EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 621 final

PART 1/2

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the

Proposal for a Directive of the European Parliament and the Council

amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652

{COM(2021) 557 final} - {SEC(2021) 657 final} - {SWD(2021) 620 final} - {SWD(2021) 622 final}

Table of contents

Glossary

Term or acronym	*Meaning or definition*
REDII	Directive (EU) 2018/2001of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, OJ L 328, 21.12.2018, p. 82–209
CTP	2030 Climate Target Plan
EGD	European Green Deal
GHG	Greenhouse gas
LULUCF	Land use, land-use, change and forestry, 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, OJ L 156, 19.6.2018, p. 1–25
ILUC Directive	Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources, OJ L 239, 15.9.2015, p. 1–29
NECP	National energy and climate plan
TFEU	Treaty on the Functioning of the European Union
GO	Guarantee of origin, based on article 19 of REDII and defined in Article 2(12), , is an electronic document which has the sole function of demonstrating to a final customer that a given share or quantity of energy was produced from renewable sources
BDS	Biodiversity Strategy
ESI	Energy System Integration
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Use
RFNBO	Renewable fuel of non-biological origin, according to Article 2(63) of the Renewable Energy Directive. This includes for instance renewable hydrogen and hydrogen based synthetic fuels.
FQD	Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC, OJ L 140, 5.6.2009, p. 88–113

Governance Regulation	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 ,OJ L 328, 21.12.2018, p. 1–77
ETS	Emissions Trading System
EED	Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ L 315, 14.11.2012, p. 1–56
EPBD	Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings OJ L 153, 18.6.2010, p. 13–35
Union database	Database to be established under Article 28 of RED II with the aim to increase cooperation between national systems tracking renewable fuels in order to improve the data availability on the EU level and minimise the risk of fraud and double counting of fuels. It shall be set up for fuels that are: • Eligible for being counted towards the target (specifically the numerator referred to in point (b) of Article 27(1) – the renewable transport target); • Suitable for measuring compliance with renewable energy obligations; • Eligible for financial support for the consumption of biofuels, bio-liquids and biomass fuels.
AFID	Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure, OJ L 307, 28.10.2014, p. 1–20
Part A advanced biofuels	Biofuels for transport made from the feedstocks listed in Part A of Annex IX to REDII
Part B advanced biofuels	Biofuels for transport from the feedstocks listed in Part B of Annex IX to REDII
RLF	Renewable and Low Carbon Fuels
H&C	Heating and Cooling
DH	District Heating
DHC	District Heating and Cooling
4GDH	4th Generation District Heating system is a coherent technological and institutional concept which by means of smart thermal grids assists the appropriate development of sustainable energy systems.
FTE	Full time equivalent (employment)

PPA	A contract under which a legal or natural person agrees to purchase renewable electricity directly from an electricity producer.
Mtoe	Million tonnes of oil equivalent

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

The European Green Deal establishes the objective of becoming climate neutral in 2050 in a manner that contributes to European competitiveness, growth and jobs. This objective, and the objective of a 55% reduction in GHG emissions by 2030 as confirmed by EU Heads of State and Government in the European Council in December 2020, requires an **energy transition and significantly higher shares of renewable energy sources in an integrated energy system**. The increased use of energy from renewable sources is crucial to combat climate change, protect our environment and health and reduce our energy dependency, as well as to contribute to the EU's technological and industrial leadership and the creation of jobs and growth.

REDII sets a binding EU target to reach at least a 32% share of renewables in the energy mix in 2030. It moves away from the national binding targets which were set within the 2020 framework to national contributions to the Union target as set by the Member States in their National Energy and Climate Plans ("NECPs"). On 17 September 2020, the Commission adopted the 2030 Climate Target Plan[1] ("CTP"), which explores options to achieve a new 2030 climate target of at least 55% GHG emissions reductions. This target was endorsed both by the European Parliament[2] and by the European Council[3]. As stated in the CTP, **renewable energy plays a fundamental role in delivering the European Green Deal[4] and for achieving climate neutrality by 2050**. The energy sector contributes over 75% of total GHG emissions in the EU and energy efficiency. Renewable are therefore central to achieving the higher climate ambition for 2030. According to the CTP, achieving at least 55% GHG emissions reductions would result in an accelerated clean energy transition and a greener energy mix, with renewable energy seeing its share reaching 38% to 40% of gross final energy consumption by 2030.

The acceleration of the ongoing energy transition requires a real paradigm shift and profound changes in the way how we produce and consume energy. This requires significant investments in new technologies, materials and fuels. Such profound changes do not happen overnight and the magnitude of investment is a challenge. To further leverage this step change, investors need certainty on the direction to go and where to invest. Compared to other "Fit for 55" measures, the revision of RED can deliver best on specific support measures for new renewable solutions and create certainty for investors to make the accelerated energy transition happen.

This revision of RED II builds on the CTP and the impact assessment[5] that underpins it, as do all the 'Fit for 55' initiatives.

Implementing the EGD roadmap, the Commission has adopted several strategies that require a review of different elements of the EU's renewable energy policy:

[1] COM(2020) 562 final
[2] European Parliament resolution of 15 January 2020 on the European Green Deal (2019/2956(RSP))
[3] European Council conclusions of 11 December 2020, https://www.consilium.europa.eu/media/47296/1011-12-20-euco-conclusions-en.pdf
[4] COM (2019) 640 final
[5] SWD (2020) 176 final

- The Energy System Integration Strategy[6] and the Hydrogen Strategy[7] aim to build an integrated energy system fit for climate neutrality and to turn hydrogen, especially renewable hydrogen, into a viable solution to contribute to this vision. Both strategies propose a number of actions to be addressed through the review of REDII, including promoting the principle of energy efficiency first, moving towards a more "circular" energy system by reusing waste heat and biomass wastes and residues, promoting renewable-based electrification in sectors such as transport, buildings, industry and promoting the use of renewable and low carbon fuels[8], including hydrogen, for hard-to-decarbonise sectors;
- The Renovation Wave initiative[9], which aims to at least double the current low renovation rates in the EU and highlights the need to speed up the integration of renewables in buildings as well as the decarbonisation of heating and cooling;
- The Offshore Renewable Energy Strategy[10], which sets out the scaling up of offshore renewable energy and its use as an EU priority;
- The EU Biodiversity Strategy[11]calls for better protection of and increasing the quantity, quality and resilience of Europe's forests, including primary forests. It also includes a mandate to the Joint Research Centre to carry out a study on use of forest biomass for energy production and related biodiversity risks, in order to inform the review of REDII[12].

Furthermore, in response to the COVID-19 induced economic crisis effects on the European economy the Commission adopted an Economic Recovery Package[13] to facilitate investments to accelerate the transition towards a climate neutral economy (amongst other matters). The review of REDII must been seen in this context as a tool to complement the Recovery Package by helping to create a legal framework that sets the right incentives for a smooth and cost-effective energy transition that supports Europe's recovery and resilience efforts, making Europe a healthier continent.

The review of REDII does not stand alone. It is part of a broader exercise that affects other energy and climate legislation and policy initiatives, as announced in the EGD roadmap, and in the Commission work programme for 2021[14] under the title "Fit for 55 package". Therefore, close coordination is undertaken with the other proposals that are part of the June 2021 'Fit for 55' package (see section 1.2).

1.1. Key aspects of the 2018 Renewable Energy Directive (REDII)

REDII is the main EU instrument dealing with the promotion of energy from renewable sources. It was adopted in 2018 and has to be fully implemented by Member States on 1 July 2021. A full review of the Directive is therefore not yet possible, and the Impact Assessment will focus on a

[6] COM (2020) 299 final, 10 July 2020
[7] COM(2020) 301 final, 10 July 2020
[8] RLF include sustainable biofuels and biogas, renewable hydrogen and hydrogen based fuels as well as non-renewable fuels with low GHG emission intensity
[9] COM (2020)662 final
[10] COM (2020)741 final
[11] COM (2020) 80 final
[12] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122719/jrc-forest-bioenergy-study-2021-final_online.pdf
[13] https://ec.europa.eu/info/strategy/recovery-plan-europe_en
[14] COM(2020) 690 final

targeted review to ensure the implementation of the Climate Target plan and other key Commission initiatives such as the Energy System Integration Strategy and the Biodiversity Strategy, while ensuring coherence with the other initiatives under the “Fit for 55” package.

It establishes an **EU-level binding renewable energy target for 2030 of at least 32 %** to be collectively delivered by Member States on the basis of voluntary national contributions, calculated according to an indicative formula included in the Governance Regulation. The national (binding) 2020 targets set in REDI also act as a minimum share of renewables (“baseline”) that Member States are obliged to maintain after 2020.

REDII also sets an indicative target to increase renewables in **the heating and cooling sector** by 1**.3 percentage point yearly**[15]. The targets are accompanied by a list of optional measures that Member States may choose to take and an obligation to, assess the potential of the use of renewables and waste heat and cold in the heating and cooling sector including District heating and cooling[16]. Member States must introduce appropriate measures in their building codes to increase the level of renewables in the building sector, in particular requiring minimum levels of renewable energy in new buildings and those undergoing major renovation. General requirements on basic information provisions and disconnection rights for consumers in district heating and cooling are also included.

REDII includes a sectorial **binding target for transport of 14%,** to be met by an obligation on fuel suppliers. It includes a cap of 7% of food based biofuels and a specific sub-target for advanced biofuels of 3.5%. Electrification of transport is only incentivised in a residual manner. The use of renewable energy in certain sectors (road transport, rail transport, maritime and aviation) is only incentivised through “multipliers”, allowing to account more than the actual energy content consumed. The consumption of renewable electricity is also incentivised through such multiplier, as well as that of advanced biofuels. [17]

REDII strengthens the EU **sustainability framework for bioenergy**. It includes enhanced sustainability criteria covering also biomass/biogas in heat and power, in addition to biofuels/biogas for transport (as under REDI). REDII includes new biodiversity and climate safeguards for forest biomass. Also, REDII lays down minimum GHG emission saving thresholds, requiring biomass in heat and power to emit 70% fewer GHG emissions (on lifecycle basis) compared to fossil fuels (increasing to -80% in 2026). Minimum energy efficiency requirements for biomass electricity

[15] The 1.3 percentage point can be fulfilled by up to 40% with waste heat and cold from district heating and cooling, if a Member State chooses so. The “pure” renewable heating and cooling target is an indicative 1.1 percentage point annual average increase, when a Member State chooses not to use waste heat and cold from district heating and cooling. Member States can justify not meeting the indicative target when due to structural barriers, such as high share of gas, cooling or disperse settlement structure, this would be too expensive.

[16] For District Heating and Cooling, Member States must promote renewables by fulfilling a 1 percentage point annual average increase in the period of 2021-2030 (which can be up to 100% met with waste heat and cold) or as an alternative, may implement third party access to district heating networks for renewables, high-efficiency cogeneration and waste heat/cold suppliers. Third party access is subject to several exceptions, which can be granted for example for systems meeting the efficient district heating and cooling definition, or systems below 20 MW threshold. Member States with low district heating penetration below 2% are exempted from these provisions.

[17] Including a multiplier of 4 for road transport, a multiplier of 1.5 for rail transport, a multiplier of 1.2 for maritime and aviation transport, and a multiplier of 2 for biogas and advanced biofuels produced from feedstocks listed in Annex IX (parts A and B)

production have also been introduced. REDII promotes the shift from conventional to advanced biofuels. Finally, article 3 of the Directive requires that, amongst other, Member States design their support schemes with due regard with the waste hierarchy, to aim to avoid undue distortions of the biomass raw material market. These criteria have not yet taken effect, as the deadline for transposition by Member States is June 2021.

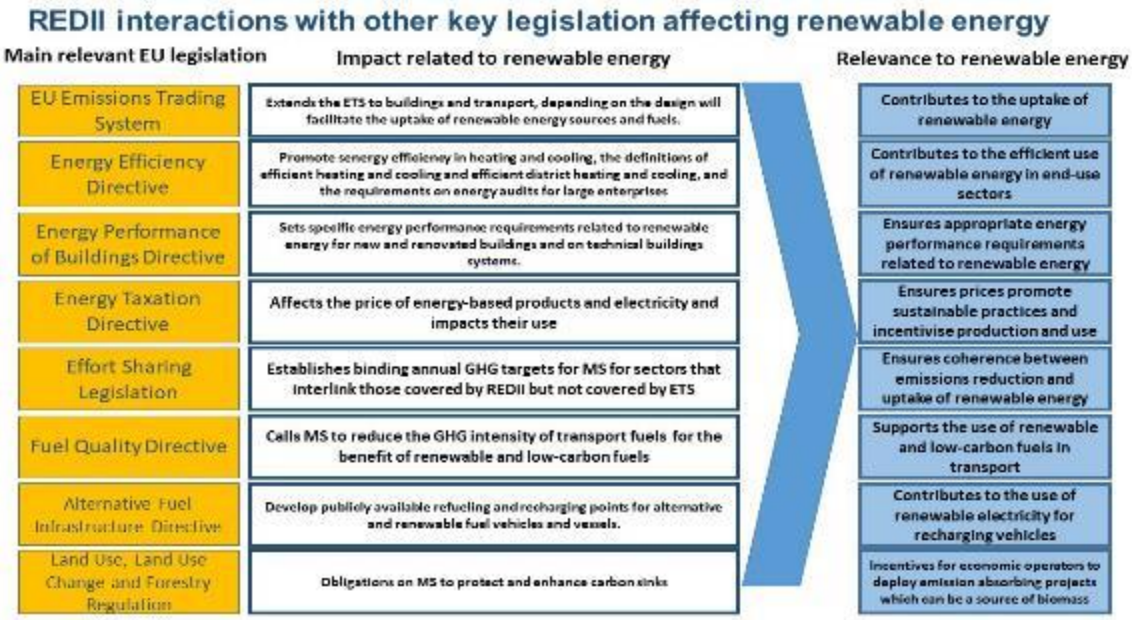
REDII also includes a **number of enabling measures** aiming to increase the renewable energy shares in the EU. These measures were calibrated in the Clean Energy for All Package with other energy, climate, environmental but also consumer legislation. They include the right for renewable self-consumers and renewable energy communities to generate, store and sell electricity without being subject to disproportionate procedures and to be fairly remunerated for the electricity they feed into the grid.

Furthermore, measures to simplify and speed up administrative and permitting procedures to ease the administrative burden for renewable projects developers. The Directive also includes general principles for the design of support schemes, in order to provide visibility to both Member States and investors on their possible design. Schemes are also subject to a voluntary opening to neighbouring Member States, with a review clause to reassess the possibility of a mandatory opening.

1.2. The Renewable Energy Directive and interactions with the key 'Fit for 55' legislation/initiatives and others

In conjunction with the REDII, the current EU climate and energy policy framework already presents several elements of synergies as shown in the figure below. Specific interlinkages between legislative instruments are explained in detail and where relevant in Chapters 5 and 6.

Figure 1 - RED II Interactions with other key legislation affecting Renewable Energy



The interactions are the strongest with the ETS – especially if extended to sectors of road transport and buildings. The analysis supporting the CTP shows that carbon pricing works best hand in hand with regulatory measures, and that this helps avoid "extreme" scenarios of either:

- very high carbon prices that can translate, in the absence of regulatory measures addressing market failures and barriers, into high energy prices for consumers (representing the highest burden for vulnerable individual consumers energy intensive industry etc.);
- very stringent energy policy requirements (e.g. very high energy savings or renewables obligations) that may be rejected by Member States because it would not give them much flexibility and would be too costly for economic operators struggling to mobilise the necessary investments and ultimately passing it through to consumers.

The proposed approach is to adjust and review the various complementary policy instruments to address various and distinct challenges in the pursuit of climate neutrality and European Green Deal objectives.

The IA is fully aligned with the GHG targets proposed in the **Climate Law**[18] for 2030 and 2050, as the IA is based on the **Climate Target Plans** scenarios achieving those two targets. The IA focuses on how to deliver the necessary level of ambition, mindful of interaction with other instruments, the governance process and subsidiarity principles. It looks at ways to formulate the sectoral RES targets, what fuels are eligible to fulfil them, which tools are proposed for Member State choice and which elements are binding. In addition to delivering the RES levels of ambition as defined in the CTP, the revision of REDII also assesses certain tools to achieve better energy system integration (ESI) and ensure that biomass sustainability criteria are fit for purpose.

In order to address the key interactions with legislative instruments mentioned above, scenarios (so-called "Fit for 55" core scenarios) were modelled to show how all instruments together can deliver the increased climate target of 55% net GHG reductions. REDII revision is reflected in those scenarios – please see methodology explained in Chapter 5.

2. PROBLEM DEFINITION

2.1. What are the problems?

REDII was designed and adopted to achieve a share of at least 32% renewable energy in gross final energy consumption in a cost-effective and sustainable way by 2030, as part of a broader 2030 climate and energy framework, which set a 40% GHG reduction target. However, the EGD and its follow-up initiatives have increased the ambition of the Union climate and energy policies. This new ambition can only be achieved with considerably increased volumes of renewable energy in the system in addition to a strong improvement in energy efficiency. The common economic analysis underpinning the 2030 Climate Target Plan shows that, in the pathway/scenario focusing on a combination of carbon pricing and medium intensification of regulatory measures in all sectors of the economy, the current REDII fails to contribute sufficiently to the increased ambition and new policies adopted under the EGD in three ways.

[18] Proposal for a Regulation of the European Parliament and of the Council establishing the framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Law)

First, the **targets and measures set in the Directive are not sufficiently ambitious** to achieve the general and sectoral shares in heating and cooling and transport sectors of renewables the CTP indicates as cost-effective **to achieve an at least 55% of GHG emissions reduction** in 2030 and climate neutrality by 2050.

While in the electricity sector the penetration of renewables has been the fastest, it will need to be scaled up substantially compared to historic rates of deployment. The key drivers remain the ETS price, energy taxation and taxonomy as well as further reducing technology costs through further enabling measures in renewables legislation in the electricity and industry sectors.

Second, **the Directive does not properly reflect the measures proposed in the Energy System Integration and Hydrogen strategies to advance towards a more integrated energy system** where there is, inter alia, a more energy efficient and circular energy system, further renewables-based electrification and further use of renewable and low-carbon fuels in those sectors where electrification is not yet a viable option.

These three goals are essential to reach the 2030 ambition in a cost-effective way. This is in particular valid for sectors that are difficult to de-carbonise such as transport, heating & cooling and industry.

Furthermore, the current certification system has already shown good results but its scope and content does not cover new fuels such as innovative renewables of non-biological origin (RFNBOs). All renewable and low-carbon fuels need robust certification across the life cycle to help achieve of both energy and climate targets.

Finally, **the current REDII sustainability criteria for bioenergy need to be reinforced in a targeted way in light of the increased climate and biodiversity ambition of the EU Green Deal**[19].

The clean energy transition will result in an overall increasing demand for biomass (particularly after 2030), be it for bioenergy or alternative uses in products, while at the same time the EU land use sink needs to be maintained and enhanced and EU biodiversity safeguarded. According to the National Energy and Climate Plans, a majority of Member States plan to increase their use of bioenergy, but in most cases without assessing the impacts on LULUCF sinks and biodiversity (see Annex 8).

Energy policy is only one among several factors influencing forest management. Nevertheless if an increased uptake of renewable energy is met through unsustainable forest biomass sourcing, this

[19] The Climate Target Plan points to the need to increase the use of sustainably produced biomass to achieve the 2030 and 2050 targets, while minimising the use of whole trees and food and feed-based crops for energy .The Biodiversity strategy sets the following objectives, amongst others: '*strictly protecting at least 10% of the EU land area, including all remaining EU primary and old-growth forests'*, and '*planting at least 3 billion additional trees in the EU by 2030, in full respect of ecological principles'*. Concerning energy, the Strategy states that*: The EU will prioritise solutions such as ocean energy, offshore wind, which also allows for fish stock regeneration, solar-panel farms that provide biodiversity-friendly soil cover, and sustainable bioenergy*'. In this respects it recalls that: '*The revised Renewable Energy Directive includes strengthened sustainability criteria and promotes the shift to advanced biofuels based on residues and non-reusable and non-recyclable waste. This approach should continue for all forms of bioenergy. The use of whole trees and food and feed crops for energy production – whether produced in the EU or imported – should be minimised'*. The Strategy mandates the JRC to conduct a study on the use of forest bioenergy, including potential risks of unintended biodiversity and climate impacts, with the view to inform the review of REDII and the LULUCF Regulation.

could put further pressure on the forest sink and the biodiversity in forests. A. In addition, the combustion of biomass in inefficient energy installations can affect air quality objectives. At the same time, the Climate Target Plan pointed out to the need for increased use of sustainable bioenergy in order to achieve the 55% target by 2030 and climate neutrality by 2050. It is therefore essential to ensure that RED II in combination with the LULUCF Regulation and other climate and environment legislation) further minimises trade-offs and maximises synergies between biomass production and biodiversity and climate protection.

Stakeholder views

The vast majority of the contributions to the Inception Impact Assessment reflected a positive attitude towards the increase of the climate ambition set in the European Green Deal and towards a revision of the Directive. A small number of stakeholders pointed out the negative impact such an early revision of the Directive could have for the stability of the regulatory framework and investor certainty. Regarding the question in the OPC 'Does REDII need to be modified?', across all stakeholder groups, the majority agreed that RED II needs to be modified, and that it needs to be more ambitious as a result of the higher climate ambition in the European Green Deal and Climate Target Plan. Top of the list for change was targets, followed by transport, and the number of replies on forest biomass shows the public interest on the issue of bioenergy sustainability.

2.2. What are the problem drivers?

2.2.1. *Insufficiently ambitious targets and measures for renewables deployment in EU and Member State legislation both in 2030 and 2050 perspective*

2.2.1.1. Insufficient ambition to achieve the overall renewable energy target in 2030

As indicated in the latest Renewable Energy Progress Report[20], if Member States meet the national contributions for renewable energy they have set in their NECPs, the Union is expected to reach a share of renewables between 33.1% and 33.7% by 2030[21] that would contribute to -41% GHG emission reduction thereby overachieving the current 32% RES target set in REDII while being significantly lower than the necessary 38% to 40% share set out in the CTP to be consistent with the overall EU target of at least 55% GHG reduction by 2030.

Apart from these identified shortcomings regarding the EU overall renewable energy target, an assessment per sector also reveals that REDII's ambition and measures are not sufficient to deliver the EGD and CTP ambition. Market barriers and lack of incentives, particularly in end-use sectors such as heating and cooling or transport, hinder further penetration of renewables, either through electrification, or via the penetration of renewable and low-carbon fuels such as advanced biofuels and renewable and other sustainable alternative fuels and gases. Further cross –border cooperation and integrated approach to develop and deploy further renewable technologies like offshore renewable energy and in industry is still missing. Enhanced and expanded measures, including

[20] COM(2020) 952 final
[21] COM(2020) 564 final

flanking and enabling measures, under RED II could deliver a larger uptake of renewable energy in the EU.

2.2.1.2. Insufficient ambition for renewables deployment in the heating and cooling sector

Heating and cooling currently accounts for half of the EU energy consumption. 60% of heating is consumed in buildings and around 40% in industrial process heating. More than three quarters of heating is supplied from fossils fuels. 80% of energy demand in residential buildings is driven by heating and cooling needs, and around 60% in service sector buildings. Many heating systems are old and inefficient and half are beyond their service lifetime. The replacement of half of the current heating stock and even more in district heating networks will have to occur in the next 5-8 years. A clear and ambitious policy framework is essential to ensure that investments for building renovation are cost-efficient and facilitate replacing fossil fuel boilers with more sustainable alternatives.

The share of renewables in this sector in the EU in 2019 was 22.1%, with only a 5.3 percentage point increase over the last 10 years[22]. In district heating the share of renewables is slightly higher around 28.9% but is mainly attributable to the use of biomass (26.9%), while other renewable heat technologies (heat pumps, solar and geothermal) amounting to only 2% are used only in a few innovative networks. In industry, only 9% of the heating requirements are supplied by renewable energy. In their NECPs, around half of the Member States did not present sufficient trajectories and measures to fulfil the current indicative heating and cooling target of an 1.1 percentage point (ppt) average annual increase (or 1.3 ppt if waste heat is used) over the 2021-2030 period, while the other half indicated the achievement of this target in their plans [23]. Likewise the gradual modernisation and building of renewable based district heating and cooling systems remained unaddressed by but a handful of Member States, even where this type of heating has a significant share. Overall the insufficiency of ambition in planned measures and trajectories signals a significant risk of long-term carbon lock-in, which will be difficult and expensive to correct if steps are not taken in the period until 2030. According to the aggregated projected trend in the NECPs, is only enough to reach a 33% RES share in H&C in 2030, in contrast with the 38-41% estimated necessary in the CTP.

Without a clear policy framework to roll-out renewable heating technologies in buildings and district heating as the main pillar of decarbonisation, replacement of heating systems will be sporadic and in many cases be based on uninformed decisions taken under duress in winter break-downs leading to replacing current fossil systems with the same and leading to fossil lock-in for the next 20-30 years. The synergies with energy efficiency and especially with building renovations are important to harness, as well insulated buildings are a pre-condition to replace old heating systems in buildings with efficient renewable heating or make connection with low-temperature modern district heating networks possible. As almost 75% of the existing buildings in the EU inefficient, they become a key barriers for deploying renewables to cover building's heating needs. Addressing this barrier, requires a framework amenable to increase the annual heating system replacement rate to at least 4% per annum as indicated in the Climate Target Plan as an integral part of building renovation. The EU Renovation Wave therefore sets heating and cooling decarbonisation as one of its key areas for

[22] EU 27 RES share in heating and cooling was at 16.79 % in 2009.

[23] Assessment of the heating and cooling related chapters of the National Energy and Climate Plans (NECPs), Toleikyte, A., Carlsson, J., JRC Technical Report, 2020.

actions and calls for strengthened heating and cooling targets and minimum levels of renewables to be part of the REDII review. The accelerated deployment of renewable heating and district heating via strengthened measures to facilitate heat planning and planned replacement schemes, ensure risk mitigation and capacity building for consumers and public authorities is critical to scale up projects and investment and ensure level playing field for an orderly and cost-effective decarbonisation of heating.

Effective market and regulatory frameworks to guide the transition to the 2030 critical milestones and towards carbon-neutrality in 2050 are missing in all but a few Member States. With the possible extension of carbon pricing instruments, non-market barriers such as lack of sufficient capacity for heat and project planning, lack of information and coordination, lack of skills to enable the switching to renewables that still exist would need to be overcome for carbon price signals to fully exercise their impacts while allowing for a fair, effective and cost-efficient achievement of the climate goals, consistent with the energy and climate policy architecture as a whole. In this regard, multi-level coordination across the many actors (local, national and EU) is needed and the key building blocks for success (clear targets and horizontal measures supporting their delivery) are developed but not sufficiently understood, diffused and applied across the EU. The lack of clear and effective EU framework jeopardises progress due to the large size of the sector and the high correlation it has with the overall RES shares.

2.2.1.3. Insufficient ambition for renewables deployment in transport sector

Transport is the only energy sector that has seen an increase in GHG emissions in the past decades, increasing mobility needs as well has a high reliance on fossil fuels[24] being the main drivers. This is happening despite the technological developments in the sector, where transport means (cars, planes) are much more energy efficient than some years ago. Furthermore, transport is the end-use sector where renewable energy is being developed at the slowest pace, with an EU 8.9% share of renewables in 2019.

REDII replaced the 10% target set in REDI for 2020 by an obligation on fuel suppliers, which must be designed in a way that allows the Member States to achieve their target of 14% renewables and a sub-target of 3.5% advanced biofuels by 2030[25]. The achievement of the target is facilitated by several multipliers on energy content both for transport sectors and for specific fuels[26]. In addition to technical standards of fuels traded on the EU market, the FQD sets out a 6% target for the reduction of the greenhouse gas intensity of transport fuels by 2020, but does not set out a dedicated target for the promotion of innovative fuels. Following the recast of the RED, the sustainability framework in the FQD is now outdated. For these reasons it is relevant to assess whether elements of the FQD are still appropriate to avoid them acting as a barrier to the achievement of the revised ambition level of the RED.

There are two main technology options to reduce this dependency on fossil fuels and decrease the sector's GHG emissions: Firstly, penetration of transport electrification and its deep, smart

[24] The transport sector depends to 94 % on fossil fuels
[25] Including multipliers
[26] While renewable fuels consumed in the aviation and maritime sector are counted towards the numerator of the formula (with a weighting of 1.2) that is applied to determine the share of renewable energy in transport, the consumption of kerosene and heavy fuel oil is not considered in the denominator, which reduces the ambition level of the target.

integration with the energy system for enhanced system flexibility and increased use of renewable electricity; secondly, in sectors that are more difficult to electrify such as aviation and maritime, increased use of renewable and low carbon fuels.

As to electricity in transport, in addition to missing price signals, barriers for electrification and its integration in the energy system are mainly the narrow range of electric vehicle models across all budgets, and insufficient recharging infrastructure, especially with intelligent or bidirectional functionality. The conditions for innovative mobility services such as aggregators are not yet in place, including access to data of vehicles, electricity grid and charging. Different charging infrastructure types and payment models also complicate the access for consumers to the infrastructure. Neither consumers, charge point operators, aggregators nor mobility service providers have access to information on the RES share or carbon intensity of the system in an interoperable manner. Further, REDII, apart from counting the contribution of renewable electricity towards the renewable energy target in transport, does not set out any mechanism ensuring that operators of recharging infrastructure are rewarded for supplying renewable electricity to electric vehicles under the obligation on fuel suppliers. This fails incentivising investments into recharging infrastructure and limits the contribution of renewable electricity contribution to the target.

The main market barrier for the use of renewable and low carbon fuels are the higher costs of such fuels compared to fossil fuels. Higher costs and low technological and commercial maturity limit the supply potential of innovative renewable fuels such as advanced biofuels and renewable fuels of non-biological origin (RNFBOs), mainly renewable hydrogen and renewable hydrogen-based synthetic fuels, which have decarbonisation potential despite their intrinsic energy inefficiency. REDII already limits the amount of biofuels produced from food and feed crops that can be counted towards the renewables targets due to their impact on indirect land use change and limited decarbonisation contribution.

The 2030 CTP Impact Assessment[27] shows that with existing policies the transport sector would fall short in delivering the contribution needed to achieve the economy-wide target of at least 55% GHG emissions reduction by 2030 and climate neutrality by 2050. The results also show that after 2030 a further significant scale up of the production of renewable and low carbon fuels is required on the pathway to achieve climate neutrality. With respect to the level of ambition, the CTP indicates that for 2030 the share of RES in transport should reach 27-29%[28] including a substantial contribution of advanced biofuels, which is significantly higher than the current 14% target set in REDII for transport. That assessment further demonstrated the importance of RNFBOs for the achievement climate neutrality in order to provide a decarbonisation pathway for hard to abate sectors. While REDII covers these fuels and sets out a framework ensuring that they achieve emission savings, it does not include specific incentives for their use. Given their early stage of technological development and high costs, a lack of dedicated incentives may slow down their commercial deployment, which would endanger the rapid uptake of renewable and low carbon fuels that is required after 2030. A possible extension of carbon pricing instruments alone would not be sufficient to drive the development of such fuels, and would create the risk to sustain less sustainable low

---

[27] Impact Assessment accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Stepping up Europe's 2030 climate ambition -Investing in a climate-neutral future for the benefit of our people', SWD(2020) 176 final.
[28] Including multipliers as per current methodology

carbon and biofuels. Other instruments that are relevant for the promotion of low carbon technologies such as the ETS are more suitable to promoting the switch to mature low carbon technologies but cannot provide by themselves the strong investment signal needed to develop new innovative technologies. Such investment signals could also keep increasing costs for consumers by carbon taxes and ETS in check.

2.2.2. Insufficient promotion of ESI in REDII[29]

The current model, where energy supply and consumption for supply for electricity, heating and cooling, transport, industry, gas and buildings takes place in 'silos', each with separate value chains, rules, infrastructure, planning and operations - cannot deliver the increased climate targets in 2030 and climate neutrality by 2050 in a cost-efficient way. The lack of integration of the energy system results in greater costs, inefficiencies, lost opportunities and a disproportionate burden on the power sector, which cannot alone deliver the overall decarbonisation effort required at EU level. In the end, it would lead to higher costs to households and businesses.

Several barriers, not appropriately addressed in REDII, still prevent the emergence of a truly integrated energy system, in particular (i) the slow rate of electrification of certain end-use sectors, (ii) the slow uptake of renewable sources in heating and low penetration of renewable and low-carbon fuels, such as biofuels, biogas, hydrogen and synthetic fuels, in particular in certain transport applications and in industry, as well as (iii) a still limited contribution to new distributed loads (electric vehicles, heat pumps) to the system integration of variable renewable electricity.

Smart and renewable use of power is crucial for heating and cooling systems, as well as electric vehicles, to live up to the European Green Deal objectives aiming to a reduction of 90% of the transport sector's GHG emissions by 2050. The fast uptake of electric vehicles (EVs) is expected to follow exponential tendencies, with an estimate of more than 30 million electric cars by 2030[30]. The potential of EVs to absorb further renewable electricity and decrease system GHG emissions has to be well appreciated and fully utilised through appropriate measures, as stipulated in the Energy System Integration Strategy.

REDII provides only limited incentives for the electrification of end-use sectors. There are no specific provisions encouraging the electrification of heating and cooling, apart from the general, indicative heating and cooling target and the equally indicative and optional district heating and cooling target (the denominator of which can be reduced through electrification). The transport obligation is also rather designed to incentivise the uptake of specific fuels, in particular advanced biofuels, with electricity only incentivised through the use of a "multiplier".

REDII does not yet include specific provisions aimed at ensuring that distributed assets such as home batteries and electric vehicles contribute to the system integration of variable renewable electricity. The Clean Energy package has brought about a significant redesign of electricity markets to ensure

[29] The increase of RES in the EU has greatly contributed to increased security of supply by replacing imported fossil fuels from third countries. This process will continue including with the electrification of transport. However, it will present its own challenges in terms of resilience of critical infrastructure, hybrid threats and cybersecurity, and the resilience of RES supply chains. This aspect has not been addressed in detail in this Impact Assessment. DG ENER has launched a study on "Resilience of the critical supply chains for energy security and clean energy transition during and after the COVID-19 crisis" which is ongoing

[30] COM (2020) 789 Sustainable and Smart Mobility Strategy – putting European transport on track for the future

that all forms of flexibility are in principle able to participate in electricity markets, however regulatory gaps still exist on the specific conditions necessary to ensure a level playing field in the participation of such small or mobile distributed assets in practice, both individually as well as through aggregation. The AFID and EPBD also regulate the deployment of EV charging points, however through fragmented scopes of application. Provisions are missing to ensure coverage at all types of locations (publicly accessible, private for own use, and private with broad access), as well as to ensure that the deployed charging points are indeed fit for system integration purposes by offering smart charging or even vehicle-to-grid functionalities. Specific measures are also necessary to ensure that integration can be supported by a competitive and innovative services market through a level playing and enhanced consumer choice.

Regarding certification systems, REDII does enable the tracing of renewable transport fuels and some low carbon transport fuels. However, this system does not allow a sufficiently clear distinction between renewable and low-carbon fuels (including hydrogen) on the one hand and more polluting energy sources on the other hand, and does not allow tracing in the transport/transmission system from production facilities to consumption centres. Moreover, the two parallel systems for tracking the consumption of renewable energy under REDII ('book & claim' system based on guarantees of origin and a certification system based on mass balance) do not sufficiently promote further the integration of the energy system.

2.2.3. Insufficient sustainability criteria safeguards for bioenergy

Today bioenergy represents the largest single source of renewable energy in the EU, making up about 60% of final renewable energy consumption, of which 60% comes from forestry[31].

In order to further inform the review of REDII, the Biodiversity Strategy has mandated the JRC to conduct a study on the use of woody biomass for energy and its potential climate and environmental impacts[32]. While bioenergy production can have positive climate and biodiversity impacts[33], JRC has identified a number of potential bioenergy pathways that should be avoided for biodiversity and climate protection. For example, an excessive removal of harvest residues, or the removal of stumps, for bioenergy use can harm soil productivity, biodiversity, and water flows. In addition, the conversion of primary and highly biodiverse forests to plantations, aiming to provide wood for material and energy use, can be extremely negative for local biodiversity and climate mitigation in the short-medium term and lead to irreversible damage.

The JRC study has found that a robust and effective implementation of the REDII sustainability criteria for forest biomass could effectively minimise/avoid several of the identified risks. However, the study has concluded that additional safeguards are needed to address the existing policy gaps in the context of future biomass demand increases. More specifically, JRC has recommended the following two key measures: a) applying the existing no-go areas for agricultural biomass also to

---

[31] Navigant 2020, 'Technical assistance in realisation of the 5th report on progress of EI renewable energy'.

[32] The use of woody biomass for energy production in the EU, EUR 30548 EN, Publications Office of the European Union, Luxembourg, 2020

[33] Impact assessment to the Climate Target Plan (SWD/2020/176 final)

forest biomass, in order to avoid the risk of biomass sourcing from primary and highly biodiverse forests: b) applying the EU sustainability criteria to smaller installations (below the current threshold of 20 MW) in order to regulate a larger share of biomass use, thus avoiding possible ‘environmental leakage’ risks.

According to JRC data, the majority of woody biomass for energy use comes from timber residues and waste produced either from the forest-based industries and post-consumer wood (49%), or from timber logging (17%). At the same time, 20% of total woody biomass supply comes from stemwood, of which at least half is from coppice forests. About 4% of total woody biomass use for energy comes from industrial quality stemwood. This finding highlights the need for Member States to further promote the cascading use of woody biomass when designing their support schemes for bioenergy. In this respect, the Biodiversity Strategy has also called for the use of whole tree harvesting for energy production – whether produced in the EU or imported – to be minimised[34].

Inefficient biomass combustion is also a source of air pollution[35]. According to the World Health Organisation, residential heating with solid fuels (coal or wood) is an important source of particulate matters and carcinogenic compounds, especially in Central Europe. In particular, biomass combustion in old and inefficient households and other small installations could compromise local and regional air quality objectives. While REDII does not include specific air quality criteria for biomass combustion, it should be noted that air pollution of fuels is effectively addressed through EU environmental legislation including a number of different measures[36]. Under the energy legislation, the Eco-design Directive has been identified as the most appropriate tool to set stricter emission requirements for new solid fuel boilers and space heaters, which are applicable since 1 January 2020.

2.3. How will the problem evolve?

REDII is the main Union instrument for the promotion of renewable energy[37]. To meet the share of 38% to 40% renewable energy in 2030 set out in the CTP, an increase in renewable energy is needed as a consequence of the proposal by the Commission endorsed by the European council and confirmed by co-legislators in the Climate Law, to step up the ambition of the climate target 2030 to at least -55%. According to the 2020 Renewable Energy Progress Report[38], based on the existing framework of REDII and analysis of the NECPs submitted by the Member States, projects that the EU’s renewable energy share will reach between 33.1% and 33.7% in 2030. **Leaving the ambition**

[34] The term “whole-tree harvesting” is used to indicate the practice of cutting the entire above ground portion of a tree and removing it from the forest, including the main trunk tops and limbs, branches and needles, and sometimes even stumps and roots.

[35] According to an analysis by the European Environment Agency, the increase of use of renewable energy led to a decrease of SO2 and NOx emissions by 6% and 1% respectively in 2017 compared to a 2005 baseline. In contrast, it led to an increase of PM2.5 and NMVOC emissions of 13% and 4% respectively, which is estimated to have occurred in all Member States except one, where the use of biomass has decreased. The EEA explains this relative increase by growing bioenergy use over the period in the EU. Since, in most cases, biomass is used for domestic heating, the EEA concludes that this is likely to have led to increases in PM2.5 concentrations.

[36] Directive 2004/107/EC aimed at reducing concentrations of pollutants in ambient air, Directive 2008/50/EC on ambient air quality, Directive 2001/80/EC on Large Combustion Plants and Directive (EU) 2016/2284 on National Emission Ceilings.

[37] CPRICE scenario achieved GHG55 but at very high carbon price imposed on end consumers. This scenario was largely dismissed.

level of the Renewable energy directive unchanged would put additional burden for increased decarbonisation on other instruments such as the Energy Efficiency Directive as well as other instruments such as the Emissions Trading System, and the LULUCF and Effort Sharing Regulations. This could increase economic costs and distributional impacts especially in sectors included in the ETS. It would also fail to incentivise the market to invest more in renewables and innovate sufficiently.

In **heating and cooling**, the low ambition shown by many of the Member States in their NECPs in relation to the indicative renewable heating and cooling target and the indicative renewable district heating and cooling target set in REDII would continue. The current target ambition, coupled with no additional measures to tackle long-entrenched barriers across the whole heating and cooling sector means there would be slow progress, technology lock-in and lack of engagement from citizens, consumers and investors to contribute to the decarbonisation of this sector.

In **transport**, it is clear that several Member States have high ambition for greening road transport, in particular by looking into policies strongly discouraging the use of cars and vans with internal combustion engine. Direct electrification with renewable electricity, in conjunction with deep integration of electric vehicles in the electricity system, are considered to be the main options to reduce GHG emissions of cars and light duty vehicles. However, there are other transport modes, such as aviation and maritime but also long-haul transport, which cannot today be easily electrified and where renewable and low-carbon fuels including renewable hydrogen will be needed to replace fossil fuels, complementing energy efficiency improvements, modal shift and electrification efforts. Such innovative fuels will not be sufficiently promoted by other means such as ETS.

Renewables are developing strongly in the **power generation** sector through lower technology costs and stable ETS prices, but this is not enough to decarbonise the electricity sector at the pace required to cut emissions in the EU by 55% by 2030. New market avenues to develop additional renewable power generation, e.g. through merchant projects or corporate PPAs, are emerging, but still at a limited scale and in only a few Member States. The use of measures for cross-border cooperation has been limited in the past. With a view to 2030, very few Member States included concrete plans in their NECPs to implemented cross-border cooperation projects in the future, and this leads to lost opportunities. With regard to offshore renewable energy, the sector has shown great progress over the past years. However, to complement the provisions on grid related planning and cooperation addressed in the proposal for the revised TEN-E Guidelines, more ambition and increased efforts on deployment plans, joint projects and regional cooperation on renewable offshore generation are essential in order to tap the huge potential offered by offshore energy needed by 2030 and beyond and to do so in a cost-effective way.

As there are no specific requirements on **industry** to increase the level of renewable energy use under REDII, it is to be expected that the uptake of renewable energy will continue to stagnate as it has done over the **past decade,** and GHG emissions from industry will not decrease.

Regarding **buildings**, on average, the percentage use of renewables in buildings is 23.5%. Without new measures to increase the use of renewable energy in buildings generally and to encourage the move away from oil and coal- boilers, emissions from the buildings sector will be very slow to decrease.

In terms of **energy system integration**, the further penetration of electricity and other decarbonised energy carriers such as renewable and low carbon fuels is expected to be moderate and uneven. Without further action to improve integration of the energy system, the burden of decarbonisation would continue to fall predominately on the power sector, and the substantial potential for decarbonisation and increased renewable energy use in end-use sectors, such as buildings, heating and cooling, transport and industry, would be partly foregone. Regarding the system integration of variable renewable electricity, the Clean Energy Package has introduced a number of provisions ensuring that electricity markets are fit for renewables. However, such provisions could be complemented by more sector-specific measures aimed at reaping the full benefit of distributed assets, such as heat pumps or electric vehicles and stationary batteries, for the integration of variable renewables.

In hard-to-decarbonise sectors such as maritime, aviation and industry, the current framework will **offer limited incentives to promote innovative fuels** such as RFNBOs and low-carbon fuels by 2030. While REDII sets a target of 3.5% for advanced biofuels in transport, high upfront capital investment needs and higher costs for RFNBOs and low carbon fuels will not allow them to penetrate these sectors before 2030 and thus provide the basis for a more significant uptake after 2030. Renewable and low-carbon fuels (including hydrogen) can be promoted most effectively if they can be easily distinguished from more polluting energy sources. Without a certification system and the provision of information to the market and policy makers about the environmental and energy efficiency performance of energy carriers, the promotion of promising energy solutions would be jeopardised.

REDII extended the **EU bioenergy sustainability framework** to cover also large-scale use of biomass and biogas in heat and power and it included new risk-based criteria for forest biomass and for agriculture biomass. It also includes minimum GHG saving criteria for biofuels for transport and biomass/biogas in heat and power and minimum efficiency criteria for biomass based electricity production. In addition, it requires Member States to design their support schemes with due regard to the waste hierarchy to avoid undue distortions of the raw material market, and not to support waste to energy in case they have not met the separate sorting obligations under the Waste Framework Directive. However, these criteria will be effective only from the transposition deadline in June 2021 and there is no information on their effectiveness.

The use of bioenergy is projected to increase moderately between 2020 and 2030 (in some scenarios biomass consumption is even projected to decrease, mitigating possible conflicts with biodiversity objectives). Post-2030 sustainable bioenergy is set to gain increasing importance, particulary in the electricity, transport and industry sectors, with the view to contribute to carbon neutrality goal by 2050[39]. While the EU sustainability criteria have been reinforced under REDII, they do not fully address the risks of sourcing forest biomass from primary and highly biodiverse forests (unless they are protected by national or international competent authorities). In addition, the exemption of installations equal or above 20MW still leaves a large share of biomass unregulated (25% of commercial woody biomass plus households use for space heating). Furthermore, thanks to the Renovation Wave, the replacement rate of inefficient biomass boilers is projected to increase, with related reduced emissions. Finally, Member States provide important financial support to bioenergy production. In 2018 the total EU27 biomass support amounted to 10.3 billion EUR, and biogas received 3 billion EUR, and when subsidies could not directly assigned to any of the two (biomass-biogas), the support amounted to 1.5 billion EUR. Without a reinforced application of the cascading principle, this national financial flows could lead to undue distortions of the raw material market, and even divert high quality wood to energy market, with associated negative impacts on resource efficiency, biodiversity and carbon sinks. The projected reduction of biomass use by households for local space heating, due to more efficient housing and higher electrification, will result in a reduction of related air emissions.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The proposal is based on Article 194(2) of the Treaty on the Functioning of the European Union (TFEU), which provides the legal basis for proposing measures to develop new and renewable forms of energy, one of the goals of the Union's energy policy, set out in Article 194(1) (c) TFEU. REDII, which will be amended by this proposal, was also adopted under Article 194(2) TFEU in 2018.

It is an initiative in an area of energy, which is a shared competence between the EU and the Member States.

3.2. Subsidiarity: Necessity of EU action

A cost-efficient accelerated development of sustainable renewable energy within a more integrated energy system cannot be sufficiently achieved by Member States alone. An EU approach is needed to provide the right incentives to Member States with different levels of ambition to accelerate, in a coordinated way, the energy transition from the traditional fossil fuel based energy system towards a more integrated and more energy-efficient energy system, based on renewables-based generation.

The CTP establishes that renewables have a key role to play to decarbonise the Union's economy and must be substantially increased to respond to the Union's new climate ambition. Taking into account the different energy policies and priorities among Member States, action at EU level is more likely to achieve the required increased deployment of renewables than national or local action alone. This collective effort is also more likely to succeed in reaching Union climate targets, as can be seen by the 2020 renewable energy target, with some Member States likely to deliver below their national contribution but others above, so that in total the contributions exceed the Union target.

The EU common framework and targets leave discretion for Member States to set concrete policies and actions that contribute to the national contributions and EU targets while respecting their right to decide their energy mix.

3.3. Subsidiarity: Added value of EU action

EU action on renewable energy brings added value because it is more efficient and effective than individual Member States' actions, avoiding a fragmented approach by addressing the transition of the European energy system in a coordinated way, ensuring net reduction of greenhouse gas emissions and pollution, protecting biodiversity, harnessing the benefits of the internal market, fully exploiting the advantages of economies of scale and technological cooperation in Europe, and giving investors certainty in an EU-wide regulatory framework.

In its Conclusions of 10 and 11 December 2020, the European Council endorsed a binding EU target of a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. The analysis in the CTP indicated that the least cost pathway to achieve greenhouse gas reduction targets in 2030 is for the renewable energy share to increase. A revised EU-wide energy and climate framework for renewable energy in 2030 will also help to steer Member States energy policies to achieve a sustainable, secure and integrated energy system for European citizens. The increase of renewable energy across the EU benefits from coordination at the EU level given the EU's single market. An increase in the 2030 target for the EU's Renewable energy share will impact all sectors and has a much greater chance of leading to the necessary transformation, acting as a strong driver for a cost-efficient change and resilient to external shocks.

This impact assessment looks at how to increase the share of renewable energy in different sectors by 2030 to contribute effectively to the goal of GHG emissions. The analysis of the Member States' NECPs is fully taken into account. Where targets are considered, this is because having ambitious Union targets will also drive ambitious contributions from the Member States. Collective achievement of the Union target will be facilitated by the measures set out in this assessment, which will give Member States the tools and the flexibility necessary to increase the share of renewable energy in their overall consumption. By acting at EU-level in combination with action at Member State level, several barriers to public and private investments can be tackled and this will effectively supplement and reinforce national and local action. Addressing the lack of coordination between various bodies at national level as well as improving administrative and technical capacity will incentivise cost-optimal deployment of renewables at city and community level, where issues such as heating, cooling and hot water use remain key and are not decarbonising rapidly enough with more details under the assessment of the measures (Section 6.2.1.3).

The role of Member States is crucial to achieve the increased overall EU GHG ambition and putting in place measures at Union level aims to focus action at nation level where it can be most effective, taking into account the very varied situations on in Member States. This is fully in line with Article 194(2) of the Treaty on the Functioning of the European Union, which states that the Union policy on energy shall aim, in a spirit of solidarity between Member States, to promote the development of new and renewable forms of energy. Simply setting targets at EU levels and leaving Member States complete freedom as to how to achieve them would however not be an effective way to achieve the agreed targets, as has been recognised by the co-legislators when they agreed the specific measures in the current REDII and the reporting and governance structure set out in Regulation 2018/1999. It also risks causing distortions to the internal market, and would lead to a less effective preservation and improvement of the environment, one of the specific aims of Article 194 TFEU.

Important national prerogatives such as the Member State's right to determine the conditions for exploiting their energy resources, their choice between different energy technologies and the general structure of their energy supply, remain fully untouched. The balance between obligations and the flexibility left to the Member States on how to achieve the objectives is considered appropriate given the imperative of achieving, ultimately, climate neutrality.

In terms of consistency with the Charter for fundamental rights, the overarching aim of this review is to increase the use of renewable energy and reduce GHG emissions, and this is entirely in line with Article 37 of the Charter under which a high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives

The general objective of this initiative is to ensure that the revised REDII is fit to contribute to the achievement of at least 55% of GHG emissions reduction in 2030 and to do so in a cost-effective and sustainable way. This needs to be done in complementarity with the other initiatives of the "Fit for 55" package and consistently with other EGD objectives and initiatives.

4.2. Specific objectives

The initiative will contribute to the achievement of the general objective by pursuing the following specific three objectives:

- **To increase sufficiently the renewables share in final energy consumption**. This will ensure that the overall and sectoral deployment of renewable energy in 2030 is in line with the CTP findings, thus contributing cost-effectively to the increased 2030 climate target of at least 55% as well as climate neutrality objective in 2050 (which requires the large scale rollout of innovative technologies including RFNBOs and advanced biofuels after 2030).

  For this objective, regulatory and non-regulatory options will be explored on the following topics: overall target, heating and cooling, including buildings, transport, accompanied by flanking and enabling measures in electricity and industry.

- **To increase energy system integration by promoting electrification based on renewable electricity, to create a level playing field for all innovative renewable and low carbon fuels and to specifically promote innovative renewable fuels** (such as hydrogen and its derivatives produced from renewable electricity). This will ensure that the increase in the RES share in final energy consumption is cost-effective by promoting ESI in line with the CTP and the ESI strategy and that innovative fuels are promoted strongly considering that they are indispensable for carbon neutrality.

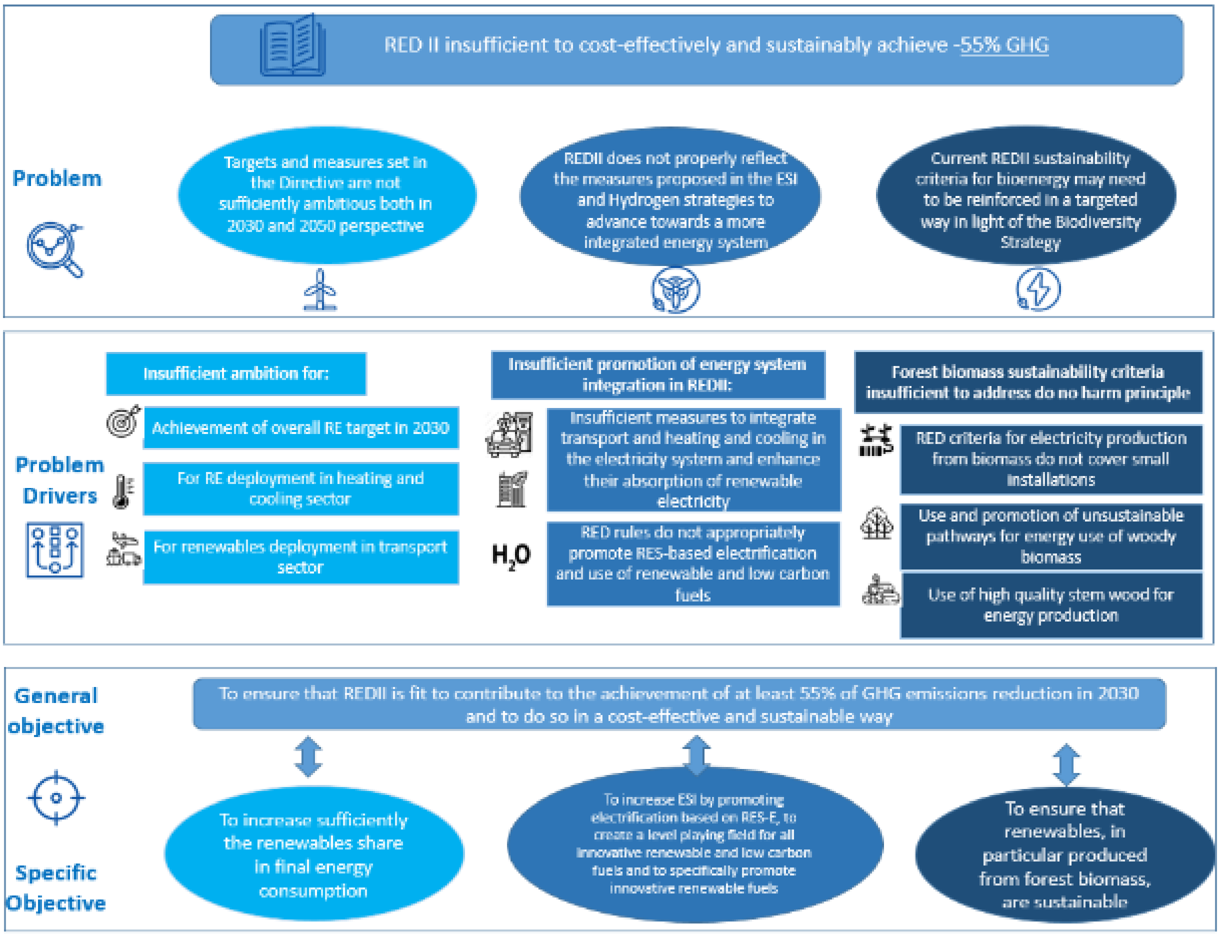
  For this objective, regulatory and non-regulatory options will be explored on the following topics: promotion of renewables-based electrification, measures to improve the system integration of renewables, and definition, certification of all innovative renewable and low carbon fuels and promotion of innovative renewable fuels.

