservations delivered on 19th April. Following the RSB opinion from 19th April the changes where introduced to address detailed comments by the RSB. Regarding key findings of the RSB, the following changes were introduced:

(i) The narrative in sections 1, 2, 4 and 5 has been improved specifically regarding the complementarities between ESR and related Fit for 55 legislation, notably the ETS and the LULUCF legislation. This includes more explicitly what elements were part of the Climate Target Plan, and which elements needed further scrutiny under this impact assessment. A new annex 10.8 includes now the 2030 Climate Target Plan policy conclusions.

(ii) In the analytical section the link with the LULUCF Regulation was reviewed, also to take into account the implications of the Climate Law political agreement.

(iii) The narrative to justify the appropriateness of keeping ESR scope untouched, is reinforced in section 6.1. and consequently reflected in sections 7, 8 and 9.

[89] COM(2020) 690 final

(iv) Annex 10.3 was elaborated and now identifies who will be affected and how, what are the main costs and benefits of the preferred option. It includes a more detailed assessment of impacts at sectoral and country level related to sector of key importance to the ESR such as road transport, buildings, agriculture and Non-CO2 emissions in general. Additionally, a summary of costs and benefits has been developed based on modelling results including energy-related costs as % GDP per residential, services and transport, air quality benefits depicted as lowered emissions of air pollutants and, finally, health and economic impacts of improved air quality.

(v) This version includes better representation of stakeholder views, namely a detailed assessment and representation of stakeholder views across the document (especially in section 6, 7 and 8) including correlation assessment of main stakeholder groups. A complete annex 10.2 also includes a complete overview of the results of stakeholder consultation activities carried out in the context of the revision of the ESR and Fit for 55 policy package.

Finally, a thorough exercise to improve readability and address editorial aspects flagged by the Board has been carried out aiming at adding explanations to make the content as clear as possible.

10.1.4. Evidence, sources and quality

See annex 10.4

10.2. Stakeholder consultation

The Commission carried out consultation activities on the plan to increase the EU 2030 Greenhouse Gas (GHG) emissions reduction target. This plan included the review of the Effort Sharing Regulation (ESR). The review started with an Inception Impact Assessment (IIA) consultation and was followed by an Open Public Consultation (OPC). The IIA was conducted from the 29th of October 2020 to the 26th of November 2020. The OPC was conducted through an EU online survey between the 13th of November 2020 and the 5th of February 2021.

10.2.1. Feedback received on the ESR Inception Impact Assessment

The Commission received 100 responses, including 40 from business associations, 22 from NGOs, 21 from company/business organisation, 8 from environmental organisations, 4 from individuals, 2 from public authorities, and 2 from other stakeholders. Almost all respondents (94%) came from 16 EU Member States, and 6% from non-EU countries [Canada (1), Norway (2), Switzerland (1), the United States (1), and the United Kingdom (1), mostly from environmental organisations and business associations]. In addition, 48 papers were received as attachments by as many stakeholders.

Respondents acknowledged the need to revise the 2030 target, perceived as an intermediate step to achieve climate neutrality by 2050, and to increase the contribution level for the ESR to achieve this goal. Regarding the specific approaches, there was strong agreement with using a cost-efficient approach, while opinions on the fair distribution based on the different economic capacities of Member States were more balanced.

A large consensus was registered for maintaining the existing architecture of the ESR (ESR IA's options 1 and 2). Some respondents expressed concerns or disagreement with the presented policy options and regretted the absence of an option to simply strengthen the ESR with its current scope without a new ETS. The other respondents expressed differing opinions as regards their preferred option for the scope (keep current scope or reduce the scope), but only very few favoured the phase-out of the ESR (ESR IA's option 3). The two public authorities who responded welcomed the ESR revision, but claimed that the impact of the proposed options on Member States should be further assessed.

A number of respondents expressed doubts about the benefits that could come from the inclusion of the road transport and buildings sectors under the ETS in terms of emissions reduction. Respondents also underlined the need to articulate ETS and ESR to ensure clarity, stability and predictability. Among alternative approaches, the reliance on carbon pricing based on the energy taxation rather than on the extension of the ETS or the introduction of an EU-wide carbon tax for the transport sector were suggested. Another

concern raised included the possibility to recourse to the energy taxation lever if the ETS were extended to the road transport sector. For the waste sector, respondents would prefer to keep it under the ESR.

In terms of impacts, respondents generally expressed concerns about the potential effect of the ESR revision on competitiveness, innovation, uptake of alternative fuels or carbon market distortions (mainly stakeholders from the private sector), and carbon leakage associated with an extended ETS scope. Likewise, respondents expressed worries regarding the just transition as price increases are passed on directly to consumer for buildings and road transport sectors, leading to affordability issues.

10.2.2. Feedback received on the Open Public Consultation (OPC)

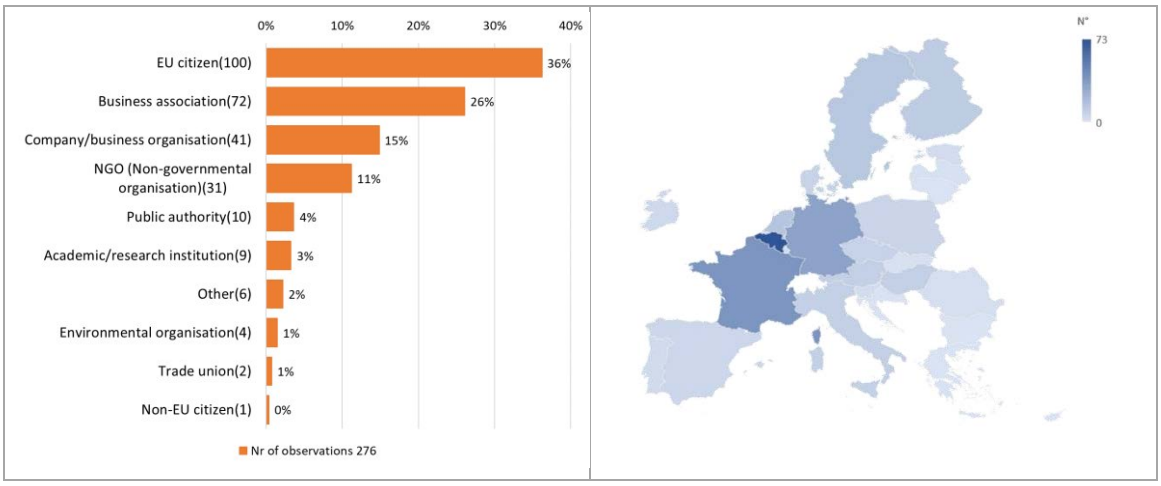
The key issues addressed by this OPC were the overall ambition of ESR and how this ambition is shared between Member States, the sectors and type of emissions covered, and the interaction between the ESR and the ETS and LULUCF.

45678 stakeholders responded to the Open Public Consultation for the ESR. 45403 responses were associated to a campaign and submitted by citizens, and 276 by other respondents from different categories of stakeholders, representing Business Associations (26%), Companies/businesses (15%), EU citizens (36%), Public Authorities (4%) and Trade Unions (1%).

Of the respondents non-associated to a campaign, 96% came from within the EU. Concretely, EU responses came from 22 Member States. Belgium was the country with most respondents[90] (26%), followed by France (14%) and Germany (12%). In addition, 45 papers were submitted as attachments by 42 stakeholders. 32 were selected for further analysis from respectively, Public Authorities, business associations, companies, NGOs, and academia.

[90] This result is influenced by the fact that one-third of business associations and NGOs that respondents are based in Belgium.

Figure 25: Distribution of respondents to the review of ESR open public consultation by type and country based on data related to EU-based respondents.



Source: Technopolis, based on data of EU-based respondents to the public consultation

Campaign

As indicated above, a web campaign[91] was identified involving 99% of total responses and supported by 45403 individuals, from EU (98%) and non-EU countries (2%). The respondents represented all EU Member States. France was the country with most respondents (45%), followed by Germany (21%), Belgium (12%) and Austria (5%). Campaign respondents agreed that the ESR regulated sectors should deliver additional reductions, that all Member States should step-up their efforts and pursue more ambitious targets, and that sectors covered in the future by the new ETS should also remain under the ESR.

Assessment of the ESR open public consultation questionnaire

The questionnaire was composed of two sections. The first collected general feedback on the contribution of the ESR to the overall climate ambition for 2030, and on the treatment of relevant sectors. The second addressed the review of the ESR scope, level of ambition, interaction with other relevant legislation, flexibility mechanisms, and finally, monitoring, reporting and compliance. According to the Better Regulation Guidelines, the results of the campaign related to this part of the questionnaire have been isolated and reported separately.

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

[91] Transport & Environment has developed and launched this web campaign, with the support of other NGOs including Birdlife, CAN-Europe, Carbon Market Watch, EEB, WWF and SumofUs. They have developed responses to the first three 'general' questions in the European Commission's public consultation, arguing that "scrapping binding national climate targets that cover sectors such as buildings and road transport would be unacceptable". https://www.everybodycounts.eu/about/about-this-campaign.

respondents to 'rate' options (from -2 to +2, including a neutral option 0). On these ratings, the report generally provides figures for the highest rating as well as for the lowest one, as these are indicative of most relevant positions. The scales for most questions included one or more 'opt-out' responses to avoid forcing respondents into giving an opinion they do not feel qualified giving. Finally, one open question at the end asked the respondent for any further relevant feedback, information, papers or opinions they wished to share.

The responses from the online survey were processed statistically and thematically, with a correlation analysis being carried out for each question.

Part A – General remarks on the ESR review (Questions from 1 to 4)

The great majority of respondents (87%; 229) agreed that the regulated sectors should deliver additional reductions. Overall, individuals (93%), Business Associations (77%) and companies (87%) agreed. Public Authorities replying to this question (6) and Trade Unions (2) responded favourably.

The majority of stakeholders (88%; 229), agreed that Member States should step-up their efforts and pursue more ambitious targets. Notably, 98% of individuals, 77% of private stakeholders, as well as 86% public authorities and all Trade Unions (2) agreed.

About 60% of the respondents either strongly agreed (50%) or agreed (9%) that sectors covered in the future by the ETS to new sectors should also remain under the ESR. Over half of those who strongly agreed or agreed were from the private sector (34). In contrast, 26% of respondents argued either very strongly (19%) or strongly (7%) that sectors covered in the future by the ETS to new sectors should not remain under the scope of the ESR. Most of those came from the private sector (54), representing 64% of all responses from private sector stakeholders to this question.

When asked about preferences in sectorial coverage of the ESR, sector-specific stakeholders for road transport, waste and building sectors typically opposed to an extension of the ETS to their sector. With regards to the exclusion of agricultural non-CO2 emissions from the scope of the ESR and their transfer to another instrument (for instance by combining agriculture non-CO2 emissions and LULUCF emissions under one regulatory instrument), there was no clear position, as opinions were almost equally split among respondents.

Part B – Expert questions (Questions from 5 to 18)

A majority of 126 respondents were in favour of parallel coverage ESR/ETS in case of an extension of the ETS, with a large majority of NGOs and citizens' in favour of this option. Instead, a smaller but significant share of 81 respondents were in favour of

reducing the sectoral scope of the ESR with a much more limited majority of private sector replies in favour of this option. Of those in favour, around half would agree to reduce the scope immediately while the other half only once emission trading for these new sectors is proven successful. Only one public authority agreed to reduce the scope immediately.

With regards to what sectors should be moved to ETS, 57% of respondents indicated all fossil fuel combustion, 20% indicated buildings, 4% indicated transport and 18% indicated a combination of building and transport.

Based on these responses, maintaining/strengthening incentives for national GHG reduction policies was seen as the most important consideration when determining double sector coverage (72%), with ensuring environmental integrity (57%) and considering the implications on flexibility (54%) as important additional factors.

A strong consensus was registered (75%; 175) for changing the current levels EU-wide and national targets under the existing ESR, in case the current scope of the ESR is kept. Strong majorities of both NGOs and private sector respondents agreed to this. Respondents also largely agreed that targets should be increased in-line with cost effective reduction potential (such as depicted in the impact assessment of the 2030 Climate Target Plan).

Regarding the distribution criteria, almost half of the respondents (46%; 105), including half of the respondents from the private sector (53%; 49) and from public authorities (3), argued in favour of changing them. The rest was equally split between those who did not see the need for a revision and those who did not answer.

As for the most relevant criteria for distributing the additional efforts between Member States, 71% of respondents either strongly agreed or agreed that those Member States that are best equipped economically to reduce GHG emissions should do relatively more, 66% either strongly agreed or agreed that the contribution of Member States should be linked to cost effective emission reduction potentials, 46% either agreed or strongly agreed that the distribution of additional efforts should also take into account Member States' ambitions in their National Energy and Climate Plans, 77% either agreed or strongly agreed that the distribution of additional efforts should also take into account long-term convergence in ESR sectors in view of climate neutrality by 2050, and 61% either agreed or strongly agreed that other criteria should be considered. The private sector, Public authorities and Trade Unions either agreed or strongly agreed on all questions above.

When asked about how LULUCF should interact under the ESR, 47% of respondents, including all Public authorities either agreed or strongly agreed that, if targets under the ESR were increased, the maximum allowed number of credits under the LULUCF flexibility at Member State level should be increased to strengthen incentives for carbon

removals. Respondents' views were also split regarding the opportunity to keep the current level of flexibility.

Likewise, respondents were split on how the ESR should contribute to the EU climate policy when it comes to agriculture. Slightly more than half of the responses were in favour of continuing to include agricultural non-CO2 emissions under the ESR, with a preference (24%) for continuing to allow for the use of LULUCF credits in the ESR up to the current limit, compensating LULUCF debits with additional reductions in sectors covered by the ESR. About one-fifth argued that emissions from agriculture should be excluded from the ESR and regulated elsewhere.

With regards to flexibility mechanisms, the most selected answers were (i) flexibility between countries (23%); (ii) flexibilities over time either through banking or borrowing; and (iii) flexibilities with the ETS and (iv) with the LULUCF being similarly rated (between 13% and 17%).

As regards the use of the ETS flexibility, respondents' views were almost equally split (38% in disagreement vs 36% in agreement) as regards appropriateness of the current limited ETS flexibility even with increased targets under current scope. A majority of respondents agreed or strongly agreed that with an extended ETS to new sectors, the ETS flexibility should be abolished or reduced. Views were more mixed towards the possibility to make the ETS flexibility accessible to all Member States. Respondents favoured the option that the ETS flexibility should only be applicable for ETS allowances originating from the ETS, and not for allowances from sectors in transitional ETS arrangements.

Last, but not least, 55% of the respondents (representing individuals, academics, and NGOs) stated that there are insufficient incentives for Member States to comply with increased ESR targets while only 17% indicated there are sufficient incentives.

Assessment of position papers received

43 papers were received as attachments to the open public consultation. Out of them, 31 were selected for a more detailed analysis. The papers were selected for analysis based on criteria regarding:

- the overall ambition increase for ESR EU and national targets;
- the distribution between Member States and associated criteria;
- the reduction of sectorial coverage due to ETS extension;
- differences between all fossil fuel combustion, buildings and transport;
- elements to be taken into consideration for emissions to enter the scope of both ETS and ESR;
- monitoring, reporting and compliance;
- consequences for emissions under ETS and ESR;

- flexibility between LULUCF and ESR and the role of the ESR for agriculture;
- flexibility mechanisms to be mobilised to achieve an increased climate ambition;
- main challenges and benefits.

The papers received came from business organisations - notably private operators from the energy sector, manufacturing of chemicals and chemical products, forestry, waste, or construction, environmental organisations or other NGOs and public administrations. The key messages of the position papers were:

- There is overall support to further raise the ambitions of the ESR.
- On the distribution of the burden among Member States, papers typically recognised the need to account for the cost-effectiveness of abatement, requiring all Member States to achieve GHG reductions. Some paper favour an objective of achieving convergence of Member State emissions by 2050.
- While the extension of the ETS finds positive support in seven papers, often this support is conditional. The papers, for instance, warned against combining buildings and road transport with the current ETS in either the absence of mitigating measures (to fend off an increased allowance price for incumbent sectors) or a (transitionally) separate ETS (for particularly buildings and road transport). Four papers supported a parallel new ETS and ESR scope, while six called for either reducing the scope of or withdrawing the ESR.
- Instead five papers assessed opposed an extended ETS scope to new sectors of which two were explicitly against including road transport.
- Eight papers commented on the LULUCF sectors of which the majority favours the creation of an AFOLU sector, but submissions by the forestry sector argue against this.

10.3. Who is affected and how?

Practical implications of the initiative

The Effort Sharing Regulation primarily addresses Member States as institutional actors and thus directly affects their national administrations. The practical implications of this initiative are related to two areas: reporting and monitoring compliance under the ESR, and, indirectly, implementation of national policies and measures for GHG emission reductions or other mitigation actions.

With respect to businesses in general and SMEs in particular there are no direct reporting obligations for SMEs or other enterprises under the ESR and the policy options would not change this status.

As explained and justified in section 6 of this impact assessment, reporting by Member States under the ESR would follow the same well established rules and procedures as in the current commitment period 2021-2030. That means annual reporting of GHG inventory reviews and compliance checks every 5 years. That implies that the associated administrative burden and costs for monitoring compliance are already reduced both for Member States and the European Commission and fit for purpose. As regards AEA transfers that are notified by Member States selling or buying AEAs, the information site is web-based and hosted by the European Commission with minimal costs and very limited administrative burden by Member States and the policy options proposed would not change this status.

Indirectly, there are strong impacts on sectors due to the measurse taken at EU and Member States' level to effectively achieve the ESR targets.

Impacts at sectoral level have been analysed in detail in the Impact Assesment of the Climate Target Plan[92], and are also further assessed in specific IA's of the Fit for 55 package, notably of the ETS (and its potential extension), the Energy Efficiency Directive, the Renewable Energy Directive, the CO2&cars/vans Regulation and the LULUCF Regulation. Member State level detail of sector transformation required in the energy system (including transport) and non-CO_2 emissions for the different core scenarios is available (see also annex 10.4).

The sub-sections below discuss which sectors in the ESR are affected by a strengthening of the ESR ambition. It uses results from the baseline ("REF") and the MIX scenario, i.e. the common and central policy scenario of the impact assessments underpinning the "Fit for 55" policy package (see annex 10.4).

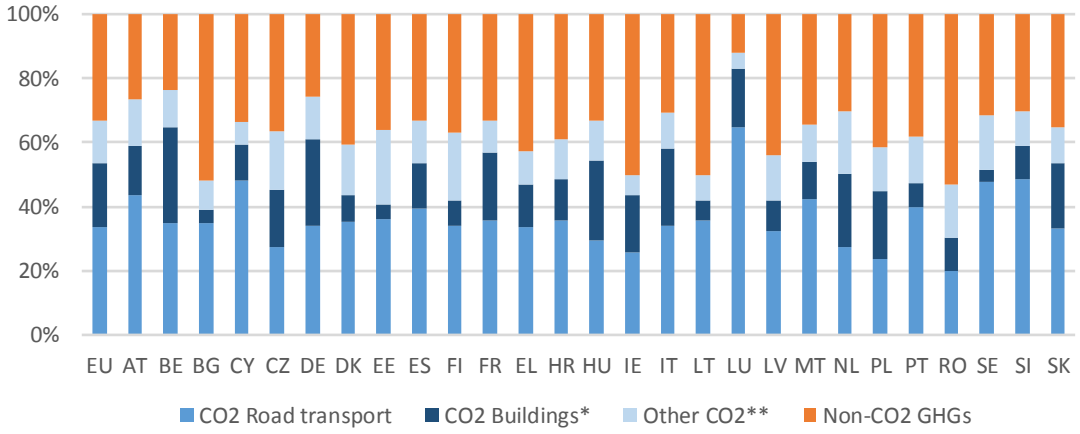
[92] SWD/2020/176 final

Current GHG emissions in ESR sectors

The EU-level GHG emissions under the ESR hide a diversity of profiles at the Member States level with regards to the contribution of sectors and gases. Figure 26 shows the relative contribution of CO2 emissions and of other GHGs to the total historical ESR emissions[93], at EU level and per Member State.

At EU level, about two thirds of the ESR emissions are CO2, with road transport alone representing about a third and direct emissions in buildings a fifth. The share of CO2 emissions ranges from close to 50% in BG, IE, LT or RO - four Member States where the non-CO2 emissions have a comparatively higher weight (although with different sectoral compositions, see Figure 27) - to around 75% for AT, BE, DE and even close to 90% for LU due in particular to the relative importance of the road transport in that Member State. Non-CO2 GHG emissions represent 33% of the total at EU level, ranging from close to 55% to less than 25%.

Figure 26: Distribution of CO2 and other GHGs in the ESR emissions (2015)



*Notes: * "CO2 Buildings" are direct emisions from fossil fuels combustion in residential and services buidlings ; ** "Other CO2" includes UNFCCC "category 3" CO2 emissions (from agriculture) as well as calibration factor to match the total ESR CO2 emissions from the inventories.*

Source: CO2 road transport and buildings: EEA GHG data viewer, "Other CO2": PRIMES model, non-CO2: GAINS model (GWP AR5)

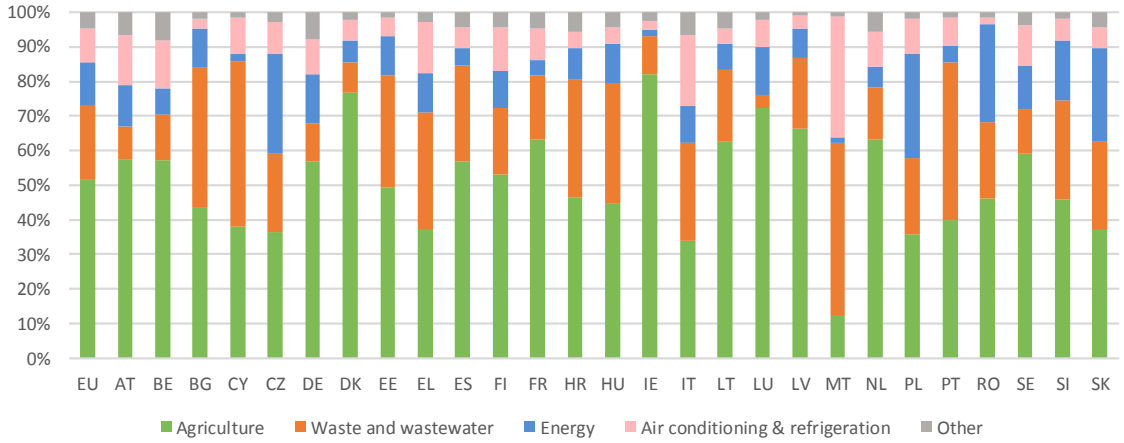
Nearly all non-CO_2 greenhouse gase emissions are covered under the Effort Sharing Regulation[94]. The split of 2015 non-CO2 GHG emissions[95] is shown in Figure 27. For the EU, the majority of these non-CO2 GHG emissions come from agriculture (54% of total EU non-CO2 GHG emissions) while waste and wastewater are the second-largest source (22%), followed by the energy sector (13%) and F-gas consuming applications in

[93] In 2015, based on information from the EEA GHG data viewer (retrieved i
on 27/4/2021) for energy CO2 emissions in road transport, buildings, the PRIMES model for other CO2 emissions and the GAINS model for non-CO2 GHGs) converted to "CO2 equivalent" using the global warming potentials of IPCC Assessment Report 5 (AR5).

[94] Less than 1% are covered by the EU Emissions Trading System.

air conditioning and refrigeration (10%). These sectors will therefore be impacted by a strengthening of the Effort Sharing Regulation.

Figure 27: Distribution of 2015 non-CO2 GHG emissions per current ESR sector



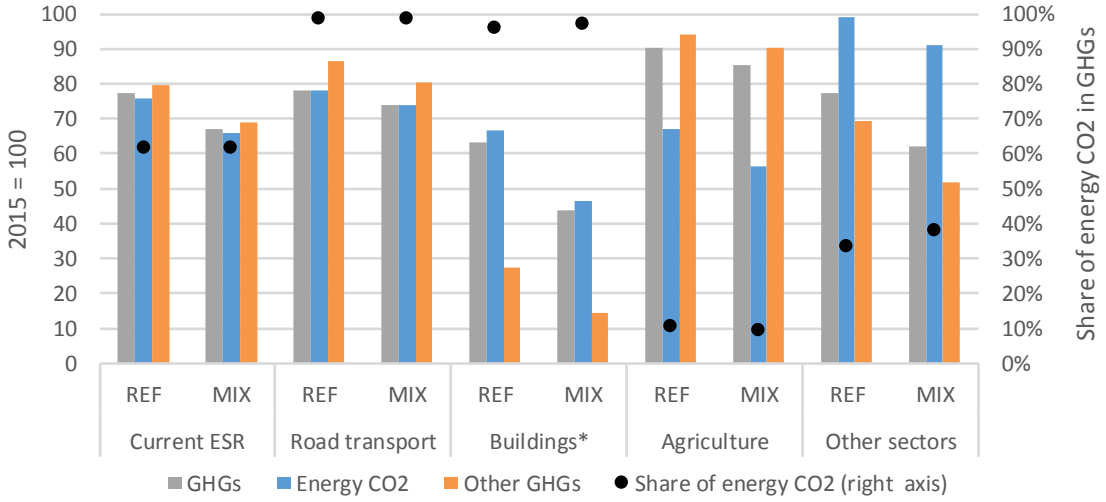
Source: GAINS model (GWP AR5)

Figure 27 shows that the options to mitigate non-CO2 emissions per sector matter differently to different countries. Agricultural emissions are the majority of the non-CO2 GHG emissions, but mitigation opportunities exist also in waste, in energy, and in the cooling sector. Member States such as Ireland or Denmark, whose agricultural sector dominates their non-CO2 GHG emissions, will be affected by the relatively smaller reduction potential from this sector. Member States with a hotter climate can see a higher demand for air conditioning and cooling services, which leads to a relatively higher share of, and higher mitigation opportunities in, F-gas emissions from that sector. This is for instance the case for Malta. Significant differences exist in waste emissions and related mitigation potential.

Figure 28 shows the evolution (compared to 2015) of EU-level GHG emissions for different sectors covered by the ESR: road transport, buildings, agriculture, and other sectors. The buildings sector will have to reduce significantly its GHG emissions by 2030 (by about 56%[95], or 53% for energy CO2 alone) in the context of a revised ESR target. While road transport and agriculture are sectors more difficult to abate, they will also contribute to the revised ESR target for 2030, by reducing GHG emissions by about 26% and 15%, respectively.

[95] Including CH4 emissions in residential and commercial buildings as per the inventories, as well as allocating to buildings the F-gases emissions related to refrigeration in commercial sector and in the domestic sector according to the GAINS model.