- **To ensure that renewables, in particular produced from forest biomass, are sustainable.** This will ensure that forest biomass consumed in the EU is produced sustainably, including by minimising the risk of significant negative environmental and climate impacts, in line with the ambition set in the EGD and the BDS.

4.3. Intervention logic

The figure below visualizes the intervention logic, linking the problem, problem drivers, specific objectives and general objectives. The policy options described in section 5 are defined to address these objectives.

Figure 2: Intervention logic



5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1. Baseline

The baseline for this initiative is the recast of REDII as described in Section 1.1

The EU Reference Scenario 2020 (REF) and its Member States specific results reflect implementation of REDII recast. REF is the baseline **in the impact assessments for all the initiatives of the "Fit for 55" Package**[40], including in this one. Complete information about

[40] Regardless of timing of specific initiatives – please see also Annex 4 explaining how "Fit for 55" initiatives are captured in the core scenarios.

preparation process, assumptions and results are included in the Reference scenario publication[41]. The most relevant information for this assessment is also presented in Annex 4.

REF reflects the agreed 2030 EU climate and energy targets: at least 40% GHG reduction, at least 32% renewables share and at least 32.5% energy efficiency (energy efficiency target is, however, not achieved – see below). REF also reflects main policy tools at EU level to implement these targets and, to the extent possible, the complete range of foreseen of bottom up national policies and measures of the final NECPs that Member States submitted in 2019/2020 according to the Governance Regulation[42]. The REF also takes into account the energy system impacts of the COVID-19 crisis that already heavily impacted the EU and Member States' economies in 2020/2021[43].

For 2030, REF projects for the EU a 33.2% share of renewable energy in gross final energy consumption[44]. It also projects that final energy consumption is 883 Mtoe, which is 29.6% below the 2007 Baseline and thus an ambition gap to the agreed 2030 energy efficiency target of at least 32.5%. For the ESR, an overall reduction of emissions of 30.7% by 2030 as compared to 2005 is projected. These projections are in line[45] with the Commission's assessment of final NECPs[46].

Taking into account the national contributions and policies put forward in the final NECPs, the REF scenario achieves 33.2% renewable energy share in 2030, and thus overachieves the current EU 32% renewable energy target. All sectoral shares show growth in renewable energy deployment compared to historical levels, which reflects the ambitious policies of the Member States. Those policies and the resulting renewables deployment are, however, not sufficient for achieving the level of ambition commensurate with the increased climate target (38-40% according to CTP). Naturally, also all sectoral shares are below the levels projected in the CTP scenarios - as illustrated in the table below.

Table 1 - Overview projected sector shares; Source ESTAT, PRIMES

		Total RES share	RES-E	RES-H&C	RES-T
2005		10%	16%	12%	2%
2015		18%	30%	20%	7%
2030	REF	33%	59%	33%	21%
2030	CTP : ranges for 55% GHG scenarios	38-40%	64-67%	39-42%	22-26%

[41] REF reference COM/2021/X

[42] Regulation (EU) 2018/1999

[43] The REF incorporates in much more detail (than the CTP Baseline) Member States' policies and objectives as put forward in their NECPs and makes assumptions on the impact of the COVID crisis linked to most recent macro-economic forecasts. Concerning renewables deployment, the most salient feature is the increased Member States' ambition in terms of renewables deployment in transport. Increased consumption in the buildings sector in 2020 (due to COVID-19) should also to be noticed as it has an impact on RES H&C shares (i.e. lowering them).

[44] The gross final energy consumption is the energy used by end-consumers (final energy consumption) plus grid losses and self-consumption of power plants. This indicator is calculated on the basis of Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

[45] Primary energy consumption reduction projections in REF (32.7%) are, however, close to the agreed target for 2030. This is not in line with the Commission's assessment that indicates that the gap in final energy consumption is mirrored by the gap in primary energy consumption. The REF projections, however, capture the latest evolutions in the power generation, notably coal phase-out (not fully reflected in the NECPs) and the latest technology outlook for renewables in power generation (notably smaller role of biomass).

[46] COM/2020/564 final

2030	RED IA: core scenarios ranges for 55% GHG scenarios	38-40%	65-66%	36-41%	27-29%

While not all trends can be captured in energy system modelling, the REF shows the impacts of several trends described in section 2.3 above.

According to REF, GHG emissions from the European Union in 2030 (incl. intra EU aviation and maritime and incl. LULUCF) would be 45% below the 1990 level. An EU allowance price of 30 EUR/tCO_2eq. in 2030[47], national policies and lowering costs of renewable technologies would drive the emissions reduction in the ETS sector.

REF models the impacts of targets and policies already adopted, but not the target of net-zero emissions by 2050. As a result, there are no additional policies driving decarbonisation after 2030. However, climate and energy policies will likely not be rolled back after 2030 and several of the measures in place today will continue to deliver emissions reduction in the long term. By 2050, some 60% GHG reductions (with regards to 1990) are projected to be achieved.

5.2. Scope of this initiative and alignment with the Climate Target Plan

All “Fit for 55” initiatives, including this one build on the CTP and its underpinning impact assessment, but they also expands CTP analysis looking more in detail of actions in different sectors and creation of necessary enabling conditions. The CTP showed, on the basis of scenarios, that achievement of increased climate target of at least 55% net GHG emissions reduction in 2030 is feasible and enables a smoother trajectory to climate neutrality in 2050 but it requires that all sectors contribute to the increased effort.

With the energy sector contributing currently to just over 75% of GHG emissions, the clean energy transition in the current decade plays a central role. This transition has to accelerate significantly compared to scenarios leading to the previously agreed climate target (of at least 40% GHG reduction in 2030). They key finding from CTP modelling was that achieving in the cost-efficient manner the 55% GHG target in 2030 would mean a **share of renewables in final energy consumption of 38%-40% in 2030**. A significant additional uptake of energy efficiency will also be necessary. CTP assessment indicated that achieving 55% GHG reductions in 2030 requires savings of 36-37% of the final energy and savings of 39-40% of the primary energy. Likewise, the CTP established the desired reductions in the GHG emissions in the current ETS and ESR sectors.more details are included in Annex 5.

Consequently, the scope of this initiative is to deliver, together with other “Fit for 55” proposals, the necessary and cost-effective deployment of renewables (via increasing the targets and addressing the market failures/non-market barriers) to contribute achievement of increased climate target.

The updated core scenarios confirmed that the range for renewables deployment in order to reach 55% GHG target cost-effectively is 38-40%. Several other “Fit for 55” proposals affect the scope of this initiative, notably extension of carbon pricing. This fundamental interaction is portrayed by core scenario set-up discussion on the core scenario results interpretation in section 5.5. Other interactions and key findings of the CTP and how these findings were fine-tuned based on the “Fit for 55” IA work are discussed in Annex 4.

[47] In June 2021, the ETS price is around 50 EUR/tCO2eq.

The updated core scenarios have an important role in this assessment as the **policy options on the level of targets (overall, sectoral) are aligned with core scenario findings** (while considering also options proposed by stakeholders). In addition, a number of policy options concerns how these options can be delivered - i.e. the ways to establish targets or enabling conditions for their achievement.

Policy options such as the ones revolving around advanced biofuels and RFNBOs are based on a dedicated variant (MIX-H2) coherent with other "Fit for 55" policy options, still lead to 55% GHG target but are in line with the goals of the Hydrogen Strategy in order to provide a stronger push to mainstream such fuels (see section 5.3).

5.3.Description of the policy options

Based on existing studies, on the inputs from stakeholders and on internal analysis, a range of policy options and measures for each policy area were screened to respond to the problems identified in the problem definition.

A set of policy options and measures under each policy area including non-legislative and legislative alternatives are considered below in order to address the drivers of the problems identified above. The concrete figures supporting the policy options are assessed in detail in Chapter 6. A 'snapshot' of stakeholders' views is included for each set of options[48], with further details in the text and a comprehensive overview in Annex 2.

How policy options are structured

Policy options are structured into four main areas. The three first areas are directly linked with the specific objectives of the initiative and thus are deemed crucial to achieve those. The fourth area contains flanking and enabling measures that are supportive of those objectives.

Core policy options

1. Options linked to the **insufficient ambition of existing legislation to reach climate neutrality**. This includes options about the overall target, heating and cooling, including buildings, and transport.
2. Options linked to the need to **increase energy system integration.** This includes options to promote electrification and the certification and promotion of innovative fuels.
3. Options linked to ensure the **bioenergy sustainability**.

Flanking and enabling measures

4. In addition, to the specific objectives of the revision of this Directive, a limited number of additional **flanking or enabling measures** could contribute to the cost-efficient deployment of renewables. This includes measures to foster regional cooperation, offshore renewables deployment and the uptake of renewable energy in industry that would complement also carbon price instruments while further reducing technology costs.

[48] Where results of the Open Public Consultation are given as percentages, this refers to the replies given to individual questions and not to percentage of the total number of replies.

5.3.1. Area I: Insufficient ambition in EU and MS legislation both in 2030 and 2050 perspective

5.3.1.1. Options to increase and ensure the achievement of the overall renewable energy target in 2030

As shown in the REF scenario both the current EU renewable energy target (at least 32% by 2030) and the aggregated ambition of the Member States (between 33.1% and 33.7% by 2030[49]) are not ambitious enough compared to the level of renewable energy shares needed to reach the -55% reduction of GHG emissions included in the CTP[50] [51] and agreed by EU leaders. This is problematic as without sufficiently high ambition levels, it is less likely that the share of renewable energy will increase at the rate required for reaching the GHG reduction target in a cost-effective manner.

Options considered are:

Level of the target

- Option 0: No change to the target i.e. keep at least 32 % (baseline scenario).
- Option 1: A minimum target in the range of 38-40%
- Option 2: A higher target than 40%

Nature of the target

- Option 0: No change to the nature of the target and EU target which is fulfilled by national contributions, i.e. EU binding target and national voluntary contributions
- Option 1: National binding targets in addition to the EU binding target

Stakeholders' opinions

In the OPC, a majority of respondents favoured a target of at least 38-40% (43% of respondents) or higher (37% of respondents). All respondents expressed a very strong preference (71% or higher) for the target being binding at both EU and national level. 22% of respondents believe that the target should be binding only at EU level. All 11 Member States responding to the consultation[52] were in favour of at least increasing the target in line with the CTP (if not beyond 40%). Regarding the binding nature of the target, most MS opted for the target to be binding at least at EU level -if not at *both* EU and national levels, while only two MS responding to the OPC opted against the target being binding at either level.

[49] Based on the assessment of the National Energy and Climate Plans: COM (2020) 564 final.

[50] RES Shares need to reach 38-40% in 2030: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0562&from=EN.

[51] EU Leaders Council conclusions: https://www.consilium.europa.eu/en/meetings/european-council/2020/12/10-11/.

[52] Plus one Member State responding separately

5.3.1.2. Options to increase renewable energy in the heating and cooling sector (RES-H&C)

For the H&C sector to contribute effectively to the overall RES Share levels indicated the CTP , Member States' efforts in this sector should be increased[53]. Heating and cooling are local and diverse across Member States. leading to highly fragmented industry and stakeholder structure, which constitutes a barrier for sharing knowledge and have access to a common framework of measures and tools (regulatory, financial, etc.), which could facilitate actions at national and local levels. EU framework in this sector is recent and incipient leading to limited EU value added and capacity to harness synergies from shared knowledge and capacity building, common regulatory framework and investment risk mitigation instruments. Clearer overarching EU objectives and more comprehensive list of measures and instruments are needed to support and guide national efforts in Member States by public authorities, citizens and businesses and scale-up the capacity of the heating and cooling industry to supply technologies and solutions. An expanded and comprehensive list of measures would diffuse best practices and would provide a list of policy instruments to guide national efforts while aiming to address non-market barriers, complementary with carbon pricing instruments, while ensuring effectiveness, cost efficiency in a balanced manner.

The options aim to ensure that renewable energy supply (sources, technologies and infrastructures) is sufficiently available and deployed, including via district heating and cooling, and that buildings becomes fit for the integration of renewables to gradually replace fossil based heating and cooling systems in line with the CTP and the Renovation Wave. When it comes to Industry, the pace of RES uptake is clearly insufficient to contribute adequately to an increased 2030 climate target in line with the CTP. Furthermore, early investments are needed to adapt production processes, e.g. through electrification, to the availability of different renewable energy carriers. Introducing more specific provisions covering the use of renewables in industry could help accelerate the cost-efficient uptake of RES in industry.

To overcome non market barriers from the fragmented nature and the limited capacity to tap on common instruments of the heating and cooling sector, the proposed options revolve around two core issues:

(1) Measures to address non market barriers in the area of heating and cooling for further fuel switching to renewables, coherent with carbon price mechanisms and energy efficiency measures that would complement the current list of measures in Article 23(4) which also, for example, cover buildings.
(2) Assessing the level and nature of RES H&C targets, including renewable energy in buildings and industry,[54] that lead to the necessary deployment of renewables in the H&C sector, contributing to overall 2030 national RES contributions and thus fulfilment of overall RES target.

Options considered are:

[53] NECPs showed only a modest 0.9% point increase
[54] Article 23 of REDII includes an indicative average increase for the 2020-2030 period for all MS specifically for the whole H&C sector. There is no inclusion of an EU level RES H&C target or targets for buildings or industry

Option 0: No changes, maintain current indicative 1.1%-point average increase in renewables at Member State level under REDII and the list of measures (baseline)

- **Option 1**: **Non-regulatory measures - Guidance and Best Practice Exchange**

This option involves the use of non-regulatory measures alone to support the full implementation of REDII provisions. These activities would take the form of Guidance and Best Practice Exchange without using legally binding measures. These could help to address those weaknesses that were identified during the assessment of the NECPs and in discussions with Member States, mainly using the forum of the Concerted Action to prepare the implementation of RED II[55]. These could cover the following areas: RES heating and cooling share accounting; interpretation of relevant definitions and provisions (e.g. in relation to waste heat, ambient energy); guidance on possible measures, renewable cooling following the adoption of the delegated act on calculation methodology foreseen for 31 of December 2021 and also specific guidance on the current measures in Article 23(4)In terms of H&C shares, the existing indicative increase target in REDII would continue to apply unchanged.

- **Option 2: Regulatory Measures - Extend the current list of measures of Article 23(4) in REDII**

Clarify and complement the current list of measures to ensure the availability of a core set of generally applicable instruments at EU level, as common buildings blocks of common relevance, applicability and replicability for heating and cooling decarbonisation. The extended list of measures will provide the missing common EU framework to ensure level playing field and enhance regulatory certainty. The list of measures an extended list of measures to cover capacity building, risk mitigation, heat purchase agreements, planned replacement schemes, renewable heat planning and updated training and qualification requirements for installers that Member States can use to implement the overall heating and cooling RES target. (See Annex 7 for detail of measures);

This option aims to overcome non-market barriers and complement carbon price signals by ensuring better coordination and planning, increasing capacity for heat system replacement and project development, ensuring accurate and sufficient information for informed decision making, reducing risks of investment and ensuring engagement of local authorities and consumers. Lack of such measures would necessitate much higher carbon prices signals, would delay the translation of carbon pricing into concrete consumer investment decision and increase cost burden for consumers, in particular low-income households and vulnerable consumers.

- **Option 3: Level and nature of the targets**
    - **Option 3a)** make the current 1.1%-point average increase at Member State level as a minimum baseline complemented by an indicative Member State-specific top-up based on the EU's RES H&C share as carried out in dedicated modelling work for this impact assessment in agreement with CTP analysis.
    - **Option 3b)** make an annual average increase binding at Member State level translated based on the EU's RES H&C share as carried out in dedicated modelling work for

[55] Concerted Actions of the Renewable Energy Directive: CA-RES. The CA-RES usually holds two sessions per year.

this impact assessment in agreement with CTP analysis to reach the overall RES 38-40% shares..

- **Option 3c) a** binding EU target for RES heating and cooling only
- ~~o~~ **Option 3d)** (Indicative) EU RES benchmarks of 49% for the EU building stock (a general numerical level of minimum RES use in national building stocks as a percentage of the overall energy use) and for renewable energy consumption of 1.1% yearly average over the 2020-2030 period in industry to monitor progress and efforts.

This set of options involves possibilities to strengthen the current target. Option 3a) makes the current target mandatory, while also adjusting its design to higher ambition in a way that reflects national circumstances in a proportionate way (indicative top-ups). Options 3b) increases the current target in a uniform way and makes it binding for all Member States. Option 3c) introduces a new design in the form of an overall EU target. Options 3a), 3b) and 3c) present different mutually exclusive design options. Options 3d) is complementary with 3a), 3b) and 3c) and can be applied to reinforce these other options.

Stakeholders' opinions

Overall RES heating and cooling targets:

In the replies to the Roadmap, most stakeholders asked for a stronger H&C target of at least 50% share of RES by 2030 and called for a higher annual RES-H&C target of 3,1%. Stakeholders also called for making the H&C target in Article 23 binding. Several gas industry stakeholders called for quotas for renewable gas and renewable hydrogen and the inclusion of these new innovative renewable fuels in the accounting for the RES H&C sub-target.

Heating and cooling was the second most popular sector (after transport) for additional efforts to increase the share of the renewable energy according to the replies to the OPC.

When it comes to the MS' answers to the OPC, most of them opted against both increasing the target and making it binding.

RES in buildings:

In the replies to the Roadmap there was a strong call to increase the share of RES in buildings, and some stakeholders suggested specific targets (e.g. 50% of RES share in buildings, ensuring that 40% of heating is provided by heat pumps in 2030 and 70% in 2050).

78% of those replying to the OPC, in particular environmental organisations (87%) and NGOs (82%), expressed the view that there should be a minimum percentage of renewables in new and renovated buildings.

5.3.1.3. Options to increase renewable energy in the district heating and cooling sector (RES-DH&C)

Examples of modern renewable-based efficient district heating and cooling (DHC) demonstrated cost-effective solutions for high renewable energy integration, increased energy efficiency and energy system integration[56]. However, while the potentials have been demonstrated in scientific studies[57] and by numerous examples, such examples remain few and far between. The current provisions under REDII require Member States to endeavour to increase the share of renewables by an annual average 1%-point

(100% of this target can be fulfilled by waste heat and cold), or implement network access for renewables, waste heat and cogeneration. These provisions, weak as they are, include several exemptions allowing Member States to do nothing even where their systems are old, mostly based on fossil fuels (for example coal still has a significant share) and subject to consumer dissatisfaction in several Member States, where DHC has significant market share (14%-50% in Northern, Central and Eastern Europe, and above 50-80% in certain cities)[58].

The NECPs analysis has shown a general lack of measures and trajectories to address DHC in line with the REDII. For example only three MS provided targets and trajectories for renewables in DHC[59], while the role of these networks is significant or increasing in all but a few countries[60].

The current provisions make it possible for 'de-facto' 100% fossil systems to continue indefinitely in the future, while other segments of the heating sector (e.g. individual heating technologies and fuels) are becoming subject to increasingly stricter requirements to decarbonise, even when their potentials are weaker, more expensive and remote in the future. The lack of EU action in this sector would allow business-as-usual to continue with ensuing lock-in-effects, wasted cost-effective possibilities to harness (especially local) renewable sources (ambient, geothermal energy via heat pumps or bespoken technologies, solar thermal, cheap waste based bioenergy or waste heat, etc.). Similarly the demonstrated energy system integration potential of DHC[61] would not materialise by lack of a clear EU framework guiding local actors and encouraging their efforts to link district heating networks with renewable electricity, waste heat and renewable gases deployment. Consumer information as regards the climate performance of these systems should in parallel be improved to ensure level playing field, greater transparency and fair competition with alternatives. The proposed measures are necessary to ensure that the next inevitable and imminent investment cycle in district heating is not wasted and directed towards future proof solutions when replace the current old and obsolete heat generation units (around two thirds of the generation assets).

---

[56] Integrating renewable and waste heat and cold sources into district heating and cooling systems. Case studies analysis, replicable key success factors and potential policy implications. Study performed by Tilia for JRC, 2021., see also Enabling Positive Energy Districts across Europe: energy efficiency couples renewable energy, JRC, Shnapp, S., Paci, D., Bertoldi, P., 2020.

[57] See for example: Towards a decarbonised heating and cooling sector in Europe. Unlocking the potential of energy efficiency and district energy, Aalborg University, Denmark, November 2019. See also the results of EU supported projects, e.g. Hotmaps (Aalborg and alia), RELaTED, WEDISTRICT, CELSIUS projects, etc.

[58] Overview of District Heating and Cooling markets and Regulatory Frameworks under the Revised Renewable Energy Directive, ENER/C1/2018-496, ongoing.

[59] Assessment of Heating and Cooling Related Chapters of the National Energy and Climate Plans, JRC, Toleikyte, A., Carlsson, J, 2020.

[60] District heating is already significant in Northern, Central- and Eastern Europe and the Baltic States; it is being increasingly deployed in Western Europe. District heating has also important potentials in the Northern part of Southern MS, while district cooling have the potential to relieve pressure stemming from increasing cooling needs in Southern Europe and the warmer regions of other European countries, including the Nordics. Only Malta and Cyprus does not have any DHC in their territories.

[61] Interaction of District Heating with the Electricity System, Provision of Balancing Services, JRC, Jiménez-Navarro, J.P., Boldrini, A., Kavvadias, K., Carlsson, J, 2021. Heat Roadmap Europe

The current measures should be aligned with the higher ambition and decarbonisation policies laid down in the European Green Deal, the ESI and the Hydrogen Strategies and the Renovation Wave. In particular, the ESI Strategy calls to accelerate investment in smart, highly-efficient, renewables-based district heating and cooling networks, if appropriate by proposing stronger obligations through the revision of REDII and the Energy Efficiency Directive. The Renovation Wave highlighted the role of district approaches to building renovation creating new business opportunities and reducing overall costs. District approaches where the simultaneous deployment of modern district heating and cooling systems offer cost-saving synergies with building renovation by allowing the scaling and aggregating projects making zero-energy or even positive energy districts possible through modern district heating and cooling systems with large potential for renewables and waste-heat recovery.

The EED review complements the REDII review by revising the definition for efficient district heating and cooling. This definition should be updated to CTP and EGD goals to make exemptions from the annual average target, network access and disconnection justifiable. The ambition level should be raised to give clear signals for investment decisions even if the target remains indicative to allow sufficient flexibility to cater to specific national conditions. The coordinated review of the EED and REDII aims to increase complementarities and synergies between renewables and energy efficiency in developing modern renewable DHC by enhancing the EED focus on primary energy savings and REDII focus on renewables in DHC; renewables thus can contribute to energy savings, while higher requirements for efficiency enable renewables and make them cheaper to implement. Thus the same renewables in DHC help achieving the renewable heating and cooling, district heating and cooling and overall renewable targets, while also contributing to the energy efficiency targets.

Options, in conjunction with the revision of the EED and the EPBD, are:

- **Option 0**: **No changes**, maintain current policies under REDII (baseline scenario);

The baseline scenario assumes continued implementation of the existing framework without changes to the REDII. Enforcement takes place through established methods - the annual monitoring of Member States' performance under the Governance Regulation, continuous dialogue with Member States under the Concerted Action, if needed supported by further Commission recommendations to Member States, and infringement proceedings where relevant.

- **Option 1: Non-Regulatory Measures - Guidance and Best Practice Exchange** covering provisions that are either new or high-level making room for diverging interpretation and implementation by Member States. Such Guidance and Best Practice Exchange could cover clarification of the following provisions: 'efficient district heating and cooling'; DHC target accounting; information provisions for consumers; network access and exemptions; sector integration between district heating systems and the electricity grid. Option 1 could in addition cover best practice exchange on areas identified by Member States, such as support schemes and financing, waste heat and renewables connection, links with buildings, flexibility and sector integration or any other element of the current framework.

This option would help address the weaknesses identified during the assessment of NECPs and the discussions with Member States preparing the implementation of RED II[62]. It would cover the

[62] In the context of the Concerted Actions of the Renewable Energy Directive.

following areas: RES DHC share accounting; interpretation of relevant definitions and provisions (e.g. in relation to waste heat and 'efficient district heating and cooling'); guidance on the role of district heating in energy system integration; renewable district cooling following the adoption of the delegated act on calculation methodology.

- **Option 2: Strengthening existing measures on** improved information for consumers, strengthened rights of renewable heat suppliers to access networks, improved and extended ESI with other energy carriers and networks.

  As exemption from access rights and other measures (disconnection, target) are based on the definition of efficient district heating and cooling, this definition also needs to be revised to align it with the European Green Deal. The review of the definition is undertaken jointly by the EED and REDII reviews, as both directives use the same definition. The shared definition and its joint review ensure coherence and synergy between the two directives.

This option aims to improve the REDII current framework for the development of modern DHC systems and ensure their greater contribution to heating and cooling decarbonisation in alignment with EGD/CTP and the options on H&C. It complements the EED and ensures better synergies between EED and REDII.

- **Option 3: Level and nature of the target**
  - **Option 3a**) No changes; maintain current indicative 1% point average increase at Member State level
  - **Option 3b)** add indicative EU renewable target for renewables' share in DHC;
  - **Option 3c)** increase the indicative 1%-point increase target;
  - **Option 3d)** increase the 1%-point increase target and make it binding;

This option involves possibilities to strengthen the current target. Option 3a) keeps the status-quo. Option 3b) introduces a new design in the form of an overall EU target. Option 3c) increases the current target but leaves it indicative. Option 3d) increases the current target and makes it binding. Options 3a)-3d) are mutually exclusive.

Stakeholders' opinions

Most respondents in the Open Public Consultation indicated that the use of waste and renewable heat (94% of the respondents of who 50% rated it as very appropriate and 44% as appropriate) and increased energy efficiency (93% of the respondents of who 64% rated it as very appropriate and 29% as appropriate) is believed to be (very) appropriate for increasing the uptake of renewable energy in district heating and cooling networks. Participants expressed a mild preference for a binding target for renewable energy in district heating and cooling (53% yes to 47% no) and for increasing the current target (51% yes to 49% no). Environmental organisations and NGOs are distinctly against both propositions (only group of stakeholders expressing this preference), a similar view expressed for the heating and cooling target, because of the effect such a target may have on demand for biomass.

5.3.1.4. Options to increase renewable energy in the transport sector (RES-T)

RED II requires Member States to set an obligation on fuel suppliers to ensure that the share of renewable energy in the transport sector achieves a 14% target - and a 3.5 % sub-target for advanced biofuels. The focus of the measure is to set out a policy framework that promotes renewables in transport. Decisions on the concrete design of obligation are largely left to the Member States. Contribution of conventional biofuels is capped based on their share in 2020. The Fuel Quality Directive (FQD) includes in addition to fuel quality standards a 6% target to reduce GHG emissions of transport fuels and an outdated set of sustainability criteria.

The options under this section aim to deliver to achieve the ambition level of the Climate Target Plan 55% GHG reduction across the economy while applying different implementation options.

The measures to limit the contribution of conventional biofuels and the flexible limit on Annex IX Part B biofuels are maintained under all options to minimise indirect land use change-risks and to take into account the limited feedstock supply, respectively.

The use of multipliers in the calculation of the share of renewable energy in the transport sector is maintained in view of the Decision of the co-legislator in 2018 on this matter[63]. However, the multipliers are adjusted to better reflect the maturity of different types of fuels and the energy efficiency of electric vehicles. Where necessary the nominal level of the target is adjusted to maintain the level of ambition. Options in this section are assessed based on their capacity to achieve the ambition level of the Climate Target Plan 55% GHG reduction across the economy as carried out in dedicated modelling work for this impact assessment in agreement with CTP analysis.

Options are:

Baseline

- Option 0: No change in the current legislation (baseline scenario);

Level and nature of the targets

- Option 1: The ambition level for renewables in transport is increased and new fuel blends are introduced to facilitate the achievement of the higher targets[64]. The 6% emission reduction target set out in the FQD[65] is removed.
- Option 1A: The target for renewables in the transport sector is increased and the sub-target for advanced biofuels is increased.
- Option 1B: In addition to the increase of the target and the sub-target for advanced biofuels a dedicated sub-target for RFNBOs is introduced.

Measures

- Option 2: The Member States are required to set out an obligation on fuel suppliers that ensures the achievement of the target. The Directive would set out design features of the obligation to harmonise the way the contribution of renewable electricity supplied to electric

[63] The Commission had proposed to abolish all multipliers.

[64] The way to calculate the target e.g. the use of multipliers may be streamlined in a way that sets the right incentives and reflects political priorities but leaves the overall ambition unchanged.

[65] Article 7a of the Directive 2009/30/EC

vehicles is taken into account and to avoid overlaps with measures implemented under the ReFuel EU Aviation initiative. Further, the following sub-options are considered:

- Option 2A: The obligation on fuel suppliers is expressed in terms of energy i.e. fuel suppliers are required to incorporate a minimum share of renewable energy in the fuels they supply to the market including minimum shares for advanced biofuels and RFNBOs. All fuels need to achieve minimum emission savings requirements;
- Option 2B: The obligation on fuel suppliers is expressed in terms of emission savings i.e. fuel suppliers are required to reduce the emission intensity of fuels placed on the market. There would be no sub targets for advanced biofuels and RFNBOs;
- Option 2C: The choice between the approaches described under A and B is left to the Member States (as currently);
- Option 2D: The obligation on fuel suppliers is expressed in terms of emission savings but operators are required to achieve minimum shares for advanced biofuels and RFNBOs;

Apart from raising the level of ambition for the share of renewables in transport including for renewable fuels of non-biological origin (RFNBOs), renewable electricity in transport and advanced biofuels[66], the options concern the design of the obligation on fuel suppliers including the question whether it should be expressed in terms of emission savings or supplied renewable energy and how it can better promote the use of renewable electricity in electric vehicles.

The options are aligned, and complementary to the ReFuel EU Aviation and Fuel EU Maritime initiatives. The role of RED II in this context is to set the overarching framework and targets for the promotion of renewables in the transport sector, including for innovative renewable fuels, while ReFuel EU Aviation and Fuel EU Maritime initiatives aim to address sector specific sectorial challenges with dedicated measures. ReFuel Aviation for example proposes sector-specific blending mandates by imposing a minimum share of SAF (Sustainable Aviation Fuels) to be supplied to airlines, and an uplift obligation on airlines to take such fuels at EU airports. The overall availability as well as the terminology and the certification scheme of renewable fuels will be ensured through the RED II framework.

Both measures contribute towards the achievement of the targets set out in RED II.

Stakeholders' opinions

Transport was the most popular sector for additional efforts to increase the share of the renewable energy according to the replies to the OPC. The majority of replies were in favour of an increase in the renewables target for transport, with 43% suggesting this should be more ambitious than the 2030 CTP, 34% that it should be as ambitious as the CTP, and 9% that it should be less ambitious. A very large majority of respondents (86%) think that the renewables target in transport should be increased in some way.

[66] The level of ambition for advanced biofuels has been reduced and level of RFNBOs has been increased in options 1A and 1B compared to the Climate Target Plan based on the commitments set out for advanced biofuels in the NECPs and taking the objectives of the H2 strategy for RFNBOs into account.

5.3.2. Area II: Insufficient promotion of energy system integration in REDII

5.3.2.1. Measures to enhance the contribution of transport and heating and cooling to the system integration of renewable electricity

With the extended use of heat pumps in heating and cooling, the deployment of stationary batteries, and especially with the proliferation of electric vehicles (EVs around 30 million vehicles expected in the EU by 2030 based on conservative estimates), it is necessary to ensure that these assets can fully contribute to the system integration of renewable electricity, and thus facilitate reaching higher shares of renewable electricity in a cost-optimal manner, while ensuring a secure and reliable supply of electricity.

The Clean Energy package introduced a number of general provisions aiming at ensuring that various storage assets can gain access to balancing markets without discrimination. Such provisions can be complemented by targeted measures aiming at ensuring that small and mobile distributed assets are sufficiently integrated within the electricity system in a manner that maximizes their potential contribution to the system integration of renewable electricity.

For EVs specifically, their contribution to system integration largely depends on the access to smart charging infrastructure with the ability to vary charging intensity according to certain signals, the availability of bidirectional flow between charger and vehicle (Vehicle to Grid, V2G) and the availability of near-real time information on pricing and share of renewable electricity. In order for integration to take place efficiently and competitively, market players such as electricity suppliers and electromobility service providers also need to have access to basic battery information and be able to offer their services via sufficient and non-discriminatory access to charging infrastructure.

The EPBD and the Alternative Fuel Infrastructure Directive focus on the deployment and planning of charging infrastructure in thermally enclosed buildings and publicly accessible areas, respectively. A gap therefore exists for structures and areas not within the above categories, such as multi-storey parking structures and off-street parking areas with controlled access. In addition, AFID’s scope is specific for ensuring infrastructure adequacy to support EV fleets for mobility, instead for system integration. A gap in regulatory scope is therefore clearly present, both in terms of geographical application and in terms of purpose, which does not enable legislating for the desired location, type and number of charging infrastructure fit for EV integration. It is important to complement these two legislations and their upcoming revisions, by creating *transversal* requirements for charging points to be deployed and operated in a manner that optimizes their contribution to the system integration of renewable electricity.

The following options are considered:

1. *Availability of RES relevant system information:*

- **Option 1.0**: No changes, availability of near-real-time information on the share of RES in the system is optional (baseline scenario);
- **Option 1.1:** In addition to price signals, mandate TSO/DSOs to make available information on the RES-share of the electricity in the system (for instance in the relevant bidding zone), as well as forecasting information where possible, in a near-real-time and interoperable

manner, which can be used by all players, including managers of Building Energy Systems and EV users and those acting on their behalf, as well as network connected devices.

- **Option 1.2:** In addition to **option 1.1,** also mandate electricity suppliers to provide information in bills on the actual RES-share of the electricity consumed, based on the real RES-share in the system at hours of consumption, which would complement the information provided through guarantees of origin for customers of green offers (and the "residual mix" for other customers).

2. *Set minimum requirements for the availability of intelligent infrastructure (intelligent charging and/or V2G) for the integration of electric vehicles in the electricity system*

- **Option 2.0**: No change in the current legislation (baseline scenario);
- **Option 2.1A**: mandate Member States to ensure that all recharging points installed in their territory are able to support smart charging functionality
- **Option 2.1B:** same as **Option 2.1A,** but allow Member States to exclude certain locations where smart charging would typically not present added value to system flexibility
- **Option 2.1C**: mandate Member States to assess the extent to which the deployment of ***additional*** **smart charging points** in their territory can further contribute to system flexibility and penetration of renewable electricity, going beyond the minimum requirements of their deployment for mobility purposes for example as required under AFID or EPBD).
- **Option 2.2A**: mandate Member States to ensure that all recharging points installed in their territory are able to support **V2G functionality**
- **Option 2.2B**: same as **Option 2.2A**, but allow Member States to evaluate the level of deployment of bidirectional charging (V2G) according to the specific needs of their system

3. *Ensure a level playing field in the market of electricity supply and electric mobility services, specifically for aggregation of distributed assets*

- **Option 3.0:** No change in the current legislation (baseline scenario);
- **Option 3.1** ensure that electricity storage systems or devices are treated by network and market operators in ways that are not discriminatory or disproportionate irrespective of their size (small-scale vs large-scale) and whether they are stationary or mobile, so that they are able to competitively offer flexibility and balancing services
- **Option 3.2:** give electricity market participants and mobility service providers access to basic battery information, such as State-of-Health and State-of-Charge
- **Option 3.3:** ensure open access to charging infrastructure that is not for own use

Stakeholders' opinions

The open public consultation gave a clear message that consumers (EV-users) should receive information on the renewable content of the electricity mix when charging. In general, many stakeholders stress that e-mobility should only be encouraged if it is powered by renewable energy. Some stakeholders suggest a fuel-neutral credit trading mechanism to stimulate e-mobility.

During the stakeholder consultation, independent electricity suppliers and electromobility service providers of intelligent charging services to EV-users through aggregation have explicitly referred to the need for the deployment of intelligent charging infrastructure with open access to the necessary battery data and also raised concerns with regard to the level playing field in the electromobility market and the practices related to network charges, taxes and tariffs. Participants (in particular aggregators) have also stressed the need for free and open access to battery data (currently controlled by manufacturers), as well as ensuring that charging infrastructure is open to all mobility service providers and electricity market participants without under equal treatments.

5.3.2.2. Terminology covering all renewable and low-carbon fuels

The Energy System Integration strategy announced as one of its key actions the establishment of 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 GHG emission savings and sustainability criteria, building on existing provisions included in REDII as well as in other interconnected policy areas. Moreover, the TEN-E Regulation proposal introduced infrastructure categories facilitating the integration of renewable and low-carbon gases into the grids, smart gas grids and hydrogen networks which require a sustainability assessment.

- **Option 0:** Continue with existing definitions of RFNBOs and RCFs as categories.
- **Option 1**: extend the definition of **RNFBOs** only
- **Option 2:** include in Article 2 a new definition of **low carbon fuels** as being: recycled carbon fuels, low-carbon hydrogen, and synthetic fuels the energy content of which is derived from low-carbon hydrogen - **without any GHG threshold** associated
- **Option 3**: same as **option 2**, but **associate a specific GHG threshold** that such low-carbon fuels have to meet in order to be considered low-carbon; empower the Commission to come up with a common methodology to demonstrate achievement of such GHG threshold by way of delegated act.

Option 3A: define a GHG threshold that is **specific to low-carbon fuels**

Option 3B: define a GHG threshold that is **the same as for RFNBOs and Recycled Carbon Fuels (RCFs).**

Such thresholds could either be expressed in absolute value of GHG emissions per unit of energy, or in terms of GHG savings to be achieved relative to a comparator – similarly to what is currently done for RNFBOs and RCFs

5.3.2.3. European system of certification of renewable and low carbon fuels

The terminology for renewable and low-carbon fuels should be underpinned by a strong certification and traceability system It is important to ensure that any claims that a fuel is renewable or low-carbon be underpinned by a proper certification, verification and traceability system. Such system should inform customers and the Member States about the sustainability characteristics of renewable and low carbon fuels, ensure that only sustainable fuels are supported and facilitate cross-border trade. Taking into account that supply chains are global, the further development of the EU certification system would also take into account the international implications of such development as well as exploring options for international regulatory cooperation.

The current certification system for renewable and low carbon fuels is based mainly on voluntary schemes, recognised by the European Commission[67]. National certification schemes are also a possible tool under REDII but are used by Member States only to a limited extend. The current system of guarantees of origin (GOs) is used only for consumer information and due to its limitations (GOs only cover renewables, can be sold separately from the electricity supply, and do not contain sustainability nor GHG emissions data), they cannot be used for proper certification of energy, consumed and reported by the Member States. REDII therefore tasks the European Commission to develop a **Union database** to register and trace along the supply chain all liquid and gaseous fuels in the transport sector.

There is currently no harmonised certification system for hydrogen, although it may be expected that some of the voluntary schemes may enlarge their scope to cover also this type of certification. The same is valid for new fuels that have the potential to increase their market share as a result of the implementation of the REDII (e.g. RFNBOs such as hydrogen-based synthetic fuels) for which a certification system will have to be put in place.

Options, grouped by category, are:

A. Scope and content of the certification system:

- **Option 0A:** No changes, maintain current policies under REDII (baseline);
- **Option 1A: Adjustment of the scope and content of the current certification system** (based on voluntary and national certification schemes) to include all fuels, covered by REDII (including recycled carbon fuels) as well as improvement of the certification process to take into account additional requirements and methodologies developed under REDII;

- **Option 2A**: Further development and harmonisation of the existing **system of Guarantees of Origin as an alternative certification system** for renewable and low carbon gases and renewable electricity.

B. Traceability:

- **Option 0B**: Baseline: remain with the current scope of the Union database to cover only liquid and gaseous transport fuels
- **Option 1B**: A single information system (e.g. Union database) is developed to improve the traceability of energy carriers and support to the mainstreaming of the mass balance system by applying one covering all energy end-use sectors and the respective supply chains in a life cycle approach (from production to place of consumption of the fuels). The enforcement of the information system to cover parts of the value chain outside of the EU will be ensured through the existing framework for voluntary schemes currently also operating outside the EU. Support for the deployment of the information system would be also ensured through strengthening of international cooperation.

Stakeholder's opinions

During the 1st stakeholder workshop, panellists acknowledged the necessity to have a fully-fledged certification system for all renewable fuels and low-carbon fuels across the life cycle.

[67] Article 30(4) REDII

In addition, adjusting the scope of this system is important to cover all emerging fuels including RFNBOs as well as renewable and low-carbon fuels.
92% of participants to the OPC found that the certification and verification system should ensure that the GHG impact of energy conversions along the value chain are fully taken into consideration, while avoiding double counting.

5.3.2.4. Promotion of innovative renewable and low carbon fuels

Whilst REDII sets a target of 3.5% for advanced biofuels in transport, the current framework offers limited incentives to promote the uptake of RFNBOs ahead of 2030. Yet, for hard-to-decarbonise sectors such as transport and industry, early investments in RFNBOs are needed to prepare a rapid upscaling of these solutions after 2030[68]. Similarly, the conversion of renewable electricity into renewable fuels and gases to provide long-term storage and buffering options is not cost-efficient yet, although this solution might be needed with the rapid rise of variable renewable electricity production.

This is also recognised in the action points in the Energy System Strategy and the Hydrogen Strategy which refer to additional measures to support renewable and low-carbon fuels, possibly through minimum shares or quotas for RFNBOs in specific end-use sectors. Based on their current framework that allows for the accounting for RFNBOs in the transport sector, there are a number of options to further promote their uptake. Based on this, the chapter will focus on innovative renewable and low-carbon fuels (both gases and liquids) produced from hydrogen and not look in detail at other renewable fuels such as biofuels.

Options are:

- **Option 0:** No changes, maintain current policies under REDII (baseline); promotion of RNFBOs with non-regulatory measures such as guidance and best-practice sharing, funding of R&D as well as raising consumer awareness.

A. *Extension of the scope of accounting:*

- **Option 1**: Extend RFNBOs accounting beyond transport, including heating & cooling and industry, improve the consistency of accounting and the way RFNBOs are counted to the overall target[69]
- **Option 2:** Allow Member States to count low-carbon fuels towards the sectoral RFNBO targets (in transport and industry), but not allowing low carbon fuels to count towards the overall RES target.

B. *Creation of specific sub-targets for RFNBOs:*

---

[68] Chiaramonti, D., Talluri, G., Scarlat, N. and Prussi, M., The challenge of forecasting the role of biofuel in EU transport decarbonization at 2050: a meta-analysis review of published scenarios, RENEWABLE and SUSTAINABLE ENERGY REVIEWS, ISSN 1364-0321 (online), 139, 2021, p. 110715, JRC121788.

[69] According to REDII, not the RFNBOs but the renewable electricity used to produce the RFNBOs is counted towards the overall target for renewable energy, which disincentives cross border trade.

- **Option 3**: Dedicated RFNBOs targets in hard-to-decarbonise sectors such as transport (including aviation, maritime) and industry - targets should be established based on additional modelling reflecting ESI and Hydrogen strategies.
- **Option 4**: Combined target for RFNBOs in transport and industry - targets should be established based on additional modelling reflecting ESI and Hydrogen strategies.

C. *Creation of specific sub-targets for all innovative low-carbon fuels:*

- **Option 5**: Dedicated low-carbon fuels targets in hard-to-decarbonise sectors such as transport (including aviation, maritime) and industry - targets should be established based on additional modelling reflecting ESI and Hydrogen strategies.
- **Option 6:** Combined low-carbon fuel target in transport and industry - targets should be established based on additional modelling reflecting ESI and Hydrogen strategies.

Stakeholder's opinions
A majority of participants in the OPC think that the use of hydrogen and e-fuels produced from hydrogen should be encouraged, provided they emit less GHG or are produced only from renewables. The latter is in particular supported by NGOs. 64% consider a supply side quota as appropriate or very appropriate, 79% favour market based support mechanisms.

5.3.3. Area III: Options to ensure bioenergy sustainability

According to the modelling for the CTP, projected increases in bioenergy use by 2030 will be limited compared to today. However, post-2030 bioenergy is set to gain increasing importance with the view to contributing to the carbon neutrality goal by 2050. Increased demand for bioenergy from forest biomass may have a negative effect on forest carbon and biodiversity protection if the raw material is sourced in an unsustainable way (e.g. through conversion of primary or old-grown forests, or through unsustainable forest management practices such as whole tree harvesting for energy). A number of options have been discarded at an early stage (see Annex 6). Options assessed are:

- **Option 0: Full application of the enhanced REDII sustainability criteria**

This option would include the following measures/initiatives: Implementing Act on forest biomass (article 29(8)); Implementing Act on standards for voluntary schemes (article 30); new reporting requirements on bioenergy supply and demand under the Governance regulation; application of the new eco-design standards for new solid fuel boilers, including biomass.

- **Option 1**: **Non-regulatory measures**

This option would involve the development of a series of non-regulatory measures to complement/support the efficient implementation of the enhanced REDII bioenergy sustainability criteria, including: new guidance on harmonised implementation of the new sustainability criteria (e.g. article 29(2) on soil management for agriculture biomass); new guidance on implementation of article 3(3) on support schemes for bioenergy; new guidance on cascading use of forest biomass; new guidance on better monitoring of forest biomass supply and demand; new guidance on efficient biomass use in the household sector;

- **Option 2: Targeted strengthening of the EU bioenergy sustainability criteria**

This option would consist in the further strengthening of the REDII enhanced sustainability criteria for biofuels, bioliquids and biomass fuels. This would involve the following additional requirements:

1. application of the existing no-go areas for agriculture biomass to forest biomass, including primary and highly biodiverse forests, in line with the Biodiversity Strategy;
2. application of the GHG saving criteria (article 29(10)) also to existing heat and power installations, in line with the higher climate ambition; and
3. stricter energy efficiency criteria for large-scale electricity installations, in line with resource efficiency goals;

- **Option 3: Application of the EU sustainability criteria to small-scale installations**

This option would consist in the application of the REDII enhanced sustainability criteria to small heat and power installations. It would involve applying option 2 also to small scale biomass-based heat and power installations below a total rated thermal capacity of 20 MW (e.g. 10 or 5 MW), in order to increase the amount of biomass covered by the EU sustainability safeguards and therefore increase their overall environmental/climate effectiveness;

- **Option 4: National caps on the use of high quality stemwood for energy**.

Building on options 2 and 3, this option would involve introducing national caps fixed at Member State level on the use of high quality stemwood for energy. The cap would grandfather existing volumes in the period 2015-2020. Salvage logging (i.e. wood from storms, pests and diseases) would not be included in the cap, nor coppicing wood. Only stemwood over a certain diameter and under certain quality characteristics would be targeted by this cap; this diameter would be chosen at Member State level and would depend on the different types of wood species, the objective being to cap the use for energy of stemwood of industrial quality. The cap would also apply to biomass imports. The technical details of this option would need to be further defined in a guidance document, including on how to address possible impacts on the single market that could result from different national approaches.

  - **Sub option 4.1: full exclusion of high quality stemwood as renewable energy source**. This sub-option would be achieved by limiting eligible forest bioenergy to waste and residues (e.g. residues from timber harvesting and timber processing). The technical details of this option would need to be further defined in a guidance document.
  - **Sub option 4.2: minimisation of national financial support for the use of high quality stemwood for energy.** This alternative sub-option would require Member States to design their support schemes for bioenergy in a way that minimises the use of high quality stemwood for energy purposes. Compliance with this new criteria will be assessed by the Commission in the context of the state aid approval process, building on the current assessment of compliance with the EU sustainability criteria. The technical details of this sub-option would need to be further defined in a guidance document.

- **Option 5**: **National caps on the use of forest biomass for energy**

Building on options 2 or 3, this option would involve of a cap fixed at Member States level on the use of all forest biomass for energy production. The cap would grandfather existing average volumes of forest biomass used over the period 2015-2020. The cap would also apply to imports. Reaching the national cap would mean that a given Member State would not be able to account the additional forest bioenergy against the European/national renewable targets/mandates and would not be able to provide financial support to it. The technical details of this option would need to be further defined in an Implementing Act.

The Impact Assessment does not assess new options related to the REDII provisions on Indirect Land Use Change of biofuels and on the definition of advanced biofuels (Annex IX). On both topics, REDII already includes appropriate mechanisms for the review and revision, if necessary, of the relevant provisions.

In line with the existing REDII provisions, economic operators in the EU outermost regions as defined under article 349 TFEU, which are remote, isolated and not connected to the EU grid, may benefit from a derogation of limited local impact and for a limited duration; provided that the concerned Member States justify so on the grounds of energy independence and ensuring a smooth transition to the sustainability, energy efficiency and greenhouse gas emissions saving criteria.

Stakeholder's opinions
Overwhelming support for stricter criteria is found in environmental non-governmental organisations and a large number of individual citizens (38700 answers) replying through a coordinated NGO campaign in the OPC.
Not considering the contributions from the campaign, participants think sustainability criteria for the production of bioenergy from forest biomass should not be modified (56% no to 44% yes), with clear splits among different groups (NGOs, industry, Member States, academia).
A cap option is supported in particular by environmental NGOs, who point to the fact that sustainability issues for bioenergy are sensitive to scale. On the other hand, forest owners and bioenergy producers oppose a revision of the REDII sustainability criteria on the basis that they have been recently revised and not yet still applied by Member States.

5.3.4. Flanking and enabling measures

In addition to the core objectives of the revision of this Directive to address the insufficient ambition in a 2030 and 2050 perspective, to address the insufficient system integration, and to update bioenergy sustainability provisions, a limited number of additional "flanking" or enabling measures could contribute to the cost-efficient deployment of renewables, and are addressed in the section below.

5.3.4.1 Measures to increase cross-border cooperation

Cross-border cooperation allows for a cost-efficient deployment renewable energy across Europe. REDII includes options for Member States' cross-border cooperation on a voluntary basis. However, their use has been very limited, thus implying suboptimal results in terms of efficiency to reach the overall renewable energy target. REDII has introduced provisions related to the opening of support schemes to other Member States, but has left that option voluntary for Member States. REDII has also created a platform aimed at facilitating statistical transfers between Member States. Finally, REDII and the Governance Regulation have created a new cooperation tool, the Renewables Financing Mechanism, which aims at organising tenders for new renewable projects involving several Member States, but managed by the Commission. The use of this tool however depends on voluntary contributions from Member States.

Options considered are:

- Option 0: No changes, maintain current policies under REDII (baseline scenario)
- Option 1: Issue updated Commission guidance on cross-border cooperation (non-regulatory option), including design options for the different Cooperation Mechanisms and guidance on cost-benefit-analysis and allocation
- Option 2: Obligation for Member States to test cross-border cooperation (pilot project) within the next 3 years (paving the way for a partial opening of support schemes in the future)
- Option 3: Mandatory partial opening of support schemes (building on the indicative partial opening of support schemes in Article 5 REDII and its revision clause).
- Option 4: Enhanced use of the Union renewable energy financing mechanism via Member State under certain conditions (e.g. when below its target/ contribution trajectory)

While Options 1 and 4 could be complementary to the other options, options 2 and 3 are rather alternatives to each other (with option 2 being a stepping stone to option 3).

5.3.4.2 Measures to promote and scale up offshore renewable energy

In line with long-term climate neutrality objective, the EU strategy on offshore renewable energy[70] proposes to increase Europe's offshore wind capacity from the current 12 GW to at least 60 GW by 2030 and to 300 GW by 2050 and ocean energy to at least 1 GW by 2030 and 40 GW by 2050. Currently, deployment plans and targets for offshore renewable energy and respective support measures are generally set at national level, while regional cooperation takes place only to a limited extent and is mainly based on best practice exchange.[71]

Options considered are:

- Option 0: No changes, maintain current policies under REDII (baseline scenario)
- Option 1: Obligation for Member States to conclude a non-binding political agreement to cooperate on the amount of offshore renewable generation to be deployed within each sea basin by 2050, with intermediate steps in 2030 and 2040
- Option 2: Introduction of one-stop shops for the permitting of the generation component of cross-border offshore wind projects per sea basin. This would complement the introduction of one-stop shops for the permitting of offshore *grids* under the TEN-E proposal.

These options can be complementary. Complementarity and coherence with the revised TEN-E Guidelines will be closely monitored and ensured, given the strong interlinkages.

[70] Commission (2020), An EU Strategy to harness the potential of offshore renewable energy for a climate-neutral future, COM (2020)741.

[71] For instance, within in the High Levels Groups for North Seas Energy Cooperation (NSEC) as well as the Baltic Energy Interconnection Plan (BEMIP).

Stakeholder's opinions

Participants to the OPC highlighted that simplifying administrative procedures for project developers is among the 5 most important changes to be made in the revision of the Directive, behind a more ambitious overall RES target and an increased transport target.

Further streamlining of permitting procedures (91%), fostering regional cooperation (88%) and supporting PPAs (88%) were considered as the most appropriate measures to tackle remaining barriers for a cost-efficient deployment of renewables in support of the higher ambition.

During the 1st stakeholder workshop it was made clear that participants also supported the uptake of energy communities and self-consumption to tackle the remaining barriers for the uptake of renewable electricity. In section 5.6 on discarded options it is explained why these measures are not addressed by this revision.

5.3.4.3 Measures to increase renewable energy in industry

The industrial sector accounts for 25% of EU's energy consumption, but has a relatively low share of renewables (9% of direct renewable energy use, and 22% if the renewable energy share in electricity is considered)[72]. The CTP points to a share of around 37%, partly through an increase use of electrification, partly through the use of renewable fuels, partly through the direct use of renewables. Specifically renewables are primarily used in the wood, pulp and paper industry, but are largely absent in other industry sectors. Since 2015, companies have started to build or purchase renewable electricity to satisfy their electricity demand, but only 3.5% of industrial electricity consumption is covered by such agreements. To achieve the objective of climate neutrality in 2050, industry is faced with investment decisions that need to be taken ahead of 2030 and that will have long-term impacts of the structure and ability of industry to be competitive within a climate neutral economy. Early investments are needed to adapt production processes, e.g. through electrification, to the availability of different renewable energy carriers.

RES in industry is not explicitly covered in REDII, but its transformation is critical to achieve the EU's objective of climate neutrality. The aim of the possible measures is to initiate an increasing share of renewables, whilst supporting an emerging market for renewables-based products. This tailor made approach for industry would provide investor certainty and ready-made solutions for this sector with specific needs compared to others. Options are:

- Option 0A: No changes, maintain current policies under REDII (baseline scenario);
- Option 1A: Introduction of use of renewable energy in the audits required in the EED;
- Option 2A: Introduction of an EU methodology underpinning the labelling for green industrial products in certain sectors, complementing the Sustainable Product Initiative.;

Stakeholder's opinions

A majority of participants in the OPC are in favour of a RES obligation for industry, either on industry in general (55%) or to specific industries (13%). Amongst all stakeholder groups, stakeholders tend to agree that there should be obligations on industry to use a minimum amount of renewable energy.