Figure 28: Evolution (2030 vs. 2015) of GHG emissions of sectors currently under ESR



*Note: * "Other GHGs" in Buildings include F-gases from cooling*

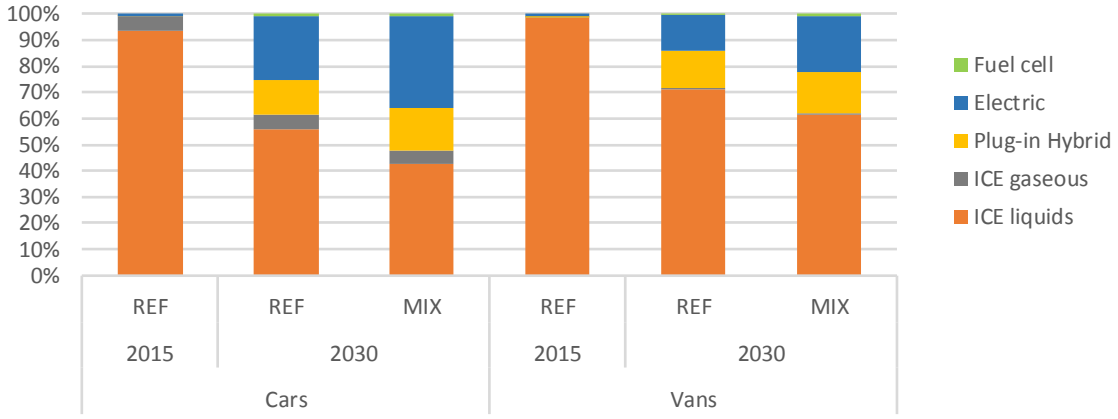
Source: Energy CO2: EEA GHG data viewer (2015) and PRIMES model, other CO2: PRIMES model, non-CO2 : GAINS model (GWP AR5)

Road transport

As shown in Figure 26, road transport CO2 emissions represented, with 747 Mt in 2015, about a third of total ESR GHG emissions. In the context of strengthened ESR target, these energy CO2 emissions should decrease to close to 555 Mt in 2030 in the MIX scenario, under the influence of the strengthened CO2 standards legislation and of the ETS price, compared to about 585 Mt in the Reference scenario.

This evolution stems to a large extent from the dynamics at play in the vehicles stocks, which progressively shift away from ICEs to electrification. Under the influence of notably the revised CO2 standards, the share of electric and plug-in hybrid cars in new vehicles will get slightly above 50% in 2030 (against just below 40% in the Reference scenario under current CO2 standards) and to more than 35% for vans (against less than 30% in the Reference scenario). Heavy duty vehicles would see a further deployment of plug-in hybrids and a limited role for electric vehicles and hydrogen.

Figure 29: New vehicles per type of drivetrain

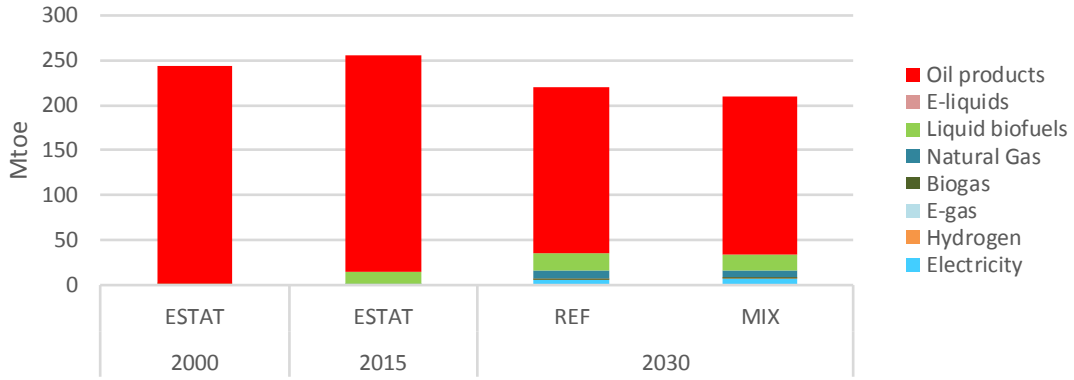


Source: PRIMES model

Although the effect of the changes on new vehicles entering the market in 2030 on the total stock structure is limited, effects are already visible in 2030, with total stock of electric and plug-in hybrids cars representing close to 20% in the MIX scenario 2030, i.e. about 3 pp. additional compared to the Reference mostly coming from electric cars.

The transformation of the vehicles fleet is completed by a limited further uptake of biofuels and biogas use in ICEs. In total, this leads to a decrease of oil products consumption by 2030, from 241 Mtoe in 2015 to 177 Mtoe in MIX (i.e. -27%) compared to 186 Mtoe in REF, higher demand of liquid biofuels (about 18 Mtoe, compared to 13 Mtoe in 2015 and 16 Mtoe in 2019), of gaseous fuels (9 Mtoe of natural gas and 1 Mtoe of biogas) and of electricity (about 7 Mtoe) – see Figure 30.

Figure 30: Final energy consumption in road transport



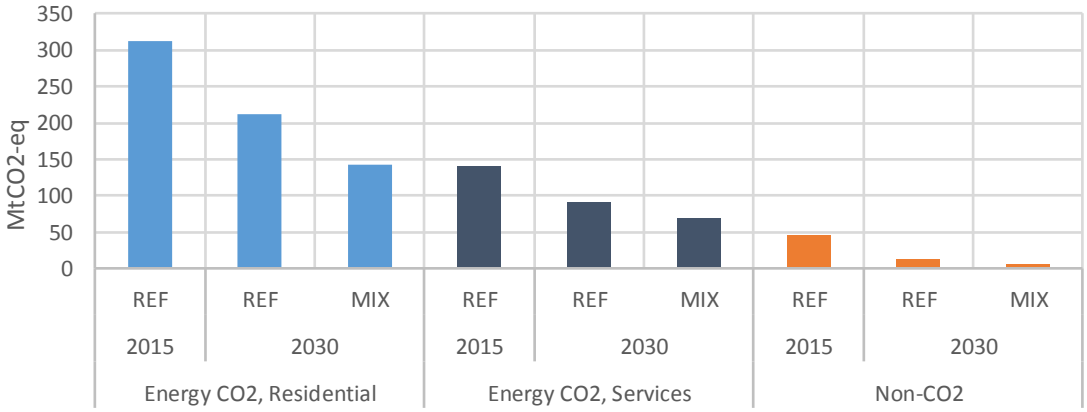
Source: 2000-2015: Eurostat, 2030: PRIMES model

Buildings

The buildings sector represents a sizeable share of current ESR GHG emissions (see Figure 26). Most of these are produced by fossil fuels combustion in the residential sector (313 MtCO2 in 2015), followed by fossil fuels combustion in services buildings

(141 MtCO2) and by non-CO2 GHG emissions mainly related to cooling (about 45 MtCO2-eq) (Figure 31).

Figure 31: GHG emissions from buildings



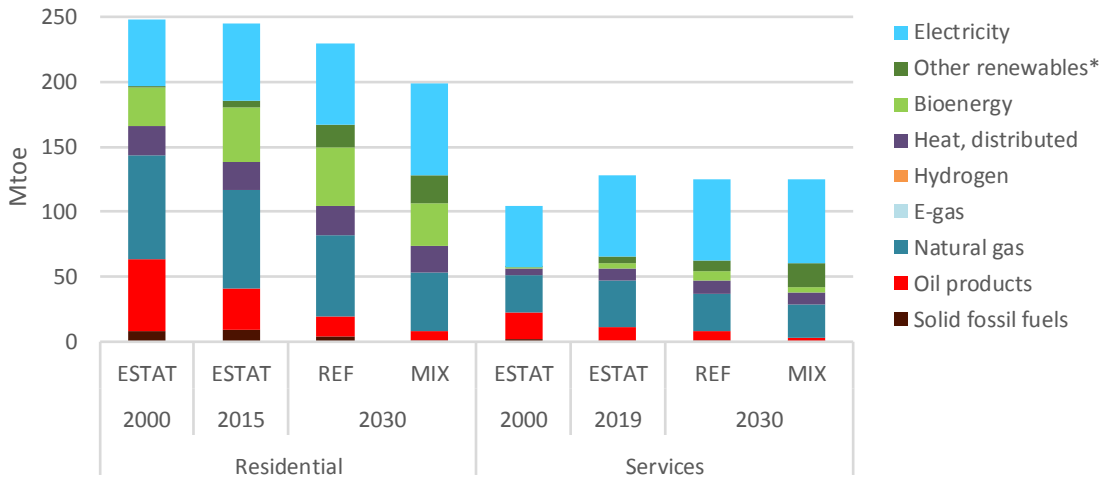
Source: Energy CO2 : EEA GHG data viewer (2015) and PRIMES model (2030), Non-CO2 GHGs: GAINS model (GWP AR5)

While representing a limited share of buildings GHG emissions, non-CO2 emissions will reduce significantly by about 73% compared to 2015 under the current ESR target in the Reference scenario and even further under the revised target (by 85%).

The reductions of energy CO2 emissions are driven by the combination of energy efficiency measures and fuel switch towards energy forms with lower carbon intensity, as shown in Figure 32. The progress in energy efficiency compared to 2015 is especially visible in residential buildings, where it is completed by a virtual phasing out of solid fossil fuels, and results also in a strong reduction of the use of oil products (close to -80% compared to 2015) and a reduction of the use of natural gas (about -40%), which are subsituted notably by heat pumps. The demand for bioenergy is actually projected to decrease compared to the Reference and to 2015, as an effect of more efficient buildings and equipment when it comes to needs for space heating.

In services buildings energy efficiency policies allow to limit the growing needs associated with a further tertiarisation of the EU economy by 2030. As for the residential buildings, the consumption of oil products is reduced by almost 75% compared to 2015, and natural gas by about 30%, replaced by a strong uptake of heat pumps and a moderate increase of the role of distributed heat.

Figure 32: Final energy consumption in buildings



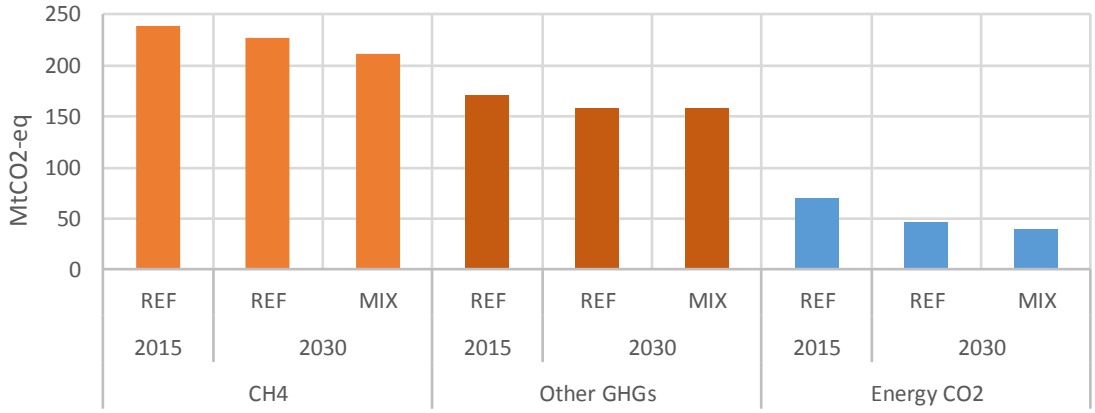
*Note: * Other renewables include ambient heat from heat pumps as well as low temperature solar thermal*

Source: 2000-2015: Eurostat, 2030: PRIMES model

Agriculture

The agriculture sector is a strong contributor to the current ESR emissions: about half the total non-CO2 emissions (Figure 27), which themselves represent about a third of the total ESR emissions (Figure 26). Although it also emits energy CO2 emissions (69 MtCO2 in 2015), non-CO2 emissions attached to agricultural activitires represent the bulk of these emissions (410 MtCO2-eq[96] in 2015).

Figure 33: GHG emissions from agriculture



Source: Non-CO2 GHGs: GAINS model (GWP AR5), CO2: EEA GHG data viewer (2015), PRIMES (2030)

Owing to its large share of non-CO2 GHG emissions, agriculture plays a key role in mitigation even though only about 10% of agriculture non-CO2 GHG emissions will

[96] According to the GAINS model, using global warming potential as per IPCC AR5

likely be mitigated through to 2030. A number of attractive zero to low-cost mitigation options exist for the sector, especially with to regards methane emissions. Satellite data show, for instance, that some illegal burning of agricultural waste is still taking place across a number of member states[97]. Bans – as well as full enforcement of existing bans – would help mitigate methane emissions at no cost. Methane emissions in EU agriculture originate to 81% from rumiants (enteric fermentation) and to 17% animal manure[98]. Feed additives and optimised feeding concepts, as well as breeding programmes focussing on health, longevity and fertility, can significantly reduce at low cost methane emissions from enteric fermentation. Moreover, manure management and tapping into anaerobic digestion of animal excrements can cost efficiently reduce methane production from animal husbandry. Feed additives and optimised feeding concepts, as well as breeding programmes focussing on health, longevity and fertility, can significantly reduce at low cost methane emissions from enteric fermentation. Moreover, manure management and tapping into anaerobic digestion of animal excrements can cost efficiently reduce methane production from animal husbandry.

Representing a smaller share of the sector's GHG emissions, by reducing CO2 emissions by close to 45% compared to 2005, the energy demand of the sector will still contribute to the sectoral mitigation in the context of the new ESR target. This reduction stems from a strong reduction of the use of solid fossil fuels and oil products, substituted by biomass and other renewable options in a context of reducing energy needs because of better insulated facilities.