During the 1st stakeholder workshop there was a common understanding from the participants

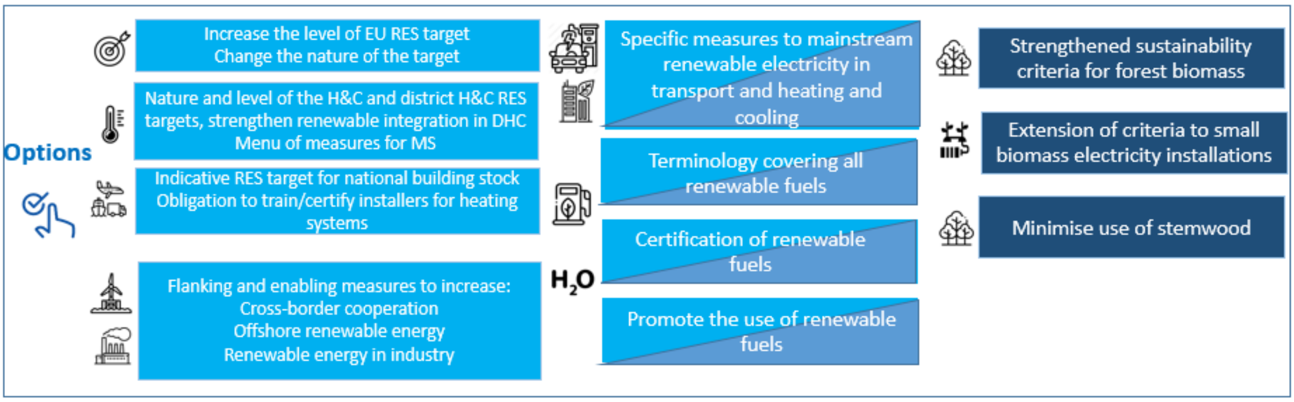
[72] Eurostat (2020) Energy Balance Sheets EU27, June 2020.

that the industrial sector will be a major growth area for renewables deployment, especially through electrification. Tools such as PPAs, state aid guidelines, (business model) innovation, and the reduction of financial risks were seen as critical to ensuring sufficient low-cost renewables.

5.4. The overview of policy options

An overview of the policy options *described in section 5.3* is presented in the figure below.

Figure 3 - Overview of policy options



5.5.The core scenarios, variants and their use in this IA

This assessment uses the three core scenarios (based on CTP analysis) that achieve net 55% GHG reduction in 2030 and confirm the cost-effective range for RES share in 2030 as already established in the CTP (38-40%). All scenarios have been built on REF - as described in the section 5.1 and these core scenarios confirm the cost-effective levels of renewables as described in Section 6.1. These scenarios were developed and used to ensure coherence across the different impact assessment of the “Fit for 55 Package”. In essence, the role of core scenarios is two-fold:

- To confirm (with respect to CTP) the internally coherent level of ambition that policy options considered in the “Fit for 55” impact assessments need to deliver.
- To establish range of impact to be expected from all “fit for 55” legislative proposals.

The three core scenarios are:

- **REG** that relays only on intensification of energy and transport policies in absence of carbon pricing beyond the current ETS sectors;
- **MIX** that relays on both carbon price signal extension to road transport and buildings and intensification of energy and transport policies;
- **MIX-CP** that illustrates a lower ambition revision of energy policies (and CO2 standards for vehicles), with a strong role for carbon price signals (as in MIX also extended to road transport and buildings).

Detailed information regarding the policy scenarios: their assumptions and storylines as well as modelling methodology can be found in Annex 4.

The core scenarios are cost-effective pathways that capture all policies needed to achieve the increased climate target of 55% GHG reductions. The fundamental design of carbon pricing and regulatory instruments working together put forward already in the CTP remains robust.

Already from the CTP analysis it is clear 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 energy prices for all consumers as illustrated by the MIX-CP scenario
- very ambitious policies that might be rejected by Member States (e.g. very high energy savings or renewables obligations) because they would be too costly for economic operators as illustrated by the REG scenario.

Therefore, the **MIX scenario is the central one,** where energy policies address market failures in a targeted manner and provide investor/consumer certainty while pushing for the uptake of innovative technologies. In the MIX scenario, both carbon pricing and energy policy actions are aligned to trigger investments in clean energy technologies and infrastructure, or even to overcome financing difficulties for certain groups of consumers (e.g. renovations shielding consumers from high energy bills linked to fossil fuels based heating).

To some extent, the REG and MIX-CP scenarios are extremes showing the undesired impacts of relying too strongly on only regulatory measures or carbon pricing. Still such scenarios could materialise. The low ambition policy options consisting of additional guidance only considered in this assessment would likely lead to results of the MIX-CP scenario. Conversely, the most ambitious regulatory options would yield results similar to the REG scenario with no carbon price applied in sectors beyond current ETS. Finally, low ambition outcome of the legislative processes or delays in implementation - be it on regulations or on carbon pricing – would be illustrated by the MIX-CP or REG scenarios, respectively.

The core 'Fit for 55' scenarios are complemented by the following variants[73] (all built on MIX) that help to assess some specific policy options:

- MIX-H2 that illustrates high uptake of hydrogen in final energy demand sectors already in 2030[74] aligned with the goal of the Hydrogen Strategy (40GW of electrolyser capacity in the EU in 2030) while considering national hydrogen strategies and "Opportunities for Hydrogen Energy Technologies considering the NECPs" by Fuel Cells and Hydrogen Joint Undertaking[75]. MIX-H2 is used for assessment of options including on the promotion of RFNBOs in industry and in transport.

- MIX-LD (MIX-Lost Decade) that aims to assess the impacts of the revision of REDII only or more precisely of the absence of such a revision rather than of the whole package of "Fit for

[73] Further variants were developed with the METIS model for the specific options aiming at assessing the contribution of demand-response measures (including dedicated RES-based signals to consumers) to enhance the integration of renewable electricity use in transport, heating and cooling as well as other electricity end-consumption featuring demand side flexibility.
[74] Core scenarios project only a small uptake of hydrogen in 2030 but more significant in 2035.
[75] https://www.fch.europa.eu/publications/opportunities-hydrogen-energy-technologies-considering-national-energy-climate-plans

55" policies. This variant removes all drivers representing REDII revision while "freezing" all other policies on their level of ambition/stringency as modelled in MIX. In this variant, a gap to overall RES and sectoral ambition (especially in H&C) appears as well as gap to GHG 55% target. Bridging the gap can be attributed to revision of REDII. As this variant achieves the carbon neutrality in 2050, MIX-LD has to considerably increase the efforts in renewables deployment post-2030.

In chapter 6, economic, the social and environmental impacts of the core "Fit for 55" scenarios (and for relevant options the variants) are part of analysis of impacts. The core "Fit for 55" scenarios can be compared to each other in the way that the CTP IA did. Where relevant, this type of analysis is performed in this impact assessment to show the advantages and disadvantages of stronger/weaker regulatory actions (notably in case of RES H&C and RES-T obligation). As an alternative approach, the MIX-LD variant provides insights about the impacts of the absence of revision of REDII in the context of the MIX scenario – this is mostly discussed in section 6.1.2. Other variants are used for specific policy options only as described above.

Importantly, some policy options analysed in this impact assessment revolve around **the type or way of implementation, and not the level of ambition of regulatory measures.** Hence for such measures the scenario results are only useful as "boundary conditions" showing the level of ambition that has to be achieved regardless of the type of regulatory actions or way of implementing it (e.g. nature of the targets).

5.6. Options discarded at an early stage

A number of policy options were discarded:

- on *targets for renewable energy*, possible scenarios representing an EU 2030 GHG emissions reduction target below 55% or higher levels of ambition as requested by some stakeholders were discarded as they did not fulfil the political mandate agreed by EU leaders of achieving the 38-40% renewable energy.

- on the *promotion of low carbon and renewable fuels*, as noted in recital 2 of the (current) Directive, its goal is to promote renewable forms of energy as one important part of the Union's energy policy. The Directive should continue to focus on this main objective. The priority for the EU is to develop renewable fuels such as hydrogen produced from renewable electricity and hydrogen-based synthetic fuels since renewables are projected to develop very strongly in power generation already in this decade (and even more strongly afterwards) while nuclear and CCS have more limited potential and, in some Member States encounter public acceptance issues. Low carbon fuels will continue to play an important role to decarbonise the energy sector for some time in particular in sectors where direct electrification is not possible or renewable fuels are not yet available. This will be addressed in other legislative proposals, including the forthcoming gas decarbonisation package (revision of the gas directive) that will focus on ensuring internal market for low-carbon gases.

- on revising the *sustainability criteria for bioenergy*, the option to apply sustainability criteria at forest unit level was considered disproportionate and overly intrusive on Member States. Introducing biogenic carbon emission factors in the calculation methodology for the lifecycle greenhouse gas performance of forest biomass, in addition to supply-chain emissions was considered unfeasible. It was not considered appropriate to introduce requirements for air pollution related to solid biomass as this issue is effectively covered by existing EU environmental legislation. In the energy field, it has also been addressed by new stricter emission requirements for new solid fuel boilers and space heaters in the Eco-design Directive (since January 2020). Applying the sustainability requirements to residential users of biomass heating would imply a disproportionate administrative burden on Member States and citizens. An option on new reporting requirements on forest biomass was also discarded as current reporting obligations under the Governance Regulation are considered sufficient. While requested by many individual citizens and NGOs, a complete ban of the use of woody biomass for energy production was considered as a too radical measure which would have significant impact on the ability of some Member States to reach the CTP objectives.

- A revision of *Guarantees of Origins (GOs) for electricity* was among the popular answers in the public consultation to the question what should be amended in the Directive. On revising the system of this option was discarded as the existing requirements of REDII and the Directive on common rules for the internal market for electricity are expected to deliver improvements when implemented.

- During the 1st stakeholder workshop '*further support the uptake of energy communities and self-consumption'* was put forward as one the measures appropriate to tackle the remaining barriers for the uptake of renewable electricity, however the current revision of RED II does not plan to change provisions on energy communities as the new rules are still being implemented in the Member States and the Commission has started non-legislative actions to foster the roll-out of energy communities.

Please see Annex 6 for full details of the discarded options.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS INCLUDING FOR EFFECTIVENESS, EFFICIENCY AND COHERENCE?

The following sections summarise the main expected economic (including specifically energy system and macro-economic impacts), environmental and social impacts of the options considered for each of the policy areas. The analysis of the different options for each policy areas also assessed their effectiveness, coherence and, where relevant, administrative burden and compliance costs.

Part of this assessment is based on energy system modelling. As explained in Chapter 5, the three core "Fit for 55" scenarios are used consistently for design and assessment of all the "Fit for 55" initiatives. These scenarios establish boundary conditions for all policy options and the **results of these scenarios establish the range of expected impacts – of all "Fit for 55" initiatives** acting together. This is complemented with insights about impacts of specific measures considered for the revision of RED II.

As explained in Chapter 5, the **MIX scenario is the central one:** carbon pricing is covering most of the sectors and works in synergy with energy policies that address market failures in a targeted manner and provide investor/consumer certainty while pushing for uptake of innovative technologies. The MIX scenario is balanced, while the **REG and MIX-CP scenarios are more**

extreme outlooks showing the impacts of relying mainly on regulatory measures or mainly on carbon pricing, respectively.

It is important to highlight that with a certain degree of simplification, low ambition policy options considered in this IA consisting of additional guidance or other soft measures would likely lead to the results of the MIX-CP scenario. Conversely (and again with certain degree of simplification), the most ambitious regulatory options would yield results similar to the REG scenario with carbon price likely at very low levels/irrelevant.

This is why the results of three core scenarios are used for the assessment. If relevant, additional variants (presented in section 5.5) results are discussed notably as concerns the innovative renewable fuels.

Finally, as an alternative approach, the MIX-LD variant provides insights about the impact of the absence of revision of RED in the context of MIX scenario – mostly discussed in section 6.1.

6.1. Overall renewable energy target level and achievement

6.1.1. Level of overall renewable energy target resulting from core scenarios and variants

As already explained in Chapter 5, the results of the "Fit for 55" core scenarios indicate a similar range for EU level of ambition on overall RES share in 2030: 38-40% as necessary for the increased climate target of 55% GHG reductions in 2030 – in agreement with CTP analysis. The RES shares in the scenarios (overall and sectoral) are summarised in the table below.

Table 2 - Renewable energy shares in core scenarios; Source: PRIMES, ESTAT

		Overall RES share	RES-E	RES-H&C	RES-T
2005		10.2%	16%	12%	2%
2015		17.8%	30%	20%	7%
2030	**REF**	33.2%	59%	33%	21%
	REG	39.7%	65%	41%	29%
	MIX	38.4%	65%	38%	28%
	MIX-CP	37.8%	65%	36%	27%

In the MIX-H2 variant, an increased overall RES share of 40.2% results from the higher uptake of RFNBOs in line with the 40GW electrolyser capacity envisaged in the Hydrogen Strategy. This variant is discussed in Section 6.6.

In the MIX-LD[76] variant, a gap of 2.1 p.p. appears to overall RES share projected by MIX scenario chiefly driven by the gap to the necessary RES-H&C share (2.9 p.p.) and to the RES-E share (2.7 p.p.).

Table 3 - Results of MIX-LD scenario; Source PRIMES

2030		Overall RES share	RES-E	RES-H&C	RES-T
MIX-LD		36.3%	62%	35%	27%

This variant is counterfactual in the sense that in the absence of the REDII revision, carbon prices would have increased, but such an outlook is already illustrated in the MIX-CP scenario. MIX-LD also has useful insights post-2030. As this variant still achieves carbon neutrality in 2050, thus in the absence of a REDII revision, efforts in renewables deployment post-2030 would have to be considerably increased to bridge the gap that would be created in the current decade.

Finally, it also has to be stressed that this variant does not capture more granular measures of the REDII revision concerning capacity building and local deployment, self-consumption and other aspects and consequently the strong negative signal towards investor and consumer confidence that the absence of a REDII revision would create.

6.1.2. Impacts projected by the core scenarios and MIX-LD variant

6.1.2.1 Economic (including Energy System) impacts

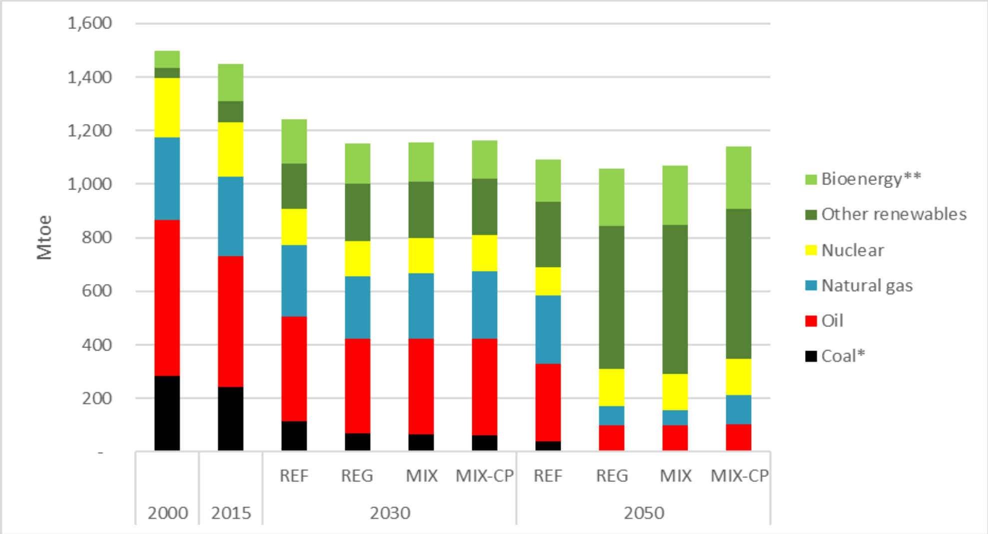
Energy system

The core scenarios lead to an acceleration of the clean energy transition. Even though their policy drivers are differentiated as described in Chapter 5, the results in terms of fuel mix are very convergent. In all core scenarios renewables deployment is the key avenue for the necessary decarbonisation of the fuel mix. This is best illustrated by the changes in the fuel mix – both in the Gross Inland Consumption (GIC) and in Final Energy Consumption (FEC). In GIC, the renewables share grows from 15% in 2015 to already 27% in REF and then 30-31% in the core scenarios. Bioenergy, that is today the main renewable source, has in REF in 2030 the same share in the GIC mix as other renewable sources together. In 2030, in the core scenarios the share of bioenergy remains stable compared to REF while other sources grow, notably wind and solar in power generation.

In MIX-H2 variant, GIC in 2030 increases very slightly (1% compared to MIX) due to additional electricity needs for RFNBOs production. Renewables share increases to 32% and it is due to higher consumption of wind and solar energy in power.

[76] As described in Chapter 5, the MIX-LD (MIX-Lost Decade) variant was developed to assess impacts of the absence of revision of RED. This variant removed all drivers representing REDII revision while "freezing" all other policies (in particular carbon pricing) at their level of ambition/stringency as modelled in MIX.

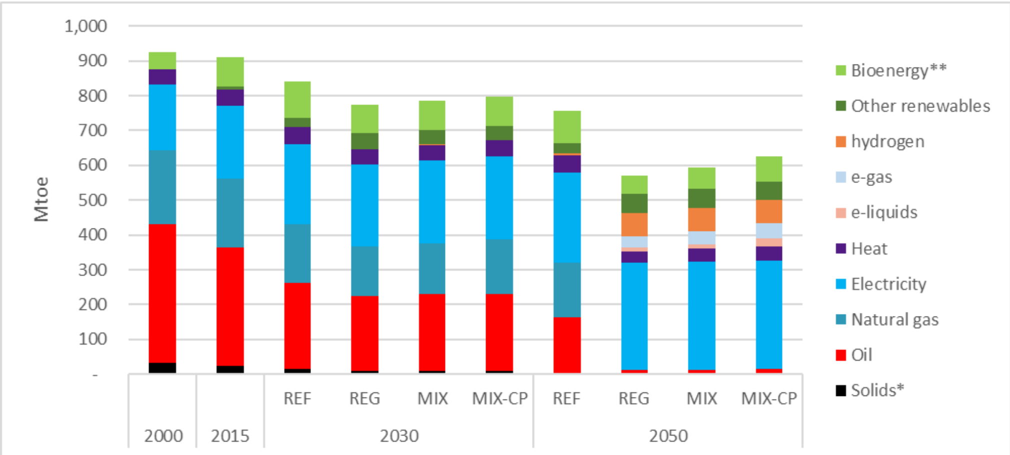
Figure 4 - Gross inland consumption in the core scenarios; Source PRIMES



In terms of fuel mix in final energy consumption the trends are less pronounced than in GIC, the renewables share grows here from 10% in 2015 to 15% in 2030 already in REF and to 16% in the core scenarios. The key trend in final energy consumption is electrification promoted by energy efficiency, renewables and decarbonisation policies. With electricity increasingly relying on renewables (see section 6.8) the electrification of final energy demand provides an additional pull for renewables deployment in the power sector.

In MIX-H2 variant, FEC in 2030 is unchanged compared to MIX. While bioenergy consumption decreases, the RFNBOs share increases but electrification remains the main trend and the renewables shares grows to 17%.

Figure 5 - Share of energy carriers in final energy consumption; Source ESTAT, PRIMES



The MIX-LD variant shows that in the absence of the REDII revision, the energy system would have lower renewables penetration both in GIC and FEC and thus would leave more space for natural gas in heating and in power generation.

Energy system costs

The clean energy transition requires investments (CAPEX) but also enables a reduction in the energy expenditure (OPEX) – both aspects are included in the energy system costs metric projected for all core scenarios.

It is important to notice that energy system costs have been steadily increasing in recent years and are projected to increase in the coming decade reflecting the effort needed to meet the current climate and energy targets for 2030. From an estimated 1,284 billion EUR (or 9.7% of GDP) in 2015, system costs (excl. carbon pricing and disutilities) are estimated to reach 1724 billion EUR (or 11.6% of GDP) in 2030 in REF.

The climate and energy policies already in place (and thus included in the REF) lead to a relatively limited increase in costs between the REF and the core scenarios. The REF already entails significant investments in energy efficiency, renewable energy deployment and shifts to low carbon technologies and fuels. This paves the way for costs reduction for energy-efficient and low-carbon technologies and fuels, which help to reduce the additional energy costs for the core scenarios. The table below shows the energy system costs (excluding carbon pricing payments and disutilities[77]) in the core scenarios.

Table 4 - Average annual Energy System Costs in the scenarios (excluding carbon pricing payments and disutility costs); Source PRIMES

		REF	REG	MIX	MIX-CP	MIX-H2 variant
2030	**in bn €**	1,724	1,777	1,769	1,753	1,784
	% of GDP	11.6%	12.0%	11.9%	11.8%	12.0%
2021-30 average annual	**in bn €**	1,518	1,555	1,550	1,541	1,555
	% of GDP	10.9%	11.2%	11.15%	11.1%	11.2%

The average annual additional energy costs/investments (excluding carbon pricing and disutilities) show very small variations across the core scenarios as both the investments and energy expenditure are similar. The average over the 2021-2030 decade increases from 10.9% of GDP in REF to 11.1% - 11.2% of GDP in the core scenarios. MIX-H2 variant has only slightly higher costs than scenario MIX. In agreement with the results presented in the CTP Impact Assessment, system costs appear to be slightly higher in the REG scenario that relies on stronger regulatory policies in absence of carbon pricing.

Due to the higher carbon price in all core scenarios, when payments for carbon auctions are accounted for and adding also disutilities, systems costs increase from 11.0% in REF to 11.5-11.8%

[77] Disutility costs measure the difference in the use of energy services compared to a counterfactual scenario using the income compensating variation method.

of GDP over the 2021-2030 decade. MIX-H2 variant has the same costs as scenario MIX. In agreement with the results presented in the CTP Impact Assessment, system costs including carbon pricing and disutilities are higher in MIX-CP scenario that relies on stronger carbon pricing.

Table 5 - Average annual Energy System Costs (including carbon pricing payments and disutility costs); Source PRIMES

		REF	REG	MIX	MIX-CP	MIX-H2 variant
2030	**in bn €**	1,740	1,855	1,890	1,919	1,903
	% of GDP	11.7%	12.5%	12.8%	13.0%	12.8%
2021-30 average annual	**in bn €**	1,535	1,598	1,630	1,647	1,634
	% of GDP	11.0%	11.5%	11.7%	11.8%	11.7%

Energy system costs increases in the core scenarios are moderate because the additional investments in new power capacity, buildings' renovations or rolling stock are offset by savings on energy purchase and in particular fossil fuels expenditure.

The MIX-LD variant shows that in the absence of the REDII revision, the system costs would be lower but the difference would be rather small: only 4bn EUR/year in 2021-30 period (metric excluding carbon pricing and disutilities). This is explained by the fact that while some investments in renewable power generation/heating would not take place, investments in natural gas power generation/heating would still be needed. Also no savings in energy expenditure can be achieved by switching to renewables (many of them with zero operational costs).

In addition to the energy system costs assessment, it is also useful to assess impacts on security of supply and savings in fossil fuels imports. The savings in energy expenditure have direct effect in fossil fuels import bill savings as today most of energy expenditure is on fossil fuels. The table below shows summary of the results of core scenario as well as MIX-H2 variant in this respect. It is clear that renewables deployment that displace fossil fuels is the key factor of these savings. The REG scenario has the highest savings.

MIX-LD variant shows that in absence of REDII revision, the fossil fuels import bill would be higher as lower uptake of renewables would leave more energy demand to be satisfied by fossil fuels. The savings between MIX and MIX-LD amount to 15bn EUR over the period 2021-30.

Table 6 - Impacts on security of supply and fossil fuels imports bill savings; Source PRIMES

	REF	REG	MIX	MIX-CP	MIX-H2 variant
Import dependency %	54%	52%	53%	53%	51%
Fossil fuels imports bill savings compared to REF for the period 2021-30 (bn €'15)	-	136	115	99	134

Zooming in on investments that are an essential element of system costs, it can be seen that policies already in place will require on average 297 billion € per year in the in the 2021-30 period (excluding transport). This is a considerable increase from the estimated 184 billion € per year spent in the past decade. When compared to the size of the European economy, the investment required in the next decade under polices already in place will amount to 2.1% of the average GDP.

The projections confirm the main trends already observed in the CTP impact assessment. An increased climate target for 2030 will require considerable additional investments. In the policy scenarios annual investments excluding transport[78], increase to 379-417 bn € per year in the 2021-30 period. This is between 2.7- 3.0% of the European GDP. Investments are higher in the scenario based on an intensification of policy measures (REG) than in a scenario with higher carbon price (MIX-CP). This result illustrates the difference in effects of bottom-up policy measures that tend to increase, for example, renovation rates in buildings compared to effects of carbon pricing that promotes mainly fuel switch.

The MIX-LD variant shows that in absence of REDII revision, the investments would be lower but the difference would be rather small: only 18bn EUR/year in 2021-30 period. This is explained by the fact that while investments in renewable power generation/heating are lower in such a scenario they are replaced by investments in natural gas power generation/heating.

The table below shows the investments by sector in the REF and in the policy scenarios. Apart for transport, the residential sector is the sector requiring the higher amount of investment highlighting the important role of buildings in emissions reduction.

Table 7 - Investment in REF and core policy scenarios (2021-2030 annual averages, billion € 2015); Source PRIMES

Investments (bn € 2015)		**REF**	**REG**	**MIX**	**MIX-CP**	**MIX-H2 variant**
	Average 2011-2020	Average 2021-2030				
Investments in power grid	12.8	35.1	43.9	43.8	43.9	46.1
Investments in power plants	32.1	41.8	54.1	54.7	55.1	63.7
Investments in boilers	2.3	2.6	3.9	3.8	3.7	3.8
Investments in new fuels production and distribution	0.0	0.0	0.7	0.7	0.6	7.3
Overall supply side investments	47.1	79.6	102.7	103.0	103.3	120.9
Industrial sector investments	10.2	17.0	23.7	24.7	24.1	24.4

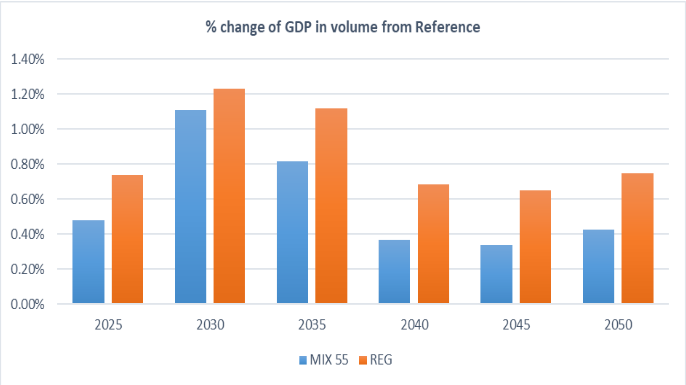
[78] Transport investments in PRIMES include vehicles replacement and are therefore not directly related to additional decarbonisation costs.

Residential sector investments	87.8	125.5	193.8	180.1	157.6	179.7
Tertiary sector investments	40.2	74.6	97.0	94.2	94.5	94.4
Transport sector investments	474.3	647.4	650.6	649.3	648.2	654.1
Overal demand side investments	612.4	864.5	965.1	948.2	924.3	952.6
Overal energy system investments	**659.5**	**944.0**	**1067.7**	**1051.3**	**1027.6**	**1073.5**
as % of GDP	**5.4%**	**6.8%**	**7.7%**	**7.6%**	**7.4%**	**7.7%**
additional to 2011-2020 annual average		*284.5*	*408.2*	*391.7*	*368.0*	413.9
Overal energy system investments excl transport	**185.2**	**296.7**	**417.1**	**402.0**	**379.4**	**419.3**
as % of GDP	**1.5%**	**2.1%**	**3.0%**	**2.9%**	**2.7%**	**3.0%**

Macro-economic impacts of core scenarios

Analysis with macroeconomic models confirms the results presented in the CTP impact assessment. The impact on the European GDP of the increased climate target (or more precisely of the investments necessary to achieve it) is small in any of the cases assessed. Projections obtained with the GEM-E3 macroeconomic model indicate a small positive effect on GDP if assuming favourable financing conditions. Compared to Reference projections, GDP is 0.52% higher in 2030. Assuming crowding out of investments, however, GDP in 2030 is 0.2% below the Reference level. In line with previous findings, result for the MIX and REG scenarios are very similar. The effect of stimulus created by investments wanes after 2030.

Figure 6 - Macro-economic impacts of core scenarios; Source GEM-E3



6.1.2.2. Environmental impacts

All core scenarios, by construction, achieve the 55% net GHG target in 2030. Renewables deployment stimulated by the overarching level of RES ambition as well as policies dedicated to achieving it play an important role in GHG abatement – in synergy with other "Fit for 55" policies. Renewable fuels are accounted as having zero emissions in the energy system and by displacing GHG-emitting fossil fuels they lead to GHG emissions savings.

MIX-H2 variant only slightly overachieves 55% GHG reduction (it has 0.4 p.p. higher GHG reductions than MIX looking at GHG emissions including intra EU aviation and maritime but excluding LULUCF).

The MIX-LD variant in the absence of drivers illustrating revision of RED, would create a gap of 1.2 p.p. to GHG 55% target. Also some synergies with energy efficiency would be lost and using the metric of the current EE targets, MIX-LD would lead to 35.0% of energy efficiency in final energy consumption in 2030.

In addition to impacts on decarbonisation, all core scenarios lead to important overall benefits in terms of heath protection and reduction of pollution. This is mainly due to the replacement of fossil fuels by renewable energy sources, notably non-combustion ones. Combustion renewable energy sources (bioenergy) emits air pollutants (PM2.5, PM10 and VOCs). The reduced air pollution compared to REF was estimated at 10% in 2030. Reduced health damages and air pollution control cost compared to REF were estimated at € 25-43 bn/year[79].

6.1.2.3. Social Impacts

The table below shows the energy-related costs incurred by households, which are key social impacts of the core scenarios. In REF, the share of energy-related expenditures (comprising both equipment and energy purchases related to both transport and buildings) as % of private consumption increases slightly from 24.1% in 2015 to 25.1% in 2030. In the core scenarios, the share increases to 25.6-25.8% in 2030 with little differentiation among scenarios. Importantly, between 2015 and 2030, the absolute amount of energy-related expenditure (growing due to investments necessary for clean energy transition and to carbon price mark-up) is moderated by the growth in overall private consumption linked to economic growth and increasing welfare of the society.

The share of **buildings-related expenditure** in private consumption differs little across core scenarios in 2030 (7.4-7.5% without counting disutilities) and in MIX-H2 variant (7.6%). Buildings-related expenditure is dominated by energy purchase expenditure. In comparison, equipment and renovation costs are smaller but also add up to the expenditure as expected from the trends in fuel switch and renovation rates[80]. The costs of heating equipment are the highest in REG, where the highest uptake of renewables in the buildings sector leads to highest replacement rate of heating equipment with households notably switching to heat pumps. Renovation costs are also the highest in REG.

[79] For complete discussion, please refer to IA accompanying ESR revision.
[80] For analysis of renovation rates, please refer to IA accompanying revision of EED.

Transport related costs are dominated by capital and fixed costs of vehicles followed by expenditure for transport services and energy purchase expenditure. For transport related costs alone, their share in total households' consumption is nearly stable between 2015 and 2030 in REF reflecting the gains of fuel efficiency standards. The overall share of transport-related expenditure in total household consumption differs very little across core scenarios in 2030 (18.1-18.5% without counting disutilities) and MIX-H2 variant remains in this range.

The MIX-CP scenario relying on high carbon price leads to the highest expenditure for energy purchases as carbon price mark-up is reflected in this expenditure. Conversely the REG scenario relying on strong regulatory action leads to highest expenditure for renovations and H&C equipment. By including more regulatory instruments alongside carbon pricing, notably via revision of RED, the carbon price increase can be lower and thus impacts on energy bill kept in check – as illustrated in the MIX scenario.

The MIX-LD variant shows that in the absence of a RED revision, energy-related share of household consumption would be very similar to MIX case. This is again explained by the fact that no savings in energy bill can be achieved by switching to renewables (many with zero operational costs) but also no additional investments for fuel switching from fossil-fuel technologies are necessary to replace renewables-based heating installation. Transport-related expenditure does not change as here the ambition stems chiefly from NECPs and not RED revision.

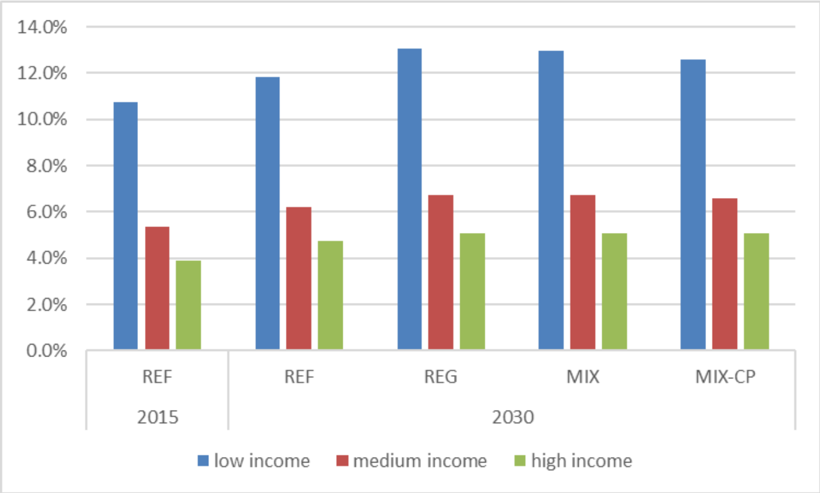
Table 8 - Energy-related expenses in 2030 (excl. disutilities); Source PRIMES

	2015	**2030**			
		REF	**REG**	**MIX**	**MIX-CP**
Energy-related expenses as % share of private consumption	24.1%	25.1%	25.6%	25.8%	25.8%
of which for related to buildings (comprising fuel expenditure, exchange of H&C and other equipment and building shell renovation expenditure)	6.1%	6.9%	7.5%	7.5%	7.4%
of which related to transport	18.0%	18.1%	18.1%	18.3%	18.5%

The social impacts can be also analysed in terms of their distributional impacts on different income groups[81]. For low-income group, in all core scenarios, the share of energy-related expenditure in their private consumption is higher (than for average of all income groups) indicating the need for targeted policies addressing needs of vulnerable households. There is only a small differentiation of results among the core scenarios and with the same logic as described for average results for all income levels.

[81] PRIMES model has only information rated to income groups in its buildings module.

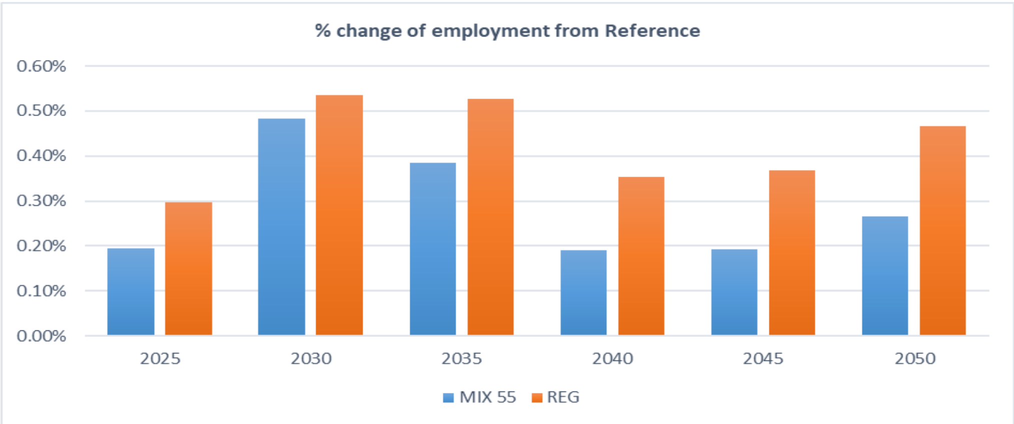
Figure 7 - Energy-related expenses in 2030 (excl. disutilities) as % share of private consumption; Source PRIMES



Macro-economic impacts of core scenarios

Analysis with macroeconomic models confirms the results presented in the CTP impact assessment. The impact on the employment in the EU of the increased climate target (or more precisely of the investments necessary to achieve it) is small in any of the cases assessed. Projections obtained with the GEM-E3 macroeconomic model indicate a small positive effect on employment if assuming favourable financing conditions. Compared to Reference projections, employment is 0.36% higher in 2030. Assuming crowding out of investments, however, employment in 2030 is 0.3% below the Reference level. In line with previous findings, result for the MIX and REG scenarios are very similar. The effect of stimulus created by investments on job creation diminishes after 2030 but its effects are stronger than in case of economic growth.

Figure 8 - Macro-economic impacts of core scenarios; Source GEM-E3



6.1.2.4. Distributional impacts

This IA, as a proportional exercise, focuses on the EU-level impacts, notably as projected by the core scenarios. But the impacts on level of MS are also a key consideration for policy proposals and national results from modelling are also available. Dedicated publication: “Technical Note on the

Results of the “Fit for 55” core scenarios for the EU Member States” is presenting the key impacts on MS energy system and beyond (notably economy-wide GHG emissions) for the core scenarios.

Importantly, these impacts result from all “Fit for 55” initiatives and represent the situation in which all MS would contribute cost-effectively to the EU-level targets. The real-life impacts will be different considering that for most of energy legislation Member States have choice in how to implement specific provisions in a way that is best suited to their own national circumstances in full respect of subsidiarity principle. The case in point are revised 2030 RES and EE contributions that Member States will be themselves putting forward. Also, the Member States’ ESR targets will build on but deviate from the cost-effective contribution indicated by the core scenarios.

In this section, some key results of core scenarios are discussed without yet correction of possible implementation on the national level and thus purely from the angle of cost-effective contribution to the EU targets.

Aggregated impacts

On the most aggregated level, the energy system costs can be assessed and they are presented in “Technical Note on the Results of the “Fit for 55” core scenarios for the EU Member States”. The impact of the increased climate target and delivering the Green Deal (and increased RES and EE uptake that go alongside) will represent the energy system cost increase for all MS. However most of the projected increase in energy system costs will occur already in the in the REF2020. On the EU level, between 2020 and 2030, energy system costs are projected to increase 20% in the REF2020 and 26-27% in the core policy scenarios.

Today, the share of GDP spent on energy system services varies considerably between Member States: from 5.3% for Ireland in 2020 to 20.9% for Bulgaria. There are several reasons for this divergence, notably including economic development. As household wealth and prices increase, the national economies tend to specialise in activities with higher value added and lower energy intensity (services). As households’ income *increases*, energy intensity of the economy tends to *decrease*. Therefore, also energy system and mitigation costs expressed as a proportion of GDP decrease[82] with increasing household income. Considering together the impact of increased climate target and increasing wealth shows small increases in energy system costs for all MS (core scenarios compared to REF2020) and that disparities remain. In central MIX scenario[83], the share of GDP spent on energy services varies from 6.1% for Ireland in 2020 to 26.8% for Bulgaria.

Still on aggregated level, the combined impacts for private consumption can be assessed and they are also presented in “Technical Note on the Results of the “Fit for 55” core scenarios for the EU Member States”. As for the system costs, with the growth of economy household wealth tends to increase faster than energy costs. For wealthier Member States, energy expenditures represents a lower share of households’ expenditures. Some MS with lower income (e.g. Bulgaria and Croatia) spend today almost double of the average EU share (approximately 7% of household income) on energy. The policies in the Fit for 55 package will increase the households energy expenses for all Member States by a small amount and the disparities will still remain.

[82] If no change of policies was assumed

[83] Very similar MS results can be observed in all core scenarios. Consequently, this section discusses only the national results of MIX scenario.

Looking at more detailed elements and most linked to revision of REDII, the changing fuel mix in H&C and in electricity are analysed below and the impacts they have in terms of costs.

Fuel mix change in H&C sector impacts

The table below shows projections of MS RES-H&C shares in MIX and how they need to increase in 2030 between REF2020 and MIX scenario (in p.p). Importantly, RES-H&C shares cover residential, services and industrial sectors. In all these sectors, a substantial fuel switch from fossil fuels to renewable fuels/electricity occurs and thus lead to change in energy-related expenditure. While the industrial and services sectors have the possibility of cost pass-through via the product prices, the consumers in residential sector have to cover the expenditure themselves and thus impacts are easier to assess. Two key elements of this residential expenditure are discussed in this section:

- fuel purchases, which have markedly higher share of renewables and electricity with the remaining fossil fuels bearing a carbon price mark-up due to ETS extension;
- H&C equipment expenditure, which shows the cost relevant to replacement of H&C equipment.

Table 9: National RES-H&C shares and impact on buildings-related expenditure (as share of private consumption); PRIMES,EC own calculations

	RES-H&C share in MIX in 2030 (% share)	Increase in RES-H&C share between REF and MIX in 2030 (p.p. increase)	Change in share of fuel expenditure as % of private consumption between REF and MIX in 2030 (p.p. change)	Change in share of H&C equipment expenditure as % of private consumption between REF and MIX in 2030 (p.p. change)
EU	38.0%	5.2%	-0.1	0.3
AT	44.4%	2.4%	-0.2	0.1
BE	17.0%	5.0%	0.1	0.4
BG	48.2%	3.7%	-0.3	0.3
CY	55.5%	17.7%	-0.8	1.6
CZ	34.6%	4.2%	0.2	0.0
DE	30.7%	7.0%	0.0	0.4
DK	61.5%	0.1%	-0.1	0.1
EE	65.2%	1.1%	-0.1	0.0
EL	49.7%	5.6%	-0.5	0.7
ES	33.0%	0.8%	-0.2	0.0
FI	63.9%	2.4%	-0.4	0.6
FR	45.3%	6.4%	-0.3	0.3
HR	49.8%	6.5%	-0.6	2.2
HU	34.0%	7.0%	0.0	0.9
IE	40.4%	11.2%	-0.4	0.0%
IT	37.6%	5.2%	-0.2	0.3
LT	67.5%	0.2%	-0.1	0.0
LU	33.8%	5.7%	-0.1	0.1
LV	68.6%	1.7%	0.1	0.0

	RES-H&C share in MIX in 2030 (% share)	Increase in RES-H&C share between REF and MIX in 2030 (p.p. increase)	Change in share of fuel expenditure as % of private consumption between REF and MIX in 2030 (p.p. change)	Change in share of H&C equipment expenditure as % of private consumption between REF and MIX in 2030 (p.p. change)
MT	39.6%	10.7%	-0.1	0.0
NL	16.2%	2.2%	-0.1	0.1
PL	34.4%	7.4%	0.5	0.7
PT	53.5%	1.2%	-0.2	0.0
RO	38.2%	5.2%	0.1	0.0
SE	72.9%	1.3%	-0.3	0.2
SI	48.2%	6.2%	0.1	0.5
SK	31.2%	7.9%	0.3	0.2

The MIX scenario projects that the share of renewables in H&C has to increase considerably in all MS and this in close correlation with respective national potentials. However, the effort is balanced across MS and the costs impacts for households are moderate. Largest fuels costs increase are mostly incurred by MS still having high share of fossil fuels in their residential energy mix and lowest costs increases are incurred by MS that have most significant fuel switch to renewables and electricity. The largest decreases in fuel costs often go hand in hand with highest expenditure increases for H&C equipment. These two elements to some extent balance out and the overall, buildings-related energy expenditure share in private consumption (including also renovation costs and other energy-consuming equipment costs) show rather small increases between REF2020 and MIX scenario in 2030 (see “Technical Note on the Results of the “Fit for 55” core scenarios for the EU Member States”).

Fuel mix change in power generation impacts

The table below shows projections of MS RES-E shares and how they need to increase in 2030 between REF2020 and MIX scenario (in p.p). The increase of overall RES ambition is the driver alongside the increase of the ETS price in the current scope. The impacts of renewables uptake in power generation can be analysed:

- from the supply-side perspective - a substantial fuel switch from fossil fuels to renewable solutions in power generation leads to a significant investment needs increase
- from the consumer perspective - in terms of electricity prices.

It can be observed that all MS need to increase considerably their investment in renewables in power generation and the effort is, even more than for RES in H&C, differentiated across MS in line with potentials for different technologies. Importantly, power generation is the sector where renewables share is already very high in REF2020 or potential is still limited due to land constraints, more remote locations and less mature technologies would be needed. Clearly, the MS with large offshore, onshore or solar potential, including repowering, (still available in addition to ambitious developments taking place already in the REF2020) have a most significant increase in investment needs such as Czechia, Italy, Romania, and Slovenia. The investments in new installations are in modelling recovered via electricity prices. It can be noticed that for most MS the electricity price declines in 2030 (comparing MIX to REF2020) and often in the strongest manner for MS that have the most ambitious developments in renewables.

Table 10: National RES-E shares and impact on investment needs in renewables in power generation and on electricity prices; Source: PRIMES, EC own calculations

	RES-E share in MIX in 2030 (% share)	Increase in RES-E share between REF and MIX in 2030 (p.p. increase)	Increase in investments in renewable power generation[84] (% change) between REF and MIX in 2021-2030	Change in electricity prices (% change)
EU	64.8%	6.3	42%	-1.3%
AT	93.6%	0.9	17%	0.1%
BE	40.4%	2.0	35%	-1.2%
BG	37.5%	2.2	18%	7.1%
CY	40.9%	13.3	66%	-1.0%
CZ	34.9%	15.7	220%	2.2%
DE	66.5%	4.4	39%	1.8%
DK	94.5%	1.0	4%	-0.2%
EE	54.0%	10.9	24%	1.6%
EL	68.2%	2.6	13%	-3.6%
ES	89.5%	2.6	20%	-4.9%
FI	53.7%	1.6	33%	-1.2%
FR	55.6%	4.3	27%	-1.7%
HR	70.8%	6.4	88%	4.5%
HU	25.0%	4.3	65%	-3.6%
IE	75.5%	5.6	13%	-2.7%
IT	67.3%	16.8	166%	-2.5%
LT	77.3%	18.6	79%	-3.9%
LU	41.5%	1.3	8%	-4.4%
LV	76.2%	1.8	9%	3.8%
MT	14.1%	3.5	161%	-4.0%
NL	82.0%	9.8	26%	-14.5%
PL	42.0%	11.0	93%	1.2%
PT	89.0%	2.3	16%	-4.4%
RO	59.6%	10.3	109%	-1.5%
SE	88.6%	5.8	220%	-3.0%
SI	45.6%	10.0	151%	7.0%
SK	31.4%	7.1	83%	1.2%

[84] Excluding biomass

6.1.3. Effectiveness

6.1.3.1 Level of target

The default Option 0 is the baseline in which the EU RES target is not increased to reflect the new climate ambition. In effect the result would be that the 38-40% renewable energy target would be aspirational rather than mandatory and would make it difficult to mobilise the necessary policy effort at national level and make use of EU-level instrument in response to non-target achievement. However, it is important to note that in the absence of an increased overall EU RES target and further renewables-specific policy intervention, some effectiveness could be reached through other regulatory instruments (EED, EPBD for example), or market based instruments with higher carbon prices to partially compensate for not increasing the overall EU RES target.

Furthermore this option would also mean Member States are not bound to revise their national contributions upwards and that there would be no action taken if Member State policy commitments are insufficient to deliver the 2030 target. Thus, an EU RES share increase would rely on Member States voluntarily revising their ambitions upwards in the context of national policy updates.

Options 1 and 2 would require increasing the EU target to at least 38-40%. Although Option 2 would be the more effective option in contributing effectively for further GHG reduction, higher shares of renewables would diverge from the cost-effective pathways established in the CTP. Furthermore higher ambition for renewable energy share would have to be balanced with different levels of ambition in other sectors hence departing from the coherence of the targets proposed under the CTP. The level of ambition proposed in the context of this initiative is fully coherent with the analysis provided in support of the CTP and would be effective in reaching the increased climate ambitions. Feedback received through the open public consultation highlights broad support for increase of climate and renewable energy targets with 80% of respondents in favour of an increase at least to the level of the CTP and higher.

6.1.3.2 Nature and delivery of the target

Once the EU target has been raised, automatically an ambition gap emerges as the collective sum of the national contributions currently documented in the NECPs are no longer sufficiently ambitious to achieve the EU target.

Option 0 would imply no change and continue relying on the current Energy Union Governance process, which is an important foundation for achieving the renewables target. In the first iteration of the review process of national plans completed in 2020 this proved to be effective in achieving a sufficiently high collective ambition for reaching the previous 2030 RES targets. Under the Governance Regulation the Member States must submit their draft updates to their NECPs by June 2023.

In that draft NECP update Member States can already show their national contribution to a new increased 2030 target and give some elements of how they are planning to reach the higher target. By the submission of the final updated NECPs by end June 2024 the Member States will be able to present concrete measures leading to more ambitious RES achievement.

However, there is no guarantee that such a process will deliver the EU-wide renewables target; it is rather likely that an ambition gap remains once this has been completed. In this case, further measures may need to be considered. One option could be that any Member State with contributions below the level calculated under the RES formula are requested to either increase the ambition level of their national contributions, as under the current Governance Regulation, or make a proportionate payment to the Union Renewable Energy Financing Mechanism[85]. Based on the total Member States payments and the expected contribution from those, the mechanism would be assigned a renewable energy target which would close (part of) the EU ambition gap. Given the competitive nature of the mechanism (EU-wide tenders) this could also increase cost-effectiveness of reaching Member States contributions and thus the overall EU renewables target (see also section 6.8.1 on cross-border cooperation. Furthermore, sector-specific EU-wide targets and measures can be strengthened to the extent needed to close the ambition gap, for example requiring higher RES shares in heating and cooling, transport or electricity specifically after co-legislation through the governance process either at EU or Member State level.

An alternative option to having gap filling instruments would be to return to a system of binding national targets for Member States as per Option 1. This would be the most effective option to help ensure target achievement. However, while a majority of OPC respondents supported this, Member States are not likely to support any change to the political agreement in 2018 also because an EU-level target has proven to be sufficient to reach the old 2030 objective.

The results of the modelling scenarios can help identify some important features regarding the projected contributions Member States could make to achieve the 2030 target. The table below illustrates the overall renewables shares across all Member States for a range of different scenarios based on modelling together with those emanating from the updated formula parameters specifically for a 40% EU RES Share target.

Table 11 - Renewable shares per Member States under various criteria; Source, EUROSTAT, PRIMES,EC calculations

2020 framework			**2030 framework**			
MS	2019	2020 target	**MS**	Final NECP contribution	Current RES formula benchmarks(based on REDII)	Updated RES formula benchmarks to reach 40% RES Shares (indicative figures)
AT	33.6%	34%	**AT**	46%-50%	46%	**54%**
BE	9.9%	13%	**BE**	17.5%	25%	**32%**
BG	21.6%	16%	**BG**	27%	27%	**31%**
CY	13.8%	13%	**CY**	23%	23%	**31%**
CZ	16.2%	13%	**CZ**	22%	23%	**31%**
DE	17.4%	18%	**DE**	30%	30%	**38%**
DK	37.2%	30%	**DK**	54-55%	46%	**55%**
EE	31.9%	25%	**EE**	42%	37%	**46%**
EL	19.7%	18%	**EL**	35%	31%	**36%**
ES	18.4%	20%	**ES**	42%	32%	**41%**
FI	43.1%	38%	**FI**	51%	51%	**57%**
FR	17.2%	23%	**FR**	33%	33%	**41%**
HR	28.5%	20%	**HR**	36.4%	32%	**40%**
HU	12.6%	13%	**HU**	21%	23%	**31%**

[85] Commission implementing regulation (EU) 2020/1294 on the Union renewable energy financing mechanism, https://ec.europa.eu/energy/topics/renewable-energy/eu-renewable-energy-financing-mechanism_en

IE	12.0%	16%	**IE**	34.1%	31%	**40%**
IT	18.2%	17%	**IT**	30%	29%	**36%**
LT	25.5%	23%	**LT**	45%	34%	**45%**
LU	7.0%	11%	**LU**	25%	22%	**34%**
LV	41.0%	40%	**LV**	50%	50%	**57%**
MT	8.5%	10%	**MT**	11.5%	21%	**27%**
NL	8.8%	14%	**NL**	27%-32%	26%	**36%**
PL	12.2%	15%	**PL**	21%-23%	25%	**31%**
PT	30.6%	31%	**PT**	47%	42%	**48%**
RO	24.3%	24%	**RO**	30.75%	34%	**38%**
SE	56.4%	49%	**SE**	65-67%	64%	**71%**
SI	22.0%	25%	**SI**	27%	37%	**43%**
SK	16.9%	14%	**SK**	19.2%	24%	**32%**
EU27	19.7%	20%	**EU27**	33.1-33.7%	**32%**	**40,0%**

6.1.4. Administrative impacts

The impacts of an increased EU RES target on administrative burden will be limited as there would be no recurring administrative requirements introduced by an increasing the RES target. It would require Member States to update their renewable contributions in the national plans update under the governance framework. The administrative costs for all policy options can be estimated to be low or even close to zero as these targets can be monitored through official statistics (renewable energy shares including sectoral and absolute amounts per technology) which are already readily available at national level and from Eurostat. However, limited resources at the level of Member States to develop new official statistics, combined with the absence of a formal legal basis for countries to report data on the share of renewables to Eurostat, may be an obstacle to monitoring renewable energy improvements in detail.

6.1.5. *Coherence*

Different combinations of policy instruments considered in the different scenarios achieving the same 55% GHG target deliver only limited differences in energy savings and renewable energy shares thus confirming the CTP findings about rather convergent pathways that represent cost-effective solutions.

Table 12 - Interaction of the 2030 GHG ambition with renewable energy share and energy savings

2030, EU-27 results		**REF**	**REG**	**MIX**	**MIX-CP**
GHG reductions (incl intra EU aviation and maritime, excl LULUCF) wrt 1990	% change from 1990	43%	53%	53%	53%
Overall RES share	%	33,2%	40%	38%	38%
PEC energy savings	% change from 2007 Baseline	-33%	-39%	-39%	-38%
FEC energy savings	% change from 2007 Baseline	-30%	-37%	-36%	-35%

The REF and MIX-LD scenario show clearly that without an increase of renewable energy to at least a binding 38-40% EU target there is a risk of not achieving the higher climate target ambition. In

REG and MIX scenario increased regulatory action is needed for achieving the necessary share while in MIX-CP very high carbon price on fossil fuels (also in buildings and road transport) plays a crucial role but also potentially exacerbates distributional impacts on poorer households. Absence of regulatory drivers representing RED revision in the context of MIX scenario leads to 1.2 p.p. gap for GHG 55% target as illustrated by MIX-LD variant.

Neither the overall level of ambition nor any changes to the policy architecture that are under consideration in this impact assessment would take place in a policy vacuum. They are bound to interact with existing and planned pricing and non-pricing mechanisms to reduce GHG emissions as well as with policies promoting energy efficiency. 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 and reflected in the core scenario design.

As explained above, it is clear that the increased deployment of renewables must contribute to the achievement of the increased 2030 EU climate target in a cost-efficient manner. Furthermore, concrete policy measures in the field of renewables can help to address existing market barriers, increase investors' confidence in new technologies and redress distributional impacts. A generic target of GHG reduction is not enough to promote renewables, while increasing the share of renewable energy is essential to reducing GHG emissions. REDII is the instrument promoting the uptake of renewable energy by targeted measures, including targets (and sub-targets, e.g. for innovative technologies/fuels), covering different sectors and addressing different market failures/non-market barriers (e.g. in terms of infrastructure, development of innovative technologies, creation of lead markets, capacity building together with increasing consumer acceptance).

The revision of RED is a precondition for fulfilment of increased ESR national targets as necessary to achieve the increased climate target. The REDII revision will ensure that Member States have the right incentives and enabling framework to deploy much more renewables in the heating, cooling and transport sectors. The uptake of renewables now has been already a key avenue to meet the increased national ESR targets. Furthermore, the revision of REDII can have many positive synergies with other elements of "Fit for 55" package as explained in section 1.2. The most relevant interactions are with the Emissions Trading System, in the option which extends it to buildings and transport.

The CTP analysis clearly showed that strengthening of regulatory measures promoting renewables works in synergy with carbon pricing as discussed (see also section 5.2) and this finding is also confirmed in the "Fit for 55" core scenarios. Such synergies are even stronger in the field of energy efficiency as discussed in the EED IA. In the field of renewables, the regulatory measures such as targets for innovative fuels or sectoral targets ensure that all sectors and all technologies contribute to increased climate ambition. Also a number of regulatory measures (on PPAs, wind offshore, renewable and low carbon fuel certification) establish an enabling framework that is essential for investments to happen. Finally, a number of measures are proposed to Member States in the field of H&C respecting national competences and yet providing a clear indication of effective measures. All these measures enable balanced pathways towards an increased climate target in 2030 and avoid the very high carbon price of the MIX-CP scenario (80€/t of CO2eq in buildings and road transport) that could further aggravate energy poverty and increase distributional impacts.

When considering the nature of the target, Option 0 combined with the governance system would guarantee that the EU target would be met while with leaving enough flexibility to Member States in setting and adjusting their national targets/contributions. The Governance process also has the merit of increasing the economic efficiency of its implementation, in that the need to consult neighbouring Member States as part of the establishment of national plans means that decisions about managing energy demand and deciding on supply options would be better coordinated among Member States across the internal energy market rather than done in isolation.

On the other hand, national binding targets (Option 1) can be a strong driver for national action, ensuring political accountability and commitment to deliver results while providing flexibility to choose and apply the most suitable tools to achieve the target. However, important synergies in policy making on EU level (e.g. cross-border cooperation) could be lost. Regarding coherence with other legislation this approach would run counter to the recently established Governance framework and might lead to increases in administrative costs linked to fragmented EU action and potential harm to businesses operating across the internal market limiting the economic efficiency of this approach.

Another important element is the coherence between the overall EU RES target and the specific sub-targets specifically in sectors where renewable energy or renewable based fuels is still lacking, thus hindering further system integration. These targets and benchmarks, generally build on the current policy design in REDII while the level of ambition is consistent and coherent with other legislative instruments under the 'Fit for 55 package' also providing investor certainty and spur innovation. The assessment of the nature and design is assessed in the specific sections.

6.1.6. *Stakeholders' Opinions*

Stakeholders' Opinions

In the OPC, 43% of the respondents (that mostly came from academic/research institutions, business associations and organizations, public authorities and trade unions, and even half of the respondents coming from consumer organisations) stated that the target should be in line with the CTP of achieving at least 38-40% of renewables in the gross final energy consumption. 37% of the respondents (mostly environmental and non-governmental organisations) indicated that the 2030 Union target should go beyond 40%. In the 1st stakeholder workshop, the majority of respondents favoured an overall renewable target that is binding at both EU and national level. In the discussions, the International Energy Agency, business associations focused on transition and large energy/utility companies, among others, clearly favoured a more ambitious overall RE target.

6.2. Heating and Cooling

The options are assessed against the objectives established in section 4.2. The impacts have been assessed via 'Fit for 55' core scenarios complemented by additional modelling, analysis and case studies carried out for this Impact Assessment. Further elaboration of impacts of specific measures that can complement options on the target are set out in Annex 7. The options complement carbon price mechanisms and energy efficiency measures (addressed under the EED, EPBD reviews and the eco-design and labelling framework).

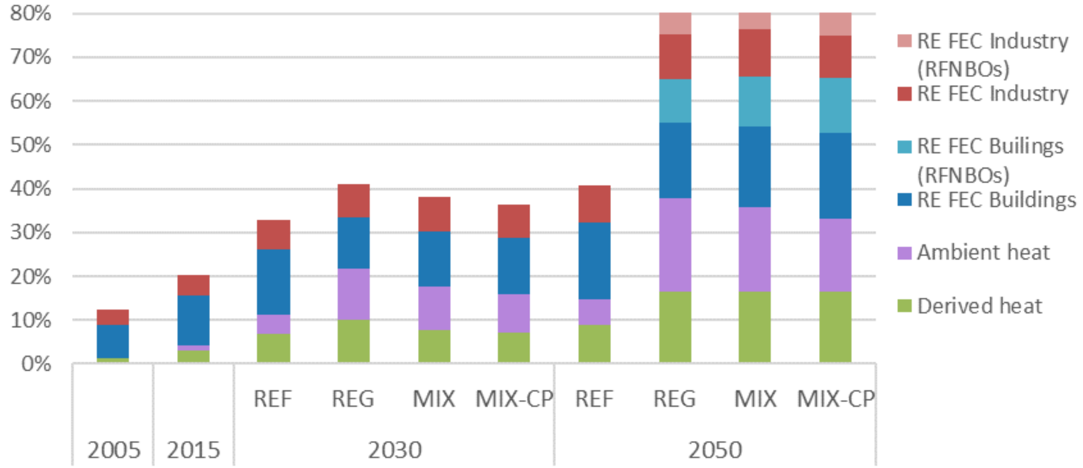
6.2.1 Target(s) and measures

The increase in RES H&C shares between 2009 and 2019 was only 5.3 p.p.[86] with the EU expected to achieve a 23.4% RES-H&C share by 2020. However, the situation varies significantly in Member States, with the share in Nordic and Baltic Member States reaching as high as 55-70% RES H&C share in 2020, and in the Netherlands, Belgium and Ireland as low as 6-8%. This reflects different starting points, different potentials and thus national fuel mixes as well as the use of collective heating and cooling systems *vis-á-vis* individual ones.

In CTP scenarios, the RES-H&C levels were projected to attain between 38-41% under policy scenarios. The results of "Fit for 55" core scenarios are in agreement with the CTP analysis as projected RES H&C shares are: 36-41%. MIX-H2 variant would be also within this range with no uptake of RFNBOS projected in buildings but some uptake in the industry. See section 6.6.

As shown in the figure below, a strong increase compared to REF of ambient heat from heat pumps and renewable derived heat consumption in district heating and cooling networks, buildings and industry is needed.

Figure 9 - Decomposition of the renewables share in heating and cooling; Source EUROSTAT, PRIMES



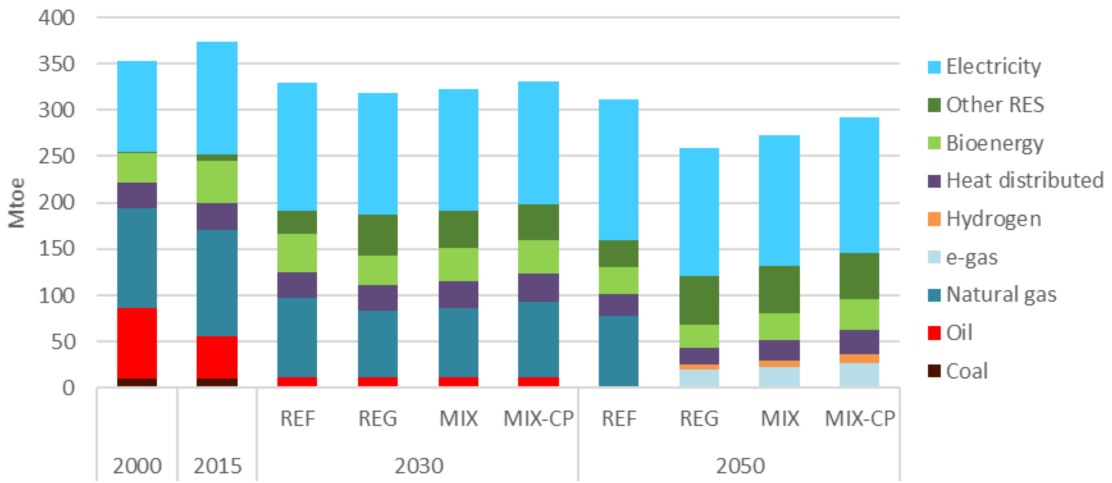
The rationale for further action is that with the implementation of current practices (option 0), the EU is projected to only reach 33% RES in H&C in 2030, contributing to the achievement of 33.2% in the overall RES-share projected in REF, therefore hampering reaching the higher GHG ambition in 2030 in a cost-effective way, which was also highlighted by the dedicated variants in the impact assessment. MIX-LD variant assessing impacts of the absence of revision of RED shows a gap of 2.9% percentage point (pp) to the necessary RES-H&C share. The fulfilment of the baseline binding target only by Member States would thus not be sufficient.

[86] EU 27 RES share in heating and cooling was 16.79 % in 2009.

Buildings have the largest share in overall heating and cooling consumption. Currently millions and millions of boilers burning fossil fuels (natural gas, coal and heating oil) are installed in buildings. Around 88% of heating is supplied from individual boilers in a highly decentralised and distributed way. Around 12% of buildings are serviced from district heating systems. District heating is also mostly based on fossil fuels[87]. The current share of renewables in the EU overall buildings stock[88] is only 23.5%[89], mostly representing biomass stoves and boilers. Heat pumps utilising ambient and geothermal energy constitute yet only 2.5% and solar thermal around 1.2%. More details are found in Annex 7 in the buildings section.

The key trend that can be observed historically and confirmed by the CTP modelling exercises, on which this IA is based, is that buildings will experience a rapid growth of electricity consumption, mostly coming from renewable sources and a decrease of fossil fuels (notably gas). As discussed in the in-depth analysis accompanying the Clean Planet for All Communication, electrification of demand combined with decarbonised electricity supply and self-generation of renewables are fundamental drivers in reaching climate neutrality by 2050[90]. Electrification is driven by rapid deployment of electric heating, most notably heat pumps, leading to efficiency gains in production and further integration of variable renewable electricity. The increased efficiency of the use of electricity in buildings is well illustrated by the limited growth in absolute electricity consumption. For specific details on the fuel mix of space heating and the share of energy carriers please see the buildings section in Annex 7.

Figure 10 - Final energy consumption in buildings; Source PRIMES

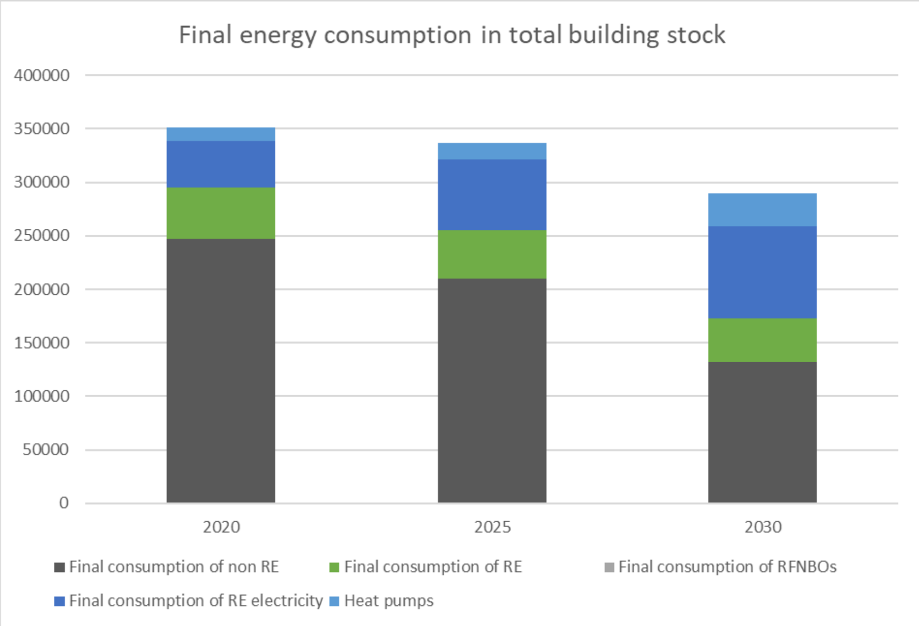


Buildings have a large potential to contribute effectively to GHG reduction through increased energy efficiency and renewable energy. The share of renewables in buildings is expected to reach more

[87] The share of renewables in district heating is 29%. Out of this 27% is biomass. Heat pumps have 1.2%, geothermal 0.7, and solar thermal 0.1%. Natural gas' share is 30%, coal and peat have 27% (2018). These shares have been calculated based on Eurostat and Euroheat & Power data under the study ENER/C1/2018-496.
[88] Residential, service and industrial sector buildings combined.
[89] This share is calculated primary energy and includes the renewable sources and fuels used to generate electricity and district heating. In final energy, the share of renewables is 16%.
[90] The paper submitted by Energy Norway for example also mentions electrification of buildings and its dependency on energy efficiency and infrastructure.

than 49% in 2030 mostly through direct renewable heat, such as solar thermal, geothermal, and bioenergy, and through a threefold increase of renewable electrification and ambient energy (see figure below). The increased renewable share also reflects reduced demand from increased energy efficiency. The aim of Option 3d) under the H&C options is to assess the need to include a minimum level of renewable energy in buildings that would complement Option 2 on the list of measures in conjunction primarily with the EPBD, the revision of which is scheduled for the end of 2021.

Figure 11 - Final renewable energy consumption in total building stock (ktoes); Source PRIMES



Stakeholders' Opinion

78% of those replying to the OPC, in particular environmental organisations (87%) and NGOs (82%), expressed the view that there should be a minimum percentage of renewables in new and renovated buildings. 15% of the participants indicated that this should only be only the case for new buildings, and 3% indicated that this should only be only for buildings subject to major renovation, and 22% of the participants think that there should not be a minimum percentage. 'Yes' is the most common reply among all stakeholder groups (environmental organisations (87%) and NGOs (82%) were the most adamant supporters and all other groups also tended to opt for this option more frequently -more than 50% of the respondents in each stakeholder group). Regarding the question which should be the minimum percentage, 45% of the participants chose the 'other' option. Amongst the provided percentages, 50% of renewable energy is the preferred e most common response (34% of EU/Non-EU citizens and 56% of respondents coming from academia/research institutions opted for this choice); followed by a renewable share of 100% (42% of the respondents coming from environmental organisations and 24% of the respondents coming from public authorities chose this answer). About 18% of the respondents chose a percentage of 40% or lower which should be set at 50%, followed by 100%. 15% of the participants indicated that this should only be for new buildings. All measures proposed to improve the replacement of heating systems were rated either appropriate or very appropriate, with a combined approval ranging from 81% to 95%. However, panellists present at the 1st stakeholder workshop warned that building-specific targets could become very expensive and miss the level of heat needed. During the 2nd stakeholder workshop, the European heating industry requested minimum targets for buildings and large renovation. Consumers requested more information measures on heat pumps and they are of the opinion that low carbon hydrogen has no place in residential heating.

6.2.1.1. Impacts projected by the core scenarios and variants

Environmental impacts

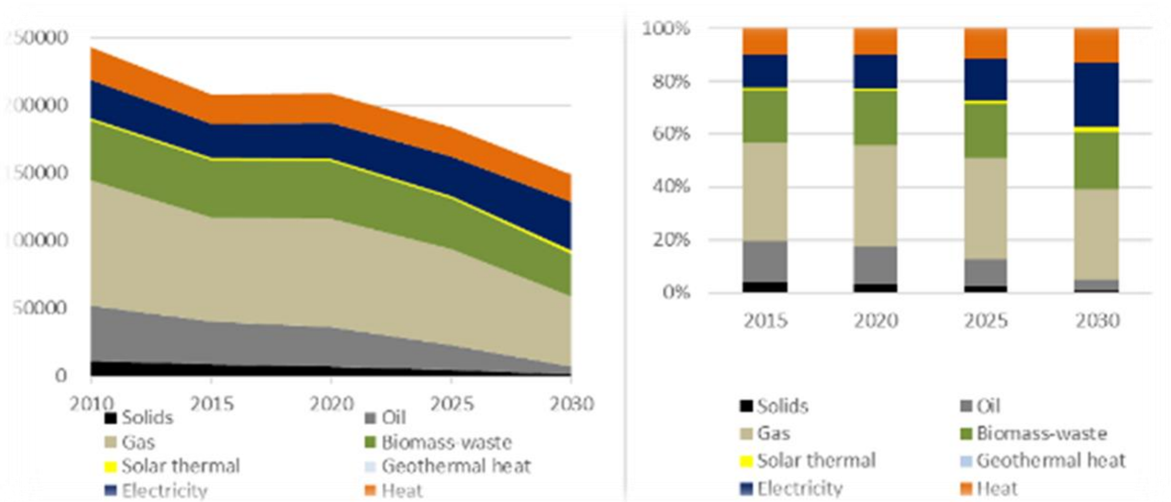
A potentially significant environmental impact of increased renewable energy in heating and cooling, together with other measures targeted at renewable heating and cooling, is pollution from inefficient biomass use. This impact is dependent on the extent biomass is used to replace fossil fuels in heating, the type of biomass and whether best available and state-of the art technologies are used, as these factor can minimise such emission. These impacts are better addressed through existing horizontal legislation as explained in more detail in Section 6.7 under bioenergy. The impact of increasing GHG ambition and increased RES-H&C on biomass deployment, the MIX scenario shows the aggregated final energy use for heating and cooling in the residential sector at EU-level.

The figure below depicts the potential evolution of the fuel mix used at residential level. The outcome of this analysis is that the biomass use remains constant (and even decreases in absolute terms) between 2020 and 2030, while oil and solid fuel use substantially decrease. This is also due to additional energy efficiency measures, extension of carbon pricing to buildings and further electrification in the heating and cooling sector. The overall combined impacts of policies targeting heating and cooling on the environment is expected to be positive. As a result significant reductions of CO2 emissions are achieved in both residential and services sector as illustrated in the table below.

Table 13 - GHG emission reduction in buildings in 2030; Source: PRIMES

Buildings sector CO2 emissions in 2030		REF	REG	MIX	MIX-CP
Residential sector	(% change from 2015)	-32%	-56%	-54%	-50%
Services sector	(% change from 2015)	-36%	-53%	-52%	-48%

Figure 12 - Final energy per energy carrier in residential heating and cooling demand; Source PRIMES



<u>Economic (including Energy System) and social impacts</u>

Fuel prices and energy expenditure

A potentially important impact of additional measures in heating and cooling would be the energy prices for households specifically for heating and cooling requirements. Using the core scenario results, the expected evolution of energy prices[91] at household level, shows an overall increase of energy prices between 2021 and 2030 (around 39% on average[92]) as shown in the figure below. Electricity (more than 60% based on renewables) and biomass energy prices are set for a limited increase (10% and 19% respectively). This increase is partially due to market developments, and partially due to climate and energy policies. The impact assessment carried out for the CTP showed that the scenario relying on high carbon pricing only, has the highest negative impact on low income households.[93] The scenario results in terms of social and distributional impacts across the core scenarios are discussed in section 6.1.2.3 and 6.1.2.4.

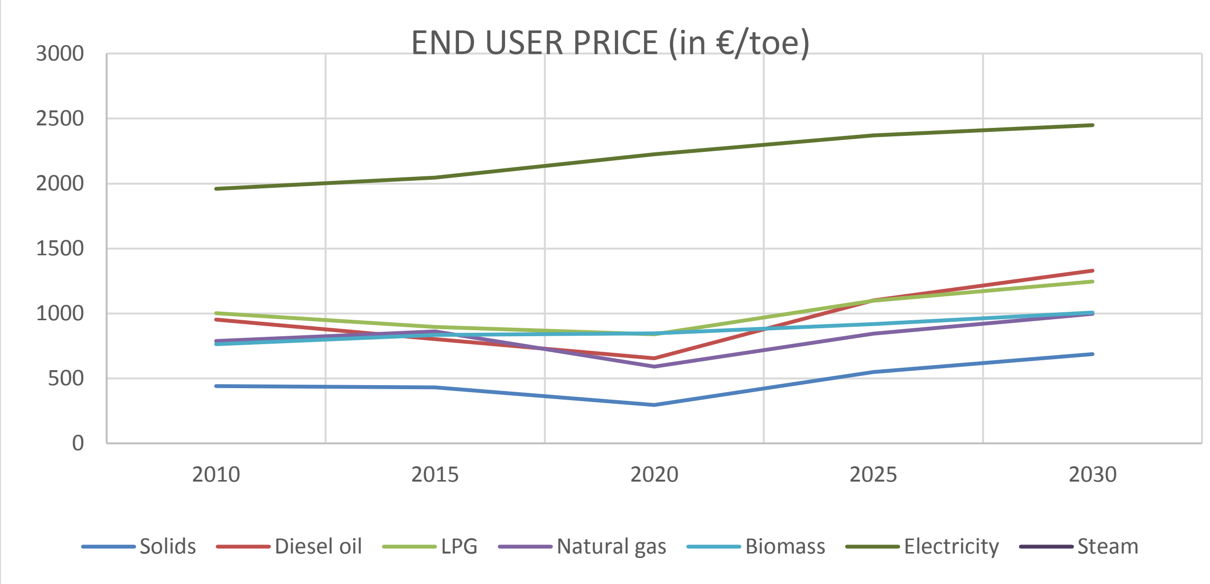
However, the distributional impacts could be at least to some extent addressed if the revenues from carbon pricing used in buildings would support low income consumers to decrease their energy bills, by e.g. focusing on these target groups with deep renovation programmes, or provide subsidies for the replacement of old and inefficient heating appliances (by renewable-based technologies such as solar thermal or geothermal based technologies which do not entail fuel prices), or providing lump sum support (possibly linked to the deployment of renewables). These targeted use of ETS revenues could offer an opportunity to accelerate both energy efficiency and renewable technologies such as heat pumps for space heating and cooling in buildings abating also air pollution especially in cities. Such programmes should be adapted to overcome the lack of capital and other barriers that may exist. The distribution of the costs and benefits of a binding H&C RES target across Member States will depend to a large extent on how a MS intends to design its framework in order to meet the target.

[91] At the system level, the mainstreaming of renewable heating systems will present additional investment cost due to the relatively low prices of oil and especially gas boilers, which have benefited from decades of market scaling, still ongoing hidden and social price subsidies and a fully amortised gas distribution network built mainly with public money in the previous decades. These legacy advantages are difficult to model together, and the relevance of locally and temporally defined costs and benefits of specific heating technologies, which would give a positive comparison of renewable heating are also not sufficiently reflected. This requires modelling tools integrating hourly resolution for demand and supply and data from geographical information systems (GIS). Other constraints are the lack of comprehensive data sets of consumption and technologies of heating and cooling as these end-uses are not directly reported in Eurostat and national statistics, but must be calculated or derived from overall energy balances and other specific or sectoral statistics, such as the recently introduced Eurostat household statistics. Thus data sets do not cover all sectors, and existing data sets are not yet available for all Member States.

[92] non-weighted average of Solids, Diesel, oil, LPG, Natural gas, Biomass, Electricity and Steam

[93] SWD(2020) 176 final – Impact assessment accompanying the document "Stepping up Europe's 2030 climate ambition - Investing in a climate-neutral future for the benefit of our people"

Figure 13 - Evolution of end user energy prices for households in scenario MIX; Source PRIMES



Modern renewable heating systems (geothermal and air/water source heat pumps, solar thermal) do not need fuel input for heating and energy consumption is limited to auxiliary energy to drive e.g. heat pumps and control systems. These manifest in positive disposable income effects from lower operating costs, reduced fuel expenditure and stable prices unaffected by global price fluctuation. While some of the renewable heat appliances require higher upfront costs, they reduce household expenditure once installed, and over their lifetime (20 years) they result in significant savings and increased disposable income. When this target under Option 3d) and the complementing list of measures under Option 2 are combined with stronger carbon pricing, as in the MIX scenario, the value of initial upfront investment decreases in relative terms and the pay-back time shortens improving the cost-benefit ratio for consumers.

In addition, some of the renewable heating appliances have lower upfront costs at installation and lower levelised cost of heat (LCOH)[94] than the reference gas (condensing) boilers (most used at EU) which varies from country to country[95]. Renewable solutions, such as heat pumps using ambient and geothermal energy, solar thermal and biomass are already competitive with the dominant gas and oil boilers. The fact that LCOH of renewable heating technologies is often already lower than that of fossil fuels, yet their market take-up remains subdued demonstrates that other, non-market barriers, such as lack of information, lack of coordination and level-playing field are at work. The list of measures under Options 2 is thus necessary to complement both the target under Option 3d) and increased carbon prices.

[94] Constant unit cost (per kWh) of a payment stream which has the same present value as the total cost incurred by installing and operating the energy/heat-producing installation over its lifetime.
[95] *TU-Wien, Fraunhofer and alia, ENER/C1/2018-494, on-going*

6.2.1.2. Impacts and analysis not based on modelling

GHG reduction:

The switch from fossil fuels to renewable heating is the main way to reduce GHG and other air pollutant emissions. Most renewable heating solutions achieve below 100 gram CO_2/kWh emissions compared to fossil fuels ranging from 240 gram CO_2/kWh to above 400 CO2/kWh[96].

Transitioning their heating and cooling systems away from fossil fuels is a key component of national strategies to achieve GHG reduction in a few Member States, which have elaborated such strategies in line with their EU and Paris agreement obligations. Among these Member States, the Netherlands, France and Germany conducted in-depth analysis and public consultation on how to pave the way towards heat decarbonisation, while Poland set a more limited objective, focussing on phasing out coal as a major source of GHG emissions and air pollution. These national strategies foresee a considerable increase of the share of renewable energy sources, while the approach to decarbonise the heating sector differs between the strategies. The Netherlands propose a district approach, in which municipalities take the lead in the transformation through "heat visions", which are developed at municipal level. The decarbonisation measures proposed in the strategies of France and Germany largely address building owners as well as professionals in the building sector. All national strategies place heating decarbonisation in buildings and renewable space heating at their core. While the strategies do not provide quantitative targets for individual renewable heat technologies, they foresee subsidy schemes and regulatory measures (RES-quota) to increase the share of renewable energies for heating.

Examples of national strategies are listed in the table below:

Climate Agreement (Netherlands) (Ministerie van Economische Zaken en Klimaat 2019)
French Strategy for Energy and Climate (Ministère de la transition écologique et solidaire 2018)
Heat Transition 2030 (Agora Energiewende 2017)
Energy Efficiency Strategy for Buildings (BMWi 2015)
Systemic challenges of Germany's heat transition (Fraunhofer ISE et al. 2020)
Energy Policy of Poland – Extract from draft (Ministry of Energy 2018)

Air pollution reduction

One of the expected impacts of the proposed Option 3d) combined with Option 2, is the significant reduction in air pollution and CO_2 emissions.

Switching for renewables from fossils in heating has been and is the main way to ensure clean air.[97] This impact has been demonstrated by the results of national strategies and case studies.

[96] Fossil heating systems CO_2 emissions are based on JRC (Petten) analysis communicated under AA 2020-520.

One such examples is that of Poland, where coal based heating is a source of emissions of sulphur compounds, nitrogen, benzopyrene and dust, as well as carbon dioxide. The main reason for poor air quality in Poland is emissions from individual sources (apart from transport) of heat generation in over 5 million buildings. Pollutants are introduced into the atmosphere from low chimneys in areas with residential buildings. Approximately 3.5 million of these buildings are supplied with heat from low-efficiency coal-fired sources. Old, energy inefficient boilers and furnaces fired with poor fuel are the main cause of smog production.

To resolve this environmental and health crisis, the "Clean Heat 2030" strategy for Poland examined how to make heating no longer a source of smog in Poland by 2030 in a cost-effective and socially acceptable way[98]. According to the analysis, health costs of pollutants can be reduced by 50% within a decade and dust emissions from individual heating by 91%. At the same time, CO_2 emissions from heating will fall by 30%. The report refers to the whole area of heating, both district heating and individual heating systems. Even with a conservative approach, the external costs of smog in Poland today exceed PLN 16 billion annually. These heat production costs are not included in the production price. Poles, however, bear these costs by paying for them with poorer health and suffering the consequences of climate change. The report suggests the elimination of solid fuels from individual heating by 2030. Domestic coal-fired furnaces should be replaced, depending on local conditions, by connection to district heating networks and on the long-term by the electrification of heating. The authors calculated that the share of heat cost in the household budget may increase by up to 2 percentage points in the short term and it will start to decrease in the long term.

Cooling

The global energy demand for cooling is growing rapidly. Cooling accounts for around 4% of final energy demand in the EU, with about 130 TWh for space cooling and about 190 TWh for process cooling[99]. Cooling is currently 99% electricity-driven, such that unlike heating, cooling typically does not involve the direct use of fossil fuels. 99% of cooling is provided by electric driven vapour compression systems (heat pumps and reversible heat pumps). Only 1% is supplied by gas or heat driven cooling generators (absorption cooling) used mainly in industry and district cooling systems. More information is included in Annex 7.

Cooling demand in buildings currently accounts for around 2% of final energy consumption in the EU, and process cooling in industry is an additional 2%[100]. Cooling demand is rapidly growing due to higher living standards, higher building energy performance standards and climate change. Space cooling (SC) in residential and service sector consumes 81.5 TWh per year[101]. Just a few countries

[97] Air pollution reduction is conditional on the extent and quality of biomass use. Low quality and inefficient use of biomass can still result in significant particulate emissions. However, the interplay between the H&C options and the bio-sustainability options ensures that limitations are placed on the use of non-sustainable and inefficient use of biomass.

[98] Clean heat 2030, Strategy for heating, Forum Energii, April 2019, available at: file:///E:/Literature/Clean%20Heat%20for%20Poland%20strategia%20dla%20cieplownictwa_en_net.pdf

[99] https://www.forecast-model.eu/forecast-en/aktuelles/meldungen/news-2016-05.php

[100] Since cooling consumption has to be calculated

[101] Renewable cooling under the revised Renewable Energy Directive, ENER/C1/2018-493 on-going. Please note that cooling consumption is not reported in European energy statistics and have to be calculated from available data on cooling stocks, building surface areas, etc.

account for the absolute majority of the final SC consumption amount of the entire EU27+UK. Spain, Italy, France, UK, and Greece come out to account for more than 80% of Europe's final SC consumption for the residential and service sectors. For countries such as Malta and Cyprus, cooling accounts for 25% and 40% in their heating and cooling mix and more than 16% and 13%, respectively, in their total final energy consumption.

The definition and calculation methodology of renewable cooling has not yet been established due to so far relatively low statistical weight of cooling in overall EU energy consumption (even if in specific countries this share can be significant). REDII specifies that the Commission shall adopt delegated acts to supplement the Directive at the latest by 31 of December 2021, including a methodology for calculating the amount of renewable energy utilized for cooling and district cooling (DC), a definition for renewable cooling, and amend the directive accordingly. In order not to prejudge the outcome of the delegated acts, no specific options were included for cooling options design.

NECPs assessment

According to the NECP assessment[102] EU 27 anticipate a share of renewable energy in the heating and cooling sector of 23% in 2020 and 33% in 2030. The 33% RES H&C share in 2030 was facilitated by more than 10% decrease in the final energy consumption for H&C projected by Member States from 2020 to 2030 in EU27[103].

The share of renewable energy is above 50% by 2020 in 5 MS (Denmark, Estonia, Finland, Lithuania, and Latvia)[104]. In Sweden, this share is above 60%[105]. Several countries report a low share of RES in the H&C sector and in three Member States the share of renewables is below 10%. In this regard, the assessment clearly shows the diverse nature of Member States energy systems and their starting points. Although Member States demonstrated significant efforts to decarbonise the H&C sector in their NECPs, there were still many aspects that were not properly incorporated by all Member States and measures were not sufficiently presented. As a result, there is a wide variation in effort levels and contribution across Member States and the burden is not shared equally in proportion of cost-effective potentials and GDP. More details are found in Annex 7.

Furthermore given the importance of the H&C sectors in the EU's final energy consumption, no action in this sector will clearly not deliver on the general and specific objective of this IA.

6.2.1.3. Effectiveness

[102] Assessment of the heating and cooling related chapters of the NECPs, JRC (Petten) 2020, J. Carlsson, A. Toleikyte.

[103] The final energy consumption (FEC) for heating and cooling represented about 46% of the total final energy consumption in EU-27 calculated on the based on the Shares Tool (Eurostat Statistics) , which reflects national data collection and do not fully report all types of consumption.

[104] Above 50%, Member States has to achieve half of the renewable increase requirement, i.e. 0.55 percentage point per year (Article 23(2)(c) of RED II).

[105] Above 60%, Member States are not subject to the renewable increase requirement (Article 23(2)(b) of RED II).

The default **Option 0 'No changes'** is the baseline and would result in the EU RES H&C share that would be in line with the -55% GHG target remaining aspirational and not reflected in the legislation with delivery of the overall RES ambition relying on other sectors or other instruments to deliver.

Option 1 'Non-regulatory measures' – Guidance and Best Practice Exchange

This option involves only the use of non-regulatory measures. These offer the possibility to enhance the correct implementation of REDII in a more harmonised manner by diffusing a common understanding and best practices. The main instrument for this would be the Concerted Action of Member States for the Renewable Energy Directive, which is a dedicated forum for informal discussion and to share best practices on implementation.

These measures would at best help reaching full delivery of the current targets and better implementation of measures. However, the current target is indicative and all measures are optional. There would not be legal possibility to enforce implementation in case of those Member States that despite receiving guidance and learning best practices would opt for low implementation efforts and low prioritisation of heating and cooling. Maintaining the current indicative target and optional measures would not raise the level of renewables sufficiently enough and would not incentivise a step change towards carbon-neutrality. The option entails the risk of carbon lock-in, the continuation of business-as-usual and failure of heating and cooling to contribute to carbon-neutrality. This would put the burden on other sectors and force a much higher carbon price on consumers and businesses. The cost-effective achievement of the 55% would suffer. There would be a risk to derail CTP and EGD due to the large weight of this sector in the EU overall energy consumption.

This likelihood of such risks is demonstrated by the low ambition of the NECPs, where half of the Member States failed to include trajectories and measures in line with the current provisions.

Option 2 '**Extend the current list of measures of Article 23(4) in REDII'**

This options introduces additional generic measures, which have proven to be essential building blocks of successfully renewable mainstreaming and decarbonisation of heating and cooling.

Option 2 complements Option 3 on possible target design options. The list is not binding and its main purpose is to provide templates how increased ambition in deploying renewable heating and cooling could be achieved. Since the proposed additional measures are reflecting best practices of effective heat decarbonisation, national implementation strategies will likely use many if not all the measures in the list. The generic and essential nature of the measures in the list ensures that sufficient freedom is left for Member States to adapt those to their specific national circumstances based on subsidiarity.

Without specific measures to increase renewable's competitiveness in both industry and building, the risk remains high that renewable would not be taken up in the H&C sector. The alternative to enforce the uptake of renewables via specific instruments would be increasing carbon pricing significantly. However due to low elasticity of demand for heating, which is a basic necessity for both consumers and industry, and the fact that once investment decision is taken, it cannot be corrected cost-effectively during the lifetime of a heating asset (appliance, generation unit or infrastructure), high carbon pricing would not be an effective drivers for a long time after a purchase and would thus lead to significant wealth transfer from consumers without producing the desired outcome.

The extended list of measures are accompanying measures necessary to guide the transition process to the medium goal of 55 GHG reduction and end goal of full decarbonisation of heating and cooling. These extended list of measures are to guide actions to realise the cost-effective renewable share in heating and cooling and thus are a necessary complement of Option 3 on target. The list of measures together with a specific heating and cooling target and in synergy with strengthened but not excessive carbon pricing, strengthened energy efficiency measures under the EED and EPBD, complemented with a revised ETD together as a package lead to the most cost-effective and cost-balanced delivery of the 55% GHG and carbon-neutrality by 2050.

Specific Measures:

Option 2-A1 *Capacity building for national/local authorities to plan/implement renewable projects and infrastructures, national and local heat planning*

One of the challenges for Member States is to transition their heating systems from high carbon to renewable and low-carbon heating at least and with minimum resources use. Local municipalities are at the forefront of this transition due to the local nature of heating, as they will have to translate the high-level EU and national objectives into concrete projects and actions. Municipalities and cities thus need to be to map the availability of local renewable and other carbon-neutral, provide a regulatory and project development framework for their mobilization, align spatial plans, coordinate with building refurbishment and with all actors involved. They are the key to ensure that local energy planning and ensuing actions, investment, projects are aligned with national energy objectives. This requires specific capacities in planning and developing renewable projects and infrastructures and coordinate among all interested actors. Option 2-A1 enables national and local authorities to gain the knowledge and skills required for integrating renewables in heating and cooling, to make plans, develop, finance and implement projects or programmes and to coordinate the many local actors. Their capacity should also cover awareness raising campaign, training and qualification.

Coordinated infrastructure planning with more involvement of local and regional authorities could result in important economic savings and avoid issues of mis-planning, mis-communication, misinformation and lack of understanding of the local particularities, needs and opportunities resulting in inefficiencies and enhanced energy system integration. It provides an enabling tool for higher ambition in renewable heating and cooling, and increases the effectiveness of other measures, not only planned replacement or targets but also with carbon pricing instruments. Heat planning enables coordination with the Long-term Building Renovation Strategies (Article 2a of the revised EPBD) and the Comprehensive Heating and Cooling Assessments (Article 14 of the EED and Article 15(7) of REDII) where MS integrated planning remains low[106]. There are currently very limited integrated planning in the MS, according to the JRC in 2018 only 26%[107] of European cities had a climate action plan or an energy transition strategy[108] [109].

[106] The Long Term Renovation Strategy of Ireland is one of the few integrated planning, which is mainstreaming renewables into the renovation of the building stock(https://ec.europa.eu/energy/sites/default/files/documents/ie_2020_ltrs.pdf)

[107] Including cities in the UK.

[108] Eurocities (2019) Cities Leading the Way on Climate Action

[109] Galindo Fernández, M., Bacquet, A., Bensadi, S., Morisot, P. and Oger, A. (2021). Integrating renewable and waste heat and cold sources into district heating and cooling systems, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-29428-3 (online), doi:10.2760/111509 (online), JRC123771

This shows that MS action alone would probably not have been sufficient to contribute to deploy renewable in the H&C. Therefore, by reason of the effects of the variant, EU action would have an added value, at least to incite MS to take think about integrated planning. This option thus is also key to ensure effective coherence also with the EED and EPBD and effectiveness of carbon pricing.

Option 2a)-A2: *Risk mitigation framework to reduce cost of capital for renewable heat projects*

Investing in new heating and cooling systems entails risks for large and small projects alike. For large projects project developers may have difficulties convincing banks and financial institutions about their loan repayment capacity or would not easily be willing to assume all the risk and uncertain or longer repayment time that the market generally allows. For small investors, banks and financial institutions may not be willing to lend due to high administrative costs and limited return, in turn small projects may face high transaction costs.

The option would effectively address risks inherent to large heat generation and heat infrastructure projects, as well as investments in individual heating systems by households and small businesses representing small capital volumes. [110]

Although, there are currently no dedicated financing instruments for H&C at EU level, many generic energy subsidies and grants are available and can be accessed for the purpose of financing H&C initiatives[111]. Given the lack of dedicated instruments, stakeholders need to have a good understanding of the different financial instruments available to exploit them for the purpose of financing green and low-carbon H&C projects. EU action is required to deliver economies of scale and Union-wide coverage as well as to ensure a competitive single market for energy at least to incite MS to take the required action.

Carbon pricing increases the attractiveness of renewable options in H&C by increasing the revenue streams (or decreasing the operating cost compared to a fossil reference). With adequate and stable carbon prices, the cost of de-risking instruments would reduce accordingly (e.g. risk insurance would be reduced to reflect the risk). Such risk mitigation framework should recall that stable and visible energy price evolution (incl. the carbon pricing components) would have a key role in mitigating the risk.

Option 2a)-A3: *Heat purchase agreements for corporate and collective small consumers*

Heat purchase agreements can be an important tool to support the creation of heat markets and are currently used much less frequently than power purchase agreements. A recent study shows that a business model based on heat purchase agreements could be used to lower the barriers to heat pump

[110] Daniilidis A.; Alpsoy, B.; Herber, R. (2017) Impact of technical and economic uncertainties on the economic performance of a deep geothermal heat system

[111] PNO, JRC (2019), Identification of EU funding sources for the regional heating and cooling sector. Available at: https://op.europa.eu/en/publication-detail/-/publication/782b29a2-4159-11e9-8d04-01aa75ed71a1

adoption associated with their high upfront costs. The study is the first to consider economic analysis of heat purchase agreements as a third-party ownership model for electric heat pumps.[112]

For the MS, the operating cost would be limited to the administrative costs to develop such global framework and the cost for covering (backstopping) pilot or demonstration projects[113] (such as for the case of Bristol Energy). After such trial/demonstration period, operating costs would be tackled by market actors, such as heat/fuel suppliers, to integrate directly in their new business models. This could also provide some commercial advantages compared to formal suppliers not adapting their business models to the needs of the transition to a low carbon heating and cooling system (driving more energy efficiency and renewable, with energy utilities and other suppliers delivering new services).

The example of Bristol Energy highlights a very big opportunity associated with this option – consumer empowerment and increased awareness. Some of the key aspects highlighted during a workshop held on September, 2019 on the topic of “heat as a service”, point out to consumer distrust due to lack of information and the underdeveloped stage of this concept. In particular consumers would be interested in having flexible contracts of no longer than 1-2 years and to be able to “roll-over” unused usage under the “Energy as a Service” contracts (similarity with mobile phone plans). Further, consumers need to be able to easily quantify the benefits and risks of taking up an offer and how the technology and service is performing in real word scenarios. The design of these instruments would be left to the MS, to comply with the implementation of the market design at national level, and possibly with building codes or requirements (addressing comfort), as inviting MS to develop such schemes would incentivise their development.

Furthermore, the success of this option is dependent on the development of adequate heat network infrastructure, increased digitalisation of buildings and smart meter roll out. By tackling these issues, authorities will support different professionals to developing new business models, helping coordination between heat markets, electricity market, building design and performance. Carbon pricing would also directly have an influence on supporting such heating purchase agreement framework, increasing the attractiveness for renewables H&C, and the interest to develop adequate business models, possibly based on a service concept.

Option 2a)-A4: *Planned heating system replacement schemes:*

The proposed options on targets for heating and cooling combined with the options proposed for supporting measures (planned heating systems replacement) would ensure that the upcoming replacement cycle is well-used to trigger a switch from fossil fuels to renewables and other carbon-neutral solutions, and prevent the installation of new fossil appliances, which due to the long lifetime of these assets, would result in carbon lock-in. This option would be effective to ensure several goals. It would help accelerate and wide the deployment of renewables in heating and cooling, and buildings. If applied together with heat planning, it could also ensure level playing field between

[112] Kircher, K. Zhang, K. M. (2021). Heat purchase agreements could lower barriers to heat pump adoption. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0306261921000490

[113] Heat as a service project in Bristol example: ttps://es.catapult.org.uk/news/bristol-energy-is-first-uk-supplier-to-trial-heat-as-a-service/

individual and district heating and cooling solutions depending on whichever is the most cost-effective.

The option on planned renovation is effective to ensure alignment with the CTP, which foresees the need for annual 4% replacement rate of heating systems in building. Since the existing fossil heating systems would be largely replaced with heat pumps and connection to modern district heating systems would grow, planned replacement would also be effective in facilitating ESI and electrification. According to ESI, in buildings, electrification is expected to play a central role, in particular through the roll-out of heat pumps for space heating and cooling.

According to JRC's NECP assessment, measures related to phasing out of fossil fuels in the heating sector were expressed by eight member states, meaning these are probably already considered as non-regret instruments. In addition to Austria and Germany, Ireland has also set up such scheme.

These schemes are concrete, driven by national or regional authorities, already implemented with success and sometimes could be considered as the key pillar of decarbonising the H&C, depending on Member States strategy. As these schemes would depend on many national/local factors, more requirements from the EU would be counterproductive, although the EU could support the sharing of best practices, and possibly provide some guidance.

Option 2a)-A5: *Update of the qualification and certification requirements of installers (article 18 and annex VI), and enabling framework/obligation for technology providers and vendors, that trained and qualified installers are available in sufficient numbers to service the required growth in renewable heating and cooling installations in buildings and industry.*

Investment in the training of skilled workers, the development of training courses, investing in teaching resources for disseminating green skills and integration of climate, environment and green energy knowledge in scholarship are measures where the initial costs associated with development and implementation of such efforts is expected to result in broader knowledge dissemination and awareness. Several literature studies highlight the importance of awareness raising and information dissemination in achieving energy efficiency and renewable resources measures[114].

Furthermore, given that replacement of heating and cooling equipment is often a result of an emergency (e.g. boiler breakdown), a lack of knowledge and information on the part of the installer when having to make a swift decision on how to replace a broken installation could result in technology lock-in[115] and significant associated costs. Thus, enhancing the skills and knowledge of installers and therefore removing a possible inclination towards the well-known (fossil based) solutions should increase the extent to which actual substitution opportunities are recognised and selected. Hence, a possible decision-bias towards fossil-based solutions would be reduced and the

[114] Pantovic, V. S., et al., Rising Public Awareness of Energy Efficiency of Buildings Enhanced by »Smart« Controls of the In-door Environment, Thermal Science, 20 (2017), 4, pp. 1307-1319
Ouhajjoua, N., et al., Stakeholder-Oriented Energy Planning Support in Cities, Proceedings, International Building Physics Conference, IBPC 2015, Torino, Italy, Vol. 78, 2015, pp. 1841-1846
[115] Davis, S. J. et al. (2016) Carbon Lock-In: Types, Causes, and Policy Implications.

competitive position of RES compared to fossil-based solutions improved, by increasing significantly investor's confidence, and hence certainty.

Furthermore, skills is an important area where the EU could ensure competitiveness. Increasing the qualification and training installers would create more experience and share of practice that would also benefit the manufacturer, and further RD&I.

6.2.1.4. Administrative burden and compliance costs

It is not expected that the target design as such would result in additional administrative burden or increased compliance costs for Member States as no new obligations or additional reporting would be required from the Member States compared to the current Article 23 of RED II or the Governance framework.

As stated in Section 6.2.1.3, depending on the measures the Member States use to reach the target there could be additional administrative burden, for example a scheme to subsidise the replacement of heating systems would involve checking applications and that the criteria for funding were met. Replacement schemes would mainly impact building owners (landlord and tenant), while tenants would be impacted to a limited extent. Administrative burden and associated costs will vary per Member State depending on the extent of multi-level governance between different levels of government (national, regional, and municipal), the choice and level of ambition of the phase-out and the existing administrative framework in place among many other variables. More details are found in the Annex 7.

Targets: RES H&C target and renewable share in buildings and industry

Option 3 'Level and nature of the targets'

Option 3 explores three different target designs (3a)-3c) for the overall heating and cooling target, which are mutually exclusive, and add a fourth target design, 3d)which is an indicative benchmark to specifically monitor efforts in buildings and industry, which is complementary with the overall H&C target designs.

Options 3a-3c assess the need to either increase or reinforce the ambition for the RES H&C related target(s). A key issue for the design of the legislation is how to provide sufficient incentives for continued delivery of national commitments and sufficiently ambitious pledges for increased mainstreaming of renewables in the heating and cooling sector. Beyond the target an extended list of measures to support higher ambitions are assessed below and in Annex 7.

Option 3a would transform the current 1.1%-pp annual increase target design as per Article 23 into a minimum baseline complementing it with indicative additional efforts tailored to each Member State to reach the desired RES H&C shares in agreement with the CTP and confirmed by the modelling work carried out in this impact assessment. In this regard the revised Renewables Directive could include indicative figures for Member States RES H&C shares to take into account when updating their contributions to the EU renewables target under the governance framework in the NECPs by June 2023. This would provide a positive incentive framework in the heating and cooling sector.

The option would incentivise the mainstreaming of renewables in the heating and cooling sector in some Member States[116] and avoid lock-in of fossil fuel technologies and ultimately stranded assets in the future. In addition, Option 3a) allows for burden sharing in mainstreaming the renewable energy deployment in the H&C sectors.

The Table below illustrates the 2020-2030 average renewable heating and cooling shares across all Member States in REF and the range for the core scenarios. Furthermore, the table includes the respective effort needed by each Member State that would close effectively the gap between the modelling work carried out in this impact assessment and the estimated figure of RES H&C share at EU, if Member States fulfil the 1.1% mandatory RES H&C shares[117] to reach the desired RES H&C levels in the core scenarios to be added to REF20. The gap has been redistributed based equally on Member States cost-effective potential from core scenarios and their GDP[118].

Table 14 - 2020-2030 average and 2030 RES H&C figures for different scenarios per MS; PRIMES EC own calculations

MS	REF20(p.p)	Mandatory increase in RES H&C share(p.p)	Range of RES H&C Shares in 2030 based on core scenarios(%)	Top ups to be added to REF20(p.p)	Resulting RES H&C shares with top ups(at least) (p.p)
AT	0,7	1,1	44-47	0,8	1,5
BE	0,3	1,1	17-21	1,1	1,4
BG	0,9	1,1	45-54	0,5	1,4
CY	0,5	1,1	51-58	1,1	1,6
CZ	0,5	1,1	33-39	0,9	1,4
DE	0,9	1,1	29-34	0,6	1,5
DK	0,9	1,1	61-64	0,5	1,4
EE	1,2	1,2	65-65	0,3	1,5
EL	1,6	1,6	49-54	0,4	2,0
ES	1,1	1,1	33-35	0,3	1,4
FI	0,5	0,6	63-70	0,3	0,8
FR	1,4	1,4	42-46	0,4	1,8
HR	0,7	1,1	45-51	0,7	1,4
HU	0,9	1,1	33-36	0,6	1,5
IE	2,1	2,1	37-43	0,8	2,9
IT	1,2	1,2	33-43	0,4	1,6
LT	1,6	1,6	67-69	0,4	2,0
LU	2,0	2,0	33-34	0,7	2,7
LV	0,8	0,8	68-69	0,2	1,0
MT	0,5	1,1	34-41	1,0	1,5

[116] For these Member States, the average increase would be effectively lower than 1.1% and their starting point is less than the discounts that current exist under Article 23(1) of REDII

[117] MS RES H&C shares in REF20(based on NECPs) below the 1.1% average 2020-2030 binding target(or half the average annual increase for Member States above 50% and up to 60% of RES H&C shares in 2020) were increased to this level. MS above these thresholds were kept at the same level as REF20

[118] Based on Eurostat's GDP per capita index to the Union average over the 2015 to 2019 period, expressed in purchasing power standard

NL	**0,7**	1,1	15-18	**0,7**	**1,4**
PL	**1,0**	1,1	34-40	**0,5**	**1,5**
PT	**1,0**	1,1	53-55	**0,4**	**1,4**
RO	**0,6**	1,1	37-38	**0,8**	**1,4**
SE	**0,3**	0,3	72-74	**0,3**	**0,6**
SI	**0,7**	1,1	46-52	**0,7**	**1,4**
SK	**0,3**	1,1	30-34	**1,1**	**1,4**
EU27	**0,96**	1,18	36-41	**0,5**	**1,5**

Option 3b proposes to raise the current 1.1 pp annual increase to the level of core scenarios[119] and make it binding. This would apply to all Member States equally. Although this option would be the most effective option to help ensure target achievement and eliminate distortion between Member States, this option is not considered proportionate and would go beyond cost-optimality for some Member States, specifically those having already high RES H&C shares in 2020, above 50% and 60% respectively[120].

Option 3c would propose a binding EU H&C RES share. This would provide greater certainty that the EU reaches the desired level of RES shares in H&C, however it does not exclude the risk of free riding by Member States, who may choose to do little and instead rely on the efforts of others.

Option 3d would put forward an (indicative) EU RES benchmark of 49% for the EU building stock[121] and industry. This would add visibility and prioritisation of the need to step up the integration of renewable energy in buildings as part of increasing their energy performance, in particular in the context of the Renovation Wave objective to at least double the building renovation rate, as heating system replacement and modernisation and are the easiest and most cost effective to implement during and as part of building renovation. In addition, this option is also to ensure that at least a 4% replacement rate of fossil based, old and obsolete heating systems with renewable based heating, as indicated by the CTP is realised. The indicative RES benchmark would leave maximum flexibility for Member States how to achieve it. It would build on the current requirement for ensuring a minimum level of renewables in buildings. Its effectiveness would be ensured with alignment with the review of the EPBD addressing gradual fossil phase-out from heating systems tailored to main building archetypes. It will support the EGD carbon neutrality goal, consistent with ESI and interact with the EPBD goal to decarbonise the EU building stock by 2050 as enshrined in the EPBD. Complementarity and no duplication is ensured as REDII relates to the overall EU building stock, while EPBD addresses energy performance at building level and by main building archetypes. The added value of the option for heating and cooling to signal the level to which renewable heating and cooling supply (sources, technologies, infrastructures) should be scaled up for buildings. The EPBD on the other would address how to make buildings fit for renewables, as most

[119] As discussed in Section 6.2.1.1 the RES H&C shares would translate to 1.3 pp-1.8pp depending on the core scenario
[120] For the purpose of Article 23(1) of REDII when calculating the share of renewable energy in the heating and cooling sector and its average annual increase Member States with renewable shares above 50% and up to 60% may count such share as fulfilling half of the average annual increase. For Member States with renewable shares above 60% may count any such share as fulfilling the average annual increase
[121] A general numerical level of minimum RES use in national building stocks as a percentage of the overall energy use

renewables can work optimally only with high energy performance buildings (sufficient insulation and adaptation of the internal energy distribution in technical building systems.

Furthermore under this option, an (indicative) EU RES benchmark in Industry of 1.1% annual increase per year, reflecting the different starting points of the different MS and following the logic of the heating and cooling target 2020-2030 would be put forward. Industrial investment cycles are relatively long, and can set the direction for a company for multiple decades. A benchmark to increase the share of renewables in industrial consumption would increase renewables, which could take place through different pathways and energy carriers (including energy efficiency measures, direct use of renewables, electrification, and renewable fuels, including renewable hydrogen) and integrate industry further to the energy system. Setting such benchmarks early would provide a long-term direction to the industry, and ensure that any existing investments are in line with our long-term objectives of climate neutrality.

6.2.1.5. Coherence

The assessment of the above options is closely interrelated with measures on energy efficiency and energy performance in buildings, which are respectively addressed in the initiatives for the revision of the EED and the EPBD. In addition, policy interactions also exist with policies covering GHG emissions (Effort Sharing Regulation but also by the horizontal EU carbon pricing instruments, such as the EU Emissions Trading System). However, the impact of carbon pricing on renewable shares and renewable deployment and respective impacts on energy costs is diverging and could cause high distributional impacts when they fully materialise. The revision of RED is also a precondition for the fulfilment of increased ESR national targets. The Member States will need to deploy much more renewables in the heating, cooling (and transport sectors) in order to meet the increased national ESR targets. Therefore re-enforcing the current heating and cooling target which covers all energy users (industrial, residential and tertiary) and updating the illustrative policies measures remains necessary and consistent.

Thus energy efficiency and carbon pricing can also play a role in increasing the share and deployment of renewables in heating and cooling. However, energy savings should mostly affect non-renewable heating, while the overall consumption of renewables in final heat remains constant with the rest of the effort supported mostly by heat pumps. Carbon pricing alone could increase direct renewable deployment as incentive fuel switching and allow for a fairer competition of innovative solutions in markets. However carbon prices might need to be very high to achieve the outcome, a risk which modelling and the resulting carbon price of EUR 80 in MIX CP indicate too. As highlighted in the assessment of the measures, carbon pricing alone cannot overcome all barriers such as unfit infrastructure planning, building codes and products standards, lack of skilled workforce for installation and maintenance, lack of public and private financing instruments, and lack of internalisation of CO_2 costs in heating fuels for the heating and cooling sector as a whole also due its fragmented nature. Such barriers hampers renewable uptake but also ESI. This translates into low replacement rates of the EU fossil heating stocks, low development and modernisation of district heating/cooling networks, and low building refurbishment rates. With the Renovation Wave initiative, the Commission will ensure that the building framework is fit for a higher penetration of renewable supply in buildings from all types of renewable sources and carriers, both via individual appliances and district heating. It will also support training programmes under the Updated Skills Agenda. This option is also coherent with and effective to implement the Renovation Wave initiative, as it ensures a higher penetration of renewables in buildings.