Other sectors

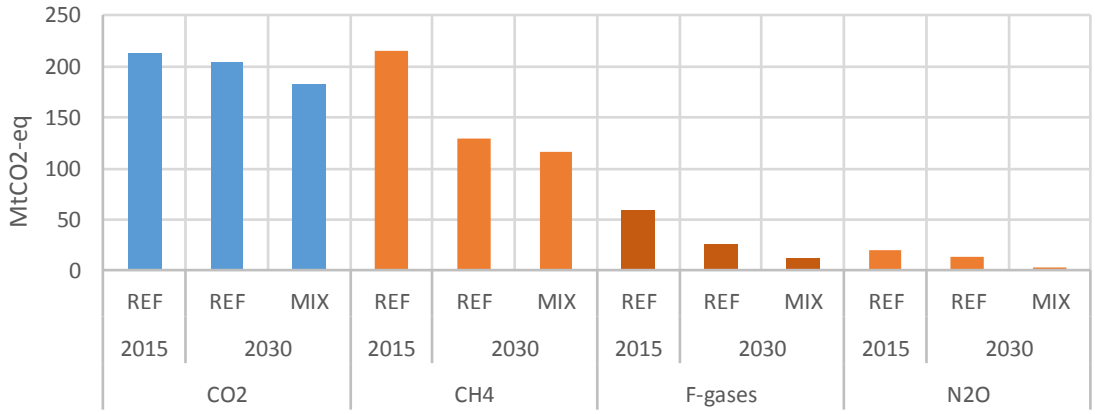
Remaing GHG emissions under ESR are produced by industry not covered by the ETS (mostly CO2, but also some N2O and F-gases emissions in specific sectors), the waste sector (CH4), the energy sector (CH4, notably related to fossil fuels production, transport and distribution infrastructure), rail and domestic navigation (mostly CO2).

Figure 34 shows that CO2 emissions in other sectors than buidings, road transport, and agriculture are expected to reduce by close to 15% compared to 2015 under the proposed new ESR target (MIX scenario), 10 percentage points (pp.) additional to the Reference scenario (current ESR target).

CH4 emissions are expected to decrease by 46% in the MIX scenario compared to 2015, although a large share of this mitigation should take place under the current policy framework already. F-gases are expected to reduce by close to 80% and N2O emissions by 86%.

Figure 34: GHG emissions from other current ESR sectors

[97] Source: GAINS
[98] EU Methane Strategy: COM(2020) 663 final



Source: CO2 : PRIMES model, Non-CO2 GHGs: GAINS model (GWP AR5)

In terms of volume, the largest expected reductions of non-CO2 emissions compared to current levels are CH4 emissions from the waste sector, including for waste water. Strict application and enforcement of existing European waste legislation, including the Landfill Directive, will ensure emissions for the waste sector to drop by nearly half. Sorting and separate collection of organic waste further helps reductions of emissions. Additional cost-effective mitigation options include the treatment of both domestic and industrial wastewater through anaerobic digestion with biogas recovery, leading to an increasingly circular treatment of wastewater streams. For industrial waste water streams this is most releveant to the food and paper industries. Further process optimisation can additionally reduce emissions of nitrous oxide related to waste water from domestic sources.

The energy sector, in turn, will cut its non-CO2 GHG emissions (mostly CH4) by more than half by 2030 through a combination of cost-effective mitigation opportunities: long-distance gas transmission and distribution networks show significant mitigation potential at very limited cost[99]. Similarly, coal mining practices could include degasification as well as oxidation of ventilation air methane for significant mitigation opportunities at no cost. Flooding of abandoned coal mines, in turn, can further cut energy-related methane.

Air conditioning and refrigeration comprises a host of specialized applications that often rely on fluorinated gases, or F-gases, many of which are powerful greenhouse gases. Alternative agents such as ammonia or HFCs with a lower global warming potential exist for most of the F-gases, which points to reductions in F-gases from air conditioning and refrigeration of over 80% by 2030. While only 10% of overall EU27 non-CO2 GHG emissions today, this sector still represents significant mitigation opportunities in all its

[99] Relatedly, the European Commission is preparing a regulatory proposal on MRV as well as leak detection and repair in the energy sector in the context of the Methane Strategy: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12581-Climate-change-new-rules-to-prevent-methane-leakage-in-the-energy-sector

applications: stationary and mobile air conditioning, as well as refrigeration across the economy: in the commercial sector, in industry, and in transport.

System cost for sectors under ESR

Table 16 shows the energy-related costs[100] per unit of GDP of the three sectors responsible of the energy CO2 emissions of the ESR, representing about two thirds of the current total GHG emissions under the ESR (see Figure 26): the residential sector, the services buildings and transport[101].

Table 16: Energy-related costs as a % of GDP for residential, services and transport (excluding carbon pricing related to the ETS extension)

		Scenario	EU	MS < 60% EU GDP/capita	MS between 60-100% EU GDP/capita	MS>100% EU GDP/capita
2030	Residential	REF	3.8%	5.1%	4.0%	3.5%
		MIX	4.1%	5.7%	4.3%	3.7%
	Services and agriculture*	REF	2.1%	2.9%	2.2%	1.9%
		MIX	2.1%	2.9%	2.1%	2.0%
	Transport**	REF	4.1%	6.9%	4.5%	3.5%
		MIX	4.2%	6.9%	4.6%	3.5%
2021-2030	Residential	REF	3.7%	5.1%	3.9%	3.4%
		MIX	3.9%	5.5%	4.1%	3.5%
	Services and agriculture*	REF	2.0%	2.7%	2.0%	1.9%
		MIX	2.0%	2.8%	2.0%	1.9%
	Transport**	REF	3.8%	6.3%	4.2%	3.2%
		MIX	3.8%	6.4%	4.3%	3.2%

*Note: * "agriculture" refers to energy-related costs of agriculture; **: includes road transport, rail, inland navigation and aviation. Results are presented for four country groupings: EU, countries with GDP per capita below 60% of EU average over 2016-2018, countries between 60% and 100%, and countries above 100%.*

[100] Energy system costs are calculated ex-post after the model is solved. They include energy purchase costs, capital costs associated with energy consuming equipment as well as with direct efficiency investments (for house insulation, double/triple glazing, control systems, ..). Capital costs are expressed in annuity payments, calculated on the basis of a financial discount rate of 10%. For transport, only the "additional" capital costs for energy purposes (additional capital costs for improving energy efficiency or for using alternative fuels) is included – the energy system associated to transport cost thus does not cover the full cost of vehicles purchasing.

[101] The table shows the cost for total transport, as a first order proxy of the behaviour the cost of road transport, which represents the bulk of the total mobility needs (about 80% for passengers and 70% for freight in 2015 at EU level) and of associated energy consumption (about 75%) – see published results of the core policy scenarios of the "Fit for 55" package [Reference to results published!]

Air quality co-benefits

While air pollution is produced by sectors covered both in the ETS and ESR, a significant share is generated by inefficient and often solid based residential heating, as well as transport, notably in urban areas. As such, achievement of the ESR targets will significantly contribute to the air quality improvements from the 'Fit for 55' package. Based on the same methodology as used for the Clean Air Outlook while using updated assumptions, Table 17 and Table 18 show these air quality co-benefits across different groups of Member States:

Table 17: Lowered emissions of air pollutants

	PM2.5 emissions			SO2 emissions			NOx emissions[102]		
	Baseline in 2015 (kt)	Baseline in 2030 (%-age change compared to 2015)	MIX in 2030 (%-age change compared to 2015)	Baseline in 2015 (kt)	Baseline in 2030 (%-age change compared to 2015)	MIX in 2030 (%-age change compared to 2015)	Baseline in 2015 (kt)	Baseline in 2030 (%-age change compared to 2015)	MIX in 2030 (%-age change compared to 2015)
MS group									
MS < 60% EU GDP/capita	558	-50.4%	-62.2%	1192	-62.5%	-78.2%	1706	-48.3%	-55.7%
MS 60-100% EU GDP/capita	391	-41.6%	-47.9%	610	-60.6%	-66.8%	2120	-56.6%	-59.7%
MS > 100% EU GDP/capita	416	-28.5%	-35.8%	671	-43.7%	-52.6%	3392	-55.9%	-60.2%
EU	1365	-41.2%	-50.0%	2473	-56.9%	-68.5%	7218	-54.3%	-59.0%

[102] NOx emissions presented here include NOx emissions from agricultural soils and differ in this regards from NOx emissions presented in the second Clean Air Outlook.

Table 18: Health and economic impacts of improved air quality

	Sum premature deaths (cases/year)			Million life years lost due to PM2.5			Lowered health damages and air pollution control cost (€billion/year)	
MS group	Baseline in 2015	Baseline in 2030 (%-age change compared to 2015)	MIX in 2030 (%-age change compared to 2015)	Baseline in 2015	Baseline in 2030 (%-age change compared to 2015)	MIX in 2030 (%-age change compared to 2015)	Difference to baseline in 2030 Low health benefits estimate	Difference to baseline in 2030 High health benefits estimate
MS < 60% EU GDP/capita	98825	-38.5%	-45.9%	78.6	-39.5%	-47.5%	9.7	16.9
MS 60-100% EU GDP/capita	94355	-36.5%	-41.7%	78.2	-37.6%	-42.9%	6.2	11.1
MS > 100% EU GDP/capita	107590	-29.2%	-34.1%	93.0	-29.7%	-34.7%	8.3	13.7
EU	300765	-34.5%	-40.4%	249.8	-35.2%	-41.3%	24.1	41.7

10.4. Analytical methods

Common analytical framework for the Impact Assessments of the revision of ESR, ETS, CO_2 standards, LULUCF, RED and EED

10.4.1. 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 **Error! Reference source not found.**) 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[103]. 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.

10.4.2. Modelling tools for assessments of policies

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

[103] 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.

assessments. In particular, it has been used for the Commission's proposals for the Climate Target Plan[104] to analyse the increased 2030 mitigation target, the Sustainable and Smart Mobility Strategy[105], the Long Term Strategy[106] 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:

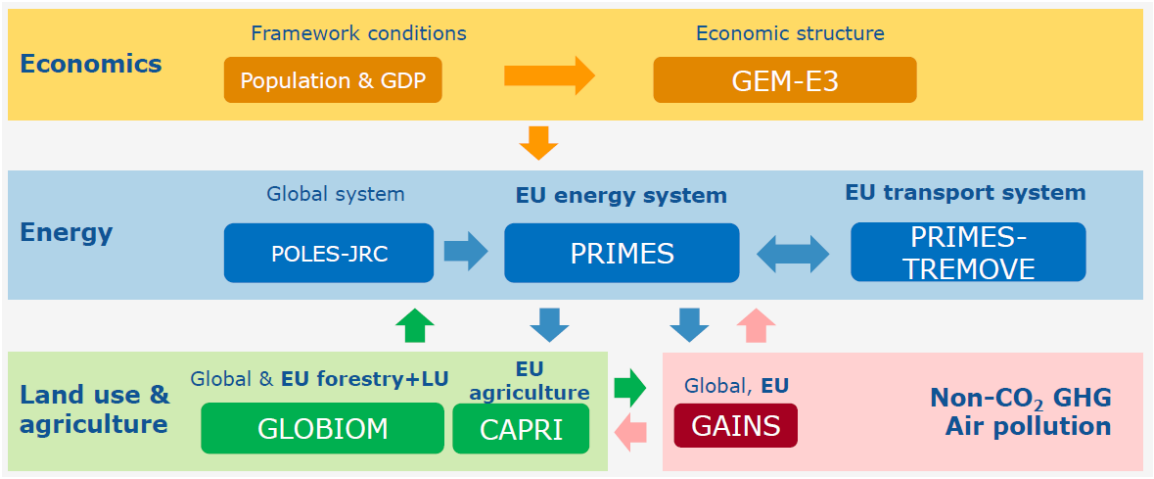
- **The entire energy system** (energy demand, supply, prices and investments to the future) and **all GHG emissions and removals** from the EU economy.
- **Time horizon:** 1990 to 2070 (5-year time steps).
- **Geography:** individually all EU Member States, EU candidate countries and, where relevant 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-CO2 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[107]) 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 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 35). These inter-linkages are necessary to provide the core of the analysis, which are interdependent energy, transport and GHG emissions trends.

[104] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176
[105] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331
[106] https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf
[107] 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.

Figure 35: Interlinkages between models



Energy: the PRIMES model

The PRIMES model (Price-Induced Market Equilibrium System)[108] 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.

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.