Furthermore measures such as local planning has synergies and is coherent with Article 14 of the EED on comprehensive heating and cooling assessments and with the long-term building renovation strategies under Article 2a of the revised EPBD. It is also coherent with and fulfils actions of the Energy System Integration Strategy while risk mitigation is already available under the EED and the EPBD and new instruments under the Resilience and Recovery Funds and new EU budget.

In this regard, a fixed renewable energy heating and cooling target complimented by further policy intervention would not only provide additional incentives to fuel-switching from fossil to renewable energy in buildings but also in industry. It would also address persisting non-market barriers that carbon pricing alone cannot fully address.

6.2.1.6. Stakeholders' Opinions

Stakeholders' Opinions

EU/Non-EU citizens as well as representatives of academic institutions (82%), consumer organizations (80%), public authorities (52%), more often think that the target should be binding. Those representing business associations (55%), companies/business organizations (57%), environmental organisations (81%) and NGOs (74%) more often think that it should not be binding.

Respondents representing academic/research institutions, business associations, companies/business organizations most often think (70%, 49%, 51% respectively) that the target should increase to match the Climate Target Plan ambitions. Citizens most often think that the target should be increased to be more ambitious (39%). Environmental organizations, NGOs and public authorities most often do not think that the target should increase (79%, 66% and 42% respectively).

In a poll conducted during the 1st stakeholder workshop, 75% of the respondents thought that the current indicative target of achieving a 1.1 pp annual average increase in renewable energy in heating and cooling set for the period of 2021-2030 in Article 23 should become a binding target for Member States.

During the 2nd stakeholder workshop, The European heating industry supported an increased RES-E target and they favour a clearer role for hybrid heat pumps under the RED II. They favour increasing the RES-H&C target and making it binding. Consumers favoured binding H&C targets. The geothermal sector asked for a de-risking at EU level and thus changing the burden from Member States to EU in article 3.5 of RED II. The heat pump industry favoured increased targets. The solar thermal industry asked for the promotion of measures for consumers to make the transition.

6.2.2 District heating and Cooling

Modern renewable-based efficient district heating and cooling (DHC) is at the very centre of heat decarbonisation and an integrated energy system[122]. The current provisions under REDII require

[122] Overview of district heating and cooling markets and regulatory framework under the revised renewable energy directive, ENER/C1/2018-496, Tilia, Fraunhofer, TU-Wien, IREES – ongoing; Integrating renewable and waste heat and

Member States to endeavour to increase the share of renewables by an annual average 1%-point increase or implement network access for renewables, waste heat and cogeneration. Several drawbacks remain allowing ‘de-facto’ 100% fossil systems continue indefinitely in the future. Consumer information and rights also need to be improved.

Updated and strengthened measures are needed to ensure cost-effective contribution and align DHC with the Green Deal, the Energy System Integration and the Hydrogen Strategies and the Renovation Wave. In particular, the Energy System Integration Strategy calls to accelerate investment in smart, highly-efficient, renewables-based district heating and cooling networks, if appropriate by proposing stronger obligations through the revision of REDII and the EED. The energy system integration potential of DHC[123] would not materialise by lack of a clear EU framework guiding local actors and encouraging their efforts to link district heating networks with renewable electricity, waste heat and renewable gases’ deployment. Consumer information as regards the climate performance of these systems should in parallel be improved to ensure level playing field, greater transparency and fair competition with alternatives. The proposed measures are necessary to ensure that the next inevitable and imminent investment cycle in district heating is not wasted, but instead directed towards future proof solutions when replacing the current old and obsolete heat generation units (around two thirds of the generation assets). The Renovation Wave highlights the role of district approaches as they can transform entire neighbourhoods and create new business opportunities. Synergies between business renovation and the roll-out of modern district heating systems become evident when scaled up to district and community approaches. Aggregating projects at this level may lead to zero-energy or even positive energy districts (e.g. advanced district heating and cooling systems with large potential for renewables and waste-heat recovery). These offer cheaper ways to decarbonise heating and cooling and increase system efficiencies at an industrial scale by fuel switch, increased flexibility and thermal storage. Additional positive impacts including creating space for nature and mobility, contribute addressing socio-economic issues.

Current situation

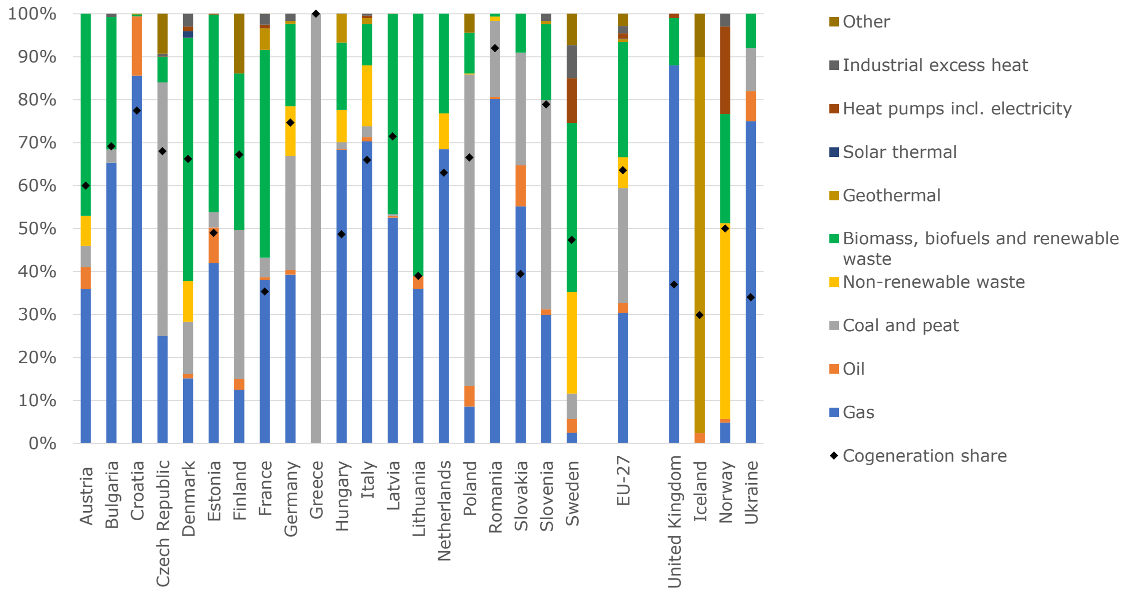
District heating is present everywhere but in a few Member States in Europe. It has significant heat market shares in Northern, Central- and Eastern Europe and in the Baltic States. District heating is growing in Western Europe and the northern regions of Southern European countries. There is no district heating in Cyprus and Malta, while in Portugal and Spain district heating is marginal and limited to a few systems. At EU level, the share of district heating is 12%. The fuel mix of district heating varies from Member State to Member State, as illustrated by the figure below[124].

cold sources in district heating and cooling systems, Case studies analysis, replicable key success factors and potential policy implications, External study performed by Tilia for the Joint Research Centre, 2021.

[123] Interaction of District Heating with the Electricity System, Provision of Balancing Services, JRC, Jiménez-Navarro, J.P., Boldrini, A., Kavvadias, K., Carlsson, J, 2021. Heat Roadmap Europe

[124] Cyprus, Malta do not have district heating systems. District heating capacity is statistically so small in Luxembourg, Portugal and Spain that there representation in chart is closed to zero. These countries were not included in Figure 16.

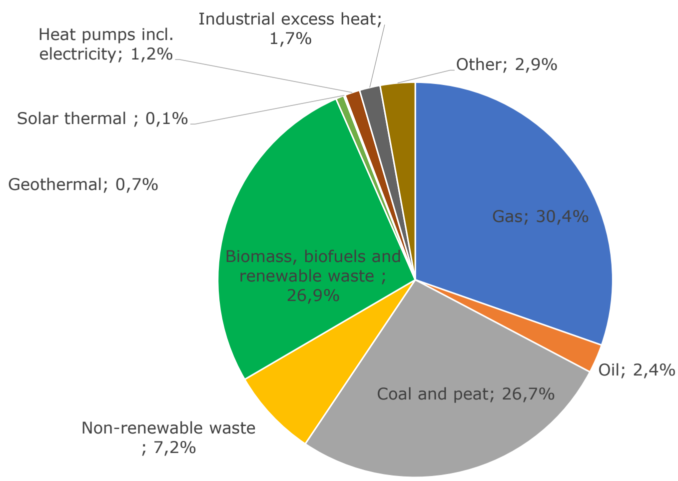
Figure 14 - District heating fuel mix and cogeneration share in 2018 (Source: Study by Tilia under ENER/C1/2018-496)



As shown in the figure below, natural gas is the major source of heat used. In many countries the share is around 60% and more in Member States such as Bulgaria, Croatia, Hungary, Italy, Netherlands, and Romania. Biomass, biofuels, and renewable waste are the second most used source of heat in the Member States with significant shares in many countries such as Austria, France, Scandinavian and Baltic countries. Coal and peat, as a third most used source of heat, has a high share in Poland, Czech Republic, Greece, Germany, Slovakia, and Slovenia.

In aggregate, natural gas has the highest share in the EU-27 district heating fuel mix accounting for 30.1% followed by biomass, biofuels, and renewable waste with a share of 26.9%, and coal and peat with a share of 26.7% (see figure below). In total, two-thirds of the district heat supply is generated with fossil fuels in the EU-27 Member States.

Figure 15 - EU-27 District heating supply fuel mix in 2018(Source: Study by Tilia under ENER/C1/2018-496)

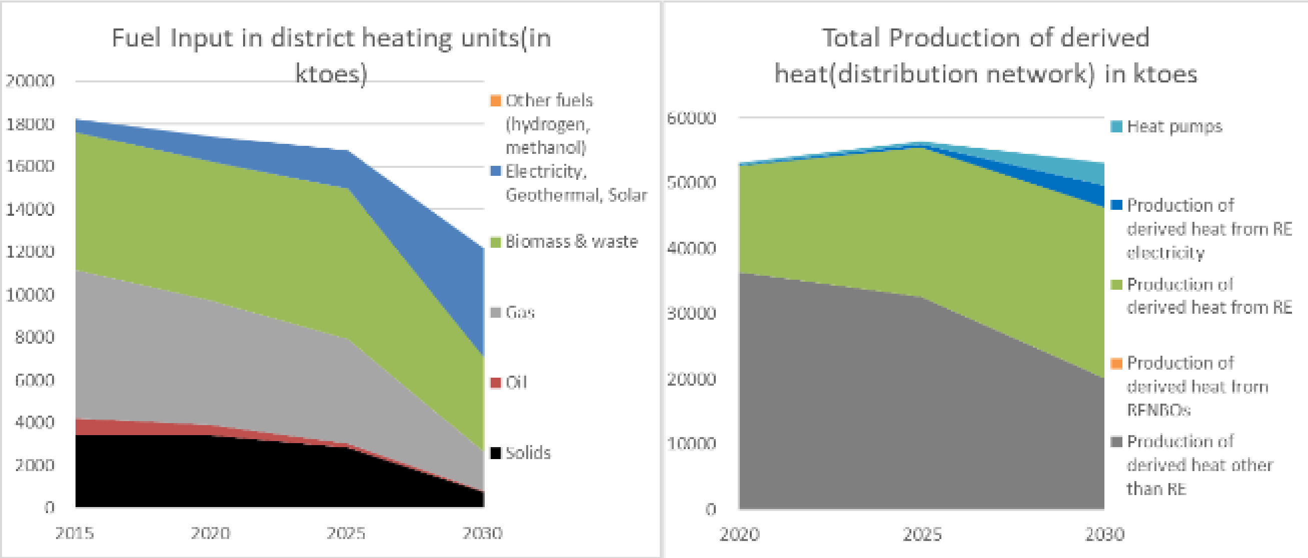


The decomposition of RES used for district heating reveals that bioenergy fuels (biomass, biofuels and renewable waste) are currently by far the main renewable sources (see figure above). In the EU-27 they constitute almost 88% of the renewable heat produced, followed by industrial excess heat (waste heat) with 6%, heat pumps with 4%, geothermal with 2% and solar thermal with a negligible share of around 0,5%.

6.2.1.1. Impacts projected by core scenarios

There was no specific modelling for the full district heating and cooling supply chain however the figure below presents the evolution of the energy mix in district heating.

Figure 16 - Fuel input in district heating units and total production of derived heat in distribution networks (in ktoe); Source PRIMES



The key trend that can be observed is a decrease of fossil fuels (notably oil and solids). Although gas remains stable between 2015 and 2025, increasing energy efficiency, renewable policies and further sector integration coupled with more ambitious climate policies (increased ETS price signal and extension of ETS to buildings) help in the overall efficiency and fuel switching in this sector. Biomass increases from 2010 but remains constant after 2015 and reduces marginally until 2030. Electricity and other renewable sources such as geothermal and solar have been increasing since 2015 to more than 40% of fuel input in DH units in 2030. When it comes to heat supplied and consumed through DH networks, the renewables shares increase to more than 50% in 2030 (at least 2.1 pp yearly increase between 2020 and 2030) which strengthens the case of a greener, smart and integrated district heating networks.

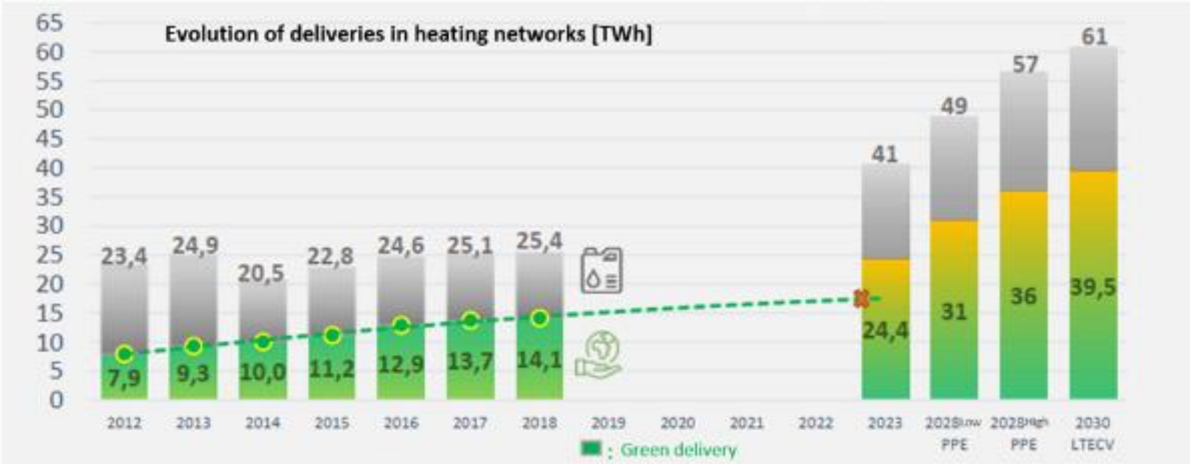
6.2.1.2. Impacts and analysis not based on modelling

<u>GHG reduction and energy saving</u>:

The deployment of renewables via district heating in cities and heat pumps in rural areas combined with energy savings results in significant greenhouse gas greenhouse gas (GHG) emissions reduction and primary energy savings as demonstrated by several studies. The Heat Roadmap Europe projects concluded that a reduction by 80-95% compared to 1990 levels was possible by 2050, entailing also a reduction of 13% or 120 TWh in primary energy consumption and cost reduction of 6 billion EUR compared to alternative decarbonisation scenarios[125]. More information on case studies on efficient renewable based and smart DHC systems are found in Annex 7.

Modern district heating and cooling can be an effective cost-effective solution to integrate renewables at large scale in heating and cooling serving buildings and small enterprises alike. This is demonstrated by the Action Plan of France with 25 actions to be implemented as of 2020[126].

Figure 17 - French 2030 objectives in DH development (total and low-carbon/green)



A host of innovative district heating and cooling systems already operating in the EU demonstrating that modern low temperature district heating systems are able to integrate renewable energy into heating and cooling at large scale at moderate and low cost and are competitive vis-à-vis fossil fuels. A list of such systems is presented in the figure below indicating the renewables' shares in this systems, the types of renewables used and the installed capacities for district heating and district cooling. More details and examples are found in the Annex 7.

[125] Towards a decarbonised heating and cooling sector in Europe, Aalborg University Denmark, prepared under the Heat Roadmap Europe project, available at: https://heatroadmap.eu/

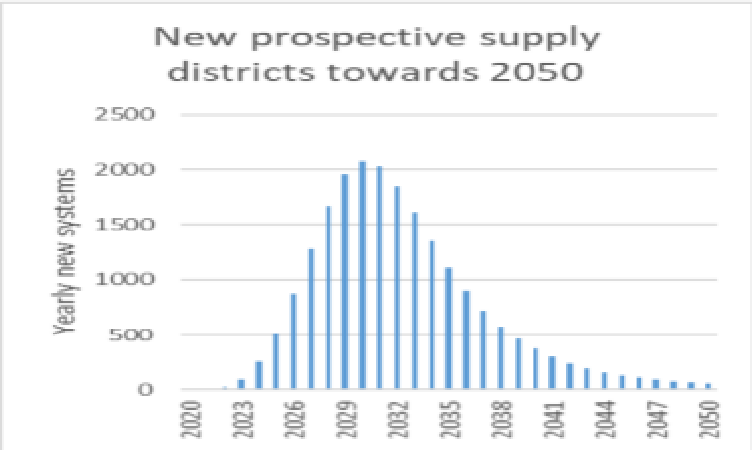
[126] The resulting Action Plan was presented in October 2019: *Réseaux de chaleur et de froid: une filière d'avenir* (link to Press release), see Tilia GmbH, Integrating renewables and waste heat and cold sources in district heating and cooling systems, 2021.

Figure 18 - disaggregation of DHC systems, including energy carriers; Source https://heatroadmap.eu/

Country	Case Study	Installed capacity	Renewable Energy Sources	Waste Heat/Cold Sources	RES share
	Taarnby DHC	DH: 60 MW DC: 6.5 MW	Renewable electricity; Thermal storage; Biomass	Ambient energy (Wastewater)	91%
	Jægerspris DH	20.1 MW	Solar thermal; Thermal storage; Ambient energy (from the air)	CHP (gas-fuelled)	56%
	Paris-Saclay DHC	DH: 37 MW DC: 10 MW	Geothermal energy	Data centers; Laboratory	60%
	Mieres DH	4.1 MW	Geothermal energy from a closed colliery		98%
	Barcelona-Districlima DHC	DH: 79 MW DC: 113 MW	Renewable electricity; Thermal storage; Ambient energy (from the sea)	Waste-to-energy	97%
	HafenCity DH (Hamburg)	28,3 MW_{th} 1,5 MW_{e}	Biogas	Industrial heat; Thermal storage	90%
	Vilnius DH	1,707 MW_{th}	Biomass	In 2021; Waste-to-energy	55%
	Milan DHC	DH: 901 MW DC: 7,5 MW	Geothermal energy	Industrial heat; Waste-to-energy	68%

The potential of district heating as a key heat transition instrument has been demonstrated in the Heat Roadmap Europe study[127], which looked at the decarbonisation potential by DH and its cost and benefits in 14 Member States. It concluded that the European energy systems could be decarbonised by 2050 by expanding district heating in urban areas to meet up to 50% of heat demand. The Heat Roadmap Europe (HRE4) project drew up low-carbon heating and cooling strategies for 14 EU countries. The figure below illustrates the number of new DHC systems to be developed across the 14 Member States of the HRE4.

Figure 19 - Approximate newly established and total amount of district heating systems in the 14 countries of HRE4 and Denmark needed for fulfilling the potential of distribution grid investments below 4 EUR/GJ; Source: Heat Roadmap Europe[128]



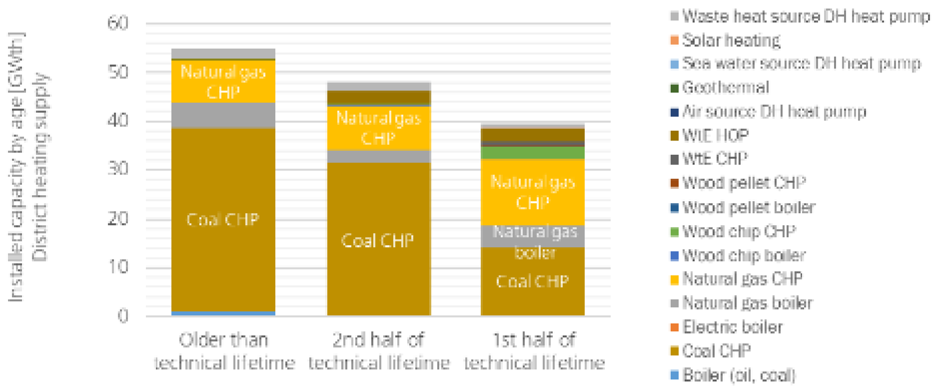
Based on the Pan-European Thermal Atlas (PETA)[129] geographical information system, the study conducted by HRE4 identified prospective supply districts areas with a potential for district heating. An annualised distribution grid investment cost of 4 EUR/GJ was used as the minimum threshold, in addition to a minimum heat demand density of 20 TJ/km2. A potential of around 25,000 areas in the

[127] https://heatroadmap.eu/
[128] https://vbn.aau.dk/ws/portalfiles/portal/316535596/Towards_a_decarbonised_H_C_sector_in_EU_Final_Report.pdf
[129] https://ec.europa.eu/environment/europeangreencapital/launch-of-the-the-pan-european-thermal-atlas/

EU was identified, allowing to reach the target of a 50% district heating share by 2050. This is a 7-fold increase in the number of district heating systems across Europe compared to the situation in 2019[130].

Replacement costs are mitigated by the fact that only around one third of oil and gas boilers and CHP units are relatively new. More than one third is beyond that lifetime and almost one third is in the second part of the lifetime. That means that two third of the capacity will need to be replaced in the next 5-8 years. The figure below shows the age.

Figure 20 - Installed capacity by age (GWh) District heating and supply; Source [ongoing ENER/C1/2018-494 Renewable Space Heating Study]



Carbon pricing could result intrinsically in cost-optimal emission reductions in the buildings. Hence, pushing for emission reductions through specific measures such as forcing RES deployment will be less cost-effective as long as the carbon price is not high enough to enable H&C RES to become competitive in DHC.

However, the currently limited uptake of renewables to support the DHC to reduce their emissions can be linked to the low competitive advantage of renewable fuels (due to the current low carbon price level, and to the other more cost effective solutions such as fuel switch – from coal/oil and natural gas), and to the lack of knowledge and risk management compared to individual fossil based appliances. With an increasing carbon price, renewables may become more attractive and deploy without any further intervention or policy action than carbon pricing. However there is probably no such guarantee without additional intervention in the frame of the RED, either with additional measures, or with a specific target for H&C in DHC.

The table below provides a comparison of upfront costs, O&M costs, payback periods and number of jobs created per MW for both fossil-based DHC and renewable supply of heat in DH networks.

Table 15: Comparison of Financial data for different DHC supply technologies[131]

	Natural Gas	Coal	Biomass	Solar Thermal	Geothermal	Heat Pumps

130 Source: ENER/C1/2018-494, ongoing.

131 KeepWarm: Renewing District Heating project (2020) Keeping our cities sustainably warm – facilitating a switch towards sustainable district heating

Upfront costs	0.5 M€/MW	1.2-2.8 M€/MWe	0.3-.07 M€/MW	200-500 €/m^2	0.7-1.9 M€/MW	0.45 – 0l85 M€/MW (elec) 0.35 – 0.5 M €/MW (absorption)
O&M costs	3% of investment + 40-60 €/MWh variable fuel costs	1.5% of investment + 3 €/MWh variable fuel costs	1.8 – 3% of investment	1-3 €/MWh	2.5% of investment	2-3% of investment
Payback period	N/A	N/A	3-13 years	6-15 years	5-10 years	8-9 years
Jobs	0.95/MW	1.01/MW	0.78-2.84/MW	0.81/MW	1.7/MW	NA

Without specific measures to increase renewable's competitiveness, the risk remains high that renewable would not take up in the DHC. The two options would then be either to increase carbon pricing significantly (which is out of scope), or to enforce the uptake of renewables via specific instruments. In the first, accompanying measures would be necessary to guide the integration of renewable in all DHC. In the second, accompanying measures will also be necessary, in addition to specific renewable targets.

More details on cost –effectiveness of DHC are found in the Annex 7.

6.2.1.3. Effectiveness

Measures

Option 0 and Option 1 would not be effective to drive that step change needed for district heating and cooling to update its fossil fuels and conventional biomass based business model, contribute to the heating and cooling target and develop its full potential for renewable energy, energy efficiency and sector integration. Information for consumers on the energy performance and renewables shares would remain limited. District heating would keep enjoy monopoly positions without increased accountability to consumer and shielded fully from competition, while its market share could potentially expand. 100% fossil district heating could continue indefinitely and receive public support.

Option 2 on strengthened existing measures would be effective to ensure the necessary minimum adjustments on consumer information, renewable heat suppliers' network access and to update ESI measures in line with the Energy system integration strategy.

Option 2b)-B0: *Align the definition of 'efficient district heating and cooling with the CTP and EGD.*

The option would ensure that district heating systems adopt a higher standard, gradually evolve to become strong contributor for renewable mainstreaming, GHG reduction and savings objectives in energy supply and buildings. It would also ensure that public support is directed for district heating system investing in modernisation and new systems developed according to a new business model aligned with CTP and EGD.

The current definition is spelled out in Article 2(41) of the EED and integrated into REDII by reference in its Article 2(20). This definition provides the criterion as regards which DHC systems should allow disconnection, network access or should align with the 1 ppt annual renewable increase rate under REDII. The current definition makes it possible for 100% fossil fuel systems to be qualified efficient indefinitely in the future. The review of the definition is an option under the EED review and therefore is not proposed as an option under the REDII review. Full consistency of the EED review should be ensured with the REDII review.

Option 2b)-B1*: Eliminate exceptions and make access to networks mandatory for renewables and other carbon-neutral sources (waste heat), including from prosumers, in large DHC networks (Please refer to Annex 7 for the detailed description of this option).*

The option aims to ensure minimum competition in district heating systems, which are natural integrated monopolies. The lack of EU level minimum access rights would risk locking out renewable and other carbon-neutral energy suppliers, while allowing incumbent operators to continue the current fossil based business models indefinitely in the future shielded from competitive pressures. However, considering the specificities of DHC systems with unique and specific adaptation features to local circumstances, as well as technical constraints (already recognised in the current provisions), third party access should not cover small networks and its design should remain adaptable and minimally harmonised at EU level.

The option would cover only large systems as network access to small systems by third party suppliers is less or not economic and is technically difficult to implement. It would not impose disproportionate administrative and compliance burdens and would be effective to trigger more competition and thus bring on the market more renewable heat and cold supply.

The option builds on the current provisions. It would thus not entail significant additional administrative and compliance costs. As described in the introduction, such network access is in one form or another already is in place in large systems. Connection of prosumers is also possible already in some systems, enhancing consumer rights and promoting active consumers.

Via stimulating more renewable heat and cold supply and increase efficiency – and in conjunction with the option on corporate and collective consumer heat purchase agreements - the option is in line with the CTP, the EPBD and the EED.

Option 2b)-B2 *Enhanced ESI between DHC systems and other energy networks*

This option would be effective to expand and replicate the already existing examples of smart district heating systems, which operate as local ESI hubs and contribute to ESI and the cost-effective deployment of renewables, including renewable electricity. The model of cooperation with the electricity DSOs and TSOs is well-developed and commercially attractive in those few Member States[132], where the regulatory framework is sufficiently adapted. It allows DHC systems to provide balancing services to the electricity grid by absorbing surplus variable renewable electricity through

[132] Interaction of district heating and cooling with the electricity system, JRC, 2021. See also Towards a smart energy system approach in Europe – Enabling robust and renewable energy investment strategies, Smart Energy System and 4th Generation District Heating, Brian Vad Mathiesen, reINVEST project, 2017.

demand response/management measures and thermal storage. They can also feed electricity back to the electric grid from their CHP units, when renewable electricity (wind and solar) is scarce.[133]

Option 2b)-B3 *Enhance ESI for waste heat and cold use via a coordination framework for key actors*

This option has similar objective as above in terms of ESI and would also be effective in facilitating the reuse of waste heat from industrial sites and data centres, through a coordination framework coupled with possible options on strengthened requirements for connection to district heating networks, energy performance accounting and contractual frameworks, as part of the revision of the Renewable Energy Directive and of the Energy Efficiency Directive (June 2021) as stipulated by ESI.

Option 2b)-B4 *Strengthen information provisions for consumers, such as:*

- *requirement to include a specific RES share and a numerical energy performance number (PEF) in the information district heating/cooling systems provide to consumer (e.g. on bills, suppliers/regulators' websites);*
- *Energy label (voluntary or mandatory) for DHC systems.*

The option in the first bullet point on increasing information to consumers about the performance of district heating and cooling system is highly effective to ensure that district heating and cooling providers become more transparent, strengthen consumer rights and improve consumer perception and acceptance. The option foresees the inclusion of clear and simple numerical values on RES share and primary energy factor. Since this builds on and merely complement the current provisions, the administrative burden is limited.

Target options

Option 3a, leaving the current, optional and indicative target unchanged. Since only eight countries addressed Article 24(4a) - which lays down the optional indicative 1 percentage point increase target for DHC -, in their NECPs, continuing with the current provisions would not be effective to increase renewables, waste heat and energy efficiency in existing district heating systems, and would leave new DHC developments without clear direction, while other sectors would carry higher burden. This would not ensure that district heating and cooling contributed to the deployment of renewables in heating and cooling in line with the CTP and EGD. It would not be effective to make these networks contribute to the increased deployment of renewables and ESI in line with their cost effective potentials.

Option 3b) by **adding an indicative EU renewable target for renewables' share in DHC** would set a clear yardstick against which the development of district heating and cooling systems could be evaluated and their compatibility with the CTP and EGD could be measured. This could be a significant improvement in the effectiveness of current framework and would provide clear signals for investors. Option 3b) would also inspire the development of new networks as regards the level of

[133] Interaction of district heating and cooling with electricity system, JRC Technical Report, finalised draft with limited distribution, 2021

renewables desired in their generation mix. While it may not be enough to change in existing DHC network, combined with an appropriately strong overall heating and cooling target to which DHC would contribute, it would be effective to ensure that old systems transform and new systems develop sufficiently to harness the full cost-effective potential of modern DHC for the large scale integration of renewables in heating and cooling. Since this option does not impose specific obligation on Member States, the administrative cost would be minimal, while the Governance framework already in place could provide the implementation and monitoring framework with no additional cost.

Option 3c) by **increasing the indicative 1%-point annual increase target** to 2.1 percentage point annual increase in agreement with the CTP and the modelling work carried out in this impact assessment. The increase would provide a clear signal as regards the needed level of contribution in renewables' deployment from district heating systems. This would ensure coherence with the overall renewable framework and ensures a level playing field with individual heating systems to contribute to heating and cooling decarbonisation. While in itself Option 3c) may not be enough to drive change to the extent cost-effective, combined with an appropriately strong overall heating and cooling target to which DHC would contribute, it would be effective in ensuring that these systems participate in renewable deployment and sector integration, and harness their cost-effective potential for large scale renewable integration in heating and cooling. As this option builds on current provisions, the administrative cost would be minimal.

Option 3d) by **increasing the current 1%-point increase target** to 2.1 percentage point annual increase **and making it binding** would be effective in ensuring DHC participation in renewable deployment. However, due to the uniformly binding nature of an increased target relevant for all existing systems, it may be disproportionate for those systems that already have high renewable shares and could also lead to the dismantling of those systems where a binding higher increase would impose high investment costs in a relatively short time. Since this options builds on current measures, there would be no additional administrative costs; however due to the binding nature, compliance costs could be significant.

6.2.1.4. Administrative burden and compliance costs

Option 2b)-B0 aligns the definition with the European Green Deal thus providing clear direction and provide certainty for policy makers and investors. It does not impose new administrative burden and compliance cost as it defines the type of systems that are to be promoted, included via public budgets and state-aid. **Option 2b-B2** represent a clarification of the current provisions rather than a new measures. On the other hand, **Option 2b-B3** extends the current coordination and common assessment requirements from the electricity grid to other energy grids. Such data would not be complicated to gather and disclose for the most efficient and smart systems, which could also be an incentive to upgrade DHC. **Option 2b-B4** could be effective, however entails more administrative burden, as such harmonised label does not yet exist. However although, setting up a labelling scheme may be complex and long, especially in the case of a mandatory scheme. If the labelling remains voluntary, the administrative burden could be reduced significantly. Support from EU-funded projects such as EcoHeat4Cities can also decrease the administrative burden by providing capacity building and information.

Options 3a-3d will not increase administrative cost but will have compliance cost for DHC systems, as they will have to gradually transform. However, combined with the ETS, EED and EPBD reviews, clear targets and policy direction will provide benefits for DHC systems, notably by raising their competitiveness in the green economy, consumer acceptance and market share.

Member States are already required to report in their NECPs on their measures to increase renewables in district heating and cooling in terms of how it will contribute to the annual increase of 1%ppt. No significant increase in administrative burden or compliance costs is therefore expected from Options 2 and 3 apart from the creation of a possible energy label.

6.2.1.5. Coherence of the target options

All but Option 3a) are coherent with the Energy System Integration Strategy, which calls to accelerate investment in smart, highly-efficient, renewables-based district heating and cooling networks, if appropriate by proposing stronger obligations through the revision of REDII. The proposed Union target for share of renewables in district heating and cooling is coherent with, and a logical corollary of, the target for heating and cooling. The level and nature of the targets will be aligned. Promoting district heating and cooling systems is also linked to the requirements under the EPBD, as such systems work best in energy efficient buildings, the renovation rate of which is addressed in the Renovation Wave and the EBPD revision.

A specific target for the H&C in DHC remains important and would complement carbon pricing instruments and market stimuli, by providing the needed trend to fully decarbonise DHC. Having in mind the full decarbonisation of the DHC by 2050, such target also supports overcoming no-economic barriers, such as the basic lack of awareness (e.g. in the industry where renewable is not associated to the core business), the administrative barriers, the lack of information (to final consumers) and public perception, the high upfront investments. However, a DHC RES target without a strong policy framework setting up a real level playing for renewable would lead to disproportionate costs and loss of value, putting the existing assets at risk.

6.2.1.6. Stakeholders' Opinions

Stakeholders' Opinions

The respondents of the OPC representing environmental organisations, NGOs and public authorities more often think that the current indicative target for renewable energy in district heating and cooling should not become binding (78%, 67% and 64% respectively). The other stakeholders tend to think that it should be binding (70% of those representing academia and 75% of those representing consumer organisations). Those representing companies/business organisations are split 50% to 50% or close. The majority of respondents representing Member States were also against the target becoming binding.

During the 1st stakeholder workshop, the International Energy Agency mentioned the need for a decent playing field for economic and regulatory deployment of District Heating & Cooling. Local governments stressed that it is key that District Heating & Cooling should be the obvious choice when compared to fossil fuels and that therefore EU level and national level should come in with technical and financial support.

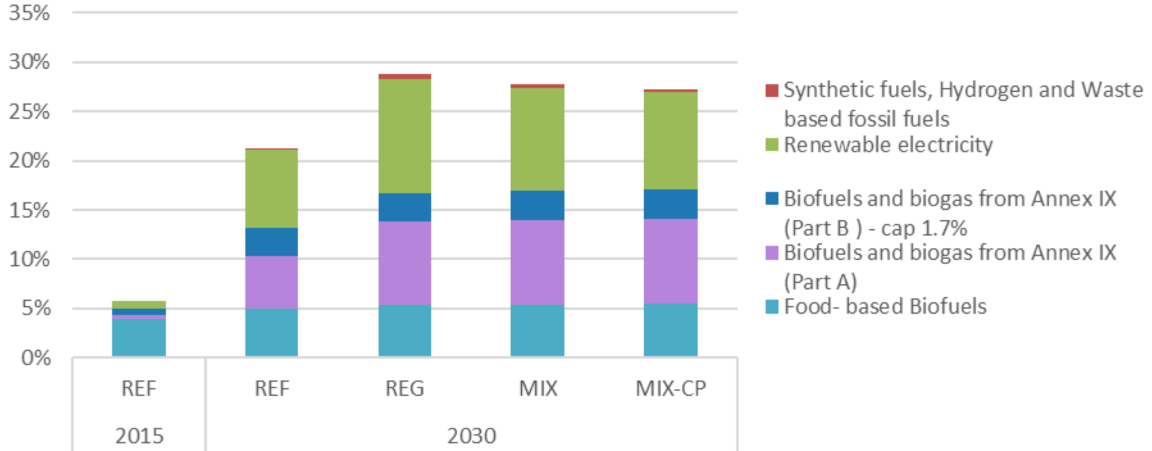
During the 2nd stakeholder workshop, consumer organisations requested a clear planning for District Heating & Cooling.

6.3. Transport

The quantitative assessment of policy options for transport is aligned to the CTP analysis but differs to the extent that it takes better into account the policies and objectives formulated by the Member States in their NECPs, which leads to an increase of the RES-T share to 21% in the Baseline (CTP BSL projected 18%). Further, the options consider the dedicated measures under the ReFuelEU Aviation and FuelEU Maritime proposals.

Based on the current RES-T[134] target calculation, the core scenarios lead to 27-29% RES-T shares (applying the accounting methodology set out in current legislation) with the REG scenario having the highest share thanks to strong energy efficiency measures.

Figure 21 - RES-T share in core scenarios; Source PRIMES



As shown in the figure above, renewable electricity would contribute around 10-12% for the target in the core scenarios (against 8% in REF), chiefly due to higher uptake of new electric vehicles driven by assumptions on vehicles standards. Liquid and gaseous biofuels have the biggest role in achievement of high RES-T shares and increase most in the core scenarios, representing in all core scenarios a share of 17%, compared to 13% in REF. With conventional biofuels and Annex IX part B biofuels capped, it is advanced biofuels that represent the highest share (8-9%).

The allocation of fuels between transport modes varies across transport modes. The maritime and aviation sectors, which mostly do not have electricity as decarbonisation option, rely chiefly on biofuels and, to lower extent, on innovative renewable and low-carbon fuels (including RFNBOs). Advanced biofuels and, in the longer run innovative renewable and low-carbon fuels would become even more important in these sectors post-2030 as the use of oil would be incompatible with carbon neutrality objectives and only limited possibilities for negative emissions are projected in most of scenarios. In other transport modes like road transport, other alternative like electrification already exist (especially for light duty vehicles), with lower environmental impacts (e.g. land use, air pollution).

134 Articles 25-27 REDII where specific caps and multipliers apply for different renewable fuels

6.1.7. Impacts projected by the core scenarios and MIX-H2 variant

Economic (including Energy System) and social impacts

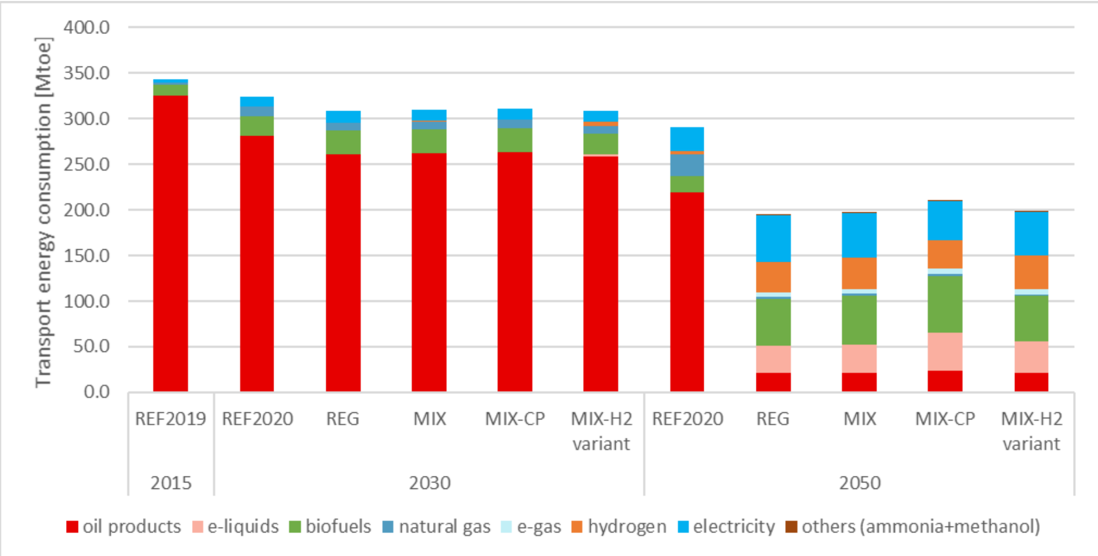
The figures below shows the change in the transport fuel mix resulting from all drivers present in the core scenarios as well as in MIX-H2 variant discussed in Section 6.6. The growth in electrification and uptake of biofuels are the most visible trends.

They figures show not only the increase in penetration of alternative fuels but also the reduction of transport energy demand due to vehicle and overall transport system efficiency. Overall transport demand is also shown in the first figure - including international aviation and international maritime transport.

The second figure shows the share of alternative fuels[135], including natural gas. The alternative fuels are projected to represent 13% of transport energy demand in REF by 2030. Not considering multipliers present in the RES-T formula around 7% of all transport fuels in 2030 would be of biological origin - driven by ambitious Member States plans to expand the use of advanced biofuels as put forward in the NECPs.

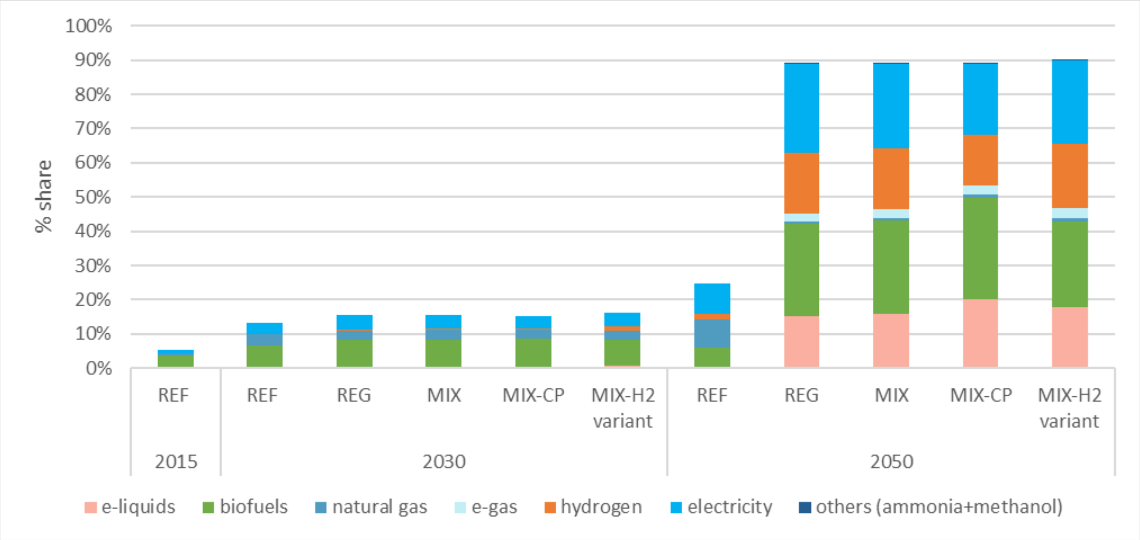
In the core scenarios the share of alternative fuels would go up to 15-16% by 2030. Biofuels and bio-methane would represent up to 8% in all core scenarios thanks to dedicated fuel policies, including for aviation and maritime navigation. E-fuels would represent 0.2-0.4% of the transport energy demand. Dedicated variant MIX-H2 (discussed in the Section 6.6) shows a possibility for a higher penetration of RFNBOs in 2030.

Figure 22 - Energy consumption in transport (incl. international aviation and maritime) in the EU; Source PRIMES



[135] According to the Directive 2014/94/EU, 'alternative fuels' means fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia: electricity, hydrogen, biofuels, synthetic and paraffinic fuels, natural gas, including bio-methane, in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)), and liquefied petroleum gas (LPG).

Figure 23 - Share of alternative fuels in Transport (incl. aviation and maritime navigation); Source PRIMES



The increase in ambition of the core scenarios in terms of alternative fuels uptake would lead to a moderate increase (compared to REF) of transport energy cost in private consumption - see table below. This increase would be most pronounced in the MIX-CP scenarios which has the highest mark-up in terms of carbon pricing on fossil fuels and the least ambitious energy efficiency measures.

Table 16 – Costs related to energy use in transport; Source PRIMES

EU, 2030	**2015**	**REF**	**REG**	**MIX**	**MIX-CP**	***MIX-H2 variant***
All energy expenses related to transport as share of private consumption (%)	18.0%	18.1%	18.1%	18.3%	18.5%	18.3%
Energy purchase expenses related to transport as share of private consumption (%)	4.3%	3.5%	3.4%	3.6%	3.8%	3.6%

There is a strong interlinkage between uptake of alternative fuels and a possible ETS extension to transport. As outlined in the CTP, such an extension could drive the quicker diffusion of the use of renewable energy in transport and hence help achieving the objectives and obligations under the Renewable Energy Directive. Such effects would however strongly depend on the level of the carbon price. While there is possible overlap between REDII and ETS coverage of road transport, as both could incentivise the use of renewable and low carbon fuels, it is unlikely that ETS extension to transport would have a significant impact, as the abatement costs of renewable and low carbon fuels are relatively high, If combined with a high ETS price, a drawback from a social perspective are the higher energy prices for consumers in the transport sector.

<u>Environmental impacts</u>

All core scenarios significantly reduce GHG emissions in transport compared to the REF – see table below[136].

Table 17 - GHG reductions in transport sector; Source PRIMES

EU, 2030	REF	REG	MIX	MIX-CP	*MIX-H2 variant*
Transport (incl. domestic and intra EU aviation and navigation) CO2 emissions (% change from 2015)	-17%	-22%	-21%	-21%	-23%

6.1.8. Impacts and analysis not based on modelling

Environmental impacts

Given that the policy options reflect the same ambition level as the MIX scenario, all options would lead to a significant reduction of the nominal level of GHG emissions in transport compared to the Baseline. Still, differences can be expected due to the distinct policy designs of the options.

In the short term the GHG emission savings will not be significantly affected by the increase of the sub-target for advanced biofuels and the introduction of a sub-target for RFNBOs in Options 1A and 1B, respectively, because the corresponding amounts of fuels are relatively minor and other decarbonisation options are available to achieve the same result. However, promoting these fuels with dedicated sub-targets prepares the ground for their upscaling after 2030 when large amounts of such fuels are needed to decarbonise hard to abate sectors such as aviation, maritime and long haul transport. Setting out sub-targets for advanced biofuels and RFNBOs is therefore serving the long-term decarbonisation effort. The increase of the sub-target for advanced biofuels leads to an increase in the biomass demand. This increase, however, is minor compared to the overall demand for biomass. Sustainability will be ensured by applying the preferred options assessed in section 6.7 on the target strengthening of the bioenergy sustainability criteria.

Expressing the obligation on fuel suppliers in terms of energy including minimum shares for advanced biofuels and RFNBOs (Option 2A) serves this long-term aspiration as it increases the likelihood that these fuels are commercially deployed and become available at scale after 2030. The emission-based approach (Option 2B) represents in principle a very effective tool to reduce GHG emissions as it promises a high emissions savings at low costs. However, as explained in the section on effectiveness in further detail, it provides a less clear signal for investments into innovative fuels such as advanced biofuels and RFNBOs. This implies risks for the future availability of these fuel options in the long term.

In addition, the environmental performance of the emission-based approach depends on the way it is implemented in practise. In order to implement the approach, it is required to measure GHG emission savings precisely, to incentivise investments into efficient production processes and to ensure that claims about the emission intensity of fuels are correct. Experience shows that, so far, the

[136] Biogenic emissions are considered under the LULUCF accounting.

implementation of the emission-based approach faced challenges in this regard. This is for several reasons:

- GHG emissions of fuels are measured applying a sophisticated life cycle assessment (LCA) methodology. This methodology, however, can take only emissions that are directly related to the production of the fuels into account. Emissions from indirect land use change and resource competition are not considered given that estimates of such indirect emissions are associated with a high degree of uncertainty and are therefore unsuitable to be applied[137]. The relationship between direct emission savings and overall emissions savings is not necessarily straightforward[138].
- The LCA methodology is designed to correctly represent the direct emissions arising over the whole production process of renewable and low carbon fuels but does not differentiate between emissions reductions that have been actively achieved and windfall gains. This can be best seen in Germany, which adopted it in 2015. Since then the reported emission intensity of biofuels has substantially decreased. This decrease is due to two main drivers: an increased use of feedstock yielding high direct emissions savings such as used cooking oil and palm oil (which is associated with high indirect emissions) and as substantial reduction of the reported emission intensity of conventional biofuels[139]. The share of advanced biofuels did not substantially increase and RFNBOs are not used at all. The average emissions savings reported for rapeseed biodiesel, palm oil, biodiesel and corn ethanol have increased to 70%, 80% and 88.6%, respectively[140]. The observed improvements of emissions savings reported for cellulosic ethanol were moderate in comparison (97% instead of 85%). The reported decrease of the emission intensity of conventional biofuels cannot be explained by increases of the processing efficiency. Biodiesel is in the regard the most important factor as it represents slightly more than 80% of total EU biofuel consumption: In case of crop-based biodiesel the bulk of emission are due to the cultivation of the feedstock (~70% in case of rape seed). The price signal for low carbon feedstock is unlikely to affect agricultural practises, however, the feedstock is sourced from commodity markets which do not take the carbon footprint into account in the price. Rather than changing the cultivation practises of feedstock, demand for feedstock with low emission footprint will promote the use of feedstock from regions, which are characterised by a low carbon footprint due to favourable natural conditions[141]. The origin of feedstock used for biofuels consumed in Germany has indeed changed substantially over time leading to an increase of imports. While it can be argued that the biodiesel from produced from such feedstock has indeed a lower emissions

[137] Woltje et al 2017: https://ec.europa.eu/energy/studies/analysis-latest-available-scientific-research-and-evidence-indirect-land-use-change-iluc_en

[138] Biofuels produced from wastes and residues will have the lowest indirect emissions if produced from feedstock which has little alternative uses. This will often be feedstock with physical characteristics that make it unsuitable for other uses. Turning such feedstock into biofuels, however, will also be more challenging and is often associated with slightly higher direct emission than using feedstock of higher quality with more alternative uses. Similarly, the mobilisation or production of additional feedstock will come with a higher direct emission impact than diverting feedstock from existing uses.

[139] BLE Evaluation and Progress Report 2018.

[140] The typical values set out in RED II for biodiesel produced from most types of vegetable oils are ~50%

[141] Cultivation emissions for biofuel feedstock differ between regions due to differences in the level because differences in the climatic. Selecting feedstock from regions with low cultivation emissions can significantly improve estimated emission intensity but does not reduce the emissions of the economy.

intensity, the overall emissions of the economy remain unchanged as this is a pure reallocation effect.

In case of bioethanol which represents slightly less than 20% of total EU biofuel consumption[142], there is more scope to reduce processing emissions e.g. by changing the type of process energy, however, the increase in reported emission savings of conventional ethanol in Germany (to 88.6% in 2018) cannot be explained by efficiency improvements, neither[143]. Indeed the most cost efficient way to increase the emission savings of conventional ethanol is the capture and use of CO_2 during the production process. Incentives for capture and use of CO_2 in ethanol plants, however, result only in reduction of the overall level of emissions if the useful demand for CO_2 is increased[144].

Verifying compliance with the GHG emission-based approach is complex, as the emission intensity of fuels cannot be measured when the fuel is placed on the market. Instead, authorities have to rely on the claims made by economic operators. Given that fuels with higher savings achieve higher prices and the renewable fuel market is very competitive, the emissions approach may incentivise operators to optimise the calculation of actual values or even to make false claims. It is therefore important to verify the claims made by the economic operators thoroughly. Given these challenges, it is therefore important to make adjustments to the LCA methodology that address the issue of windfall gains and resource competition e.g. by removing the possibility to claim emission savings due to carbon capture and replacement, the use regional values for cultivation emissions. The use of credits for emission savings due to improved agricultural practises, unless evidence can be provided that these measures do not lead to negative environmental effects and excessive incentives the use of feedstocks that while qualifying as wastes or residues are fit for use in the food or feed market. Furthermore, it is important to maintain measures that address the issue in indirect land use change.

Option 2D combining the emission-based approach with energy-based sub-mandates and an improved LCA methodology would ensure that innovate fuels with a high decarbonisation potential are promoted .

Impact on air pollution

Vehicles propelled by internal combustion engines are one of the drivers for local air pollution in cities and electrification of transport is seen as one of the main options to address a major part of this problem. Options 1 and 2 would contribute towards a further reduction of air pollution given that they would provide further incentives to electrify road transport. Setting out further details, how renewable electricity supplied to electric vehicles and ships should be considered under the obligation on fuels e.g. by the e introduction of the credit mechanism would provide incentives to invest into public recharging infrastructure and hence facilitate the electrification of road transport and accordingly decrease local air pollution.

Social impact

---

[142] EurObserv'er 2019 report

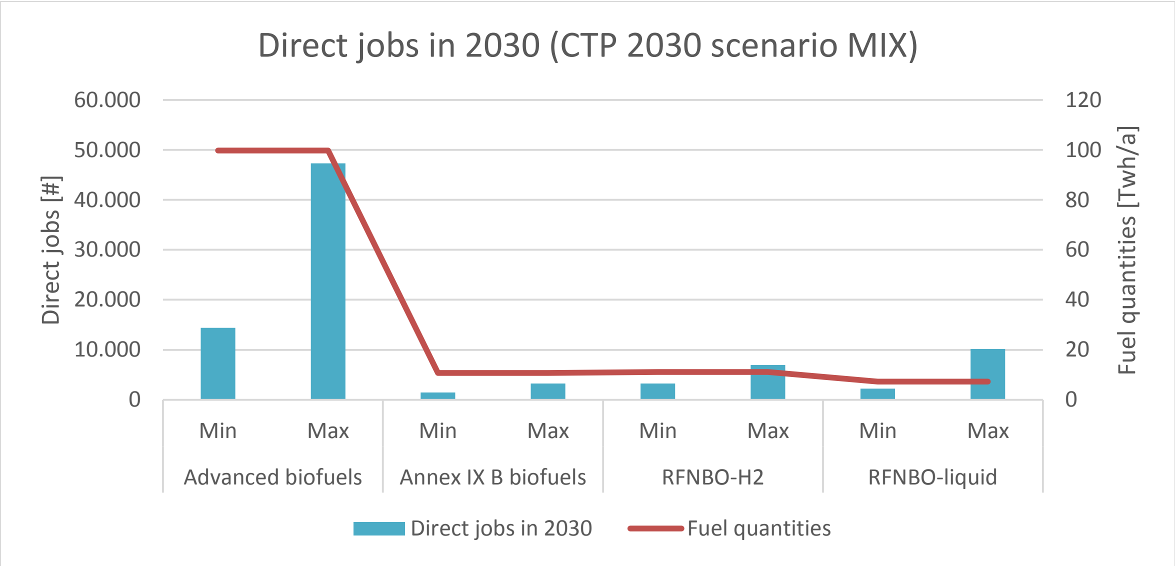
[143] According to Appendix 2 of the JEC WTW report version 5, bioethanol production continues to use natural gas a process energy.

[144] Ethanol plants capture CO_2, which is used in the beverage industry but do not increase the overall demand for CO_2 which means that less CO_2 is captured in other industries.

Employment

The increase of the ambition level foreseen under Options 1 and 2 is expected to create a moderate number of direct jobs. The largest increase is expected to be created in the production of advanced biofuels followed by hydrogen-based synthetic fuels. Figures do not include indirect jobs created in the supply chain for feedstock or in the construction of renewable electricity generation capacity where the most important effect can be expected[145] but also disregard potential losses in other industries. Overall polices promoting renewable energy have moderate positive net benefits on employment.