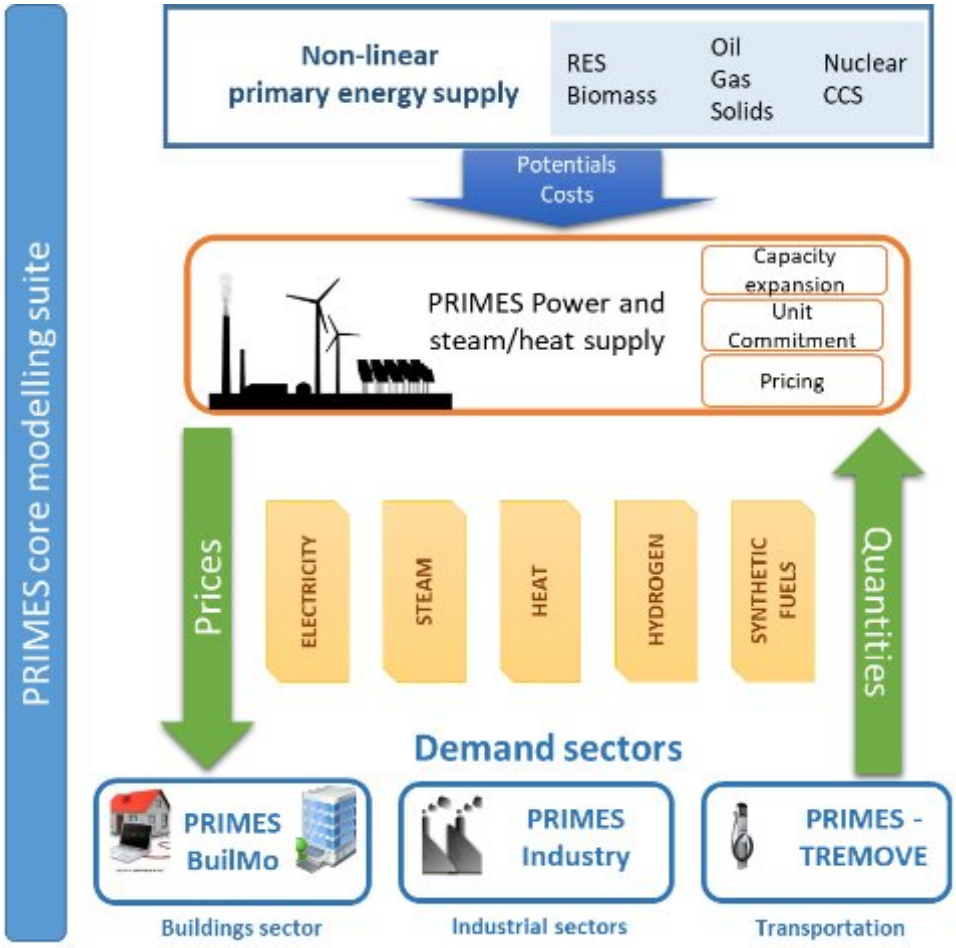
PRIMES is designed to analyse complex interactions within the energy system in a multiple agent – multiple markets framework. Decisions by agents are formulated based on microeconomic foundation (utility maximization, cost minimization and market equilibrium) embedding engineering constraints and explicit representation of

[108] More information and model documentation: https://e3modelling.com/modelling-tools/primes/

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 36 shows a schematic representation of the PRIMES model.

Figure 36: 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[109], 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[110]; 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[111], ICARUS, Eco-design, VGB (power technology costs), TECHPOL – supply sector technologies, NEMS model database[112], IPPC BAT Technologies[113]
- Power Plant Inventory: ESAP SA and PLATTS
- RES capacities, potential and availability: JRC ENSPRESO[114], JRC EMHIRES[115], RES ninja[116], ECN, DLR and Observer, IRENA
- 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[117], INSPIRE archive, BPIE[118]), JRC-IDEES[119], update to the EU Building stock Observatory[120]

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

[109] 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).
[110] SEC(2011)1569 : https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1569_2.pdf
[111] https://www.odyssee-mure.eu/
[112] Source: https://www.eia.gov/outlooks/aeo/info_nems_archive.php
[113] Source: https://eippcb.jrc.ec.europa.eu/reference/
[114] Source: https://data.jrc.ec.europa.eu/collection/id-00138
[115] Source: https://data.jrc.ec.europa.eu/dataset/jrc-emhires-wind-generation-time-series
[116] Source: https://www.renewables.ninja/
[117] Source: https://www.entranze.eu/
[118]Source: http://bpie.eu/
[119] Source: https://ec.europa.eu/jrc/en/potencia/jrc-idees
[120] Source: https://ec.europa.eu/energy/en/eubuildings

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-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[121] modelling community. Part of the model (e.g. the utility nested tree) was built following the TREMOVE model.[122] 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

[121] Source: https://www.tmleuven.be/en/navigation/TREMOVE

[122] 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.

Pocketbook "EU transport in figures[123]. 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.

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.

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

[123] Source: https://ec.europa.eu/transport/facts-fundings/statistics_en

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[124], 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 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[125]. 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.[126] 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.

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

[124] Bioheavy refers to bio heavy fuel oil.
[125] Source: https://ec.europa.eu/transport/facts-fundings/statistics_en
[126] https://mrv.emsa.europa.eu/#public/eumrv

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 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[127] and has been developed and is maintained by the International Institute of Applied Systems Analysis[128]. 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.

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.

[127] Source: http://gains.iiasa.ac.at/models/
[128] Source: http://www.iiasa.ac.at/

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 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[129].

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[130]. 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[131]. 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)[132], 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.

[129] Source : http://www.iiasa.ac.at/

[130] See You, L., Wood, S. (2006). An Entropy Approach to Spatial Disaggregation of Agricultural Production, Agricultural Systems 90, 329–47 and http://mapspam.info/ .

[131] 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.

[132] MCPFE (2015). Forest Europe, 2015: State of Europe's Forests 2015. Madrid, Ministerial Conference on the Protection of Forests in Europe: 314.

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 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[133]. 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.

[133] 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

10.4.3. 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)[134].

The main assumptions related to economic development, international energy prices and technologies are described below.

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[135] 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[136] by the Directorate General for Economic and Financial Affairs, which are based on the same population growth assumptions.

Table 19. 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%
Croatia	4.06	3.94	3.83	0.2%	0.6%
Cyprus	0.89	0.93	0.96	0.7%	1.7%

[134] See related publication.
[135] EUROPOP2019 population projections
https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data
[136] The 2021 Ageing Report : Underlying assumptions and projection methodologies
https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en

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.

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[137]) – are used to obtain long-term estimates of the international fuel prices.

The COVID crisis has had a major impact on international fuel prices[138]. 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[139].

Table 20 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 20: 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)

[137] https://ec.europa.eu/jrc/en/geco
[138] IEA, Global Energy Review 2020, June 2020
[139] IEA, Oil Market Report, June 2020 and US EIA, July 2020.

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[140].

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.

10.4.4. The existing 2030 framework: the EU Reference Scenario 2020

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 revised 2030 climate target to at least -55% compared to 1990 proposed under the Climate Target Plan[141].

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,

[140] JRC118275
[141] COM/2020/562 final

- review of the LULUCF EU rules.

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[142] 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.

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 0), as well as, to the extent possible, the 2020 edition of the EU Agricultural Outlook 2020-2030 published by DG AGRI in December 2020[143].

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.

[142] The 2021 Ageing Report : Underlying assumptions and projection methodologies https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en

[143] 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

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[144]. 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.

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 21 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[145].

Table 21: 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%

[144] COM(2016) 860 final.
[145] Link to reference.

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%
- 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[146] is calculated ex-post with a private

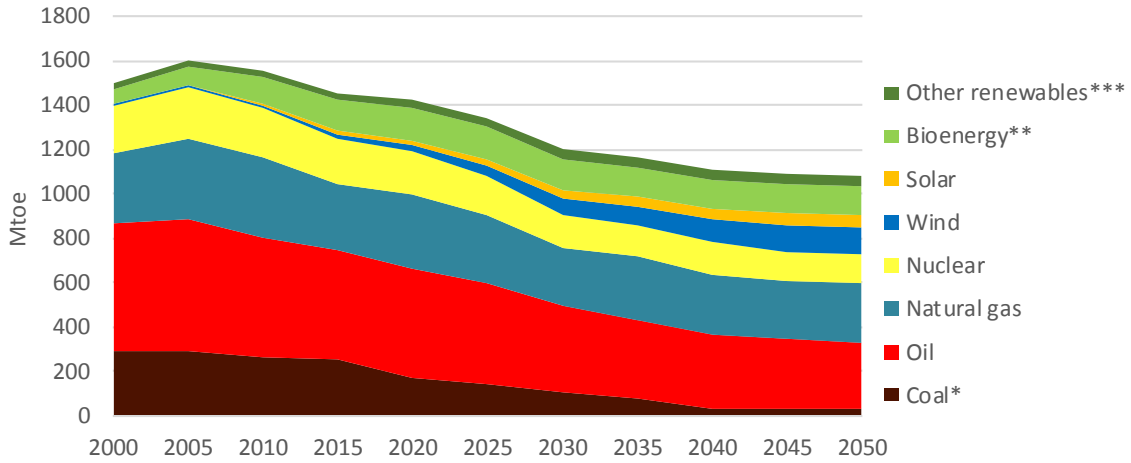
[146] Energy system costs for the entire energy system include capital costs (for energy installations such as power plants and energy infrastructure, energy using equipment, appliances and energy related costs of transport), energy purchase costs (fuels + electricity + steam) and direct efficiency investment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

sector perspective applying a flat 10% discount rate[147] 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.

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[148] and in the CTP.

Figure 37: Fuel mix evolution of the Reference Scenario 2020



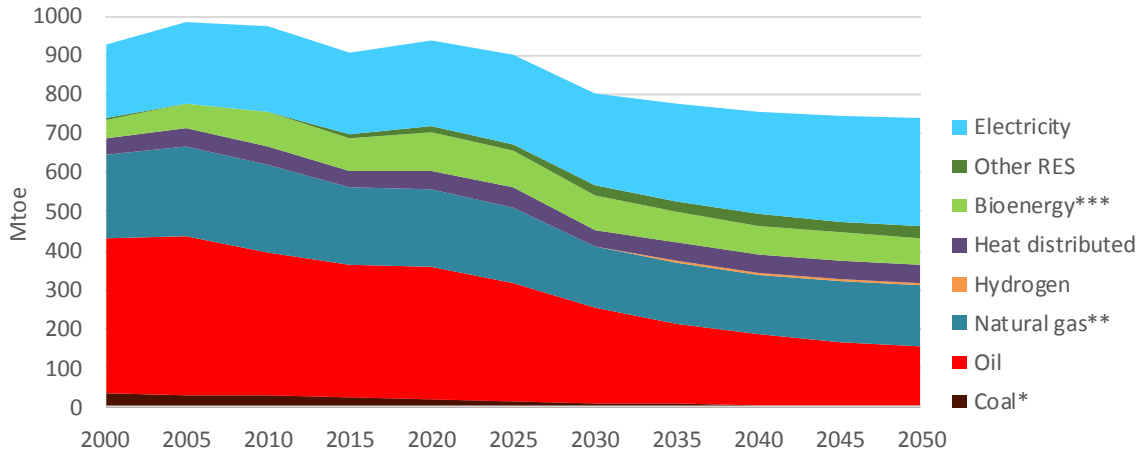
Source: Eurostat, PRIMES model

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.

[147] 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.

[148] COM(2018) 773

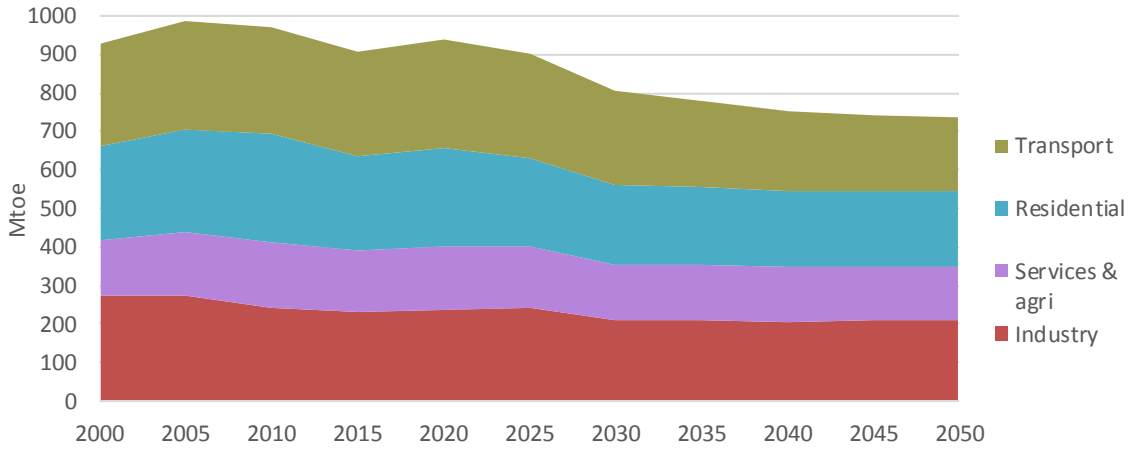
Figure 38: Share of energy carriers in final energy consumption in the Reference Scenario 2020



*Note: * includes peat and oil shale; ** includes manufactured gases, *** includes waste*
Source: Eurostat, PRIMES model

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 39: 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%).

10.4.5. Scenarios for the "Fit for 55" policy analysis

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[149] 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.

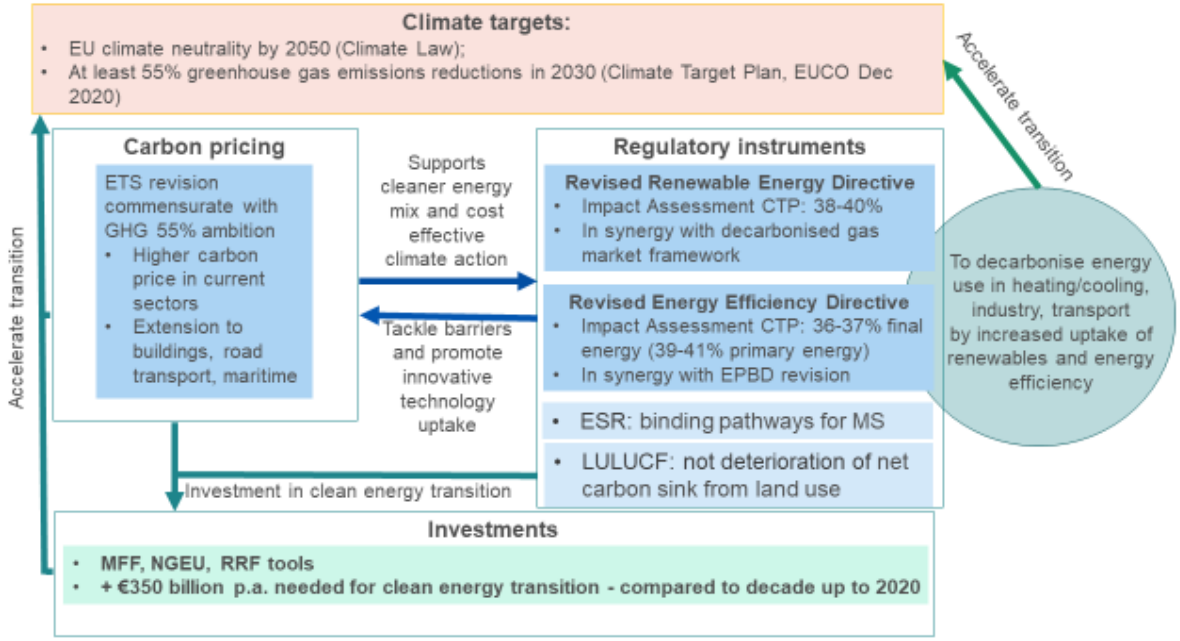
The third lesson was that carbon pricing working hand in hand with regulatory measures helps avoid "extreme" scenarios of either:

- 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 40 below illustrates the interactions between different policy tools relevant to reach the EU's climate objectives.