Table 18 - Direct jobs created in renewable fuel industry; Source: "Technical support for RES policy development and implementation: delivering on an increased ambition through energy system integration" ENER/ C1/2020-440



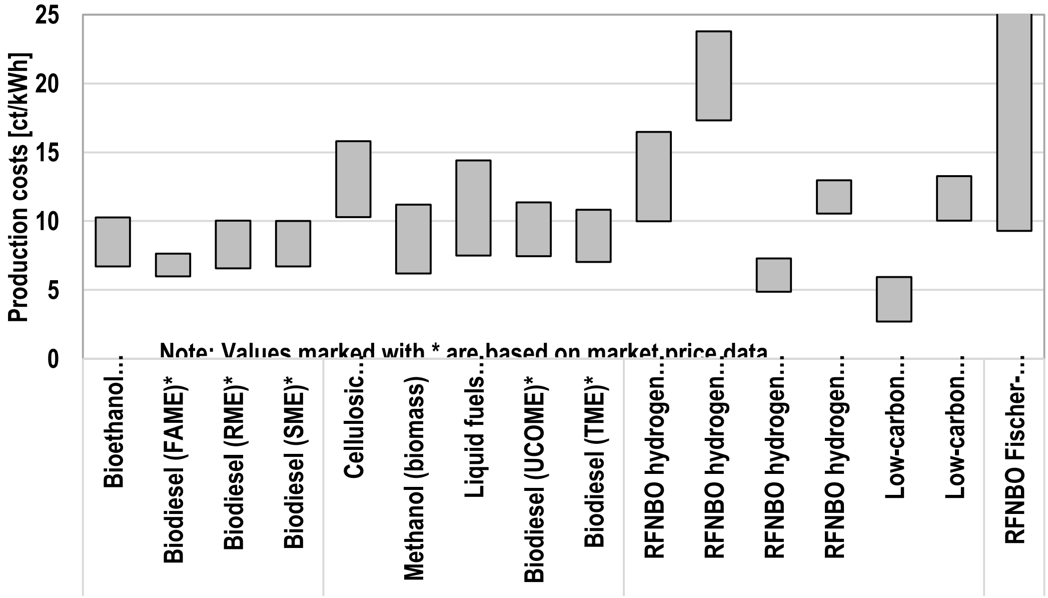
Economic impacts: Fuel prices

Innovative renewable fuels are more expensive than fossil fuels. The figure below shows estimated ranges of production costs of emerging innovative fuels and observed market prices for fuels which are already on the market[146]. Prices and costs estimates for liquid renewable fuels range from ~6 ct/kwh to ~24ct/kwh while prices for petrol and diesel are currently ~ 3ct/kwh at a very low level. Assuming a blend of 10% renewable fuels priced at 6ct/kWh increases the fuel price by ~3 ct/l. depending of the type of fuels costs can be higher. While measures such as the introduction of new fuels blends and the introduction of the credit mechanism for fuel suppliers would facilitate compliance and help to reduce costs, s the increase in the ambition level foreseen under Options 1 and 2 would still lead to an increase in combustion fuel prices. The increase in fuel costs would be limited, though, as the share of renewable fuels does not increase significantly between the main options and the baseline. The cost would be mostly borne by the aviation and maritime sectors, with costs passed on to consumers, as consumption of renewable and low carbon fuels in road transport remains stable and more expensive options are only marginally reaching the road sector

[145] IRENA 2019: Renewable Energy and Jobs
[146] In case of hydrogen estimated costs for delivery of fuels in filling stations are included

In the short to medium term fuels costs would increase more under Options 1A, 1B, 2A and 2D as those scenarios would lead to a more pronounced uptake of innovative renewable and low carbon fuels which will be initially more expensive. Due to increased technology learning, the long-term costs would be lower after 2030.

Figure 24 - Production costs and prices of different types of renewable and low carbon fuels; Source "Technical support for RES policy development and implementation: delivering on an increased ambition through energy system integration" ENER/ C1/2020-440



6.1.9. Effectiveness

The increase of the ambition level in the core options is defined by design as capable of meeting the 2030 targets which are "Fit for 55" as well as to contribute to the commercial development and deployment innovative renewable and low-carbon fuels.

The most relevant indicator for effectiveness of the options is the ability to reach cost-effectively and sustainably the "Fit for 55" ambition level. The pace of development and deployment of fuels with high decarbonisation potential is instrumental as an indicator to measure the achievement of the overall target. The measures in place will aim at promoting the commercial development of innovative fuels with high decarbonisation potential as this is a prerequisite for achieving climate neutrality by 2050.

There are barriers in promoting innovative fuels which are not yet fully competitive. Advanced biofuels for example, may encounter difficulties fulfilling the existing 2030 requirements with regard to their volume availability as well as technological availability. As stated by the Sustainable

Advanced Biofuels Technology Development Report 2020[147], advanced biofuels production for the transport sector remains limited on a commercial scale notably due to technological challenges. However in the last decade, considerable progress in technology development has been made. Another main barrier may be the feedstock supply, especially with regard to the possibility to find materials not used by other sectors, in order to have the possibility to limit costs and price volatility.

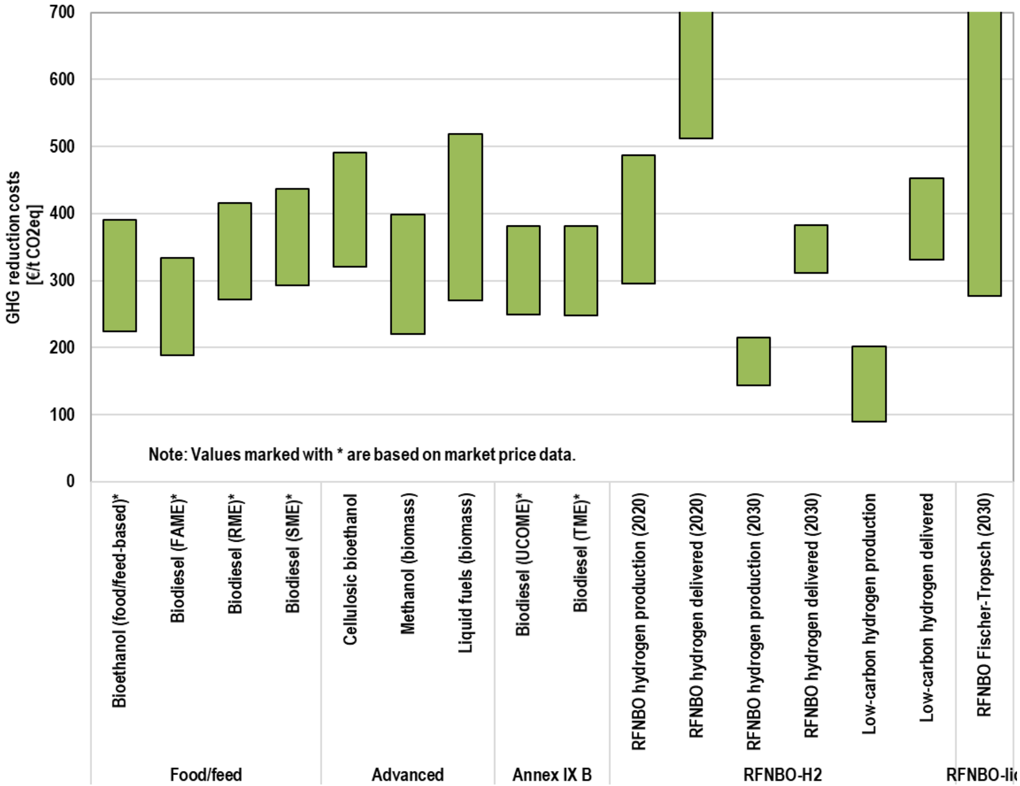
Production could be supplemented by imports, although in general it is only practical to import feedstocks which have a high energy density. Sugar and starch crops, oil crops, and waste fats and oils are already commonly traded internationally. Forestry residues may also be traded, but typically over shorter distances due to their lower energy density and the fact that there are no well-established trading markets in these products yet.[148] For all other feedstocks, it is likely that they would be converted into fuel near to their point of production, meaning the final fuel would need to be imported.

On the one hand, the setting of energy based sub-targets combined with sub-mandates in the fuel supply obligation (Option 1A, 1B, 2A and 2D) are more effective in supporting innovate renewable and low carbon fuels. Option 1B is in the regard more effective than Option 1A as it sets out also a sub-target for RFNBOs, which have a high potential but are still very expensive. This maximises the chances that these fuel technologies are further developed and sufficiently mature to be deployed at large scale after 2030. Option 2B applying an emission-based approach also features a higher level of ambition, but would risk promoting mostly mature fuels with comparatively low production costs and high direct emission savings such as biofuels produced from feedstock listed in Part B of Annex IX, biofuels produced from other types of residues as well as conventional biofuels. While RFNBOs and advanced biofuels achieve high emissions savings and have large cost reduction potential, they face higher technology risks and are not yet competitive with mature types of fuels on this basis (See figure below). Setting of energy based sub-targets combined with sub-mandates in the fuel supply obligation (Option 1A, 1B, 2A and 2D) may be effective in supporting innovate renewable and low carbon fuels. Option 1B is in the regard more effective than Option 1A as it sets out also a sub-target for RFNBOs, which have a high potential but are still very expensive. This maximises the chances that these fuel technologies are further developed and sufficiently mature to be deployed at large scale after 2030. Option 2B applying an emission-based approach also features a higher level of ambition but would risk promoting mostly mature fuels with comparatively low production costs and high direct emission savings such as biofuels produced from feedstock listed in Part B of Annex IX, biofuels produced from other types of residues as well as conventional biofuels. While RFNBOs and advanced biofuels achieve high emissions savings and have large cost reduction potential, they face higher technology risks and are not yet competitive with mature types of fuels on this basis (See figure below).

[147] Sustainable Advanced Biofuels - Technology Development Report 2020; https://ec.europa.eu/jrc/en/publication/sustainable-advanced-biofuels-technology-development-report-2020

[148] LBST, E4tech, S.E.E.C. (2020): Modalities to foster use of renewable energy sources in the transport sector by the Energy Community Contracting Parties; https://author.energy-community.org/enc-author-prd/dam/jcr:67ca5b20-edf1-4dd1-b9f9-80c9cc7d7711/RECG_LBST_0420.pdf

Figure 25 - GHG emission reduction costs of different types of renewable and low carbon fuels (excl. ILUC effects); source "Technical support for RES policy development and implementation: delivering on an increased ambition through energy system integration" ENER/ C1/2020-440



The experience with the implementation of the emission-based approach in Germany as well as the data set out in the Figure above on the estimated GHG emission reduction costs demonstrate that innovative fuel technologies such as RFNBOs and advanced biofuels are not yet competitive with mature renewable fuel technologies. Otherwise, at least advanced biofuels would have already emerged in the market as Germany adopted the emission-based approach in 2015. Apart from operating costs, the main competitive disadvantage for innovative fuels is that production facilities for mature types of renewable fuels are already in place while only a few installations producing advanced biofuels and RFNBOs at commercial scale exist, capex costs are high and technological risks remain. When applying an emission-based approach RFNBOs and advanced biofuels would enter the picture only at the moment the limit for conventional biofuels and the resource limits for Annex IX Part B biofuel would apply. Combining the emission-based approach with energy-based sub-mandates for advanced biofuels and RFNBOs would address this issue.

The revision of existing technical standards of fuels traded in the EU with respect to the maximum levels of bio-based content is relevant for all options as it facilitates the achievement of higher targets including the introduction of B10, which is currently not provided for in the FQD in the interest of vehicle compatibility. In such event, the introduction of an EU-wide B7 protection grade is recommended as a significant share of vehicles not compatible with B10 expected to be present in the fleet by 2030 (potentially 28%). The specific assessment of the introduction of new fuel blends is provided in Annex 10.

6.1.10. Administrative impacts

All core options would reduce the administrative burden for public authorities compared to the baseline as all options would eliminate the current overlaps between the FQD and REDII. These overlaps have made it impossible for economic operators and national authorities to disentangle administrative costs under the two Directives. Administrative costs induced by the current monitoring and reporting obligations under Article 7a of the FQD and REDII[149] amount to around 1-2 FTEs per year and fuel supplier ranging between €41.000 and €82.000[150]. In most cases, operators and Member States indicate 1 FTE handling administrative obligations, while 2 FTEs result from the choice to include monitoring regulatory trends as an administrative cost. On the EU27 scale, this corresponds to 27-54 FTEs - an equivalent of EUR 1.7-2.9 million per year. One Member State reported 15 FTE, and is considered as an exception as it assigns administrative costs to wider monitoring activities, such as the national trading system.

None of the policy options are likely to raise administrative costs, given the monitoring and reporting system is already in place for both FQD and RED implementation. Option 2B and 2D, however, would require a higher effort from public authorities and certification schemes to verify the claims made by economic regarding the emission intensity of renewable and low carbon fuels than the options based on the energy-based approach because operators are incentivised to determine the specific greenhouse has emission intensity of their production and their claims would need to be thoroughly verified in order to avoid unfair advantages of individual producers. The application of a union wide approach as foreseen under options 2A, 2B and 2D, however, would lead to more harmonised national rules, which would reduce administrative costs for fuels suppliers.

6.1.11. Coherence

All policy options apart from the baseline are coherent with the objectives of the CTP as well as related Union policies but the degree of coherence differs between the options.

All options apart from the baseline complement policy measures aiming at the reduction of GHG emissions such as the ETS and the ESR by providing incentives for the promotion of renewable and low carbon fuels in sectors, which are difficult to decarbonise via the ETS carbon signal. All options are complementary in this regard as they directly promote the use of low carbon energy carriers and provide incentives for the deployment of renewable and low carbon fuels formulated using different metrics.

The increase of the ambition level for RFNBOs and advanced biofuels is consistent with the additional demand stemming from the Refuel EU Aviation and Fuel EU maritime initiatives which will contribute towards the fulfilment of the target. If a stronger emphasis is put on the promotion on

[149] Administrative costs were obtained from the stakeholder consultation exercise in the framework of CLIMA.A4/FRA/2009/0011 support study. Stakeholders' views were collected through a targeted written survey and scoping interviews with industry and Member States.

[150] Estimate assume a labour cost according to Eurostat data: 37.1 average hours per week, 56 weeks in a year, €20 average hourly labour cost levels (plus taxes minus subsidies) in the EU-27 for administrative and support service activities [lc_lci_lev]

RFNBOs as set out in option 1B, this choice would also need to be reflected in potential sub-targets under the Refuel EU Aviation initiative. Focussing on the promotion of RFNBOs and advanced biofuels under Refuel EU Aviation would also avoid the reallocation of existing biofuels from road transport to aviation which could have negative effects on parts of the existing biofuel industry which cannot be transformed to produce aviation fuels. While the supply obligation for renewable fuels envisaged under the Refuel EU Aviation initiative could have been integrated into the RED, which would have made it easier to maintain the consistency between the legal instruments and would have provided the Member States with more flexibility, integrating this measure into a dedicated Regulation applying directly to the suppliers of aviation fuels has the advantage of creating a fully harmonised system, which is particularly important in the aviation sector[151]. A continuation of the 1.2 multiplier for the use of fuels in the maritime sector under the energy based options would further provide incentives that the demand for renewable and low carbon fuels stemming from the obligation on fuel demand set out under the Fuel EU Maritime initiative will be met with renewable fuels.

Setting out a target for renewable energy in transport will further complement legislative instruments aiming at the promotion of zero emission vehicles such as the CO_2 standards for vehicles, the AFID and the EPBD by endorsing the measures taken by the Member States to promote sales of electric vehicles and investments into the recharging infrastructure. Requiring the implementation of measures such as the set-up of a credit mechanism would facilitate the participation of electricity providers to contribute towards the fulfilment of the targets and provide incentives to invest into public recharging infrastructure. An uptake of renewable electricity coupled with smart charging would promote both maximum use of renewable electricity for charging, and cost efficient integration into the power system. The promotion of zero emission vehicles will also contribute in the same way to other environmental objectives such as the reduction of local air and noise pollution.

6.1.12. Stakeholders' Opinions

Stakeholders' Opinions

In the replies to the Roadmap, businesses & associations from the biofuels sector called for an increase of the 14% transport target. Actors from the renewable and low-carbon fuel sectors called for the establishment of sub-targets for synthetic fuels in different sectors. Several companies called for the introduction of a minimum target for renewable gas. The EV industry, representing a minority of the stakeholders that responded, pleaded for an increase of the transport target. On another side, some actors called for recycled carbon fuels (RCF) to be excluded from the transport target.

In the OPC, Business associations and company/business organizations agree that the target in transport should increase but in a more ambitious way than indicated in the 2030 Climate Target Plan. Environmental organisations and NGOs tend to disagree more (47% and 30%, respectively, of these stakeholder groups do not think that the level of the renewable target in transport should increase). Stakeholders from business associations, public authorities and NGOs mention how more ambitious targets are necessary to achieve the Paris Climate Agreement. With regard to representatives form Member States responding to the OPC,

[151] See IA of Refuel EU Aviation initiative for details.

opinions were almost split: half of the respondents were against an increase in the target for transport, while the remaining were in favour of the increase but had differing views in terms of how ambitious, compared to the CTP, the new target should be.

During the 1st stakeholder workshop, all the speakers agreed that efforts for promoting renewables in transport should be stepped up. There was a clear consensus that an overall sub-target for RFNBOs is critical for decarbonizing all the transport sectors. Some panellists agreed that a better harmonisation of policy instruments in RED II is desirable while some others worried about the effect of the review of RED II on policy certainty and investments. Different views were expressed on the importance of biofuels and hydrogen-based fuels for transport decarbonisation and the way electrification of road transport should be promoted.

During the 1st stakeholder workshop, NGOs argued that it would be better to have a lower target of sustainable fuels than higher targets fulfilled with unsustainable fuels (quality over quantity). Regarding electrification they requested a coordinated approach across sectors, including aviation and shipping. They also favoured the phase-out of high-ILUC fuels such as fuels from palm or soy oil and favoured the shift to more advanced biofuels, while RFNBOs should focus on long-distance transport. Although the multiplier for renewable electricity in transport is too generous, they favoured keeping it, in light of the absence of a better system. The biofuel sector requested only a minimal revision of the provisions regarding the transport sector, for the sake of regulatory stability and not to harm ongoing investments; The biofuel industry warned against the risk of an inflation of multipliers. The shipping industry, acknowledged the sense of urgency and requests a strong regulatory framework, certification that rewards first movers. However, they prefer a revision of the Fuel Quality Directive rather than a revision of RED II. They favour a solid fuel certification system. Maritime and aviation sector favours that the existing multipliers should be increased.

6.4. Measures to enhance the contribution of transport and heating and cooling to the system integration of renewable electricity

Modelling was conducted to assess the effects of various levels of integration of distributed loads (heat pumps and electric vehicles) and the availability of RES-share information, in overall system costs and levels of decarbonisation reached. This analysis should be considered in a broader context for the promotion of renewable electricity use in transport, heating and cooling, charging of home stationary batteries, as well as other types of electricity use featuring demand side flexibility or the capacity to be used as electricity storage. The financial aspects of reaching high levels of integration were specifically analysed with respect to the deployment of the needed smart charging infrastructure.

Further qualitative analysis was conducted to identify and address barriers to the integration of such distributed loads within the energy system and to the establishment of competitiveness and level playing field for the benefit of the energy system and the consumers.

Integrating renewable electricity

The Electricity Regulation and the Electricity Directive, as part of the Clean Energy package, have laid down the foundations of a new market design for electricity which will enable better rewards for flexibility, by providing adequate price signals, and will ensure the development of functioning integrated short-term markets. However, the current legislative framework does not provide for signals to consumers and market players that are specific to renewable based electricity penetration, nor does it entail specific clauses for integration of small and mobile storage assets such as domestic batteries and electric vehicles, whose numbers are increasing fast. It was therefore deemed necessary to assess the impact of certain legislative measures to enhance integration of renewable electricity in the system. If such measures prove insufficient, additional technical rules can be put in place through the Commission’s empowerment for network codes provided by the Electricity Regulation.

Both the electricity price and RES-E share information are available in nearly real time in the electricity market system as auctions are cleared every 30 minutes (or less) and Transmission System Operators (TSOs) have access to this data. In addition, Distribution System Operators (DSOs) have own data of RES-E production from self-production within their grid. Heat pumps, buildings’ Energy Management Systems and Smart Charging infrastructure for electric vehicles could be configured in a way that they do not only take into account the electricity market price signal, but also information on the RES-E share in the system. Shifting power demand for heating and cooling (via controlling the operation of heat pumps and thermal storage systems) and EV charging into hours with high RES-E share would thus favour the use of renewable electricity and incentivise the absorption of RES generation in real-time.

Aggregators and other stakeholders have informed on the need on such additional “RES signal” would complement the incentives provided by electricity prices, which would enable them to offer “real” time renewable services when managing the charging and discharging of distributed loads. Currently such information is mostly not readily available and needs to be estimate through cumbersome and risky calculations. Such information is also used differently than guarantees of origin (GOs) and they are relevant to different types of consumers and service products.

It should also be noted that although low electricity prices sometimes coincide with the availability of renewable energy in the system, the relationship between the two is many times coincidental and not always that of cause and effect. Electricity prices are at times low due to the must-run requirements of other generation assets such as nuclear or coal in conjunction with low demand, while in other occasions prices are high at times when both demand and RES production (PV) are high.

Deployment of smart and bidirectional charging infrastructure

EVs, if well integrated into the electricity system can reduce investment needs in other flexibility assets, including back-up generation facilities and align their demand with the penetration of renewable electricity in the system, thus reducing both system costs and GHG emissions. On the contrary, if EVs are not charged in line with the overall system conditions, they can increase both investment needs and the overall system GHG emissions.

The level of integration depends on the access to intelligent charging infrastructure with the ability to vary charging intensity according to certain signals, the availability of bidirectional flow between charger and vehicle (V2G) and the availability of near-real time information on pricing and RES-share of the grid to EV users and EV fleet aggregators. Especially as intelligent charging and V2G become widely accessible technologies, EVs will act not only as a valuable flexibility and storage service to the grid, but also as an additional remuneration stream for EV users, thus further incentivising the penetration of electric vehicles in the market and their contribution to the energy system.

Adequate integration of EVs would be needed, especially in situations where they are parked for long periods of time, either at private (e.g. home, office, depots, etc.) or public places (e.g. on-street parking, off-street parking, shopping centres, etc.). The role of charging stations at public parking areas, especially on-street parking used over-night at residential areas, or over-day when users park near the place of employment, will become increasingly important as EVs become mainstream[152] and will increasingly need to park in such areas.

Currently there are no requirements on installed charging infrastructure to be integration-ready (i.e. to be able to support intelligent charging and/or V2G). As non-supportive charging stations continue to be installed, their operation will limit or even negate their contribution to the grid for their entire lifetime. With regard to V2G specifically, it is still largely unavailable in the EU because a supporting protocol (ISO 15118-20) has not yet been agreed.

Ensuring level playing field in the integration of distributed assets through aggregation

The role of aggregators is considered vital in enabling home batteries and EVs to integrate with the grid, as they will be carrying out the task of using market signals to control the charging and discharging of the home battery systems and the intelligent charging and V2G operation of the vehicle fleets they aggregate. For the EVs specifically, such control needs be enabled while they are parked and plugged-in, regardless where (home, work, on-street, off-street). It is therefore essential to ensure a level playing field in the aggregation and electromobility service market and the electricity supply market, especially through aggregation.

Access to basic battery information, such as State-of-Health, capacity, power set-point and State-of-Charge by independent market players and aggregators[153] is currently restricted or controlled by the manufacturer / OEM. Knowledge of this information is necessary in order to optimally handle domestic, industrial and EV batteries during intelligent charging, discharging and V2G operations. Without access to such information certain operations cannot be performed or are performed with limitations and risks to the battery’s value. As stakeholders point out, without free and open access to such information, the development of competition in aggregation and electromobility service markets will be hampered, with limitations in the quality and value of services offered to consumers.

In addition, publicly accessible charging infrastructure and in general charging infrastructure not operated for own use, is usually not available to all electromobility service providers, unless it is operated based on transparent and not discriminatory terms, which is not always the case. This further limits the development of electromobility services, especially through aggregation, since it hampers the development of competition. Although updates to other legislation include non-discriminatory terms for pricing (including provisions for availability ad-hoc prices), this is not sufficient to ensure competition in the more complex electromobility services which are critical for the integration of EVs.

---

[152] About half of the publically accessible parking in EU is on-street; Scope of Parking in Europe – Data Collection by the European Parking Association (2013) www.europeanparking.eu

[153] Not affiliated to battery or vehicle manufacturers

Charging infrastructure is a limited infrastructure resource, especially in urban areas and service exits on highways, therefore lack of open access to the current and future developed charging infrastructure, would have negative impact on its effective use and the quality and quantity of integration services provided. This has also been a top-priority request from stakeholders, while interviews with operators who operate their charging infrastructure under open access parameters in certain Member States attest to its feasibility and benefits to market participants, system and users. Unless competition in the electromobility services for integrating EVs is safeguarded at these early stages, especially through aggregation, the market's ability to develop would be rather questionable. Drawing from experience in development of electricity and gas infrastructure, non-discriminatory access would be much preferred than applying other methods later, such as unbundling or third party access which would bring unnecessary market disturbance and higher cost for both businesses and administration.

At Member State level there are also different terms of operation between small storage devices (e.g. home batteries), or mobile storage devices (e.g. EVs), vs large stationary facilities. For example home storage is usually required to conform to the same high security standards as large facilities in order to offer balancing services, which causes a disproportionate cost to the owner. In other cases only stationary storage systems are exempted from grid charges, which substantially limits the profitability of storage services through EVs.

6.1.13. Impacts projected by scenarios produced with METIS model

To estimate the effect of various levels of demand response from heat pumps and EVs to flexible pricing and real-time RES-share information, modelling of additional variants was carried out by METIS, with hourly based granularity and joint dispatch and capacity optimisation of the MIX scenario.

The variations considered for 2030 with the energy capacity mix according to the MIX scenario for 2030, with 30% price driven demand response from heat pumps and EVs (baseline), 70% price driven demand response (HighDR), 70% price driven demand response with V2G (HighDR+V2G), and 70% demand response driven by price signals and real RES information but with no V2G capability (HighDR + vRESshare).

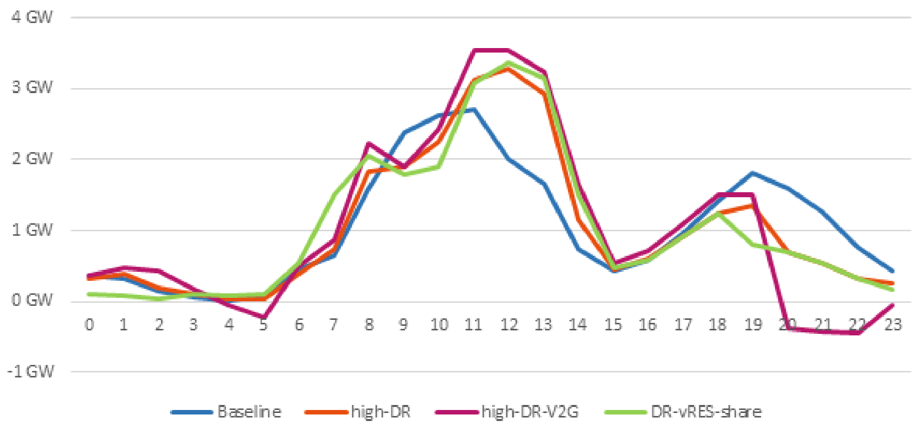
It should be noted that the above scenarios assume that when these EVs are parked for long time periods (e.g. over-day or over-night), whether at private or public locations (e.g. on-street parking), they are plugged to an intelligent charger or intelligent charger with V2G respectively. For heat pumps, it is assumed that intelligent meters and energy management systems are available. The model also assumes that flexible tariffs are made available to consumers, including vehicle users or those acting on their behalf (i.e. aggregators or mobility service providers).

The contribution of EVs was found to be substantially higher in all cases (about 70-75%) and are considered the predominant driver, in comparison to heat pumps. This dominance is expected to increase significantly post 2030 as the EV proliferation increases.

In solar countries especially, while achieving a cost-efficient integration of renewables, consumers provide flexibility by adjusting their EV charging or heat pump engagement patterns to hours of large renewable generation during daytime. As shown in the figure below, increasing the flexibility share in the high-DR model run enables electric vehicles to shift their consumption pattern to match

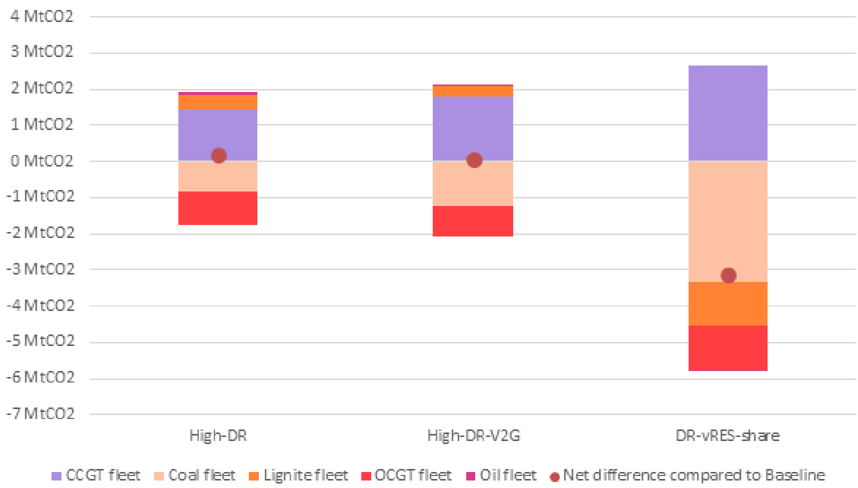
PV peak generation. EVs featuring V2G are able to integrate further PV generation at mid-day, and return electricity to the grid at night when flexibility needs are stronger due to low renewable generation.

Figure 26 - Example - Average EVs daily consumption profile, for different DR strategies.



The most significant impact from a decarbonisation perspective, is shown by the analysis on the GHG emissions of the system. As shown in the GHG results illustrated in the below, a reduction of GHG emission would only be possible when flexibility services are combined with near-real time information on the RES share or CO_2 content of the grid. Based on the modelling results, the high level of GHG reduction is also attributed to the re-optimisation of the electricity production mix (i.e. reduction of electricity production from coal and lignite), made possible with the availability of information on such information.

Figure 27 - CO2 emissions, compared to Baseline



According to the model results on system costs, the increase of intelligent charging from 30% to 70% is accompanied by 1.2 Billion Euro annual savings in the overall system. With the addition of V2G, those savings increase to 1.6 Billion Euro. If V2G capability is removed and real time RES-share information is added, the savings are limited to 0.6 Billion Euro (more storage will be necessary in the system, since demand is shifted and EVs don't contribute their storage). In practice, the revenues from EV sales would be reinvested in RES production and storage solutions, which would tend to compensate for the reduced system savings. It should be understood that RES installed capacities were constrained by the model based on the MIX central scenario produced by PRIMES – i.e. it was excluded that the additional demand for RES would trigger additional investments in RES new capacity.

6.1.14. Impacts and analysis not based on modelling – qualitative analysis

Policy options 1.1-1.2, 2.1-2.2 and 3.1-3.3 aim to facilitate the necessary infrastructure and market conditions so that the deep and renewable-specific integration of distributed loads such as heat pumps, domestic battery systems and EVs, can be achieved in practice and competitively. Options 2.1-2.2 and 3.3 are specific to charging infrastructure.

The measures described in options 2.1-2.2 aim to increase the availability of intelligent charging and V2G enabled charge points, to the level necessary to sufficiently integrate EVs in the electricity system while parked for long periods of time (over-night, while at work, at shopping outlets etc.). Such infrastructure requirements largely exceeds the needs for keeping EVs charged for mobility purposes, as required within the scope of AFID and its revision.

For reducing system costs and for decarbonisation purposes, EVs should be connected to the system via intelligent charging infrastructure, otherwise their charging will begin on the instant of connection and continue at steady rate until the desired charge is reached, which would have negative instead of positive consequences to system stability and decarbonisation. In order to achieve the positive effects projected by the modelling on system cost reduction and decarbonisation, such technical availability is considered a prerequisite at a level matching that of corresponding share of contributing EVs (30% / 70% respectively). The availability of bidirectional (V2G) functionality in the charging infrastructure would increase the benefits to integration and decarbonisation even further.

Options 2.1 and 2.2 examine the deployment of intelligent charging infrastructure and bidirectional charging infrastructure (V2G) respectively, with variants offering flexibility to the Member States to decide on the level of deployment of these two technologies, depending on their specificities and level of EV rollout.

The two option groups have different potentials for contribution to the overall goal of integrating EVs, since intelligent charging is widely considered as the most cost optimal and contributes to system decarbonisation to the largest extend (between 60-80 %) in comparison to bidirectional charging. The contribution of the latter can also vary according to the specificities of the energy system, such as the type of renewable energy production (solar pv or wind) which have different time variation characteristics.

Options 3.1-3.3 aim to provide a level playing field for the aggregation market. Option 3.1 eliminates potential discrimination against small/domestic energy storage assets or mobile storage devices, in comparison to large stationary storage facilities. This is relevant for home battery management and V2G services and aims to safeguard that charges and fees payed by the two types of storages, as well as the technical and security requirements to enable their participation to the market are not disproportionate. Otherwise homes and EVs injecting electricity back into the market would be at a competitive disadvantage compared to stationary storage systems, which will eventually diminish their potential to contribute to the electricity system, thus raising system costs and limiting the penetration of renewable electricity (e.g. by self-production).

Option 3.2 aims to provide equal access for independent electricity suppliers and electromobility service providers (especially when acting as aggregators to the necessary battery information (i.e. State-of-Health, State-of-Charge, etc.), so that they can manage domestic batteries and EVs via intelligent charging / V2G services in an optimal manner. This would foster a level playing field and facilitate competition in the market of aggregation of building energy management and electro-mobility services. Consequently, it would enable consumer choice and facilitate their ability to provide balancing and flexibility services to the electricity market, while being remunerated, thus bringing positive effects in the quality and cost of services provided to home owners and EV users.

Most importantly, since many EV manufacturers, while in control of the access to battery information, are now becoming active in electricity supply and electromobility services, the measure is expected to alleviate any lock-in effects placed on consumer choice for electricity and electromobility supplier services, in link with the choice of vehicle brand and vice-versa. Electricity suppliers and electromobility service providers interviewed have expressed strong concerns with the current situation and explained the difficulties faced when trying to access basic battery data to offer services to their customers. Some vehicle manufacturers allow such access at a fee or through an affiliation agreement, while others refuse access.

Option 3.3 deals with open access to the publicly available intelligent charging infrastructure, especially at locations where EVs are left for long hours (e.g. over day, or overnight). In locations of high demand for parking spaces, such as dense urban or residential areas, this would enable EV users to find a charging station with access to the aggregator / service provider of their choice. This would also reduce the need for infrastructure duplication, since less stations will be used by more aggregators and mobility providers. As aggregators will have much more infrastructure available to offer their services, such measure would facilitate increased competition in the electromobility services market and the development of best technology to cater for customer needs. Last, the measure will reduce the lock-in and market fragmentation trends of current practices and eliminate any chance of distortion of the EV market in areas where charging services might become affiliated with specific vehicle brands.

The basic characteristics of an openly accessible charging infrastructure would be the following:

- It is functioning based on open, non-proprietary and non-discriminatory communication protocols;
- The process of how an EMSP can conduct a bilateral agreement with the CPO is transparent, with defined timeframes and same for all interested parties. As best practice this includes a standardised requirement list, which includes registration and credit check requirements;
- Terms and conditions for access are fair, non-discriminatory and made known upfront to interested EMSPs, or made publically available. As best practice this includes a standardised contract and pricing policy.
- CPOs are free to set their prices, which could be different depending on the location of certain charge points, and could also be differentiated based on the volumes of various EMSPs. However, there can be no discrimination between EMSPs, or in transparent ways of rejecting access.
- Security Certificates are usually registered and managed by an authority, or recognised body.

The need for open access to the charging infrastructure aims to address two main issues, one being the lack of consumer choice and the other being the limitations on competition of recharging and integration related services. In many cases one does not actually choose their charging point, as it is physically linked to the place they need to park and integrate their vehicle with the electricity system. In such situations, often the case where people park overnight at their place of residence or while at work, but also elsewhere, without open access the EV-user would be captive to the mobility service provider affiliated with the specific charge point. This would also limit the ability of the EV-user's provider of choice to integrate the EV at the locations where the EV is usually parked.

Integration is done via aggregation of many individual EVs, under contractual agreement with their aggregator (EMSP / electricity supplier) of choice. EV-users enter in such contracts after carefully understanding and agreeing on a complicated set of terms and conditions which involve personal data handling (location, driving habits), battery management and risk of degradation, preferences of type of electricity (e.g. renewable), remuneration for flexibility / balancing / storage services offered via the EVs etc. This is a strong consumer protection side of the benefit of having one subscription, which has been carefully conducted once, being honoured in multiple charging points.

This also allows EMSP-aggregators to "follow" the EVs of their fleet, and predict the interaction between EVs and electricity system, knowing the specific routine habits of EV-users and the available capacity in their battery beforehand. They will combine this information with the dynamic signals they get from the electricity market (prices, renewable electricity share, congestion etc), to offer best value added to their EV-users according to their preferences, as well as the grid operators. Most importantly, they can influence the charging behaviour of EVs via their daily interaction with their EV-users.

From analysis and interviews conducted with numerous market players of the energy and electromobility ecosystem, such as electricity suppliers, electromobility service providers, charging point operators, research institutions, technical consultants, providers of specific technological solutions and others, additional benefits of open access were identified as follows:

- It facilitates bilateral agreements between EMSPs and CPOs, since the connection requirements and pricing policies are known ahead of time and parties will approach each other if there is mutual interest.
- It reduces the need for infrastructure, in contrast to proprietary deployment. Since more EV-users and EMSPs would be served by the same number of charging points, there would be less charging points needed to cover the needs of the EV fleets, Open access would improve the economics of charging points by increasing the utilization rate, which is a key driver in the cost per kW of charging given the high fixed costs of charging point deployment. The example in highways where many CPO/EMSP groups are represented at the same exit, each one with their own stations, may already be an indication of infrastructure redundancy, since they all need to be present at certain distances.
- It ensures that small, new players, both CPOs and EMSPs can enter the market and have a level playing field to grow. Open access to infrastructure would be necessary for start-up or independent EMSPs and electricity providers, in order for them to have an unobstructed route to offer their services to EV-users. Open access is very favourable for small EMSPs, because they can offer services through many CPOs without building their own infrastructure. Otherwise, small EMSPs could only rely on their own infrastructure or suffer a difficult negotiation with a CPO/EMSP group they won't have much leverage on. Open access would

be favourable to small CPOs as well, who can offer their infrastructure both to large EMSPs, thus securing volume, and to smaller upcoming ones with innovative solutions, thereby offering a diversified range of value added services to EV-users. Otherwise the small CPOs could only rely on their affiliated EMSPs.

- It brings multiple revenue streams to CPOs, since more EMSPs can be connected to their infrastructure and therefore bring more users. This works specifically well with independent CPOs, and to their experience well justifies any administrative burden, which may stem from the once-off conducting of numerous bilateral contracts.
- It provides the opportunity of EV users to use their electricity supplier of choice to charge and integrate their electric vehicle, in an analogous way to the wright of supplier choice that other electricity final-customers have for their homes or businesses[154].
- It enables competition to develop based on the innovation and value added of the services offered and not through restricting access to infrastructure on specific locations.

To ensure that the measure does not bring any negative impact on the continuing deployment of charging infrastructure, any negative impact on the business case of CPOs had to be carefully examined. Towards this end, interviews were conducted specifically with CPOs whose main business interest and main revenue stream is directly linked to the operation of charging points. This was done to set aside any influence of the measure to any other business interest aside from charge point operation. CPOs interviewed have confirmed that operating their infrastructure under open access conditions increases their profitability. Those CPOs are represented with over 500,000 charging points across 27 Member States.

It is also noted that provisions for open access to charging infrastructure, as well as much stronger conditions of access regulation and governance measures, are currently requested by many public authorities, especially in urban settings[155].

Further quantitative analysis could be conducted, if data can be available from CPOs on the various revenue streams from different EMSPs, as well as other sources. However, such auditing analysis would require consent and independent verification. From the information received through the interviews and the argumentation results of the qualitative analysis, it is not expected that a quantitative approach would yield a different conclusion.

Open access has also been implemented at Member State level. In The Netherlands, interoperability of the charging network and open access practices and bilateral contracts between all market players have been established early-on, on the onset of the shift to electromobility. Currently (2020 figures), The Netherlands also host the highest number of recharging points in EU[156].

With regard to any need for limiting the scope of application of an open access requirement, all benefits brought by the measure should be considered. It could be the case that certain situations

[154] From a strictly legal interpretation of the provisions of the Directive (EU) 2019/944, EV-users are considered final-customers according to the definition in Article 2(3) of the Directive, since they purchase electricity for own use and would therefore be entitled to choose their electricity supplier.

[155] Sustainable Transport Forum, 'Recommendations for public authorities on: procuring, awarding concessions, licences and/or granting support for electric recharging infrastructure for passenger cars and vans', adopted on 26 November 2020. The STF was established by Commission Decision C(2015)2583.

[156] Link to Commission's rollout plan for alternative fuels infrastructure, once published

provide more opportunities for integration than others, where EVs only park briefly to recharge and continue on a journey. Although limiting the scope of application of the measure to the locations where EVs park for long periods of time will still have almost the same positive impact to integration, it would fall short of bringing the benefits of open access to other charging situations, where it could also be beneficial. Innovative recharging services geared specifically for highways, for example inviting ad-hoc approaching cars when shares of renewable electricity sharply increase in a specific area, could also immerge. Keeping the scope of application universal, would ensure that the benefits of level playing field to competition and innovation can be applied to the entire ecosystem of electromobility.

6.1.15. Effectiveness

Response to pricing and RES-share information

As illustrated by the modelling analysis, the increase in the demand-side-related flexibility potential across the different scenarios triggers such response that brings a re-optimisation of the electricity generation capacity mix, as demand-response makes the system less reliant on expensive peak generation technologies from gas turbines, with investments reduction of the order of 13-23% to those technologies, such as Open Cycle Gas Turbine (OCGT).

In addition, the implementation of option 1.1, which adds information on RES-share information, has a clear, positive effect in reducing the GHG emissions of the energy system. In contrast, analysis of scenarios where demand response was engaged only through price-signals, regardless of the level of engagement (i.e. share of participating heat pumps or electric vehicles), has shown no effect on GHG emissions. This constitutes a strong indication that for demand response to contribute towards decarbonisation, real time information on variable RES share or carbon content of the grid must be provided, in addition to price signals. In case forecasting is provided where available, the predictability of the contribution of the EV fleets, as they are mobile assets, would increase the measure's effectiveness even further.

The introduction of RES share information also shows the tendency to further optimise the investment and use of conventional sources, while giving more priority to less polluting ones. Specifically, the corresponding scenario has shown a decrease in generation from lignite-based power plants by 7% and from coal-based power plants by 9%. Generation from natural gas CCGTs has also indicated an increase of 2.5%.

In addition, the introduction of such information could be used by the market for the delivery of advanced digital products and solutions in energy and other areas.

Option 1.2 would have some positive effects in improving consumer information, by complementing the information provided through guarantees of origin (and their residual mix for other customers), it would bring limited added value in terms of inducing behavioural reactions to near-real-time system conditions.

In order for the benefits of option 1.1 to be facilitated in practice, preferred options from options groups 2 and 3 are considered as below.

Deployment of Intelligent and bidirectional charging infrastructure

Options 2.1C would be the preferred option in terms of intelligent infrastructure deployment (smart charging functionality), as they would help ensure the availability of the required intelligent charging infrastructure in an optimized way. While option 2.1A ensures that the negative lock-in effects associated with the deployment of non-intelligent chargers are avoided while satisfying the EV mobility needs, 2.1C adds the additional smart charging infrastructure required for EV integration by providing flexibility to the Member States and Regulators to optimise it according to their specificities.

Most EVs are currently parked within private premises (homes, offices, depots, etc.). However, as proliferation of EVs continues and since half the parking locations in the EU are on-street, it is expected that other parking areas such as off-street parking premises as well as on-street parking locations would be required to host EVs and therefore would need the installation of additional intelligent chargers in order to keep these vehicles integrated into the grid while parked. Applying a universal requirement for intelligent charging (public, private for own use and private for wider use locations) would facilitate a much broader integration share of EVs and would cover any gaps stemming from legislations with specific scope (EPBD/AFID).

With regard to bidirectional charging, option 2.2B is preferred, which requires Member States to assess where V2G would be relevant in their systems and proceed accordingly. As V2G may bare additional costs and since the benefits depend on various system factors, it was deemed necessary to provide such flexibility so that they can to act specifically according to their national conditions (e.g. share of home / office / public charging) and degree of EV proliferation.

Since the measures described in the selected options (2.1C and 2.2B) aim to increase system integration and are specific to the benefit of the electricity system, it would be best that the relevant assessments and recommendations are carried out by the National Regulatory Authorities, in cooperation with the TSOs and DSOs. Member States would then proceed to the appropriate measures based on such recommendations.

Competition and Level Playing Field – access to infrastructure and information

With regard to the aggregation market, Option 3.1 aims at eliminating any regulatory barriers against balancing and electricity storage services provided by domestic batteries and EVs, in participating in the electricity markets. This would ensure that small and mobile electricity storage systems will be competing on an equal footing with larger stationary storage facilities. Without such conditions the business case for domestic battery management and V2G would be substantially diminished and domestic batteries and EVs would not be able to contribute in lowering the system costs associated to storage capacity. This option does not concern intelligent charging or behind the meter discharging, therefore its effectiveness, although substantial, would be applicable less broadly. Nonetheless, judging from the low implementation costs, it is still considered as a no-regrets measure thus it is recommended that it is applied in parallel with options 3.2 and 3.3.

Option 3.2 is considered the most effective in setting a level playing field from the early stages of market development, therefore its early implementation would bring positive long term effects in the availability, quality and cost of services provided to domestic battery owners and EV users. This is considered the most preferred and timely required option from the group. Such an option could be easily applied in practice, as basic battery information such as State of Health and State of Charge can be made available by manufacturers in many ways, either via the connection to the grid or over the internet (through the back-end). With regard to interoperability of information, a common format is essential and can be agreed through the preparations of protocol ISO 15118-20, currently under development.

It is important however, that the provision of such information is not made available at a cost or based on other bilateral agreements – access should be provided under open and free conditions.

Besides been supported by comments received by stakeholders, free and open access to basic battery data was considered crucial for competition and a level playing field in the electromobility and aggregation markets by the extensive study recently conducted by the Commission on EV integration "Best practices and assessment of regulatory measures for cost-efficient integration of electric vehicles into the electricity grid"[157]

Option 3.3 is expected to become increasingly pertinent in the near future as the proliferation of EVs becomes mainstream. However, based on the current market dynamics, it would be critical to address early on any market barriers or foreclosure tendencies, which would hinder market development. Enacting the measures under option 3.3 would effectively make all public intelligent charging infrastructure available to the general pool of electromobility service providers and their customers especially through aggregation. This would in turn increase the efficiency of infrastructure deployment and increased its accessibility, especially in areas of high parking demand, with substantial added value to competitiveness and innovation in the electromobility and electricity supply services market. As explained above, it is recommended that the measures of options 3.1, 3.2 and 3.3 are applied in parallel, since they are not mutually exclusive.

6.1.16. Administrative impacts

No considerable administrative burden is expected from the suggested options. With regard to the provision of information (e.g. RES share or carbon intensity of the grid), the information is already available internally by the network operators and the administrative costs of making it available to the public is expected to be marginal (in certain Member States this is already available on the internet on a real-time basis and accompanied with forecasting). In contrast, the automation brought by the use of digital technologies is expected to increase by large the efficiency of transactions and procedures associated with system integration. Therefore, no considerable administrative burden is expected to arise from implementing option 1.1.

For implementation of option 2.1C and with regard to the cost difference between an ordinary charger and a smart charger, based on the aforementioned study conducted by the Commission on EV integration, the current cost difference for a charger up to 22kW is calculated to be 300 Euro per charger, with an estimated decrease to 136 Euro per charger by 2025 and to 113 Euro per charger by 2030. For public charging points specifically, these costs also need to be considered in connection to the other cost parameters associated with the installation of a charger (construction works, cabling, connection fees, etc.) which brings the overall costs to several thousands of euros per charging point, depending on the situation and therefore makes the cost difference attributed to smart functionality marginal. For the cases of private charging stations, where the cost difference between a smart and a non-smart charger could bare more consideration, incentives such as subsidies may help. However,

[157] Link to study when published

the short-medium term financial benefits of the intelligent charger option to the EV-user and system operators, are expected to outweigh its cost difference considerably and be amortised within the first three years of operation.

With regard to the overall financial impact of the implementation to the energy system, the modelling has shown that the additional cost incurred, for example the added installation of stationary electricity storage to accommodate availability of renewable electricity at times of reduced production, will be driven and supplied by market dynamics as a result of preferential demand. Once the optimisation gains are considered, the net costs to the energy system are expected to be negative (i.e. savings) between 0.6 and 1.6 billion Euro annually. The financial benefits are additional to the overall benefits of GHG reduction.

With regard to the assessments relevant to options 2.1C and 2.2B, it is estimated that such assessments could incur costs in the order of 10,000 – 100,000 Euro per Member State depending on the population, which are considered marginal (e.g. 0.5 – 5 Euro cents per citizen). Regulators and operators would also be able to reclaim such costs through tariffs and licencing fees.

With regard to the implementation of measures of Option 3.1, it is anticipated that the regulatory adaptation would not be substantive and would in any case be part of the overall transition / transposition process for implementing the Electricity Market Regulation and Directive. Option 3.2 would require some software adaptation on behalf of the manufacturer, in order to allow access to the data to third parties, which is not expected to be of substantial cost, since the data is already collected by the Battery Management Systems and the software update will be replicated automatically via a download process.

For Option 3.3 specifically, some admin cost may arise to CPOs, switching from a proprietary system to an open access system in two ways. First, Any CPOs using outdated or highly proprietary hardware, on which open protocols and standard identification software cannot be installed, may need to gradually update their infrastructure. In such case, exceptions can be considered for existing infrastructure. This is however not common and it was not encountered during the interviews with various CPOs and market players. In any case, hardware interoperability will need to be in place in order to allow ad-hoc transactions, as required by AFID.

Second, CPOs switching to operation based on open access, would need to gradually come into bilateral agreements with EMSPs who would be interested in accessing the charging infrastructure to serve their EV-users. It is expected that only EMSPs active in the area of the CPO would have any incentive to enter in such agreement, since it would be an administrative cost for them also, which they wouldn’t wish to endure without expecting revenue. In addition, once a CPO starts operating their infrastructure based on open accessibility, it is expected that the transparency in his requirements, procedures and pricing policy would by itself prevent a substantial part of the administrative cost of reaching an agreement, since any interested EMSP will know what to expect before deciding to approach for a bilateral agreement. As explained in section 6.4.2, according to the experience of CPOs currently practicing open access policies, the additional financial benefits of having multiple bilateral agreements with EMSPs, largely offsets the initial, once-off administrative burden. For a complete picture, the additional revenue stream for the electricity suppliers and EMSPs should also be taken into account.

6.1.17. Coherence

The suggested measures aim to increase the level of absorption of renewable electricity by the end-use sectors, through the availability of interoperable information on the near-real time share of renewable electricity and its forecasting, access to the necessary infrastructure, as well as putting in place the needed provisions to facilitate competition in the market and level playing field. This would work in conjunction with a high level of integration of EVs and other distributable loads such as heat pumps in the electricity system, so that they are able to respond to the above information. The measures aim to facilitate market dynamics to work towards further decarbonisation of the electricity system and trigger more demand for renewable electricity.

The integration of EVs is specifically considered within this context, as opposed to the adequacy of recharging infrastructure for mobility purposes[158], or the need to reduce the environmental impact and oil-dependence of the transport sector[159], or the need for regulatory framework to facilitate the connection of such recharging infrastructure and the neutrality of DSOs[160].

In particular, option 1.1 will enable EVs, heat pumps, domestic batteries and other distributable loads in end-use sectors adjust their energy absorption to the times of most availability of renewable electricity, thus reducing GHG emissions and enhancing RES penetration through system integration. This stems directly from the key actions of the ESI Strategy, calling for the development of specific measures for the use of renewable electricity in transport. The suggested options 2.2, 3.1, 3.2 and 3.3 aim to ensure the availability of appropriate intelligent infrastructure, access to information and the necessary level playing field in the energy aggregation market, in order to achieve GHG reduction and increased penetration of renewable electricity through mobilizing market dynamics.

Option 3.2 specifically, is complementary to the provisions on access to battery data related to the process of repurposing a used battery for 2nd life, currently present in the proposed Commission regulation ‘concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020/EC. The measure suggested under Option 3.2 adds dynamic access to data and access to information on ‘state of charge’, as well as ensuring that this access is provided during the use of the battery in the vehicle, necessary to facilitate operations related to system integration (smart charging, bidirectional charging).

The EPBD and the Alternative Fuel Infrastructure Directive focus on the deployment and planning of charging infrastructure in thermally enclosed buildings and publicly accessible areas, respectively. A gap therefore exists for structures and areas not within the above, such as multi-storey parking structures and off-street parking areas with controlled access. In addition, AFID’s scope is specific for ensuring infrastructure adequacy to support EV fleets for mobility, instead for facilitating system integration. . For example, the currently proposed ad-hog payment in the revision of AFID may solve many mobility related concerns, however it is not sufficient to cater for the requirements and purposes of integration of electric vehicles, as they are described in section 6.4.2. A gap in regulatory scope is therefore clearly present, both in terms of geographical application and in terms of purpose, which does not enable legislating for the desired location, type and number of charging infrastructure

[158] Article 4(1) of Directive 2014/94/EU
[159] Article 1 of Directive 2014/94/EU
[160] Article 33(1)&(2) of Directive 2019/944/EU

fit for EV integration in a universal and coherent manner. The suggested measures within the RED will complement these two legislations and their upcoming revisions, by creating *transversal* requirements for charging points to be deployed and operated in a manner that optimizes their contribution to the system integration of renewable electricity.

6.5. Certification of renewable and low carbon fuels

6.1.18. Impacts and analysis not based on modelling work

Adjusting the scope of REDII by including new definitions of renewable and low carbon fuels will allow certification schemes to subsequently adjust the scope of the certification services they provide. This will in turn enable a larger number of options in terms of energy carriers to be considered on the market for achieving the energy targets. Extending the scope of the Union database would support this process by providing more transparency and traceability of the different energy carriers in all end-market segments.

Economic impacts

Overall, the application of an EU-wide certification system, based on common standards and supported by a transparent and comprehensive information system to trace all energy carriers would bring about economic benefits for all economic operators in these supply chains in addition to the positive effects on consumers disclosure. This would also allow bringing closer supply and demand of sustainable energy in a cost efficient way leading to additional economic benefits along the supply chains.

The introduction of the union database for centralising the tracking of fuels in a mass balance system on EU level would have a significant positive effect on centralising the available information and on preventing the risk of fraud. Apart from the transport sector, the risk of fraud is substantially higher for heating and cooling, since in case of gases and electricity, the data on produced volumes can be checked by Transmission System Operators and Distribution System Operators. The renewable fuels used in heating and cooling are more easily replaceable with other non-renewable fuels and therefore require higher cost of auditing[161].

The inclusion of RFNBOs, waste heat and RCFs into the accounting for demonstrating the compliance with sectoral targets would level the playing field for those fuels with standard renewable fuels, potentially opening new demand for them and increasing their revenues. It can be expected that the potential benefits for these new actors in the renewable supply chain will largely compensate the additional compliance costs, that they will incur to demonstrate their compliance with the certification system (to get involved into certification system and costs connected e.g. to acquiring certificates). The harmonisation of certification schemes into one database will also enable more cross-border trading, increasing competition on the markets. This is particularly valid for the gas market, where the proposed flexible implementation of the mass-balance system supported by

[161] Verwimp et al (2020). Technical support for RES policy development and implementation. Establishing technical requirements & facilitating the standardisation process for guarantees of origin on the basis of Dir (EU) 2018/2001. Available at: https://www.aib-net.org/news-events/aib-projects-and-consultations/fastgo/project-deliverables.

the Union database would be expected to contribute greatly to overcome national markets fragmentation[162].

Environmental impacts

Addressing the interaction between the system of guarantees of origin (GOs) and the certification system, based on a mass-balance system, would bring more clarity to the accounting. Including information on carbon content would also significantly improve the information for energy consumers. The data on the certification system will be centralised in one system, making it easier to compile national data.

Social impacts

Integrating and centralising in the Union database data on all renewable and low-carbon energy carriers (except electricity), based on an EU-wide harmonised certification system would make the system more understandable to the general public and therefore also more trustworthy.

6.1.19. Effectiveness

The specific combination of measures extending terminology under REDII, improving traceability of energy carriers through the Union database, as well as mainstreaming the mass-balance system supported by the Union database will allow the effective assessment of the sustainability potential of the different energy solutions. The results of this assessment through the certification will allow market operators and policy makers to take the right decisions for their energy mix. In addition, the overall transparency and effectiveness of the energy system would be strengthen avoiding any risks of double counting by solving the issue of co-existence of a certification system, based on a mass balance with a GOs system. This will be done by defining the boundaries and rules to follow when GOs have been issued for consignments of energy which will have to be transferred into the Union database.

Specifically for gases, an EU-wide certification system, combined with a tailor-made mass-balance system would very much support the cross-border trade of renewable and low carbon gases, bringing supply and demand closer.

Including low carbon fuels as a category under the terminology of RED II combined with respective requirement for its certification (based on a specific threshold for GHG emission savings) will basically allow to certify low carbon hydrogen as a decarbonisation option in the energy mix, since recycled carbon fuels are already part of it under RED II. This will provide a shared understanding of what low carbon fuels are, which is a prerequisite for a wider promotion of low carbon fuels also outside the RED II, namely through national support schemes or at EU level outside of RED II (i.e. FuelEU Maritime). This way an important complementarity of legal tools can be ensured.

[162] Renewable and low carbon gases injected into a grid could be retrieved in a flexible manner at any other point of the grid provided the grid is interconnected.

6.1.20. Administrative impacts

Extending the current certification scheme to cover low carbon fuels and waste heat will entail some, but limited administrative burden for MS administrations since MS will have to implement the definitions will be set out in REDII.

As presented below some compliance costs for industry to get these new fuels certified can occur but it can be expected that they will be largely compensated by the market opportunities, which the certification and respective labelling would provide to them. Current fees, which existing voluntary schemes charge to economic operators active in the biofuels supply chain, contain two components, namely annual audit fee and annual licencing fee. The annual audit fee cost vary depending on the audit complexity within a range of 800 euro- 2000 euro per day, while such audits normally take 1-2 days. On that basis, we can conclude that depending on the complexity of the audit and the size of the economic operator, the annual audit fee for an economic operator would be in the range between 1600 euro to 4 000 euro per year. In addition to that the annual licencing fee is normally calculated based on the size of the economic operator.

Below there are a few examples of such fees being charged by voluntary schemes.

ISCC (the biggest certification scheme) charges from 50 euro to 500 euro per year for issuing the certificate + an annual fee between 0.08 euro and 0.010 euro per tonne of sustainably certified product. [163] Another certification scheme (RSB) [164] charges primary producers the following fees based on the size of their farms, namely:

- No charge for up to 150 hectares,
- 151 to 500 hectares $0.95 per ha
- 501 to 1,000 hectares $0.75 per ha
- > 1,000 hectares $0.50 per ha.

RSB charges feedstock processors and fuels producer annual fee based on the volume of certified production, namely:

- for the portion between 0 – 250,000 metric tons $0.14/ ton
- for the portion between 250 – 400,000 metric tons $0.10/ ton
- for the portion above 400,000 metric tons $0.00/ ton

Applying a mass balance system for gases will not bring additional burden or costs since the physical tracing of the molecules will not be required. On the contrary, this will strongly support the EU-wide energy trade.

The extension of the Union database may to a certain extent increase the administrative burden and costs for economic operators, voluntary schemes and Member States. However, the development of the Union database is already part of the baseline as it is an existing obligation for liquid and gaseous transport fuels under RED II. Therefore, its extension to other sectors would have only marginal

[163] https://www.iscc-system.org/wp-content/uploads/2017/02/ISCC-Fees.pdf
[164] https://rsb.org/wp-content/uploads/2020/07/20-07-06-Bio-based-and-Advanced-Liquid-Fuels-for-web.pdf

additional costs, which can be expected to be compensated by the benefits of having a harmonised information system tracing energy carriers through the supply chain and in all end-sectors.

In addition, for those MSs already maintaining national databases, there will be only minimal additional costs compared to current situation. Integrating the certification systems across the EU into the union database, can also be expected to have a positive medium and long term effect on decreasing the overall costs of system maintenance. The same is valid for existing industry-based databases, covering parts of the supply chains, if they wold be integrated in the Union database.
Consumers that have to demonstrate renewable energy share in consumed fuels are already used to work with databases, so adapting to the Union database should not bring substantial new costs.

6.1.21. Coherence

The Energy System Integration strategy includes as one of its key actions to propose 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 emission savings and sustainability criteria. The Hydrogen Strategy also calls for European-wide criteria for the certification of renewable and low-carbon hydrogen. With the exception of Recycled Carbon Fuels, low carbon fuels are however not objectives part of the REDII. A political decision will need to be made whether for coherence reasons low-carbon fuels can be included in the wider scope of REDII, or whether the certification of such fuels should be addressed in the Hydrogen and Decarbonised Gas Market Package.

6.1.22. Stakeholder's Opinions

Stakeholders' Opinions

In the OPC, regarding GOs, the majority of respondents (64% among which: 70% of the respondents from academia and 66% of business associations, 75% of consumer organisations) agree that the obligation for electricity suppliers to certify to consumers the share of energy from renewable sources by guarantees of origin, should be extended to both renewable fuels and low-carbon fuels. This view is shared consistently across all stakeholder types, with the exception of environmental organizations. Their views were split along the different options, with some being in favour and some against the abovementioned obligation (32% were in favour of the obligation to certify for renewable fuels only, 32% were in favour of the obligation for renewable fuels and low-carbon fuels, while 37% were against it).

With regard to renewable hydrogen and whether it should be added to the cooperation mechanisms, the majority of respondents (60%) think that cooperation mechanisms set out in RED II should be extended to cover renewable hydrogen regardless of its end use, to allow Member States to support renewable hydrogen projects in other Member States and in third countries while counting the energy produced as their own. However, this view is not shared by all stakeholder types—academic/research institutions, environmental organisations, NGOs, and trade unions do not agree with this. A large majority of these stakeholders (55%, 83%, 71% and 67% respectively) selected "no" as a response.

During the 1st stakeholder workshop, energy traders favoured a cross-sectoral, cross-commodity, technology neutral approach. Certification organisations, referring to the fact that RED has demonstrated that sustainability requirements can be introduced for specific sectors, favoured a dedicated regulation. The hydrogen sector favoured the development of a new system for hydrogen certification.

6.6. Promotion of innovative renewable and low carbon fuels

Innovative renewable fuels (RFNBOs) and innovative low-carbon fuels[165], both gases and liquids, especially hydrogen produced from electricity and its derivatives (so-called "e-fuels") can offer solutions to decarbonise the economy in sectors where electrification are not feasible, not efficient or have higher cost.

The analysis in the CTP shows that such fuels are essential for achievement of climate neutrality but appear in all scenarios in significant quantities only post-2030. This is especially driven by high production costs for hydrogen and high conversion losses, which especially occur at the production of liquid hydrogen-based energy carriers. Currently, these fuels are not competitive with conventional fuels (in transport or heating) or with current processes for hydrogen production (in industry, currently mainly based on steam methane reforming).

However, it can be argued that technological and commercial readiness of these fuels should be demonstrated already by 2030 in order to create investor certainty and allow the necessary deployment at scale after that period thanks to accelerated costs reductions. According to the CTP, neither carbon price alone nor the intensification of regulatory framework in the current architecture (i.e. without dedicated pull for such innovative fuels) would sufficiently trigger demonstration and deployment of innovative renewable and low carbon fuels in transport and industry sector at a significant scale in 2030.

6.1.1. Impacts projected by the core scenarios and MIX-H2 variant

In the REF scenario, innovative renewable and low-carbon fuels are virtually non-existent in 2030 and only marginal in 2050 (it is mostly hydrogen for heavy-duty vehicles (HDVs)). In the core scenarios (that achieve also carbon neutrality), innovative renewable and low-carbon fuels appear in 2030[166] thanks to HDVs standards and aviation and maritime fuel mandates. By 2050, they are, however indispensable for achievement of carbon neutrality and this in significant quantities. By 2050, these fuels represent visible shares of final energy consumption in buildings, industry and transport. These results are fully in agreement with the CTP analysis.

In order to test higher uptake of RFNBOs for the purpose of this IA, an additional variant was developed: MIX-H2 (see description in section 5.5). This variant illustrates a sizable uptake of renewable hydrogen and its derivatives (e-fuels) in final energy demand (and other) sectors already in 2030 in line with Hydrogen Strategy aiming for 40 GW of electrolysers capacity producing

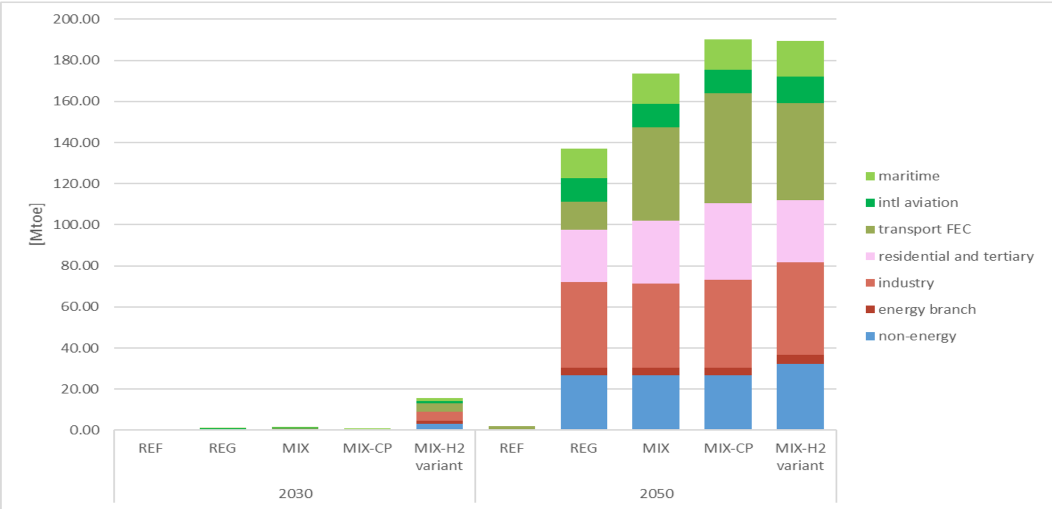
[165] According to the Energy System Integration Strategy, low carbon fuels comprise also recycled carbon fuels and these fuels have a role to play in the transition phase of the decarbonisation of the energy sector. The promotion of recycled carbon fuels (fossil fuels produced from non-recyclable waste streams) is already possible today under the RED II Directive, on voluntary basis by Member States. Therefore, this Impact Assessment considers specific targeted support measures for specific sectors and the extension and revision of the accounting methodology, as well as more specific options to support the uptake of RFNBOs and low-carbon fuels in the different end-use sectors.

[166] Core scenarios project only small uptake of hydrogen in 2030 but more significant in 2035.

renewable hydrogen already by then[167] . This variant shows much higher uptake of RFNBOs in transport and in industry in 2030. By 2050, however, the amounts of RFNBOs are similar between MIX-H2 and core scenarios and shown figure 28 . It shows that RFNBOs could represent in 2030 in the EU:

- **2.4%[168] of fuels consumed in industry in final energy consumption and non-energy purposes;**
- **2.6% of fuels consumed in all transport modes (including international aviation and international marine bunkers and hydrogen consumed in energy branch)**

Figure 29: RFNBOs use in energy system; Source PRIMES



The current provisions on RFNBOs under REDII are limited in scope and apply to transport only. They do not provide the necessary support to foster the required market ramp-up leading to a cost reduction of RFNBOs. From the analysis of MIX-H2 scenario it is clear that either dedicated support for electrolyser capacity, subsidies for fuels or end-use targets are needed in order to bring RFNBOs to the market in sizeable amounts, already in 2030. The MIX-H2 scenario makes assumption that certification system is in place and producers of RFNBOs can demonstrate the additionality principle as required by the REDII currently.

In 2030, with the electrolyser capacity ramped up in this variant to 40 GW (in line with the Hydrogen Strategy) and production of some 16 Mtoe of RFNBOs (all being e-fuels) for the

[167] This variant also took into account national Hydrogen strategies as well as "Opportunities for Hydrogen Energy Technologies considering the NECPs" by Fuel Cells and Hydrogen Joint Undertaking.

[168] To direct the use of RFNBOs to those industrial applications and in those Member States where hydrogen is a 'no-regret' option, the sub target should be calculated on the basis of the total hydrogen consumption in industry in 2030. This requires consideration of the consumption of hydrogen, which is produced on-site as a byproduct. Based on FCH JU hydrogen observatory, which collects this data annually, the total consumption of hydrogen produced as a by-product is 3 Mtoe (FCH JU, 2021). Based on this data, as well as estimations for hydrogen required for ammonia production in 2030, total hydrogen consumption in 2030 can be estimated as 14.52 Mtoe, excluding the use of hydrogen in refineries. Considering the RFNBO uptake of 7.64 in this sector, the total share of RFNBO in industry, excluding refineries, is estimated to be 52.6%.

consumption[169], the overall RES share reaches 40.2% (according to current formula) or 38.8% (according to formula counting RFNBOs consumption rather than renewable electricity to produce them – see the following paragraph). Importantly this variant is still comparable with other core scenarios as it only slightly overachieves 55% GHG reduction (it has 0.4 p.p. higher GHG reductions than MIX[170]). The overshoot is limited since RFNBOs displace the advanced biofuels in maritime and aviation sectors. Consequently, Part A biofuels share amounts to 6.8% compared to 8.5-8.7% in core scenarios – calculated according to the current formula).

This variant provides also results that are useful for consideration of the alternative formula for the overall and sectoral RES shares. RFNBOs are according to current legislation accounted via the renewable electricity used in the Member State where RFNBOs are produced, and not in the Member State where they are consumed.[171] This is not consistent with the accounting methodology for other renewable fuels and the implications of such accounting on the overall and sectoral RES Shares would be important for several Member States. While the main impact of the formula revision would be on the overall RES share, also sectoral shares RES-E and RES-T (that applies RES-E shares for electricity consumed in transport) would be affected as electricity used to produce RFNBOs should not be counted twice also in the RES-E share. The impacts would be, however, very small in 2030.

The current formula also leads to inefficiencies and possible misallocations due to the high conversion losses during the production of RFNBOs (conversion efficiency of 70% for hydrogen via electrolysis and about 50% for further processing into liquid RFNBOs), and is not fully compatible with the requirement for additionality (RFNBOs should be produced by new RES installations) set by the legislator. The Commission is currently developing a delegated act setting out appropriate rules to approach the question of additionality.

The table below shows the impact on the EU level of the change of the formula for the overall RES share.

Table 19: Illustration of RFNBO accounting on overall RES Shares; Source PRIMES

	Overall RES shares	MIX	MIX-H2
2030	Baseline: Accounting RFNBOs with amounts of renewable electricity used to produce them (and thus in place of production)	38.4%	40.2%
	Accounting RFNBOS with their actual amounts (and thus where they are consumed)	37.8%	38.8%

Ramping up the electrolyser capacity has benefits in terms of demonstrating the technology already in 2030 and thus a smoother pathway towards quantities necessary post-2030. But as technology is not yet cost-competitive, both cost increase and an investment challenge arise.

Looking at the investments that are an essential element of system costs, it can be seen that delivering on the 40 GW of electrolysers producing renewable hydrogen would require on average 22 billion € per year in the in the 2021-30 period (including transport) increase compared to MIX

[169] In MIX-H2 scenario there is also some 4 Mtoe of hydrogen as transformation input into e-gas and e-liquids.
[170] Without considering impact of reduced biofuels demand on LULUCF.
[171] Article 7(4)(a)

both for supply and demand side investments. The impact on overall system costs[172] would be limited: € 5bn more on average in the current decade compared to MIX scenario.

In exchange, there is a higher GHG reduction that in MIX scenario (additional 0.4 p.p. reduction in the way the overall GHG target is measured) as well as higher security of supply benefits (additional € 19bn of savings on the fossil fuels import bill in the current decade).

6.1.2. Energy System impacts not based on modelling

Option 0 only provides limited support for RFNBOs and low carbon fuels, including the possibility for streamlining the permitting process for renewable hydrogen production technologies. Non-regulatory measures such as financial support through national and EU research programmes cover both RFNBOs and low carbon fuels. These measures alone, however, will most probably not be sufficient to provide the investment certainty and trigger the private sector investment needed to scale up these options whilst those fuels are still not cost-competitive, and prepare the ground for a stronger uptake in view of carbon neutrality objective.

For a large-scale market ramp-up of up to 40 GW Electrolyser capacity or 10 Mt hydrogen use as outlined in the Hydrogen Strategy[173], incentives for a bigger market for renewable and low carbon fuels should be given, so that customers are willing to pay the price premium for renewable or low carbon fuels compared to fossil-based technologies. An important element could be the implementation of a carbon contract for difference system (CCfD) in industry, steering investments into renewable and low-carbon technologies by providing investment security. The introduction of a carbon border adjustment mechanism (CBAM) would help minimising the risk of carbon leakage and to ensure fair competition with non-EU companies.

Option 1 would extend the accounting beyond the transport sector, and consider the use of RFNBOs in the industrial end-use sector as well. An important element would be to account for the uptake of RFNBOs as a feedstock for the production of chemicals, which is currently not considered in the accounting of renewables uptake. Furthermore, the accounting rules would need to be adapted to ensure that RFNBOs are accounted in the Member States where they are used, and not, as it is currently the case in REDII, in the Member State producing the electricity for its production. Such a measure would eliminate the risk of double counting and create a more consistent framework for the calculation methodologies. Moreover, it would contribute to a higher ambition to achieve renewable energy targets in the electricity producing countries.

Accounting RFNBOs towards the H&C sector could support their deployment in hard to decarbonise industrial sectors if the H&C target is set at an ambitious level, contributing to the creation of an early market demand for RFNBOs. However, other renewable alternatives for the building and the industrial sectors remain more competitive than RFNBOs, and may be preferred solutions to reach the H&C target.

---

[172] Excluding carbon pricing and disutilities.

[173] COM (2020) 301 final"…In a second phase, from 2025 to 2030, hydrogen needs to become an intrinsic part of an integrated energy system with a strategic objective to install at least 40 GW of renewable hydrogen electrolysers by 2030 and the production of up to 10 million tonnes of renewable hydrogen in the EU…"

Furthermore, there is a question on whether the criteria put in place for RFNBOs for the transport sector (REDII, recital 90) need to be expanded if RFNBOs are use in other sectors. The overarching objective of these criteria is to ensure that RFNBOs contribute to greenhouse gas reductions, and that the electricity used for the fuel production is from renewable origin. This objective is also applicable to the use of RFNBOs in other end-use sectors, and as such could be applied accordingly, including to ensure a level-playing field for the consumption of RFNBOs across different end-use sectors. At the same time, the specific criteria introduced in the REDII can be relaxed in the medium-term, especially in those cases where the share of renewable power generation in the electricity mix is sufficiently high to ensure greenhouse gas reductions[174].

Additionally, the REDII requires that the production of RFNBOs should be based on renewables and follow the additionality principle[175] - meaning that the fuel producer is adding to the renewable deployment or to the financing of renewable energy. Assuming that hydrogen consumption in end-use sectors is consumed on the basis of the breakdown in the Hydrogen Roadmap (FCH JU, 2019)[176], a significant increase of RES production would be needed in order to achieve the objective of 10 Mt hydrogen outlined in the Hydrogen Strategy. This requires a quadrupling of the renewable power generation capacity installed today (from around 500 GW to almost 2000 GW). Compared to what is currently planned in the NECPs, it would mean 8% more power generation.

Including low carbon fuels in the accounting towards the renewable energy sub-targets (Option 2) could provide an incentive for the uptake of low-carbon fuels, but would not create a level-playing field between decarbonisation options and not support the uptake of RFNBOs. In particular, it is important to recognise that the production of low-carbon fuels can build upon existing infrastructure and existing assets, such as the retrofitting of existing natural-gas based steam methane reforming plants. In contrast, there is no existing asset base for the production of RFNBOs and the additionality requirements means that additional investments in renewable power generation capacity are needed to create a dedicated renewables resource base. Furthermore, RFNBOs are more compatible with a future energy system that will increasingly be based on renewable energy sources. This risk could be reduced through a separate target for low carbon fuels, separate from renewable targets However, this option was discarded early (see also Annex 6) as it would lead to reduced investments into renewables as long as renewable fuels are more costly.

Options 3 and 4 for the RFNBOs target setting would provide stronger incentives by including renewable fuels into sectoral targets. Sector-specific targets in hard to decarbonise sectors will create an early market demand for RFNBOs. This is necessary, given the current low carbon price (ETS) as well as high production costs for RFNBOs. RFNBOs are far from competitive regarding kerosene (aviation), maritime fuels or on-site production of hydrogen via steam methane reforming for industry purposes. The production of low-carbon hydrogen should, based on the latest estimates, become cost-competitive through an increase in the expected carbon price under the EU ETS, with estimates for cost-effectiveness ranging between €55-90/tCO2[177].

[174] For example, a greenhouse gas emission intensity of 46g CO2/kWh can result in a 80% reduction in greenhouse gas emissions compared to the use of fossil fuels. In comparison, the greenhouse gas emission intensity of electricity in the EU is still 226g CO2/kWh (EMBER (2021) EU Power Sector in 2020).
[175] Recital 90
[176] The roadmap assumes 7% of hydrogen blending, which is considered for industrial purposes instead.
[177] EU Hydrogen Strategy, COM (2020)301.

Around 8-10 million tonnes of hydrogen produced from natural gas is used in industrial processes, in 22 MS. 45% of hydrogen is consumed in refineries, primarily as feedstock. 38% is used for the production of ammonia, and 8% is used for the production of methanol. The consumption for MS differs substantially, ranging from 2.3 Mt in Germany to less than 0.2 Mt in about 6 Member States. Several Member States do not consume any hydrogen.

There exists a clear opportunity to replace the existing use of fossil-based hydrogen (produced from natural gas) with renewable hydrogen. The PAC energy scenarios estimates a potential of 71 TWh of direct use of renewable hydrogen to replace fossil-based hydrogen, and a potential of 68 TWh for replacing fossil fuels in steel production. FCH JU (2019) identifies a comparable value of 62 TWh of renewable hydrogen consumption in the steel sector, with fossil-based hydrogen consumption in the chemicals sector primarily decarbonised with CCS.

Considering the objective of producing 10 million tonnes of renewable hydrogen by 2030, a target of 5 million tonnes of renewable hydrogen consumption in industrial applications is a do-able and politically feasible option. Considering the diverse consumption patterns per MS, the most appropriate target would be to set a target for RFNBOs for those Member States consuming hydrogen. Such targets will create investment security for a respective market ramp-up of production facilities as well as the required renewable electricity potential.

Defining a target for RFNBO consumption in industry could either be accomplished through a demand-side obligation on the respective industries, or a supply-side obligation on energy suppliers to these respective industries. However, industry is much more diversified in terms of sectors, applications, fuels, and suppliers. Furthermore, there is only a very limited market for hydrogen with the majority of production and consumption of fossil-based hydrogen locked in through existing supply contracts. Nevertheless, a supply-side obligation would require significantly less administrative resources from the economic operators affected. As for transport, RED II already works with supply side obligations to increase the share of RES in the sector, a supply-side obligation specifically for RFNBOs would follow the same logic. Following the hydrogen strategy and numerous studies[178] the industry and transport sector are the two priority areas for the deployment of RFNBOs. A generic target for RFNBO could lead to hydrogen deployed in non-priority sectors. Considering that energy consumption in industry and transport are covered by different policy tools and involve different stakeholder groups, Option 2 of splitting the requirements across these two sectors based on the most cost-effective allocation as identified in the CTP analysis. For more details for RFNBOs in transport please look at the Transport Section 6.3.

Environmental impacts

Renewable fuels can contribute to GHG emissions reduction in different hard-to-decarbonise sectors. To a lesser degree, this is also the case for low carbon fuels. As to RFNBOs, the high efficiency losses that occur during production of liquid RFNBOs have however to be taken into account. They should therefore only be used as a decarbonisation option when electrification or even RFNBOs with lower efficiency losses, such as hydrogen, are not feasible.

[178] final_insights_into_hydrogen_use_public_version.pdf (europa.eu)

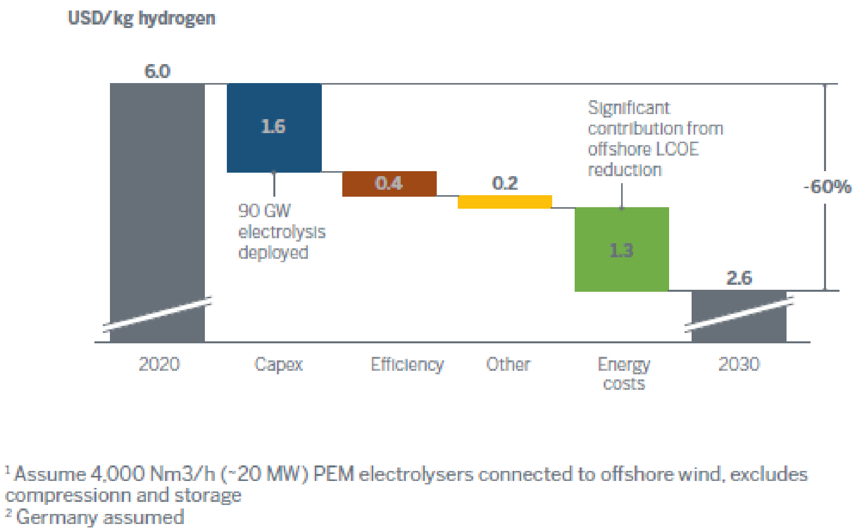
The introduction of sector-specific targets for RFNBOs will support the introduction of RFNBOs with a small CO2 footprint in sectors, where decarbonisation via direct electrification is difficult, and could thus in the case of renewable hydrogen lead to less air pollution and higher GHG emissions reduction The impact on air quality will depend on the mix of RFNBOs and to what extent their replace traditional fossil fuels. The air pollution of synthetic fuels (Power to x) should be minimised by focussing on sectors which are difficult to electrify and where direct use of hydrogen faces technical barriers. Given the high costs of synthetic fuels as well as emission standards for vehicles provide can ensure that the development goes in this direction. Where relevant, the matter should be addressed in dedicated legislative instruments.

An RFNBO target for hard-to-decarbonise industry sectors would have positive direct environmental impacts as GHG reductions take place in the EU. However, carbon leakage will lead to increased GHG emissions outside the EU, potentially even overcompensating the GHG reductions in the EU without accompanying measures.

Economic impacts

RFNBOs, despite their potential, suffer still from low competitiveness due to high production costs. The EU Hydrogen Strategy has set the objective to increase the renewable hydrogen production capacity by the installation of at least 40 GW electrolysers by 2030. Based on an analysis of the Hydrogen Council[179], a significant cost reduction in renewable hydrogen production will be achieved spurred by further technology development due to high deployment rates (in case of 90 GW globally by 2030). Cost for renewable hydrogen from electrolysis have already fallen by 60% since 2010 to about 6 $/kg[180] hydrogen (average case, offshore wind). Large scale manufacturing as well as low cost for renewable electricity will further decrease the cost, enabling hydrogen production at about 2.6 $/kg181 in 2030 in regions such as e.g. Northern Europe with high wind potential.

Figure 30 - Estimated cost reduction for renewable hydrogen from offshore wind in Europe until 2030 (Source: Hydrogen Council, 2020)



[179] Hydrogen Council: Path-to-Hydrogen-Competitiveness, 2020
[180] Equivalent to about 5.40 €/kg or 16.3 ct./kWh, assuming an exchange rate of 1 $ = 0.9 €.
[181] Equivalent to about 2.34 €/kg or 7.1 ct./kWh, assuming an exchange rate of 1 $ = 0.9 €.

In hard-to-decarbonise industry sectors such as steel, ammonia and methanol production or the production of high-value chemicals, which are included in the ETS, an RFNBO target could raise the costs for these sectors. Further support mechanism such as CCfD and carbon boarder adjustment mechanism may be required to provide a level-playing-field with producers in non-EU countries.

Early support to the development of this new technology is expected to have large mid and long term benefits and is mentioned in the Commissions Recovery Plan as one important element to be addressed in the clean transition. Europe is highly competitive in clean hydrogen technologies manufacturing and is well positioned to benefit from a global development of clean hydrogen as an energy carrier. Cumulative investments in renewable hydrogen in Europe could be up to €180-470 billion by 2050, and in the range of €3-18 billion for low-carbon fossil-based hydrogen[182].

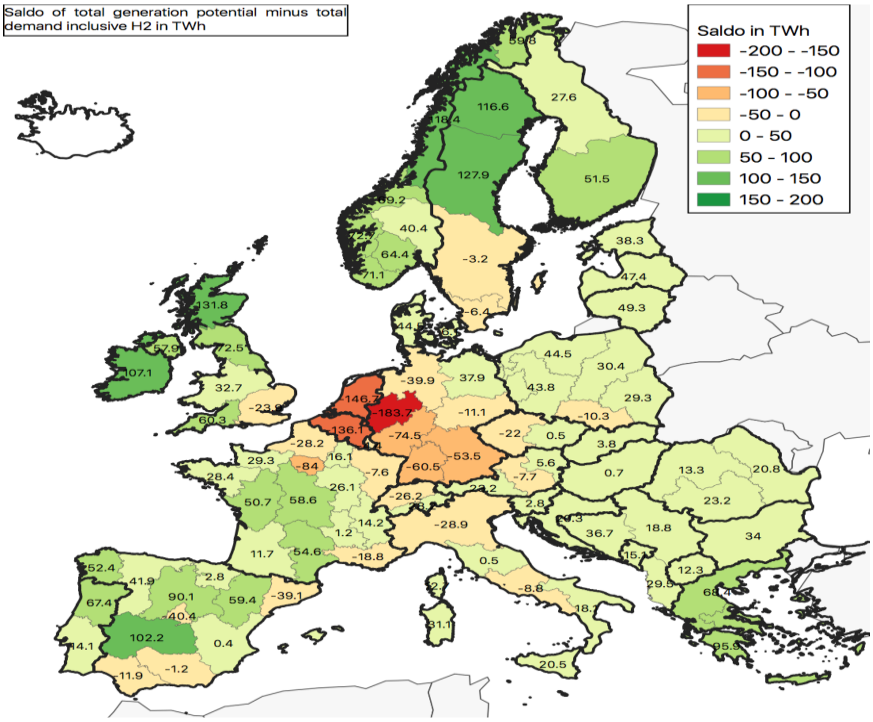
Social impacts

Increased hydrogen production and supply offers potential in particular to EU Member States with high renewable potential, since they can supply hydrogen and RFNBOs to the main industry and demand centres. This can stimulate job creation along the different supply chains, either for RFNBOs or for low carbon fuels. Hydrogen and hydrogen technologies in particular promise the creation of an entirely new supply chain with high added value in the domestic economy, the application of liquid RFNBOs as drop-in fuel to conventional transport fuels also supports existing industries like maritime and aviation propulsion systems.

An increase in the production of RNFBOs within the EU may lead to distributional effects among Member States. For north-western Europe with its strong industrial clusters and high energy demand, a deep electricity sink of 325 TWh (without hydrogen production) and 467 TWh (with hydrogen production) has been identified for 2050[183]. Regions with a high renewables surplus in northern or southern Europe could supply electricity or renewable fuels with the necessary energy infrastructure in place. The requirement for cheap hydrogen production could also lead to a relocation of energy-intense industries due to lower energy prices.

[182] https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1257
[183] Wuppertal Institut: Infrastructure Needs for Climate-Neutral Industry in Europe, Policy Brief, 10.06.2020. Available at https://wupperinst.org/fa/redaktion/downloads/projects/INFRA_NEEDS_Policy_Brief.pdf (accessed on 02.02.2021)

Figure 31 - Balance of renewable generation potential and demand with electricity for hydrogen in Europe 2050[184]



The impact of the use of RFNBOs in specific transport sectors (maritime and aviation) has been shown in the relevant Impact Assessments (Refuel Aviation and Maritime).

6.1.3. *Effectiveness*

The increase of the ambition level foreseen under Options 1 and 2 would set strong incentives for the development of RFNBOs and low carbon fuels respectively, while Option 0 will not contribute sufficiently in this respect.

The extension of the scope of accounting of RFNBOs and the improvement of its consistency (Option 1) would also provide a stimulus for further RFNBO deployment, and in particular address misallocations under the current system if RFNBO production takes up. Due to the high energy needs for their production, it would be more effective to account RFNBOs in the Member State where it is consumed rather than in the Member State where it is produced. This would reduce the incentive that RES electricity used for the production of RFNBOs substitutes renewable electricity generation needed elsewhere, although the energy is not usable for final consumption due to high conversion losses.

Table 20 - Effectiveness

	Total	Hydrogen	e-gas	e-fuels
Conversion efficiency (%)	-	70%	55%	30%
RFNBO (TWh)	1447	671	212	564

[184] See also G. Kakoulaki, I. Kougias, N. Taylor, F. Dolci, J. Moya, A. Jaeger-Waldau, Green hydrogen in Europe – A regional assessment: Substituting existing production with electrolysis powered by renewables, Energy Conversion and Management, Volume 228, 15 January 2021, 113649

Share in FED (%)	19.36%	8.97%	2.83%	7.55%
Required RES electricity (TWh)	3224	959	385	1880
Share in FED (%) with RED II methodology (considering RES electricity)	34.84%	10.36%	4.17%	20.32%

The effectiveness of introducing a RFNBO target (Option 4) depends on its scope, nature and level. A specific target for industry might force industry to use renewable energies which are less competitive than their fossil-based counterparts. A lower target limited to transport would be effective in increasing renewable fuels in a cost-effective way. Specific targets for innovative low carbon fuels (Option 5 and 6) would bear the risk to crowd out renewable fuels and create a barrier to their market development in particular until 2030/2035.

6.1.4. Administrative impacts

The extension of the scope of accounting of RFNBOs and the improvement of its consistency (Options 1) would require Member States to change their accounting methodology which would have very limited costs taking into account their small market share today. Also, a specific targets for RFNBOs (Option 2) set at an early market development stage would allow Member States to integrate this in their mid-term energy planning and NECPs at low cost. For industry, the introduction of a specific sub-target for RFNBOs would bring, as described above, additional costs in the short term.

6.1.5. Coherence

Promoting the use of renewable fuels is fully in line with the CTP, and specifically highlighted in the Energy System Integration Strategy and the Hydrogen Strategy. This is in particular valid for the options 1 and 2 focusing on RFNBOs. A specific promotion of low carbon fuels would change the main objective of REDII aiming at promoting renewable sources. This would correspond to the opinion of stakeholders including from NGOs, while concerned industry associations would support a consideration of low carbon fuels. With the exception of Recycled Carbon Fuels, low carbon fuels are not addressed in REDII. The certification of low-carbon fuels should be rather addressed in a separate legislative proposal such as the Hydrogen and Decarbonised Gas Market Package.

As industry will also be subject to any increased requirements relating to renewables in heating and cooling, the impacts of the level and nature of a benchmark need to take that into account. In particular, this would address other barriers to the deployment of renewables in industry than only the cost differential with fossil fuels, including a lack of experience and trust in new technological solutions.

Even though the ETS price has increased recently, the effective price, taking into account free allocation, is still rather low and as a consequence GHG abatement in industry happens at a relatively low pace. The revised and improved ETS is expected to significantly increase the carbon price, and accordingly the incentive to invest and use renewable and low-carbon sources. However, due to the lock-in effects of investments cycles in the industry, this does not directly materialises in investments to increase the share of renewables in the period up to 2030. At the same time, this will lead to substantial challenges to rapidly increase the share of renewables immediately after 2030. Mandating a renewable energy benchmark for industry will allow industries to already consider renewables within the period up to 2030, avoiding any lock-in situations after 2030.

6.1.6. Stakeholders' Opinions

Stakeholders' Opinion
In the OPC, when asked which type of renewable and low carbon fuels should be supported, advanced biofuels and RFNBOs are among the three top choices (behind "other fuels"). Participants from NGOs and environmental organisations as well as citizens think that only renewable fuels should be promoted. Promotion of advanced biofuels is chosen by those from academia, trade unions and other organisations, compared to other stakeholder groups in terms of stakeholder group share. RFNBOs have high support among business and companies. A majority of stakeholders in the 1st stakeholder workshop favoured REDII and other relevant EU legislation having a clear, consistent, and transparent European definition of renewable hydrogen across all European policies and laws. During the 1st stakeholder workshop, environmental transport NGOs requested RED II to phase out crop-based biofuels, to introduce a dedicated credit mechanism at the EU-level to make sure the potential of renewable electricity is fully reflected and to not broaden the scope of RED to include low carbon fuels, while some business organisations, in particular Gas transmission system operators favoured the extension of the RED II scope to include low carbon fuels with simple accounting rules, clear sub targets but no additionality principle. In the 1st stakeholder workshop, the International Energy Agency emphasised that he focus for hydrogen should be on establishing the enabling conditions, including infrastructure, standards & certification, and investments in electrolyser to further reduce costs.

6.7. Bioenergy sustainability criteria

6.1.1. Current and projected bioenergy demand and supply in the EU

According to the CTP and previously also the "a Clean Planet for all" Communication[185], bioenergy use is projected to increase in a limited way up to 2030. However, in the period thereafter, bioenergy demand would increase significantly as it replaces fossil fuels in hard to decarbonise sectors including industry and long-distance transports, and delivers negative emissions through biomass-based Carbon Capture and Storage (BECCS). This trend is confirmed by the core scenarios.

The REF scenario shows that the use of bioenergy[186] will increase by 13% between 2020 and 2030 under the currently agreed targets (from 147 Mtoes in 2020 to 166 Mtoes in 2030). In the REF scenario the bioenergy is chiefly used in thermal power and heat generation (demand is stable between 2020 and 2030) and in all final energy consumption sectors (and here mostly for residential and tertiary sectors where its use increases by 17% between 2020 and 2030).

As illustrated in the figure below going to the 55% GHG target as illustrated by the core scenarios would then allow a decrease (10% on average for all core scenarios) in 2030 compared REF (or to put it differently to come back to 2020 levels) chiefly driven by a decrease of bioenergy use in

[185] COM (2018) 773

[186] In PRIMES, bio-energy and waste (including non renewable waste) are reported together and projections cover bioenergy, renewable and non-renewable waste (the latter representing only small amounts).

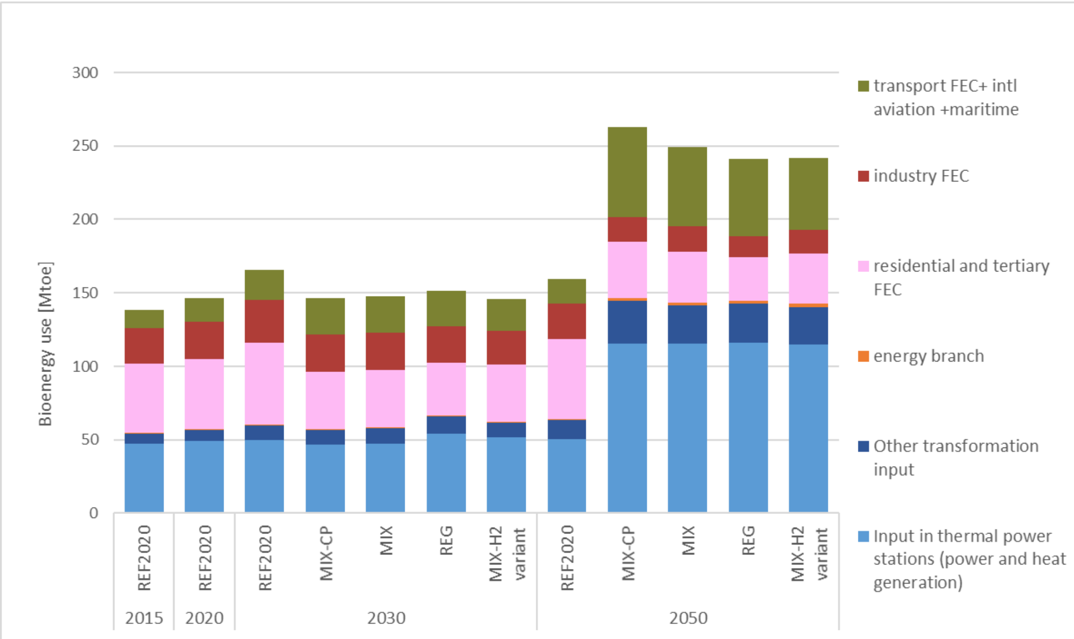
residential and tertiary sectors. This is because buildings heating largely electrifies and buildings renovations increase their efficiency (bioenergy for heating is expected to decrease from 56 Mtoes in REF to 35-39 Mtoes in the core scenarios).

Biomass use in industry is also expected to decrease (12% for all core scenarios), from 29 Mtoes in REF to 25 Mtoes in the core scenarios. This decrease of bioenergy use in the residential and tertiary sectors as well as in the industry largely compensates the increase in bioenergy used in transport (notably in aviation and maritime sectors, which so far have limited decarbonisation alternatives). Bioenergy use in the thermal power (and heat) generation in the core scenarios would remain stable compared to REF levels (around 50 Mtoes).

It can be noted that in MIX-H2 variant, the bioenergy demand would slightly decrease below the levels of the core scenarios as RFNBOs substitute some amounts of advanced biofuels in transport.

The combination of feedstock used to supply the demand in bioenergy by 2030 is similar to today's needs with in particular biofuels relying on cereal and oil crops. In all the scenarios, more than 90% of the bioenergy used in the EU economy is produced domestically in 2030 and there is sufficient supply of sustainable biomass. These modelling results should however be contrasted with final NECPs, where the majority of Member States foresee an increase in bioenergy use from 2021-2030, without assessing the related impacts on LULUCF and biodiversity.

Figure 32 - Biomass-waste use in Gross Available Energy in core scenarios and Reference, Source: PRIMES

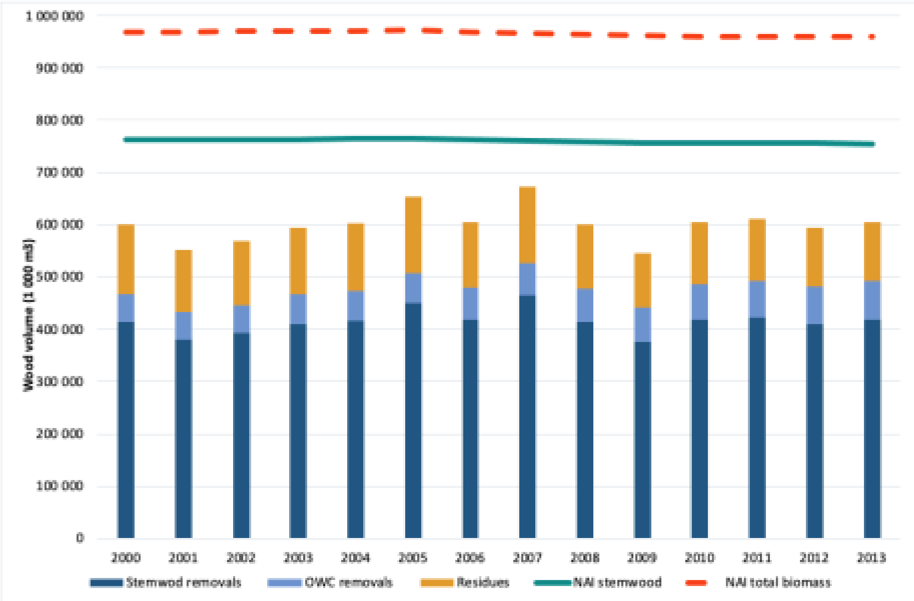


According to the core scenarios, there would be significant increases in bioenergy consumption post-2030 as needed to achieve carbon neutrality. More specifically demand in thermal power stations would grow as growth in electrification requires significant increase of power supply even if considering that demand response and newer technologies will to some extent reduce the amounts of necessary bioenergy use in power (needed to balance variable renewables). In the 2050 perspective, there is also an increased demand for biomass in high temperature industrial processes in industry and for advanced biofuels, especially in maritime and aviation sectors. As a result, in core scenarios, the overall bioenergy demand grows by, on average, 69% in 2050 compared to 2030.

The majority of bioenergy is today sourced from forest and other woody biomass. According to JRC report data, woody bioenergy is largely (66%) based on residues and wastes from logging and timber processing (e.g. branches and tops, saw dust, waste wood). The remaining 34% is supplied from so-called 'primary biomass sources', which include low-quality stemwood and thinnings (20%). It is estimated that at least half of this stemwood used for energy is derived from coppice forests (also known as low forest in Mediterranean countries). Only 4% of total wood energy demand for energy is supplied by industrial stemwood. Wood-pellets imports from US have a minor role in the EU after Brexit. The USA, Canada and Russia are together responsible for supplying 89% of the EU import of wood pellets.

The JRC analysed statistics about the growing stock (volume of living trees), the quantities of roundwood and residuals removed from forests and the net annual increment (NAI) of forest volume (see figure below). It concluded that, while the harvest to increment ratio appears to be increasing (resulting from increasing harvest levels and a relatively stable NAI) removals are still below the level of growth. This leaves a margin for further sustainable extraction of forest biomass for the wider bioeconomy use, including bioenergy.

Figure 33 - Net annual increment, removals, and fellings in the EU FAWS. Source: Camia et al. 2018



Going forward, according to the CTP modelling, the use of harvested stemwood is projected to stay at 2015 level in all analysed scenarios while the sustainable extraction of forest residues increases, in total the forest sector provides 60 to 65 Mtoe of wood for energy. Other sectors will also contribute to deliver bioenergy supply. For instance, due to the implementation of the EU waste legislation, a significant share of the feedstock used to produce bioenergy is projected to come from the waste sector that could supply about 100 Mtoe of feedstock to the energy sector by 2050. Biogas or biofuels produced from food crops will be very marginal in EU by 2050 but more agriculture residues are used for the production of biogas or solid biomass. The optimisation of the sustainable exploitation of all these classical sources of biomass could supply just over 200 Mtoe of feedstock for bioenergy production to the EU economy. Fast growing energy crops will provide for the rest of needs in biomass. Scenarios vary substantially in their demand for these new energy crops. Most of the demand is supplied via lignocellulosic grass such as switchgrass and miscanthus while short rotation coppices, poplar and willow, provide only 20 to 25% of the demand in energy crops.

6.1.2. Impacts not based on modelling

Economic impacts

Economic impacts will affect both economic operators - both in the energy (bioenergy generators and other renewable energy producers) and forest sectors (forest owners, forest industry) - which need to deliver action on the ground, and national policy-makers, who will be responsible for implementing and verifying compliance with the different options. More in general, the economic impacts will affect all European and world citizens, as climate and biodiversity action is a public good that is cross-border in nature. The overall cost of the identified policy options will be driven by changes in the volume of bioenergy use affected by each option.

The reduction of total bioenergy demand due to the effects of policy options 1-2 is likely to be very small. Where such reductions occur, they will lead to compensation with other renewable energy sources in order to meet the renewable energy targets, with effects on gross added-value, investment costs and employment. Strengthened sustainability criteria may also reduce biomass imports from outside the EU, as operators in third countries choose not to comply with them and redirect their export away from the EU.

Option 3 would apply the EU sustainability criteria set out in option 2 to installations below 20 MW, thus affecting a larger share of biomass use. It should be noted that the solid biomass sector is relatively fragmented and heterogeneous. Half of the solid biomass for energy is consumed by households. The consumption of solid biomass by commercial and industrial installations is more concentrated in larger plants. In particular, around 75% of the solid biomass supply is consumed in installations larger than 20 MW, while 25% is consumed in smaller installations (1 MW to 20 MW). There are a high number of small installations using wood chips, over half of the installations are below 5 MW (see figure below). The majority of biomass used in commercial and industrial installations is in form of woodchips used in large (above 20MW) plant (see figure below). Extending sustainability criteria to installations below 20 MW would cover largely woodchip used in heat only and CHP plants.

Figure 34 Share of installations and share of consumption by installation size

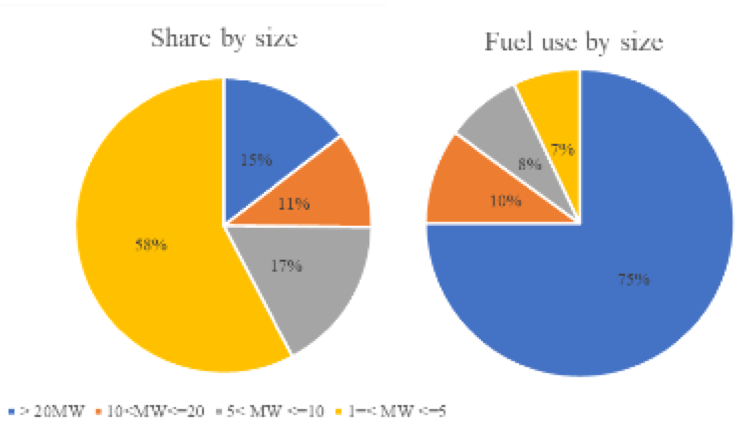
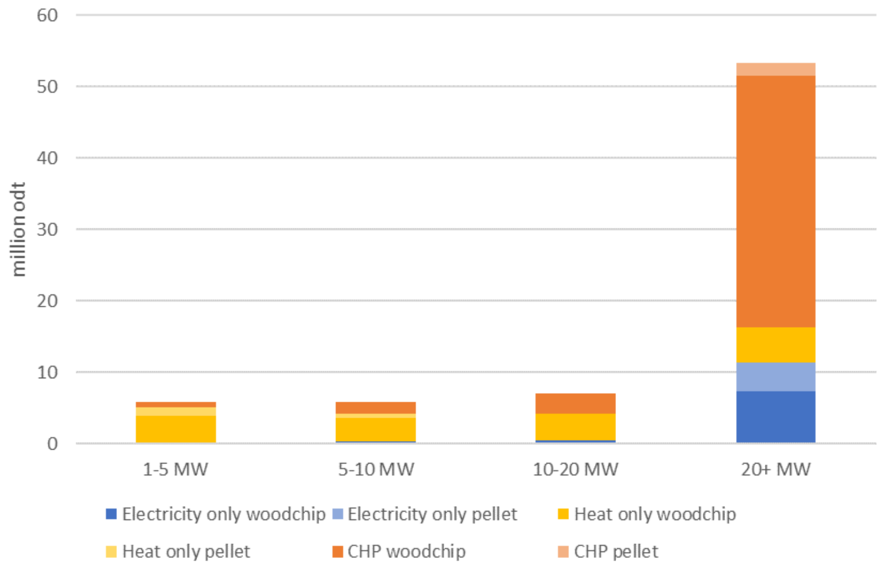


Figure 35 Consumption of woodchips and pellet by use and installation size



Depending on the level of the threshold, compliance costs could have a moderate impacts on bioenergy production and on the overall costs of achieving the renewable energy target. But this could again be compensated by increased investment in other renewable energy sources. It could also have minor positive effects in other economic sectors, including certification services.

Option 4 and 4.2 could result in a stagnation in the use of bioenergy or in a slower increase of the final renewable energy share. According to the JRC, today 20% of woody biomass use is supplied by stemwood, and 4% from industrial stemwood and 4% from industrial quality stemwood, corresponding respectively to ~14% and ~1.5% of renewable energy use.

If bioenergy use was in addition restricted to wastes and residues only (option 4.1), this could lead to a significant decrease in bioenergy production from forest biomass. At least at third of this production is supplied by primary biomass sources, or roughly 20% of the current final renewable energy. Other renewable energy sources, like solar, wind and geothermal, will need to develop further to compensate the lost bioenergy production. It should be noted that to achieve the higher

RES 2030 target, the installed capacity of wind and solar power need already to double and triple compared to 2020 level, respectively.

Bioenergy heating is currently one of the cheapest forms of renewable heating. A reduction in bioenergy could lead to price increases in the heating sector while overall societal costs linked to air pollution might decrease. In the power sector, wind and solar prices are by now significantly lower than bioelectricity. Therefore, a decrease in costs can be expected, if those sources are used instead of bioelectricity. Options 4, 4.1 and 4.2 would have different economic impacts depending on how it is actually implemented by Member States and how much high quality stemwood is used for energy production. The impact of these options on biomass import levels would depend on the availability of wood pellets made from other sources than stemwood, in particular from industrial residues.

Other indirect effects could be expected. For instance, under option 4.1 the price of sawmill by-products (such as sawdust) might increase, leading to an increased profitability of sawmills. On the other hand, a higher price of by-products might lead to increased competition for resources for the pulp and panel industries with the sectors manufacturing wood-based panels and pulp and therefore to lower feedstocks availability for material use.

Option 5 could result in significant impacts on overall bioenergy use (60% of today renewable energy use), leading to either a slower increase of the final renewable energy or higher shift from bioenergy to other renewable energy sources. In the heating/CHP and industrial sectors, this could lead to increases in total costs for achieving the increased sectorial renewable energy targets, because of bioenergy being among the cheapest energy sources. In the power sector, this would lead to a decrease in generation costs if production is shifted to cheaper renewables. At the same time, bioenergy can provide the needed flexibility to the power sector to facilitate the cost-effective integration of variable renewable energy sources such as wind and solar. This option would also risk creating significant regulatory instability and undermine existing investments in the whole bioenergy sector — two issues that were pointed out by economic operators in their response to the public consultation. On the other hand, having strengthened sustainability rules in place that are consistent with the higher renewable energy ambition could stimulate market signals for faster deployment of other forms of renewables such as wind and solar, or new technologies

Environmental impacts

The most important impacts of the revision of the EU bioenergy sustainability criteria will be on the EU climate and environmental objectives, including biodiversity conservation and air quality. By promoting a swift and robust implementation of the existing REDII criteria, option 1 would lead to positive biodiversity impacts compared the baseline, albeit limited.

Option 2 would lead to important positive biodiversity and climate impacts. Applying the existing REDII no-go areas for agricultural biomass also to forest biomass would ensure that the latter is not sourced from primary and highly biodiverse forests thus avoiding the risk of significant carbon and biodiversity impacts, as highlighted in the JRC report on the use of woody biomass for energy. As such, option 2 would be in line with the Biodiversity strategy goal of increasing the protection of primary forests, including old grown forest, and would also help further protecting the EU and global forest sink.