[149] A 50% GHG target was also analysed

Figure 40: Interactions between different policy tools



With the 55% GHG target confirmed by EU leaders in the December 2020 EUCO Conclusions[150] and the 2021 Commission Work Programme[151] (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:

[150] https://www.consilium.europa.eu/media/47328/1011-12-20-euco-conclusions-fr.pdf
[151] COM(2020) 690 final

- 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).

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,
  - 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 **Error! Reference source not found.**.

- **Scenario design** in order to align better with policy options as put forward in the CWP 2021 and respective Inception Impact Assessments[152].

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.

[152] 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.

- **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[153].

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 22 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[154]: 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.

[153] This is a feature not implemented in the CTP CPRICE scenario.
[154] For modelling purposes "national maritime" is considered as equal to "domestic navigation", i.e. also including inland navigation.

Table 22: 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[155]
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>
<tr><td>Brief description: sectoral policies</td><td>High intensity increase of EE, RES, transport policies versus Reference</td><td>Medium intensity increase of EE, RES and transport policies versus Reference</td><td>Lower intensity increase of EE and RES policies versus Reference.
Transport policies as in MIX (except related to CO2 standards)</td></tr>
<tr><td>Target scope</td><td colspan="3">EU27</td></tr>
<tr><td>Aviation</td><td colspan="3">Intra-EU aviation included, extra-EU excluded</td></tr>
<tr><td>Maritime</td><td colspan="3">Intra-EU maritime included, extra-EU excluded</td></tr>
</table>

[155] “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
navigation			
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		
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[156] 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	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		

[156] 50% of all incoming and all outgoing extra-EU voyages

Scenario	REG	MIX	MIX-CP
HDVs	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)
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		

Scenario	REG	MIX	MIX-CP
Additional non-CO_2 policies (represented by a carbon value)	Medium ambition increase		

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[157],
- 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 23 shows the evolution of the ETS prices by 2030 in the Reference and core scenarios.

Table 23: ETS prices by 2030 in the difference scenarios (€2015/tCO2)

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[158] post 2030. Investment decisions take into account expectations about climate and energy policy developments, and this carbon value achieves in 2050 levels between €360/tCO2 (in REG, where energy policy drivers play comparatively a larger role) and €430/tCO2 (MIX-CP)[159].

[157] For more information on the roles and levels of discount rates applied per sector, see the EU Reference Scenario 2020 publication.
[158] 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.
[159] 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

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 24 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 24: 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

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 22), 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

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.

vehicles are of particular importance. The existing standards[160], 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;
- 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

[160] 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.

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-CO2 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 efficient mitigation potential (based on the GAINS modelling tool) in specific sectors such as waste, agriculture or industry.

Table 25: Carbon value applied to non-CO2 emissions in the GAINS model (€2015/tCO2)

Scenarios	Non-CO_2 carbon values	
	2025	2030
REF2020	0	0
REG	4	4
MIX	4	4
MIX-CP	5	10

Key results and comparison with Climate Target Plan scenarios

Table 26: 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*[161].

Source: PRIMES model, GAINS model

[161] 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.

Table 27: 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%
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[163] (except the CTP ALLBNK that achieves 55% net reductions including also emissions from extra-EU maritime and aviation).*

Source: PRIMES model, GAINS model

10.4.6. Results per Member State

This document is completed by detailed modelling results at EU and Member State level for the different core policy scenarios[162]:

- Energy, transport and overall GHG (PRIMES model)
- Details on non-CO2 GHG emissions (GAINS model)
- LULUCF emissions (GLOBIOM model)
- Air pollution (GAINS model)

10.4.7. Specific analytical elements for this impact assessment

For this IA an additional scenario, referred to as 'MIX-NECP-plus' was developed. Whereas the Reference scenario mimics national energy efficiency and renewable energy targets, it sometimes overshoots or undershoots emission reductions in the ESR compared to individual Member States estimates in the NECP. For those Member States where the Reference does not project the achievement of the NECPs ambition in the ESR, the MIX-NECP-plus scenario assumes the achievement of additional reductions compared to the MIX scenario, equal to half of the gap between the Reference and the NECPs. Conversely, for those Member States where the Reference overshoots the NECPs estimates, the MIX-NECP-plus scenario assumes less reductions compared to the MIX scenario equal to half of this gap.

This scenario allows to assess to what extent deviation of the Reference projections from the NECP projections by Member States may impact overall results.

10.5. Distributional impacts

10.5.1. Overview potential gaps and surpluses for ESR review in options 1.1 and 1.2

Table 28: Member States ESR GDP target (avg 2017-2019) compared to the efficient emission reduction (MIX scenario) for options 1.1 and 1.2 [High Income Member States in grey, gap in bold]

	Efficient Emission reduction projections 2030 delivering -40%	ESR Review 2030 GDP target delivering -40% (option 1.1.)	Potential surplus (efficient > target) (+) or gap (-), to deliver -40% (option 1.1.)	ESR Review 2030 GDP target delivering -35% (option 1.2.)	Potential surplus (efficient > target) (+) or gap (-), to deliver 35% (option 1.2.)

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

EU-27	-40%	-40%	**0%**	-35%	**5%**
Belgium	-43%	-49%	**-6%**	-44%	**-1%**
Bulgaria	-11%	-10%	**1%**	-5%	**6%**
Czechia	-35%	-28%	**7%**	-22%	**13%**
Denmark	-33%	-50%	**-17%**	-45%	**-12%**
Germany	-43%	-50%	**-7%**	-44%	**-1%**
Estonia	-18%	-27%	**-9%**	-22%	**-4%**
Ireland	-28%	-50%	**-22%**	-45%	**-17%**
Greece	-51%	-22%	**29%**	-17%	**34%**
Spain	-45%	-37%	**8%**	-32%	**13%**
France	-44%	-47%	**-3%**	-42%	**2%**
Croatia	-33%	-16%	**17%**	-11%	**22%**
Italy	-47%	-43%	**4%**	-38%	**9%**
Cyprus	-28%	-35%	**-7%**	-30%	**-2%**
Latvia	-13%	-18%	**-5%**	-13%	**0%**
Lithuania	-19%	-22%	**-3%**	-17%	**2%**
Luxembourg	-53%	-50%	**3%**	-45%	**8%**
Hungary	-32%	-18%	**14%**	-13%	**19%**
Malta	17%	-38%	**-55%**	-33%	**-50%**
Netherlands	-43%	-50%	**-7%**	-45%	**-2%**
Austria	-34%	-50%	**-16%**	-45%	**-11%**
Poland	-31%	-17%	**14%**	-11%	**20%**
Portugal	-42%	-28%	**14%**	-23%	**19%**
Romania	-15%	-12%	**3%**	-7%	**8%**
Slovenia	-31%	-28%	**3%**	-23%	**8%**
Slovakia	-31%	-22%	**9%**	-17%	**14%**
Finland	-45%	-50%	**-5%**	-45%	**0%**
Sweden	-51%	-50%	**1%**	-45%	**6%**

Source: Commission Services – MIX55 scenario

10.5.2. Overview Member States with GDP per capita below or above the EU average(s)

High income Member States are for the purposes of this impact assessment defined as Member States with a GDP per capita above the 2017-2019 EU average.

Table 29: Overview of Member States' GDP data used for calculating high income Member States

EU MS	EU MS	2013 GDP/Cap[163]	Avg. 2017-2019 GDP/Cap[164]
EU-27	**EU**	26.700	30.227
Belgium	**BE**	35.400	40.293

[163] 2016 Impact Assessment - SWD (2016) 247 final.
[164] Eurostat, Nama_10_pc [Downloaded 31.05.2021, 23h00].

Bulgaria	**BG**	5.800	8.057
Czechia	**CZ**	14.900	19.723
Denmark	**DK**	45.500	52.363
Germany	**DE**	35.000	40.477
Estonia	**EE**	14.400	19.670
Ireland	**IE**	39.000	67.360
Greece	**EL**	16.500	16.777
Spain	**ES**	22.100	25.723
France	**FR**	32.100	35.103
Croatia	**HR**	10.200	12.653
Italy	**IT**	26.500	29.503
Cyprus	**CY**	21.000	24.437
Latvia	**LV**	11.300	14.973
Lithuania	**LT**	11.800	16.220
Luxembourg	**LU**	85.300	98.670
Hungary	**HU**	10.200	13.940
Malta	**MT**	18.100	25.950
Netherlands	**NL**	38.700	44.907
Austria	**AT**	38.100	43.457
Poland	**PL**	10.200	13.010
Portugal	**PT**	16.300	19.923
Romania	**RO**	7.200	10.530
Slovenia	**SI**	17.400	22.040
Slovakia	**SK**	13.600	16.390
Finland	**FI**	37.400	42.320
Sweden	**SE**	45.400	46.793

10.6. Further information on related policies impacting notably energy system emissions in the ESR

Any changes to the policy architecture that are under consideration in this impact assessment evidently would not take place in a policy vacuum but are rather bound to interact with existing pricing and non-pricing mechanisms to reduce GHG emissions. Assessing the interplay of various elements of a changed policy architecture – in particular the option of an expanded ETS – with existing related EU-level and national level policies is key. Overall, these policies will have to see updates and ambition increases to contribute to increased greenhouse gas emission reductions in the ESR sectors. The ESR can be an incentive at national level to undertake this additional ambition. Most EU policies are also under review in the fit for Fit for 55 package.

10.6.1. Related policy initiatives on the EU-level

Next to the Effort Sharing Regulation (ESR), the Emissions Trading System (ETS) and the Land-Use, Land-Use Change and Forestry regulation (LULUCF), which together provide the direct regulation of emissions reductions, there are a range of relevant other regulations indirectly affecting GHG emissions.

In 2018 and 2019, the EU adopted the Clean Energy for All Europeans Plan, consisting of eight legislative acts setting the European energy targets for 2030 and paving the way

for their achievement. The new legal framework sets a binding EU target of at least 32% for renewable energy sources in the EU's energy mix and of at least 32.5% energy efficiency by 2030. The EU headline target of 32.5% of energy efficiency to be achieved by 2030 requires Member States to undertake common efforts to ensure to the target achievement on EU-level by committing to ambitious national commitments. For the period 2021 to 2030 Member States have set their contributions to the Union target in their National Energy and Climate Plans and to establish Long-term building renovation strategies[165].

The binding EU-level 32% renewable energy target to be achieved by 2030 signifies a move away from nationally binding targets agreed for the 2020 framework. For the next decade Member States have set their contributions to the Union target in their National Energy and Climate Plans. In addition, a renewable energy target for transport of 14% has been set with a sub-target to promote advanced biofuels. A specific indicative target to increase the share of renewables by 1.3 pp. a year has been defined for the heating and cooling sector.

The EU headline target of 32.5% of energy efficiency to be achieved by 2030 requires Member States to undertake common efforts to ensure to the target achievement on EU-level by committing to ambitious national commitments. For the period 2021 to 2030 Member States have set their contributions to the Union target in their National Energy and Climate Plans.

The Clean Energy for all Europeans Plan also includes legislation to adapt the electricity market design to increasing shares of decentralised and variable generation assets.

In the transport area, the Commission adopted in December 2020 a Sustainable and Smart Mobility Strategy together with an action plan with 82 initiatives for the next for years[166], following a European strategy for low-emission mobility in 2016[167]. This acknowledges that achieving deep emissions reductions will require an integrated system approach that includes promoting (i) overall vehicle efficiency, low- and zero emission vehicles and infrastructure; (ii) a long-term switch to alternative and net-zero carbon fuels for transport; (iii) increased efficiency of the transport system. In 2019, the European Parliament and Council adopted Regulation (EU) 2019/631, setting CO2 emission performance standards for new passenger cars and for new vans in the EU. Expected benefits of the new targets include a 23% reduction of GHG emissions from road transport in 2030 compared to 2005, supporting Member States in meeting their national targets under the Effort Sharing Regulation. Furthermore, Directive 2014/94/EU

[165] The EPBD requires Member States to establish a long-term renovation strategy to support the renovation of their national building stock into a highly energy efficient and decarbonised building stock by 2050.
[166] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789
[167] https://ec.europa.eu/transport/themes/mobilitystrategy_en

on the deployment of alternative fuels infrastructure requires Member States to develop National Policy Frameworks for the development of alternative fuel markets and infrastructure in the transport sector.[168]

The Energy Taxation Directive, which was last updated in 2003, provides important context to any policy architecture reform regarding emission reductions. Energy taxes are decided on a Member State level; however, there are minimum excise duty rates that Member States must apply to energy products for motor, heating and electricity fuels.

As regards energy poverty, it is worth highlighting the Energy Poverty Recommendation[169] and the Renovation Wave Communication[170], as well as the assessment of energy poverty and other distributional aspects in the NECPs, tackling at these elements at Member State level in accordance with the country-specific recommendations on just transition.

10.6.2. National measures in the building and transport sectors

Emissions currently under the scope of the ESR and its binding emission reduction targets are primarily regulated through national measures. National regulations are diverse. They reach from outright command-and-control instruments, such as bans, to pure price-based measures such as the national carbon-trading system coming into force in Germany.

Whilst administratively costly double coverage should be avoided, national measures must not be changed or abandoned in ways contravening EU-level measures and objectives. Also the ESR targets will impact how Member States plan to further develop their policies, next to EU policies.

Member States have multiple regulatory instruments in place for reducing GHG emissions in the buildings and transport sectors. Table 30 below aims to categorize groups of key measures currently in place or planned in Member States.

Table 30: Examples of Member State level policies in buildings and transport

Instrument Group	**Member States**
National carbon trading system, including transport and building	Germany (the German national emissions trading system in place from 2021 starts as a fixed-price system and turns into a traditional volume-based trading system from 2026 onwards)

[168] Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure
[169] Commission Recommendation (EU) 2020/1563 of 14 October 2020 on energy poverty
[170] COM/2020/662 final

emissions	
Explicit national carbon price for transport and/or building fuels	• Denmark • Finland • France • Germany • Ireland • Portugal • Slovenia • Sweden
Energy efficiency obligations (EEOs)	• Austria • Bulgaria • Denmark • Spain • France • Ireland • Italy • Malta • Poland • Slovenia • UK • Luxembourg • Greece • Latvia • Cyprus • Croatia • Hungary • Portugal • Czech Republic notified an EEOS in its NECP for the next energy savings obligation period
EEOs allowing trading in the form of White Certificates implemented under Article 7 EED	• France • Italy • Poland

Command & Control regulation (standard setting, bans)	Announced ICE bans: • Denmark (2030) • Ireland (2030) • Netherlands (2030) • Slovenia (2025-2030) • Sweden (considered 2030) • France (2040) • Spain (2040) Announced oil boiler bans: • Denmark ban of new where district heating or gas is available (2016) • Germany ban of new if alternative available (2026) • Other

Source: Commission Services

10.6.3. *Untapped potential for additional emissions reductions in EU level policy as per National Energy and Climate Plans*

Building on the four specific objectives, there is an untapped potential for emission reductions in a set of measures mentioned in the Member States' National Energy and Climate Plans (NECPs). These are the circular economy measures, and as outlined in the Long Term Strategy for 2050[171] in the scenarios for climate neutrality by 2050[172] and to achieve net greenhouse gas (GHG) removals thereafter, a highly circular economy scenario is described as being also one of the most cost-efficient. As the NECPs are part of the planning, monitoring and reporting requirements in the context of the Governance of the Energy Union, the framework for following up these additional emissions reductions is in place.

Circular economy (CE) contributes to climate neutrality while creating jobs and increasing GDP[173], as well as net savings for businesses[174]. The increased recycling targets adopted in May 2018 as a result of the first Circular Economy Action Plan avoids 477 million tons of greenhouse gases emissions[175] between 2015 and 2035[176], while creating 140,000 direct jobs. For key sectors, the circular economy can cut CO2

[171] The European Commission (2018), The Long Term Strategy for 2050, A Clean Planet for All
[172] p 7: The eighth scenario builds upon the previous scenario but assesses the impact of a highly circular economy and the potential beneficial role of a change in consumer choices that are less carbon intensive. It also explores how to strengthen the land use sink, to see by how much this reduces the need for negative emissions technologies.
[173] 700 000 new jobs to 2030 and increase of GDP with 0.5% with circular economy measures. Impacts of circular economy policies on the labour market, Cambridge Econometrics, Trinomics, and ICF (May 2018)
[174] Net savings in businesses in the EU of up to €600 billion of their annual turnover. AMEC Environment & Infrastructure and Bio Intelligence Service, 2014
[175] Thus avoiding emissions from landfilling municipal waste
[176] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015SC0259

emissions by 61%[177] in the construction and building sector, by 70% in the mobility sector and by 49% in the agri-food sector[178].

The majority of the Member States addressed circular economy in their NECPs, but to different degrees, from a full integration in the narrative and quantification of impacts, to just an acknowledgement of relevance without further details. Some Member States have calculated the climate change mitigation potential of certain circular economy measures. Examples from Member States' CE actions include cuts of GHG emissions by 11% by 2030 in the agri-food sector, by 40% by 2050 in the forestry sector, by 69% by 2050 in the waste sector and by 4% by 2040 in the residential sector. Circular agriculture, circular buildings and new concepts of mobility are particularly mentioned alongside circular business models, as well as recycling rates, green public procurement and economic incentives such as taxes.

National Circular Economy and Climate scenario modelling is variable and uses either available commercial models or own models. Nonetheless, current models assess the benefits of specific CE scenarios rather than a comprehensive assessment of the full potential of CE-related intervention. A comprehensive scenario representing the whole CE quantifying the actual impact on decarbonisation is still under development, both by individual Member States[179], the EC[180] and the European Environmental Agency[181].

A first step to uncap the potential would be to foster exchange of best practices between Member States, which would support the model developments and future target setting and policy developments.

10.7. Starting point and trajectory of annual emission allocations – further analysis

[177] EEA (2020) Quantification methodology for, and analysis of, the decarbonisation benefits of sectoral circular economy actions

[178] Ellen MacArthur Foundation and Material Economics (2019), Completing the Picture, How the Circular Economy Tackles Climate Change

[179] The Netherlands and Portugal have included CE measures in their climate modelling for their NECPs, and the Netherlands are developing their CE-climate model further.

[180] DG CLIMA modelled the circular economy scenario of the EU LTS 2050. DG GROW/ EASME is leading a study called "Study on the contribution of the circular economy to EU climate policies" in collaboration with DG CLIMA and DG ENV. The aim of the study is to establish a LCA-based methodology to model CE contribution to climate change mitigation. DG RTD will be launching a study under Horizon Europe/ climate sciences, focusing on the modelling of CE contribution to climate change mitigation.

[181] The EEA has performed a study on Quantification methodology for, and analysis of, the decarbonisation benefits of sectoral circular economy actions, with the Construction and Building sector exemplified. Next sector to be explored is the Food sector.

Table 31: Characteristics of alternative trajectories for option 1.2

	Option 1.2 Possible new AEA trajectories		
	A	B	C
Current trajectory applies	2021-25	2021-22	2021-22
New trajectory			
Period	2026-30	2023-30	2023-30
Trajectory starting value	Current AEA 2025	Current AEA 2022	2016-18 emissions
Trajectory starting time	2025	2022	2019+5/12
Total AEAs (Mt CO2eq)	19 453	19 208	19 068
Current	10 534	4 368	4 368
New	8 554	14 292	14 700
Evaluation in REFMIX scenario: unused AEAs, annual average, Mt CO2eq			
2021-2030	74	49	35
% of 2005 ESR base year	*2.9*	*2.0*	*1.4*
Current trajectory	43	35	35
% of 2005 ESR base year	*1.7*	*1.4*	*1.4*
New trajectory	104	53	35
% of 2005 ESR base year	*4.1*	*2.1*	*1.4*
Evaluation in MIX scenario: unused AEAs, annual average			
2021-2030	116	91	77
% of 2005 ESR base year	*4.6*	*3.6*	*3.1*
Current trajectory	103	83	83
% of 2005 ESR base year	*4.1*	*3.3*	*3.3*
New trajectory	128	93	76
% of 2005 ESR base year	*5.1*	*3.7*	*3.0*
Evaluation in LOW scenario: unused AEAs, annual average			
2021-2030	148	123	109
% of 2005 ESR base year	5.9	4.9	4.3
Current trajectory	152	141	141
% of 2005 ESR base year	*6.1*	*5.6*	*5.6*
New trajectory	143	119	101
% of 2005 ESR base year	*5.7*	*4.7*	*4.0*

Source: Commission services' own calculations.

Table 32: Alternative AEA trajectories and total emission allowances for option 2.1

	Option 2.1 Possible new AEA trajectories		
	A	B	C
Current trajectory applies	2021-25	2021-22	2021-22
New trajectory			
Period	2026-30	2023-30	2023-30
Trajectory starting value	Current AEA 2025	Current AEA 2022	2016-18 emissions
Trajectory starting time	2025	2022	2019+5/12
Total AEAs (Mt CO2eq)	14 760	11 412	11 086
Current	10 534	4 368	4 368
New	4 226	7 043	6 717
Evaluation in REFMIX scenario: unused AEAs, annual average, Mt CO2eq			
2021-2030	41	21	-12
% of 2005 ESR base year	*3.5*	*1.8*	*-1.0*
Current trajectory	43	35	35
% of 2005 ESR base year	*3.8*	*3.0*	*3.0*
New trajectory	38	17	-23
% of 2005 ESR base year	*3.3*	*1.5*	*-2.0*
Evaluation in MIX scenario: unused AEAs, annual average			
2021-2030	82	56	23
% of 2005 ESR base year	*7.1*	*4.9*	*2.0*
Current trajectory	103	83	83
% of 2005 ESR base year	*9.0*	*7.2*	*7.2*
New trajectory	60	49	8
% of 2005 ESR base year	*5.2*	*4.3*	*0.7*
Evaluation in LOW scenario: unused AEAs, annual average			
2021-2030	110	77	44
% of 2005 ESR base year	9.5	6.7	3.9
Current trajectory	152	141	141
% of 2005 ESR base year	*13.2*	*12.2*	*12.2*
New trajectory	67	61	20
% of 2005 ESR base year	*5.8*	*5.3*	*1.8*

Source: Commission services' own calculation.

Table 33: Key characteristics of emission allocations for option 2.2

	Option 2.2 Possible new AEA trajectories		
	A	B	C
Current trajectory applies	2021-25	2021-22	2021-22
New trajectory			
Period	2026-30	2023-30	2023-30
Trajectory starting value	Current AEA 2025	Current AEA 2022	2016-18 emissions
Trajectory starting time	2025	2022	2019+5/12
Total AEAs (Mt CO2eq)	15 037	11 827	11 580
Current	10 534	4 368	4 368
New	4 502	7 459	7 211
Evaluation in REFMIX scenario: unused AEAs, annual average, Mt CO2eq			
2021-2030	68	62	38
% of 2005 ESR base year	*5.9*	*5.4*	*3.3*
Current trajectory	43	35	35
% of 2005 ESR base year	*3.8*	*3.0*	*3.0*
New trajectory	93	69	38
% of 2005 ESR base year	*8.1*	*6.0*	*3.3*
Evaluation in MIX scenario: unused AEAs, annual average			
2021-2030	109	97	73
% of 2005 ESR base year	*9.5*	*8.5*	*6.3*
Current trajectory	103	83	83
% of 2005 ESR base year	*9.0*	*7.2*	*7.2*
New trajectory	115	101	70
% of 2005 ESR base year	*10.0*	*8.8*	*6.1*
Evaluation in LOW scenario: unused AEAs, annual average			
2021-2030	137	118	94
% of 2005 ESR base year	11.9	10.3	8.2
Current trajectory	152	141	141
% of 2005 ESR base year	*13.2*	*12.2*	*12.2*
New trajectory	122	113	82
% of 2005 ESR base year	*10.6*	*9.8*	*7.1*

Source: Commission services' own calculations.

10.8. Climate Target Plan policy conclusions

The Communication on stepping up Europe's 2030 climate ambition - the Climate Target Plan (CTP)[182] and its underpinning impact assessment are the starting point for the initiatives under the Fit for 55 package.

The plan concluded on the feasibility - from a technical, economic and societal point of view - of increasing the EU climate target to 55% net reductions of greenhouse gases (GHG) emissions by 2030 compared to 1990. It also concluded that all sectors need to contribute to this target.

In particular, with energy supply and use responsible for 75% of emissions, the plan put forward ambition ranges for renewables and energy efficiency, which correspond in a cost-efficient manner to the increased climate target. The climate target plan also established that this increase in climate and energy ambition will require a full update of the current climate and energy policy framework, undertaken in a coherent manner.

As under the current policy framework, the optimal policy mix should combine, at the EU and national levels, strengthened economic incentives (carbon pricing) with updated regulatory policies, notably in the field of renewables, energy efficiency and sectoral policies such as CO_2 standards for new light duty vehicles. It should also include the enabling framework (research and innovation policies, financial support, addressing social concerns).

While sometimes working in the same sectors, the policy tools vary in the way they enable the achievement of the increased climate target. The economic incentives provided by strengthened and expanded emissions trading will contribute to the cost-effective delivery of emissions reductions. The regulatory policies, such as the Renewable Energy Directive (RED), the Energy Efficiency Directive (EED), the Regulation on CO_2 standards for vehicles supported by the Directive on the alternative fuels infrastructure, and the Re(FuelEU) aviation and maritime initiatives, aim at addressing market failures and other barriers to decarbonisation, but also create an enabling framework for investment, which supports cost-effective achievement of climate target by reducing perceived risks, increasing the efficient use of public funding and helping to mobilise and leverage private capital. The regulatory policies also pave the way for the future transition needed to achieve the EU target of the climate neutrality. Such a sequential approach from the CTP to the Fit for 55 initiatives was necessary in order to ensure coherence among all initiatives and a collective delivery of the increased climate target.

[182] COM (2020) 562 final.

With the "MIX" scenario, the impact assessment included a policy scenario that largely reflects the political orientations of the plan.

The final calibration between the different instruments is to be made depending, *inter alia* on the decision on the extension of emissions trading beyond the maritime sector and its terms.

The Table 34 below shows the summary of the key CTP findings:

Table 34: Key policy conclusions of the Climate Target Plan

POLICY CONCLUSIONS IN THE CTP	
GHG emissions reduction	• At least 55% net reduction (w.r.t. 1990) • Agreed by the European Council in December 2020 • Politically agreed by the European Council and the European Parliament in the Climate Law
ETS	• Corresponding targets need to be set in the EU ETS and the Effort Sharing Regulation to ensure that in total, the economy wide 2030 greenhouse gas emissions reduction target of at least 55% will be met. • Increased climate target requires strengthened cap of the existing EU ETS and revisiting the linear reduction factor. • Further expansion of scope is a possible policy option, which could include emissions from road transport and buildings, looking into covering all emissions of fossil fuel combustion. • EU should continue to regulate at least intra-EU aviation emissions in the EU ETS and include at least intra-EU maritime transport in the EU ETS. • For aviation, the Commission will propose to reduce the free allocation of allowances, increasing the effectiveness of the carbon price signal in this sector, while taking into account other policy measures.
ESR	• Corresponding targets need to be set in the Effort Sharing Regulation and under the EU ETS, to ensure that in total, the economy wide 2030 greenhouse gas emissions reduction target of at least 55% will be met.
LULUCF	• Sink needs to be enhanced. • Agriculture forestry and land use together have the potential to become rapidly climate-neutral by around 2035 and subsequently generate removals consistent with trajectory to become climate neutral by 2050.
CO2 standards for cars and vans	• Transport policies and standards will be revised and, where needed, new policies will be introduced. • The Commission will revisit and strengthen the CO_2 standards for cars and vans for 2030. • The Commission will assess what would be required in practice for this sector to contribute to achieving climate neutrality by 2050 and at what point in time internal combustion engines in cars should stop coming to the market.
Non-CO2 GHG	• The energy sector has reduction potential by avoiding fugitive methane

emissions	emissions. The waste sector is expected to strongly reduce its emissions already under existing policies. Turning waste into a resource is an essential part of a circular economy. Under existing technology and management options, agriculture emissions cannot be eliminated fully but they can be significantly reduced while ensuring food security is maintained in the EU. Policy initiatives have been included in the Methane Strategy.
Renewables	• 38-40% share needed to achieve increased climate target cost-effectively. • Renewable energy policies and standards will be revised and, where needed, new policies will be introduced. • Relevant legislation will be reinforced and supported by the forthcoming Commission initiatives on a Renovation Wave, an Offshore Energy strategy, alternative fuels for aviation and maritime as well as a Sustainable and Smart Mobility Strategy. • EU action to focus on cost-effective planning and development of renewable energy technologies, eliminating market barriers and providing sufficient incentives for demand for renewable energy, particularly for end-use sectors such as heating and cooling or transport either through electrification or via the use of renewable and low-carbon fuels such as advanced biofuels or other sustainable alternative fuels. • The Commission to assess the nature and the level of the existing, indicative heating and cooling target, including the target for district heating and cooling, as well as the necessary measures and calculation framework to mainstream further renewable and low carbon based solutions, including electricity, in buildings and industry. • An updated methodology to promote, in accordance with their greenhouse gas performance, the use of renewable and low-carbon fuels in the transport sector set out in the Renewable Energy Directive. • A comprehensive terminology for all renewable and low-carbon fuels and a European system of certification of such fuels, based notably on full life cycle greenhouse gas emissions savings and sustainability criteria, and existing provisions for instance in the Renewable Energy Directive. • Increase the use of sustainably produced biomass and minimise the use of whole trees and food and feed-based crops to produce energy through inter alia reviewing and revisiting, as appropriate, the biomass sustainability criteria in the Renewable Energy Directive,
Energy Efficiency	• Energy efficiency policies and standards will be revised and, where needed, new policies will be introduced. • Energy efficiency improvements will need to be significantly stepped up to around 36-37% in terms of final energy consumption[183]. • Achievement of a more ambitious energy efficiency target and closure of the collective ambition gap of the national energy efficiency contributions

[183] The Impact Assessment identifies a range of 35.5% - 36.7% depending on the overall design of policy measures underpinning the new 2030 target. This would correspond to a range of 39.2% - 40.6% in terms of primary energy consumption.

	in the NECPs will require actions on a variety of fronts. • Renovation Wave will launch a set of actions to increase the depth and the rate of renovations at single building and at district level, switch fuels towards renewable heating solutions, diffuse the most efficient products and appliances, uptake smart systems and building-related infrastructure for charging e-vehicles, and improve the building envelope (insulation and windows). • Action will be taken not only to better enforce the Energy Performance of Buildings Directive, but also to identify any need for targeted revisions. • Establishing mandatory requirements for the worst performing buildings and gradually tightening the minimum energy performance requirements will also considered.

10.9. Glossary

Table 35: Glossary

Term or acronym	*Meaning or definition*
Land Use	EU Agriculture, Forestry and Land Use. Also known as Land Use instrument.
BACS	Building Automation and Control Systems
Biofuels	Biofuels are liquid or gaseous transport fuels such as biodiesel and bioethanol which are made from biomass.
Biofuels (conventional)	Biofuels are produced from food and feed crops.
Biofuels (advanced)	Biofuels produced from a positive list of feedstock (mostly wastes and residues) set out in Part A of Annex IX of Directive (EU) 2018/2001.
BOE	Barrels of oil equivalent
CAP	Common Agricultural Policy
CAPRI (model)	Common Agricultural Policy Regionalised Impact model: a global multi-country agricultural sector model, supporting decision making related to the Common Agricultural Policy and environmental policy.
CCS	Carbon Capture and Storage: a set of technologies aimed at capturing, transporting, and storing CO2 emitted from power plants and industrial facilities. The goal of CCS is to prevent CO2 from reaching the atmosphere, by storing it in suitable underground geological formations.
CCU	Carbon Capture and Utilisation: the process of capturing carbon dioxide (CO2) to be recycled for further usage.
CEDEFOP	European Centre for the Development of Vocational Training
CEF	Connecting Europe Facility: an EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level.
CGE	Computable General Equilibrium: a family of economic models.
CHP	Combined Heat and Power: a combined heat and power unit is an installation in which energy released from fuel combustion is partly used for generating electrical

	energy and partly for supplying heat for various purposes.
CH_4	CH_4 is the chemical formula for methane, a greenhouse gas. CH_4 is used as shorthand to refer to methane.
CO_2-eq	CO_2-eq stands for carbon dioxide-equivalent. This is a measure used to compare quantities of different greenhouse gases in a common unit on the basis of their global warming potential over a given time period.
COP	Conference of the Parties: decision-making body of the United Nations Framework Convention on Climate Change (see UNFCCC)
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
COVID-19	Global pandemic caused by a coronavirus unknown before the outbreak began in Wuhan, China, in December 2019.
DG ECFIN	Directorate General Economic and Financial Affairs
E3ME	Energy-Environment-Economy Macro-Econometric Model: a model for macroeconomic analysis.
ECB	European Central Bank
EE	Energy Efficiency
EEA	European Environment Agency
EED	Energy Efficiency Directive: Directive 2012/27/EU and amending Directive 2018/2002/EU
E-fuels	Liquid fuels produced on the basis of hydrogen obtained from electricity via electrolysis
E-gas	Gaseous fuels produced on the basis of hydrogen obtained from electricity via electrolysis
EIB	European Investment Bank
EII	Energy intensive industries
Energy system costs	Sum of fixed and variable costs for the energy system, including investments, operations and maintenance, as well as fuels.
EPBD	Energy performance of buildings directive: Directive 2010/31/EU and amending Directive 2018/844/EU
EPC	Energy Performance Certificates

	(see also EPBD)
ERDF	European Regional Development Fund
ESOS	Energy savings obligation scheme
ESR	Effort Sharing Regulation: Regulation 2018/842/EU
ETD	Energy Taxation Directive: Directive 2003/96/EC
EU ETS	European Union Emissions Trading System as established under Directive 2003/87/EC
EU, EU-27	European Union with 27 Member States since 1 February 2020
EU-28	European Union with 28 Member States from 1 July 2013 to 31 January 2020
EUTL	European Union Transaction Log: central transaction log, run by the European Commission, which checks, records and authorises all transactions between accounts in the Union Registry (see also EU ETS, NIMs)
FAO	Food and Agriculture Organization
FEC	Final Energy Consumption: all energy supplied to industry, transport, households, services and agriculture, excluding deliveries to the energy transformation sector and the energy industries themselves (see also GIC, PEC)
F-GASES	Fluorinated greenhouse gases, including hydrofluorocarbons (HFCs) perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
FRL	Forest Reference Level (see also LULUCF)
G20	Group of 20: international forum for the governments and central bank governors from 19 countries and the European Union (EU)[184].
GAINS (model)	Greenhouse gas and Air Pollution Information and Simulation
GDP	Gross Domestic Product
GEM-E3-FIT (model)	General Equilibrium Model for Energy Economy Environment interactions: a computable general

[184] The Group of Twenty (G20) is a forum made up of the European Union and 19 countries: Argentina, Australia, Brazil, Canada, China, Germany, France, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom and the United States.

	equilibrium model, version operated by E3Modelling, a company (see also JRC-GEM-E3).
GHG	Greenhouse Gas
GIC	Gross Inland Consumption: the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration, i.e. the Total Energy Supply, plus the international aviation (see also FEC, PEC).
GLOBIOM (model)	Global Biosphere Management Model: a model for land use of agriculture, bioenergy, and forestry.
$GtCO_2$	Giga tonnes of CO_2
GW	Gigawatt
HBS	Household Budget Surveys: national surveys of households focusing mainly on consumption expenditure.
Hydrogen	A feedstock for industrial processes and energy carrier that can be produced through a variety of processes from fossil fuels or electricity via electrolysis.
Hydrogen (GHG neutral)	Hydrogen from GHG neutral sources, mainly through electrolysis using GHG neutral electricity. This includes renewable hydrogen, which is from renewable electricity via electrolysis.
Hydrogen (Clean, Renewable)	Hydrogen, which is from renewable electricity via electrolysis.
IA	Impact assessment
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICT	Information and Communication Technology
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
JRC	Joint Research Centre of the European Commission
JRC-GEM-E3	General Equilibrium Model for Energy Economy

	Environment interactions: a computable general equilibrium model, version operated by the JRC (see also GEM-E3-FIT)
JTF	Just Transition Fund
Land Use instrument	LULUCF + agriculture.
LRF	Linear Reduction Factor (see also ETS)
LTS	COM(2018) 773: A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy
LULUCF	Land Use, Land-Use Change, and Forestry
LULUCF regulation	Regulation on emissions and absorptions of the LULUCF sector: Regulation (EU) 2018/841
MFF	Multiannual Financial Framework
MRV	Monitoring, Reporting and Verification scheme implemented in Regulation (EU) 2015/757 on the monitoring, reporting and verification of CO_2 emissions from maritime transport
MSR	Market Stability Reserve (see also EU ETS)
$MtCO_2$	Million tonnes of CO_2
Mtoe	Million tonnes of oil equivalent
MWh	Megawatt hour
N_2O	N_2O is the chemical formula for nitrous oxide, a greenhouse gas. N_2O is used as shorthand to refer to nitrous oxide.
NDC	Nationally Determined Contributions (as required by the Paris Agreement)
NECP	National Energy And Climate Plan
NGEU	Next Generation EU
NIMs	National Implementation Measures, submitted under Article 11 of the ETS Directive (see also ETS)
NOX	Nitrogen Oxide(s)
'No Debit rule'	Under EU legislation adopted in May 2018, EU Member States have to ensure that greenhouse gas emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO_2 from the

	atmosphere in the period 2021 to 2030.
NZEB	Near Zero Energy Building
OECD	Organisation for Economic Co-operation and Development
PDF (indicator)	Potentially Disappeared Fraction of global species
PEC	Primary Energy Consumption: Gross Inland Consumption (GIC) minus the energy included in the final non-energy consumption (see also, FEC, GIC)
PHS	Pumped Hydropower Storage
PM 2.5	Particulate Matter with a diameter of 2.5 micrometre or less
POLES-JRC (model)	Prospective Outlook on Long-term Energy Systems: a global long-term energy system model operated by the JRC
PRIMES (model)	Price-Induced Market Equilibrium System: an energy system model for the European Union.
PRIMES-TREMOVE (model)	Model for the transport sector, integrated in the PRIMES model.
PtG	Power to gas: technologies for the production of E-gases (see also E-gases)
PtL	Power to liquids: technologies for the production of E-fuels (see also E-fuels)
QUEST / E-QUEST (model)	Quarterly Economic Simulation Tool: a global macroeconomic model used by the Directorate General for Economic and Financial Affairs (DG ECFIN)
RED / RED II	Renewable Energy Directives 2009/28/EC and 2018/2001/EU
RES	Renewable Energy Sources
RES-E	Renewable Energy Sources in the generation of Electricity
RES-H&C	Renewable Energy Sources in Heating and Cooling
RES-T	Renewable Energy Sources in Transport
RFNBO	Renewable Fuels of Non-Biological Origin: liquid or gaseous fuels which are used in the transport sector other than biofuels or biogas, the energy content of which is

	derived from renewable sources other than biomass
SET-Plan	EU Strategic Energy Technology Plan
Sink	Any process, activity or mechanism that removes a greenhouse gas, an aerosol, or a precursor to a greenhouse gas from the atmosphere
SME	Small and Medium-sized Enterprise
Synthetic fuels and gases	See E-fuels, E-gases
TEN-E	Trans-European Networks for Energy
TEN-T	Trans-European Networks for Transport
TFEU	Treaty on the Functioning of the European Union
TWh	Terawatt-hour
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
ZELV	Zero and low emissions vehicles
ZEV	Zero emissions vehicles