Primary forests, including old-growth forests, in the EU are rare, small and fragmented. These forests represent below 3% of the total forest extent of the EU. About 90% of the reported primary and old-growth forests in the EU is located in Sweden, Bulgaria, Finland and Romania (see table below). The share of primary forest out of national forest is the highest in Sweden, Bulgaria, Slovenia and Romania. The mapped area of primary and old-growth forests in the EU is ~1.35 million hectares. However, there is a pronounced mapping deficit estimated at ~4.4 million hectares (an area equal to the size of the Netherlands).

Table *21* - Area of primary forests in EU countries. Forest area according to FOREST EUROPE (2020).

Country	Forest area 2020 [1,000 ha]	Forest undisturbed by man (Forest Europe, 2020) In forest [1,000 ha]	In other wooded land [1,000 ha]	In forest and other wooded land [1,000 ha]	Primary forests (FAO, 2020) [1,000 ha]	Primary forests (Sabatini et al. 2020a) [1,000 ha]
Austria	3,881	63	55	118	63	15.2
Belgium	689	0	0	0	0	0.3
Bulgaria	3,833	704	0	704	704	56.9
Croatia	1,922	7	0	7	7	9.6
Cyprus	173	13[a]	ND	13	ND	0.0
Czech Republic	2,668	10	ND	10	10	12.8
Denmark	625	21	3	24	21	1.7
Estonia	2,421	52	2	55	52	0
Finland	22,409	205	11	214	205	2,814.6[F]
France	16,836	30[a]	0	30	ND	12.3
Germany	11,419	0	0	0	0	14.3
Greece	3,903	ND	ND	ND	ND	1.9
Hungary	2,061	0	ND	0	0	0.5
Ireland	755	ND	ND	ND	0	0.0
Italy	9,297	93	0	93	93	8.7
Latvia	3,391	17	0	17	17	4.8
Lithuania	2,187	27	0	27	27	32.0
Luxembourg	89	0	ND	ND	0	0.0
Malta	0	0	0	0	0	0.0
Netherlands	365	0	0	0	0	0.1
Poland	9,420	0	ND	0	0	22.4
Portugal	3,312	24[a]	ND	24	24[a]	16.4
Romania	6,901	165	0	165	165	70.0
Slovakia	1,922	11	0	11	11	13.1
Slovenia	1,248	34	17	50	34	9.5
Spain	18,551	ND	ND	ND	ND	10.5
Sweden	27,980	2,240	1,075	3,324	2,249	37.8[e]
Total EU	**158,258**	**3,723**	**1,163**	**4,886**	**3,679**	**3,165[d]**
% of forest	**100**	**2.35**	**-**	**2.71[b]**	**2.32**	**2.0**

Figure 36 - Map of primary forests cross the EU; Source: Sabatini, FM, Burrascano, S, Keeton, WS, et al. Where are Europe's last primary forests? Divers Distrib. 2018; 24: 1426– 1439.

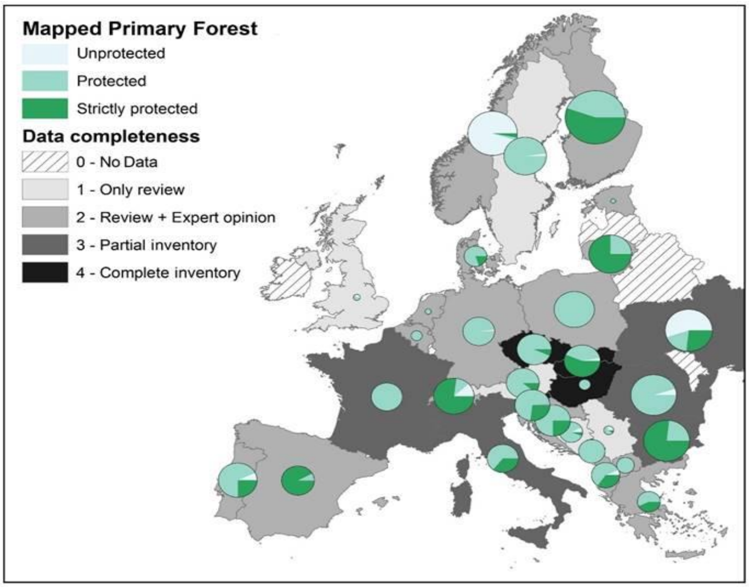
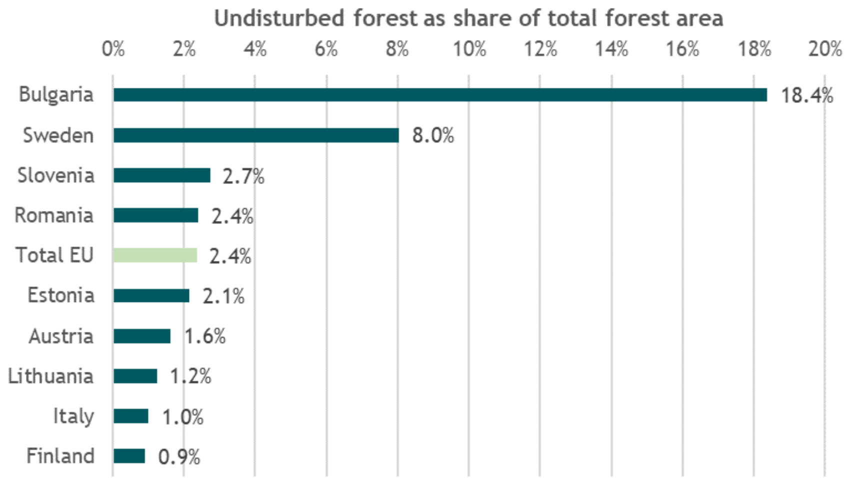


Table 22 - Area of primary forests in EU (Sabatini et al. 2020) and percentage falling in Natura 2000 sites (EEA 2020) and in IUCN protected areas

Country	Primary forests (Sabatini et al., 2020) (1,000 ha)	Natura 2000 (%)	IUCN category (%)						
			Ia	Ib	II	III	IV	V	VI
Austria	15.2	78	0	13	38	0	27	14	0
Belgium	0.3	100	0	0	0	0	69	0	8
Bulgaria	56.9	99	75	0	3	1	1	4	2
Croatia	9.6	99	0	0	0	0	0	0	0
Cyprus	0	-	-	-	-	-	-	-	-
Czech Republic	12.8	82	10	6	10	3	24	46	0
Denmark	1.7	75	6	0	26	0	30	1	0
Estonia	0	-	-	-	-	-	-	-	-
Finland	2,814.6	94	6	69	16	0	2	0	0
France	12.3	85	16	0	4	0	45	8	0
Germany	14.3	82	0	0	43	0	24	10	0
Greece	1.9	99	39	0	44	12	5	0	0
Hungary	0.3	100	0	0	49	0	18	22	0
Ireland	0	-	-	-	-	-	-	-	-
Italy	8.7	93	22	0	71	0	2	1	0
Latvia	4.8	100	0	2	98	0	0	0	0
Lithuania	32.0	99	77	0	12	0	0	11	0
Luxembourg	0	-	-	-	-	-	-	-	-
Malta	0	-	-	-	-	-	-	-	-
Netherlands	0.1	97	0	0	0	0	100	0	0
Poland	22.4	100	1	0	85	0	11	2	0
Portugal	16.4	77	13	13	1	1	0	7	53
Romania	70.0	92	2	0	48	0	7	5	0
Slovakia	13.1	97	45	8	3	0	1	36	0
Slovenia	9.5	96	0	29	8	2	0	7	0
Spain	10.3	90	35	2	48	1	1	1	0
Sweden	37.8	37	2	31	3	0	2	0	0
Total	**3,165**	**93[a]**	**8**	**62**	**17**	**0**	**2**	**1**	**0**

[a]

Figure 37 - Share of forest undisturbed by man in the total forest area, by country, Forest Europe 2020

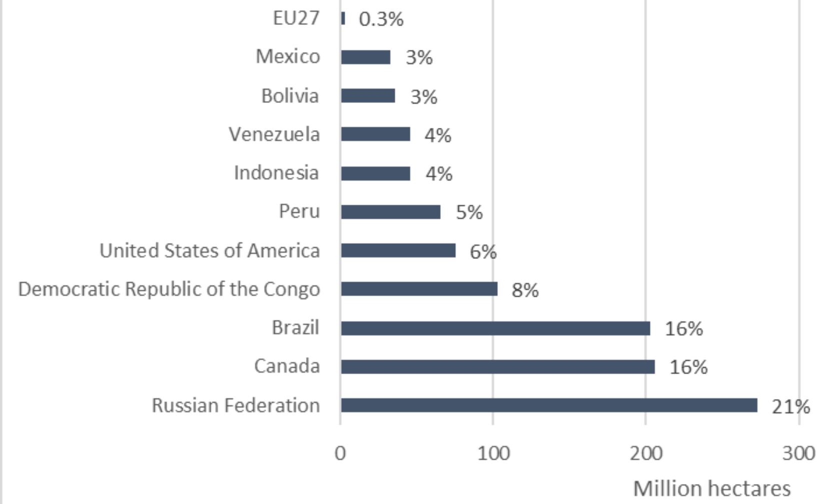


Option 2 would have different implications at Member States level and vary according to whether logging is currently allowed in forests not strictly protected. About 93% of the mapped primary and old-growth forests are part of the Natura 2000 Network, and 87% are strictly protected (, i.e. IUCN categories Ia, Ib and II). However, if we exclude Finland, which represents most of the mapped primary and old-growth forests in the EU, these shares drops to 87% and only 57%, respectively. Considering the wide data gaps in mapping, however, these figures should be considered with caution. Nevertheless, it is important to note that timber harvesting and salvage logging is allowed in many national parks in Europe (outside core areas). This means that forest biomass may still be extracted from strict protection areas. However, the data presented suggests that most Member States protect primary forests, but gaps exists. Therefore a restriction on forest biomass extracted from primary forests is expected to have limited impact on European production, but would ensure that primary forests in countries with lower coverage are protected.

Option 2 is expected to also impact more significantly biomass imports from 3rd countries, where most of the world primary forests are located (see figure below). According to the Global Forest Watch initiative[187], primary forest occupies 11% of the world (1.28 Gha). Together, Russia, Canada and Brazil account for 53% of the world's primary forest. Extending the no-go areas as part of option 2 will reduce the forest area available to be harvested for the purpose of bioenergy. The level of impact will depend on the current level of protection for old-growth forest in place. While in the EU there is a significant level of protection, and the impact on total available forest area will be minimal, this option is expected to lead to a reduction of imports by 7% by 2030 as criteria would exclude some non-EU supply. The decrease on imports due to inability to comply with more stringent requirements may lead to a rebound effect on EU production, increasing their prices.

[187] https://www.globalforestwatch.org/

Figure 38 – Area and global share of primary forest in top 10 countries (and EU27). Source: Global FAO forest cover



Additional no-go areas would include highly biodiverse forests. These would broadly include areas included in Natura 2000[188], areas covered by the EU Nature Directives, protected areas defined by Member States, Important Bird & Biodiversity areas and IUCN Key Biodiversity Areas (KBA). To date, no clear mapping of these areas is available. The Commission is currently working to identify criteria to define which habitats should be included to reach the 30% target land area protected set in the Biodiversity Strategy. According to the Strategy, this 30% target is equal to an extra 4% for land and 19% for sea areas, as compared to today.

By extending the REDII GHG saving criteria to existing installations, option 2 would also lead to exclusion of the less-carbon efficient production pathways, thus further ensuring direct GHG emission savings. Applying the GHG saving criteria to existing heat and power installations using biomass would impact over 540 installations over 20 MW[189] (where the 88 largest plants account for over 30Mt biomass per year). Option 2 would also include a stricter minimum level of thermal efficiency requirement for large (above 100MW) electricity-only plants (e.g. 38% compared to the 36% threshold set out in REDII). This requirement could apply only to new electricity-only installations, in order to protect existing investments. A threshold increase of the efficiency criteria would lead to taking into account only the most efficient power-only plants into account for the purpose of renewable generation, given that currently Best Available Techniques (BAT) efficiency ranges for solid biomass and peat boiler large combustion plants are 33.5% - 38% for new units and 28% - 38% for existing units. Both the number of planned large electricity-only biomass power plants in the EU and the share of this which would be captured by the efficiency requirement are difficult to ascertain. While some analysis, suggest significant planning for new coal-to biomass conversion[190], modelling carried out for the Climate Target Plan projects very little new biomass-based electricity-only capacity for the 2020-2030 period (~1% of total solid biomass consumption between 2020 and 2030). Everything considered and based on the available data, it can be assumed that the current 36% threshold is already sufficient to exclude all but a few electricity-only plants. This option would also lead to an improvement of ambient air quality.

[188] https://natura2000.eea.europa.eu/
[189] Bioenergy Europe 2016 – BASIS bioenergy project
[190] https://ember-climate.org/wp-content/uploads/2020/10/Ember-Playing-With-Fire-2019.pdf

Option 3 is likely to lead to increased environmental and climate benefits given that a larger share of biomass for heat and power will be subject to the enhanced EU sustainability criteria, thus avoiding potential leakages of impacts from larger installations to small ones. Depending on the threshold applied, the administrative burden associated to verification of the sustainability criteria and the related certification requirements could result in additional compliance costs. As smaller plants also use local non-recyclable waste and residues with positive environmental impact, this could have the negative environmental effect of excluding local waste biomass supply, which is generally considered the most sustainable[191].

Options 4, 4.1 and 4.2 would have positive effects on biodiversity and climate compared to option 2 on which it is constructed. These options would help addressing the Biodiversity Strategy goal of minimising the use of wholetrees for energy use. Option 4.1 would add further environmental safeguards by limiting forest bioenergy feedstock only to residues and waste from timber harvesting and processing. On the other hand, a cap of stem wood could negatively affect the demand for the large diameter stemwood of low quality. This option could increase demand for industrial wood residues that are largely used for manufacturing wood-based panels and pulp, resulting in lower feedstocks for material use. This option could have other unintended indirect effects which could undermine its environmental ambition, such as incentivising unsustainable changes in forest management to harvest just before the maximum diameter for energy is reached, thus leading to younger (i.e. with lower average carbon stock) and even less biodiverse forests.

In this respect, modelling conducted for the Commission[192] in 2016 suggests that an exclusion of the use of stemwood for energy could be compensated by an increase in stemwood use in the material sector (to substitute for by-products diverted to energy use)[193]. According to this study, this could therefore imply that the overall effect on the level of wood harvest and related climate benefits from a cap on stem wood could be relatively small. However, these results should be read in conjunction with the strong assumptions made in the study, including a stable demand for bioenergy.

The diversion of harvest to long lived products could also underpin a more ambitious climate policy in the LULUCF sector.

Option 5 would ensure that no further expansion of energy from forest biomass would take place, thus very likely reducing further pressure on forest biodiversity. However, this option would indiscriminately cap all forest bioenergy pathways and origins, both those detrimental for carbon stocks and biodiversity and those beneficial for them. The JRC study has identified a limited number of potential bioenergy pathways can be considered a win-win solution. Thus it can be expected that overall environmental impacts will be positive. Stopping additional timber harvest for energy use could appear a simple and direct approach to increase the net forest sink in the short-medium term.

[191] Smaller plants have the potential to use local waste and residues, with positive environmental (e.g. forest cleaning to avoid forest fires, use of biomass non-recyclable waste from industry or households) and social (additional revenues for small farmers) impacts

[192] ReCeBio' project 2016. https://op.europa.eu/fr/publication-detail/-/publication/5dd96712-27c8-11e6-914b-01aa75ed71a1

[193] According to the modelling, the resulting gap in the feedstocks for bioenergy in the EU is, in this scenario, fulfilled by industrial by-products, mostly through a change in the feedstock composition within the pulp and board industries towards use of stem wood instead of by-products, and an increase in sawn-wood production, since sawmills become more profitable as the by-products are in high demand for bioenergy and achieve high market prices

At the same time, this approach could lead to a net forest sink saturation in the medium-long term. In this respect, it should be noted that the LULUCF regulation, while not imposing a direct cap on harvests, already places responsibility for excess accounted emissions upon Member States if their harvest rates would exceed the levels encapsulated in the LULUCF Forest Reference Level and reporting framework. The review of the LULUCF Regulation further upgrades this stringency, including through new LULUCF targets for Member States by 2026.

All options including a reduction of combustion of solid bioenergy use are expected to lead to a decrease in air pollution, which is especially caused by inefficient space heaters and boilers.

Social Impacts

A quantitative assessment of the social impact has not been undertaken. Bioenergy is the largest renewable energy source in terms of direct and indirect employment, providing 703,200 jobs and a turnover of 66.6 billion euros[194], in particular in rural areas.

Option 1 is not expected to significantly alter underlying trends in bioenergy use and production, and therefore minimal social impacts are expected. The more prominent ones would be associated with skills and knowledge of sectoral workers.

Overall, option 2 may have marginal employment effect in the energy sector compared to baseline, as they would mostly depend on additional job opportunities in the certification industry and the additional jobs created by operators in order to cope with the additional requirements. Small negative employment effects could arise for forest owners or farmers linked to additional certification costs. Option 2 would further reduce the risks of unintended social impacts on local communities associated to forest biomass sourcing in primary forests, particularly in third countries.

Option 3 is likely to lead to negative employment effects as small heat and power installations could be unable to comply and are forced to close. Positive employment impacts will also arise as a result of the small shift from bioenergy to other renewable energy in the policy options, due to a higher labour-intensity of other renewable energy sources.

Options 4, 4.1, and 5 could also lead to negative employment impacts because of the significant administrative burden on forest owners and forest communities. Option 4.2 would minimise such negative impacts by reducing the administrative burden on economic operators, depending however on the way it will be implemented by Member States. In particular, option 4.1 could have high socio economic impacts on primary producers of forest biomass with its likely impact on reducing biomass use for energy. This would be felt mostly in countries with the largest workforces employed in forestry and logging activities (Poland, Romania, Sweden, Germany and Italy), and where forestry and logging activities occupy the largest share of active population (Latvia, Slovakia, Estonia, Croatia, Lithuania)[195]. However, for all options which would lead to a reduction in bioenergy use, an increase in employment in other renewable technologies can be expected.

[194] Eurobserver 2019
[195] Eurostat, National accounts employment data by industry

All options including a reduction of combustion of solid bioenergy would result in reduced air emissions and associated health benefits, especially in case of installations located in densely populated areas.

6.1.3. Administrative impacts

Administrative impacts are understood in terms of regulatory costs that affect the economic operators to take action on the ground and demonstrate compliance with the identified options and those that affect Member States authorities in charge of implementing the EU sustainability criteria and other related measures.

Option 1 is the only option that may reduce overall administrative burden and compliance costs with the REDII sustainability criteria for economic operators. Providing guidance at EU level could also generate (modest) compliance cost savings for national authorities in charge of implementing bioenergy sustainability criteria. Guidance and tools may also limit administrative costs of future heat and power installations by providing a tool for the calculation of GHG savings.

Option 2 is likely to moderately increase the administrative burden and compliance costs for economic operators. Administrative costs for bioenergy operators may increase because of additional certification costs to demonstrate compliance with new sustainability criteria. Fuel cost for biomass plants owners may also increase, due to producers passing the additional costs and, to some extent, reduced supply (particularly for biomass imports). However these administrative costs can be minimized if existing datasets and remote sensing technologies are exploited. National authorities are likely to face moderately increased administrative burden associated with the monitoring of the new no-go areas.

Applying the REDII GHG saving criteria also to existing installations would lead to limited increases in administrative costs for economic operators (chiefly related to collect evidence of GHG savings of the biomass pathways used). Increasing the energy efficiency threshold for electricity only plants would not add administrative costs compared to the baseline. However, considering that few biomass-based electricity-only plants met the current level of 36%, an increase to this energy efficiency requirement is likely to stop any new coal-to-biomass conversion or new investments in power-only plants running on biomass.

Options 3 is likely to increase the administrative costs for small heat and power installations under 20MW which would have to demonstrate compliance with sustainability and GHG criteria. The majority of administrative costs in both cases are expected to be associated with certification costs, rather than compliance and change of operational practices. For a hypothetical 1 MW heating plant, the cost of certification are estimated to be on at least 10% of the fuel cost. However, these costs could be higher for more complex supply chains where audits and certification costs will be charged to all operators along the value chain. As fuel quantities increase with plant size, the cost of compliance as a share of fuel cost would also decrease, because the cost of certifying a 1MW and a 15MW plant are not expected to be substantially different. On the other hand, supply' chain compliance and administrative costs would be reflected in the fuel price, which would vary by the same amount in both cases.

This option would also indirectly affect local forest owners and forest-based industries, as they often provide biomass to these smaller plants. For smaller forest owners and agriculture biomass producers, certification costs may be prohibitive, as biomass is a by-product. National authorities are also likely to face some additional monitoring and verification costs associated with the increased number of installations subject to the sustainability criteria. Extending the sustainability criteria to smaller installations would have the following impacts on currently existing installations[196]:

- The existing 20 MW threshold covers 75% of commercial woody biomass used in plants above 1MW, while affecting 15% of wood chip plants
- Lowering the threshold to 10 MW would capture 85% of commercial woody biomass used in plants above 1MW, while affecting 25% of the wood chip plants (~400 additional plants);
- Lowering the threshold to 5 MW would capture 93% of commercial woody biomass used in plants above 1MW, while affecting 42% of the wood chip plants (~500 additional plants);
- The Member States most affected by an extension of the minimum threshold from 20 MW to 10 MW are Sweden, France, and Austria. They remain the most affected countries even when the threshold is lowered to 5 MW.

The Member States most affected by an extension of the minimum threshold from 20 MW to 10 MW are Sweden, France and Austria. They remain the most affected countries even when the threshold is lowered to 5 MW.

Table 23 - Share of consumption of woody biomass for energy by plant size class

Plant size	1-5 MW	5-10 MW	10-20 MW	20+ MW	Total
Number of installations	**1,961**	**595**	**388**	**546**	**3,490**
% wood chips installations	58%	17%	10%	15%	100%
% wood chips consumption	7%	8%	11%	74%	100%
% wood pellet consumption	15%	8%	2%	76%	100%
% woody biomass consumption	7%	8%	10%	75%	100%

Table 24 - Number of biomass plants by size and Member State[197]

Member Sate/ Size	10 MW -20 MW	5 MW - 10 MW
Sweden	81	81
France	69	142
Austria	46	69
Germany	40	41
Finland	35	59
Lithuania	24	15
Latvia	17	45

[196] Data from BASIS project, BioenergyEU, 2016
[197] Data for Austria is incomplete

Spain	16	27
Slovakia	16	24
Denmark	13	28
Italy	8	24
Other EU	42	103
Total	**407**	**658**

Options 4, 4.1 and 5 would lead to significant administrative impacts on public administrations. Increased compliance and monitoring costs for forest owners are expected to be associated with both the need to tracing and certification all wood assortments to demonstrate compliance with the required dimension and quality characteristics. The need to establish a tracking system from forest plot to the factories would be necessary. Certifications and audit costs will be charged to all the market actors participating in the transaction. Each intermediary step of the value chain needs to be certified and bear the costs of auditing and certifications, having the potential to impact biomass fuels costs and the bioheat/bioelectricity costs. In some cases, compliance costs could be also related to changes in forest management practices. Administrative burden is likely to be high for many SMEs.

In case options 4, 4.1 would involve a monitoring obligation on forest owners, the administrative costs would be higher and have a much more significant impact. This is because often forest owners are small holders and for them logging is a secondary activity, e.g. providing an income of few thousands euros per year. Analysis carried out in 2017 with the Green-X model198 estimates 1.2 million EU forest owners, grouped into 1,452 forest entities would be needed to produce 110 Mtoe of bioenergy. In 2020, bioenergy from forest amounted to 80Mtoe, which suggests 0.87 million forest owners may be affected. However, reliable and wide-ranging estimates on costs are not available because compliance and certification costs depend on a wide range of factors.

Under options 4, 4.1 and 5, national authorities are also likely to face significantly increased administrative costs for setting up national systems and procedures to monitor and verify the type and quality of stem wood assortments going to the energy sector. In particular for option 4 and 5 (national caps on stemwood / on overall forest bioenergy), Member States would need to improve the statistics and monitoring systems in order to set up and enforce this option, and take them into account when setting up support schemes for bioenergy. Option 4.2 would offer an alternative solution which would be easier to implement.

6.1.4. Coherence

The initiative for the revision of the REDII sustainability criteria is part of the EGD and a wider package of initiatives that cover in particular the review of sectorial legislation in the fields of climate, energy, transport, and taxation. Different options score differently in terms of coherence with other initiatives.

Option 1 maintains a level of coherence (albeit weak) with the EGD, by strengthening the implementation of the EU bioenergy sustainability criteria but would only address the concerns

[198] https://www.bioboost.eu/uploads/files/bioboost_d1.1-syncom_feedstock_cost-vers_1.0-final.pdf

raised in the Biodiversity strategy if Member States would implement e.g. new guidance on cascading use of woody biomass.

Options 2 and 3 exhibit a high level of coherence with other EU initiatives, particularly the Biodiversity Strategy, including its goals to protect primary forests and old grown forests, and the LULUCF Regulation, including its review which aims to also to protect high carbon stock areas. These could produce synergies of protecting forest stock (i.e. areas where harvest would risk releasing large levels of CO2), while also enlarging the effectiveness of the EU sustainability criteria.

Options 4, 4.1, 4.2 would be also in line with the Biodiversity Strategy goal of minimizing the use of wholetrees for energy. Due to its significant implementation/verification challenges, increased administrative costs for economic operators, options 4 and 4.1 would likely significantly impact the deployment of bioenergy, which in turn could make it more difficult to reach future climate and energy targets cost-effectively, especially after 2030.

Option 5 would be in line with the Biodiversity Strategy objectives. However this option may not be in line with the CTP as it would both eliminate climate beneficial bioenergy pathways and affect the cost-efficient achievement of the EU 2030 renewable targets.

All options should also be seem in the context of parallel other initiatives under the Fit for 55 Package, in particular the review of the LULUCF Regulation and of the EU ETS, which are aimed at introducing additional safeguards for promoting sustainable forest biomass production for all uses, not limited to bioenergy.

Synergies and trade-off between the bio-economy and forest carbon sinks.

Land Use, Land Use Change and Forestry presently absorbs more CO2, by storing it in biomass or in soil carbon, than it releases to the atmosphere. The forest-based bio-economy can contribute to climate change mitigation through various options: by increasing carbon stocks in the forest pools (living biomass, dead organic matter and soils) and in the harvested wood products, and through so-called substitution effects, i.e. using wood to replace energy-intensive materials (e.g. cement, steel, etc.) and/or fossil-fuels. While changes in carbon stock are accounted under LULUCF, the substitution benefits are accounted in other sectors.

Trade-offs and synergies exist among these options, along different time scales. In the short-term (less than 10 years), a trade-off occurs between increasing the carbon stocks of forest pools and making more wood available for the other options, because more harvest typically decreases the net forest sink. In the medium-term (approx. > 20 years), only measures to substantially increase the total forest net annual increment (e.g. active sustainable forest management practices and new forest plantations) would allow to reverse the current trend of declining sink (bringing it in line with the EU climate neutrality target by 2050) and at the same time provide additional biomass for the wider bio-economy. Furthermore, in the longer-term (> 50 years) additional trade-offs may occur, e.g. a low harvest rate could slow down forest growth, with a likely consequent decrease (saturation) of the net forest carbon sink.

The more ambitious LULUCF Regulation presented in the Fit-for-55 package support the REDII review, by creating additional policy incentives for further encouraging climate-positive bioenergy pathways and minimize possible trade-offs. This is because any additional forest harvest is expected to be guided by a more careful assessment of its carbon impacts in the short term, which are negative on the LULUCF sink and positive on material and energy substitution (recorded in non-LULUCF sectors). In addition, increased afforestation will provide additional biomass for the wider bio-economy, while increasing the forest carbon sink and enhancing biodiversity.

6.1.5. Stakeholders' Opinions

Stakeholders' Opinions

During the OPC bioenergy sustainability attracted strong views throughout the questionnaire One question received over 38,700 answers, of which 38,313 thorough a coordinated campaign. The campaign chose not to answer the other questions concerning bioenergy sustainability.

The question whether there should be limits to the type of feedstock used for bioenergy production under RED II was answered by more than 38,700 participants. 99% said that REDII should be changed to remove biomass from the list of renewable resources, limiting the use for bioenergy to locally-available waste and residues, and that this should be accompanied by a moratorium or a cap on the total amount of solid biomass in electricity and heating, by an accelerated phase-out of high ILUC risk fuels, and by the removal of incentives for bioenergy.

Participants think that the sustainability criteria for the production of bioenergy from forest biomass should not be modified by a small margin (56% no to 44% yes), with clear splits among different categories (this question was not answered by the individual citizens stating their objection to the use of biomass). Overwhelming support for stricter criteria is found among NGOs/environmental organisations and individuals. A 50-50 split is found concerning the extension of criteria to installation below 20MW for solid biomass and 2 MW for biogas.

Industry, trade unions and several Member States authorities opposed the revision of the sustainability criteria for forest biomass bioenergy industry and forest owners did not want a revision of Articles 29 - 31 given that they have not been applied yet and to ensure regulatory stability to support the required investments. The remaining 44% of respondents, chiefly from environmental NGOs, academia and individuals, but also some Member States, support the strengthening of the REDII criteria.

During the 1st stakeholder workshop, industry and forest owners saw the REDII sustainability criteria (complemented by the LULUCF Regulation) as important steps forward, calling for a stable regulatory framework to support investments, while NGOs considered REDII insufficient and called for stricter sustainability criteria, including limits on roundwood use for energy. Research institutes argued that the focus for bioenergy should be on sectors that are hard to abate. Environmental NGOs argued to keep woody biomass out of the renewables mix. The bioenergy sector highlighted, among other arguments, that compared to solar and wind, bioenergy has added value as a flexibility source and can deliver negative emissions with coupled with CCS. This sector stresses that they are already subjected to substantial sustainability criteria compared to other economic sectors. They request to keep a simple and stable regulatory approach.

During the 2nd stakeholder workshop, NGOs called for a cap on bioenergy, to end support for burning biomass and for a feedstock based approach. Industry advocated that current RED II sustainability criteria should not be changed to avoid regulatory instability.

6.8. Flanking and enabling measures

Impacts projected by the core scenarios in the electricity sector

The below assessment analyses impacts related to the increase of renewable electricity stemming from ETS and enabling conditions in electricity sector assumed in the core scenarios. Actions facilitating offshore renewable energy and uptake and cross-border cooperation are key enabling conditions for renewable deployment in the electricity sector. Specific impacts and qualitative assessment for both cross-border cooperation and offshore renewable energy are discussed in sections 6.8.1 and 6.8.2.

Economic (including Energy System) and social impacts

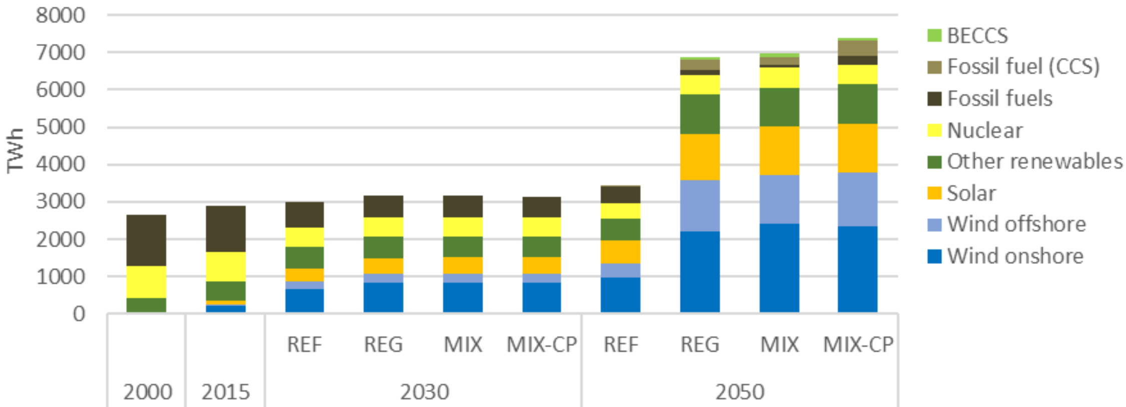
According to the core scenarios and in agreement with the CTP analysis, the electricity sector will see a high share of renewables (i.e. RES-E share): 65% in all core scenarios compared to 59% in REF (in 2030) and around 30% today. By 2050, renewables in power generation are projected to have around 85% share. The strongest drivers of renewables deployment in the electricity sector are carbon price and so-called RES values[199] representing the support policies that would need to happen as a result of RED revision and the necessary additional actions by Member States in the electricity sector. Of course there are also other strong drivers of the change in the power generation system: coal phase-out and national plans for phase/out or expansion in nuclear generation – all already present in the REF.

In MIX-H2 variant the penetration of renewables in electricity would be even higher but these would be amounts dedicated to RFNBOs production.

Between 2015 and 2030, the share of wind and solar energy in gross electricity generation is projected to increase from 13% to 41% in REF and to 48% in all core scenarios. In 2030, wind energy would be also the largest electricity source, providing 34% of gross electricity generation in all core scenarios. Solar energy would have a 14% share in all core policy scenarios.

[199] The renewables value is a shadow price, a signal of potential costs per unit of renewable energy not achieved (relative to the target) which is internalized in the optimized behaviours of actors and thus leads to higher renewables uptake. Renewables values do not describe in detail the renewables supporting policies, but are introduced if needed, in addition to the supporting policies, so as to complement them and reach the renewables target. The renewables value should not be confused with feed-in tariffs or green certificates. Renewables projects compete on equal economic grounds with other forms of energy.

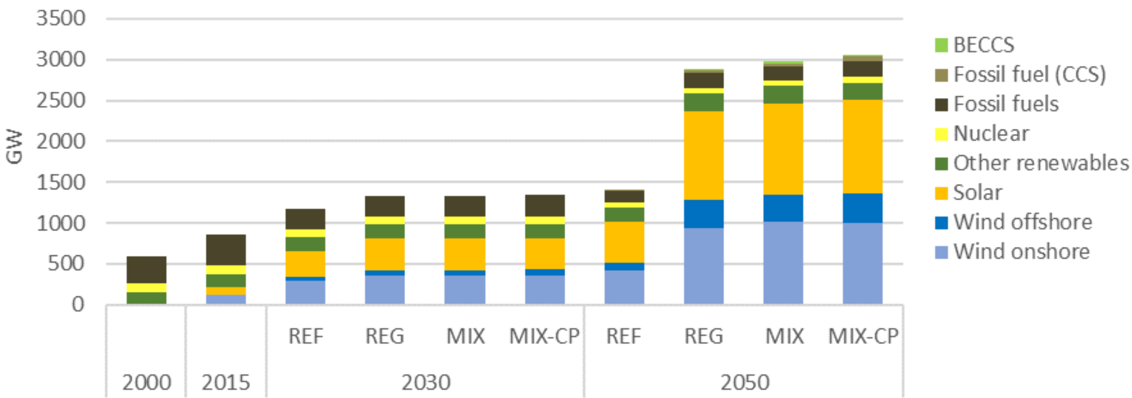
Figure 39 – Gross electricity generation in the EU; Source EUROSTAT, PRIMES



Due to the variable load factors of renewables the total installed capacity will have to increase more than the rate of the electricity produced. In the REF, the installed capacity increases from some 870 GW in 2015 to nearly 1200 GW in 2030 and to nearly 1350 GW in the core scenarios.

By 2030, wind energy is projected to have the highest installed capacity (nearly 430 GW in the core scenarios), with most of the installed capacity being located onshore. As already shown in the CTP IA and confirmed by the EU strategy on offshore renewable energy[200], offshore wind would reach in 2030 nearly 60 GW in the REF scenario and some 10 GW more in the core scenarios. Another fast development would take place for solar energy that would grow to some 300 GW in the REF scenario and to some 380 GW in the core scenarios.

Figure 40 - Installed power production capacities; Source EUROSTAT, PRIMES



As a result of high uptake of renewables, by 2030 the installed fossil-fuel capacity will decrease both in REF and in policy scenarios compared to 2015. By 2030, the combined installed capacity of the EU's nuclear power plants is also projected to decline as result of planned phase-outs in several Member States.

Policy options in the electricity sector considered in the sections below were captured in the core scenarios only in an implicit manner as so called "enabling conditions" and not differentiated among the scenarios. The key drivers remain the ETS price and generic incentive in support of renewables

[200] COM(2020)741

uptake in power generation (the RES value). The lower RES-E value in core scenarios compared to REF indicates that with current assumptions on the cost of technology, the projected ETS prices and necessary enabling conditions, the policy incentive can be smaller so that mature renewable technologies are competitive with fossil fuel technologies.

Table 25 - Incentives in power generation sector and electricity prices; Source PRIMES

2030, EU	REF	REG	MIX	MIX-CP
RES-E value (€/MWh)	54	51	51	51
ETS price in the current sectors (€/tCO2)	30	42	48	52
RES-E share	59%	65%	65%	65%
Average price of electricity for final consumers (€/MWh)	158	156	156	157

The average price of electricity for final consumers (including charges and levies) is 156-157 EUR/MWh in the core scenarios and stable compared to REF. This shows that renewables investment costs (recuperated by utilities through electricity prices) do not lead to a significant increase in electricity prices benefiting from economies of scale and better storage possibilities as electricity system continues to grow.

Environmental impacts

Strongly increased penetration of renewables in power generation combined with coal phase-out and only slightly decreasing share of nuclear (both aspects already captured in REF), lead to strong reductions of GHG emissions in power sector as illustrated in the table below.

Table 26 - GHG reduction in power generation; Source PRIMES

2030, EU	REF	REG	MIX	MIX-CP
Power generation CO2 emissions (% change vs 2015)	-51%	-64%	-65%	-67%

6.1.1. Cross-border Cooperation

The rationale for cross-border cooperation on support schemes for renewable energy is that a more cooperative approach can help Member States to achieve the EU target cost-effectively, tap into additional renewable energy potential (that one Member State alone would not be able to realise) and limit negative impacts on the internal energy market. This can also allow for a strategic and long-term energy cooperation, for instance through joint projects, where Member can share the added value of the project and also benefit from knowledge transfer and joint learning.

The default Option 0 is the baseline in which provisions under REDII on regional cooperation remain unchanged and no additional action is taken. The assessment compares this baseline to additional measures taken to enhance regional cooperation. 4 options are being assessed: guidance on cross-border cooperation (option 1), obligation to implement a pilot project (option 2), mandatory partial opening of support schemes (option 3) and an enhanced use of the Union renewable energy financing mechanism (option 4).

Given that the required level of cross-border cooperation across the four options differs from low (option 1) to moderate/high (options 2 and 3) and highest (option 4), the impacts described below refer to all options while the extent of their impacts increases with increased cooperation levels introduced by the options. Impacts relating to specific options are indicated below.

The results of the assessment incorporates finding from modelling undertaken by Trinomics/Artelys (METIS model) and results from other studies, in particular the AU RES II project.

6.8.1.1. Impacts and qualitative assessment

Economic impacts

Enhanced cross-borders cooperation results in lower capital expenditures. This is primarily due to geographical shifts of installations to better sites, in particular those with higher renewables potential with more load hours that require less renewables capacity to produce the same amount of electricity. Moreover, sites with lower cost of capital could be thus privileged.

When looking only at the levelised cost of electricity (LCOE), according to modelling undertaken by Trinomics/Artelys[201], savings on LCOE may reach up to 60% given the significant heterogeneity in climatic conditions across all EU Member as well as differences in capital costs (WACC).[202] While this part of the analysis does not factor in renewables integration and additional interconnector capacity needs, it gives an indication of the available potential for cost reductions resulting from different LCOEs. Looking specifically at option 3 and taking such factors into account the analysis from a partial opening of support scheme of 10% as of 2025 estimates savings on system cost to amount to 520 million €/year. In addition, such a partial opening of support schemes would also reduce renewables curtailment by 20%.

Furthermore, regional cooperation helps to mobilise larger investments compared to what a single Member State could do on its own. It can enable larger projects (e.g. for important offshore wind parks/ hybrid projects which might be too large to fit to the energy planning of one Member State but be suitable if developed by two Member States[203]) as well as enable riskier projects (e.g. applying less mature technologies, such as floating offshore wind) to materialise that would not necessarily be financed by a single Member State. Risk sharing between Member States and exploitation of cost-effective potentials drives down costs.

---

[201] *"Technical support for RES policy development and implementation: delivering on an increased ambition through energy system integration" ENER/ C1/2020-440, study performed by consortium led by Trinomics B.V.*
Impact Assessment for the revised Renewable Energy Directive *[adapt to title of final report]*.

[202] For instance, the load factor of Denmark is nearly twice as high as the one in Cyprus. For solar PV, the most beneficial hosting countries under the given assumptions include Cyprus and Spain, as they feature high capacity factors and favourable WACC conditions. For onshore wind, the most attractive hosting countries are the Nordic countries (Denmark, Sweden, Finland) as well as France.

[203] E.g. a joint offshore wind park as discussed between Estonia and Lithuania, where a project with a commercially viable size would likely be too large for one of the Member States to develop alone.

The access to more favourable renewable energy potentials via cross-border cooperation also allows for a reduction of support cost. For instance, as part of the AU RES II project, TU Vienna estimates reduced support expenditures for new renewables installation of 3.2 to 3.4 bn EUR annually for the period 2021 and 2030 in case of regional cooperation compared to a scenario without cooperation.[204] In addition, results from a case study analysis assessing joint support schemes between Hungary and the neighbouring countries Austria, Romania and Slovakia, revealed significant reductions of total cost of support to reach the respective renewable energy targets: 87-89% in the case of Austria and Romania, 7-31% in the case of Hungary and Austria and 6-13% in case of Hungary and Slovakia (range depending on renewables demand level).[205] Furthermore, increased cross-border cooperation on supporting renewable energy can lead to sharing best practices and a joint learning process resulting in better alignment of support schemes which can increase internal market distortions and investor's transaction costs due to different regulatory national regimes.

Relating specifically to the Union Renewable Energy Financing Mechanism, quantitative results are not yet available given the novelty of the instrument, with first potential tender rounds being prepared by the end of 2021. In the first expression of interest phase a number of Member States already officially indicated interest to participate in the mechanism, either as contributing or host Member State, in addition to some Member States who indicated that they are potentially interested to participate at a later stage. Expected economic benefits for contributing Member States include more cost-effectiveness to reach national renewables shares, by accessing more favourable renewables potentials in other Member States leading to support cost savings compared to purely national RES deployment[206]. This would be particular the case when focussing on established and mature renewable energy sources.

Environmental impacts

Cross-border cooperation can help to encourage renewables deployment in countries that have a large unused renewable energy potential but often still rely on a large fossil fuel share in their energy mix. It can also help to use renewables in energy-intensive economies that do not have a high renewables production potential. For instance, an industrial region formerly based on coal can develop renewable hydrogen or other innovative technologies, thanks to cooperation to other regions with high renewables potential, but not industrialised to the same extent. Thus, entering into such cooperation on renewable energy is likely to result in a reduction of fossil fuels combustion and associated air and water pollution and lead to GHG emission reductions in the hosting countries[207].

Cross-border cooperation helps to reduce the negative impact on use of natural resources. It allows Member States to make use of most favourable sites in terms of natural resources. This implies that less capacity is required for a given amount of energy needed which in turn translates into higher resource efficiency. Therefore, cooperation may reduce environmental impacts of renewable energy deployment related to for instance land use, impacts on ecosystems and species, and use of raw

[204] AU RES II (2020), Central vs Decentral Policy Making for RES: the need for both and the role of RES Cooperation *[presentation – update with final publication title expected by end March 2021]*

[205] AU RES II (2020), Proposal for a cross-border auction design for Hungary.

[206] See also more detailed overview of benefits for contributing and host countries in AURES II (2020), The new renewable energy financing mechanism of the EU in practice, p. 11 ff.

[207] *[Potentially add data on fuel avoidance from upcoming publication AU RES II (2020), Central vs Decentral Policy Making for RES: the need for both and the role of RES Cooperation (expected by end March 2021)]*

materials for the manufacturing of renewable energy installations. It may also reduce pressure on environmentally protected areas, by providing a larger pool of potential sites for RES investments projects than what would be possible if based on national approaches only[208].

Social impacts

For Member States, entering into cross-border cooperation can be challenging due to – anticipated or actual – low public acceptance. This might be particularly the case when a Member State supports renewable energy projects in another Member State and might face difficulties in explaining to national taxpayers or consumers that part of their funds may be used to support renewables projects in other countries and explaining the overall positive cost-benefits analysis of the cooperation. Here, benefits associated with the deployment of renewable energy such as local added value and employment, emission reductions, additional security of energy supply might be considered to be lost while the host Member State would receive these benefits.

However, this possible negative perception can be counteracted by the positive impact that cross-border cooperation would have on the total cost of support passed on to the final customers. For instance, opening auctions for renewable energy to sites in other Member States allows projects with more favourable conditions to participate that can compete at a lower price. Such benefits in terms of reduced support costs for renewable energy deployment are described above (subsection on economic impacts). In addition, with the increasing deployment of renewable energy, available land and cost-effective potential may become increasingly limited in some Member States, making cross-border cooperation the means to still contribute to the overall EU target in a cost-effective way.

Moreover, depending on the type of cooperation, Member States can decide to enter into a more strategic and long-term energy cooperation, for instance through joint projects, where Member can also benefit from knowledge transfer and joint learning which might entail additional advantages compared to simpler forms of cooperation such as statistical transfers.

6.8.1.2. Effectiveness

Given the gradual increase of the required cross-border cooperation over the four options, their effectiveness can be summarized as low for option 1 (given its voluntary nature), moderate/high for options 2 and 3 (given their mandatory nature) and high for option 4 (given its possible wider scope and mandatory nature).

Options 0, 1 and 2 seem politically feasible as they respect the principles of proportionality and subsidiarity allowing Member States to test the implementation of cross-border projects. Option 3 with the partial mandatory opening as the core concept is similar to what the Commission proposed under REDII but changed to a voluntary opening by the co-legislators in the legislative process. Thus, the general political constraints against this option might still remain. At the same time, given the enhanced framework facilitating the implementation of cross-border projects - notably funding opportunities under the revised Connecting Europe Facility 2021-2027, the Union renewable energy

[208] See also AURES II (2020), The new renewable energy financing mechanism of the EU in practice, p. 11 ff., while the benefits referred to also hold true for the other options of increased cross-border cooperation

financing mechanism and the Union renewable energy development platform for statistical transfers – Member States now have greater opportunities to implement cross-border projects. Option 4, of mandatory Member State use of the financing mechanism, may be more politically challenging as it would in certain cases oblige Member States to use the European tender scheme on which they have limited influence. However, if linked to certain objective criteria of when its use would be mandatory (e.g. when a Member States is below its target/ contribution trajectory) this could increase acceptability.

6.8.1.3. Administrative impacts

Given its voluntary and non-regularly nature, Option 1 does not include any additional administrative burden or compliance cost for Member States. However, as described above its effectiveness is also estimated to be lowest. Option 2 involves certain administrate and compliance efforts as for Member States without any experience on cross-border cooperation a pilot project can imply challenges as with the introduction of any new instrument. However, this option should be assessed in the context of being an interim step to a potentially wider cooperation in the future after successful implementation of a pilot project. Option 3 includes moderate administrative efforts which should however be outweigh by the benefits. Option 4 would rather lower than increase administrative burden on Member States as auctions under the Union Renewable Energy Financing are designed and implemented by the Commission[209].

6.8.1.4. Coherence

The options are coherent with other EU instruments and initiatives, in particular the Union Renewable Energy Financing Mechanism, the new window for cross-border cooperation in the field of renewable energy under the revised Connecting Europe Facility and the proposal for the revised TEN-E Guidelines.

6.8.2. Offshore renewable energy

In order to meet the goals set in the EU strategy on offshore renewable energy, Europe's offshore wind capacity will need to massively scale up until 2030 and beyond.[210]

The default Option 0 is the baseline in which provisions under REDII energy remain unchanged and no additional action is taken. The assessment compares this baseline to additional measures taken to enhance the planning and permitting of offshore energy deployment. Two options are assessed: mandatory joint offshore energy capacity planning per sea basin (option 1), and a one-stop shop for permitting of cross-border projects (option 2). These options can be complementary.

The options would complement the provisions as included in the Commission proposal on a revised TEN-E Regulation. The proposal foresees joint agreements by Member States per sea basin on the deployment of offshore renewable generation and the creation of 'offshore one-stop shops' for facilitating and coordinating the permit granting process for offshore grids and the coordination

[209] Also compare assessment in AURES II (2020), The new renewable energy financing mechanism of the EU in practice, p. 11 ff.

[210] From an offshore wind capacity of currently 12 GW to at least 60 GW by 2030 and to 300 GW by 2050 and for ocean energy to at least 1 GW by 2030 and 40 GW by 2050.

between the permitting process for the energy infrastructure and the one for the generation assets. Under option 2 the designation of an 'offshore one-step shop' for offshore generation assets would complete the framework to facilitate offshore developments. The regional approaches to both grid and energy generation capacity planning are complementary and build upon each other. The results of the assessment incorporate elements from the impact assessment of the Commission's proposal for the revised TEN-E Regulation[211] as similar aspects where addressed there as well as other study results, in particular from COWI[212] and Roland Berger[213].

6.8.2.1. Impacts and qualitative assessment

Option 1: Joint offshore energy capacity planning per sea basin

Economic impacts

An optimised and long-term offshore renewable capacity planning is paramount for investment certainty and for making best use of the limited available resources. Joint capacity planning provides visibility of the planned accumulative capacity in sea basins allowing long-term and sound investment decisions. Such joint planning and cooperation in its rollout can lead to significant cost savings. For instance, for the Baltic Sea region, an analysis study revealed that regional cooperation on offshore power hubs and interconnections could lead to savings of aggregated generation costs of 700–900 million €/year in 2050[214].

In addition, given the scope, complexity and still innovative nature of offshore renewable energy projects a joint approach on offshore renewable energy planning would facilitate a joint learning curve and could help expand offshore technologies, including less established ones, in sea basins where they are less common today. This could have significant positive impacts on turnover and employment by contributing to maintain Europe's technological leadership in this area.

Environmental impacts

A joint planning of offshore renewable energy projects could result in significant environmental benefits. Offshore renewable energy projects could be optimised regardless of territorial borders. This would enable planners to better take into account environmental concerns in the siting decisions, e.g. impacts on seabed, biodiversity and environmental protection areas. It can incentivise the choice of places and approaches benefitting also biodiversity, in line with the Biodiversity Strategy. Additionally, if grid planning is taken into account as proposed by the Commission in the revised TEN-E Regulation, the required grid expansion related to the new offshore projects can be made in an environmentally optimal manner. Joint offshore energy planning per sea basin could make more sites available for renewable energy expansion while respecting the environment and biodiversity objectives.

---

[211] Commission (2020), Impact Assessment accompanying the document proposal for a regulation of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Regulation (EU) No 347/2013, SWD(2020) 346 final.

[212] COWI (2019), Study on Baltic Offshore Wind Energy Cooperation under BEMIP.

[213] Roland Berger (2019), Hybrid projects: How to reduce costs and space of offshore developments - North Seas Offshore Energy Clusters study.

[214] COWI (2019), Study on Baltic Offshore Wind Energy Cooperation under BEMIP.

Social impacts

As set out in the strategy on offshore renewable energy, a large-scale increase in the deployment of offshore renewable energy and the related value chain should benefit a large number of regions and territories. It may provide an opportunity for the regions most affected by the transition to a climate-neutral economy to diversify their economies, ranging from carbon-intensive and coal regions, regions where gas and oil offshore industry needs to reconvert, to peripheral and outermost regions. It could offer alternative high quality employment opportunities to skilled workers affected by the transition. Maintaining offshore energy infrastructure could also have balancing economic effects in locations with highly seasonal industries (tourism, fishing, etc.) by providing a stable and predictable work stream for local workers and for SMEs all year round. Currently about 62.000 people work in the offshore wind industry and 2.500 in the ocean industry sector in the EU. Studies on offshore wind and ocean industry employment show that the right framework and investments could generate between 0.8 and 1.8 million jobs by 2050. These job creations in the offshore renewable sector should of course not happen at the expense of other maritime economic actors and sea users, such as fisheries, shipping or tourism. The Offshore energy strategy puts a strong emphasis on developing a balanced and sustainable multi-use/multipurpose approach for the use of the sea space. It builds in particular on Maritime Spatial planning, as an essential and well established tool to anticipate change, prevent and mitigate conflicts between policy priorities while also creating synergies between economic sectors.

Option 2: A one-stop shop for permitting of cross-border renewable energy projects

The revised TEN-E Regulation proposes to establish one-stop shops for infrastructure related permitting processes. The activities of such one-stop shops could be expanded to cover the permitting for the generation assets for offshore projects that are not limited to the territorial waters of one Member State.

Economic impacts

Building on the findings of the impact assessment for the revised TEN-E Regulation, the creation of a one-stop shop per sea basin could have positive economic benefits for offshore renewable generation located in the territorial waters of more than one Member State by accelerating the permitting for such projects. This could help avoid a costly duplication of procedures.

Environmental impacts

As described in the impact assessment for the revised TEN-E Regulation, the creation of a one-stop shop per sea basin could mitigate negative impacts or even bring positive environmental impacts as strategic environmental assessments could be performed at sea basin level. Moreover, with one entity being responsible for coordinating the permitting process of cross-border projects could also lead to a better coordination of the environmental impact assessment across borders.

6.8.2.2. Effectiveness

Given the binding nature of Option 1, this option would be very effective to ensure a joint planning and target setting per sea basin. Option 2 can be expected to have good effectiveness of facilitating permitting of cross-border offshore renewables projects, which would increase with the number of concerned projects.

6.8.2.3. Administrative impacts

Option 1: Joint offshore energy planning per sea basin

Long-term planning and long lead times are required in offshore energy. Planning already takes place at a national level: Member States plan the capacity they wish to install nationally. The Maritime Spatial Planning Directive already requires Member States to consult each other on their maritime spatial planning. The administrative burden linked to this option would therefore be limited to a better coordination of planning processes. In some sea basins, regional cooperation forums, such as NSEC or BEMIP already exist and facilitate the joint capacity planning.

Option 2: A one-stop shop for permitting of cross-border renewable energy projects

If the one-stop shop is established based on the one-stop shop established in the proposal for the revised TEN-E Regulation, it would require very limited additional resources as the assessment would continue to take place on the basis of the national requirements for the different Member States on the territory of which the project is located. The one-stop shop would ensure a single point of contact for the project promoters and the coordination of the national one-stop shops. As the current renewable energy directive established single contact points for developers of renewable energy projects at national level, a one-stop shop at sea basin level would only have to bring together the involved national contact points. Currently the number of projects located across territorial waters is very limited but could increase with the right regulatory framework at European level.

6.8.2.4. Coherence

The options are coherent with other EU instruments and initiatives, in particular the proposal for the revised TEN-E Guidelines. The options complement the proposed revised TEN-E Guidelines that focus on similar provisions in the infrastructure part, while in this proposal parallel required measures are addressed with regard to planning of renewable offshore energy generation.

Moreover, the options are coherent with other EU instruments aiming at facilitating cross-border cooperation in the field of renewable energy such as the Union Renewable Energy Financing Mechanism and the new window for cross-border cooperation in the field of renewable energy under the revised Connecting Europe Facility.

6.8.3. Industry

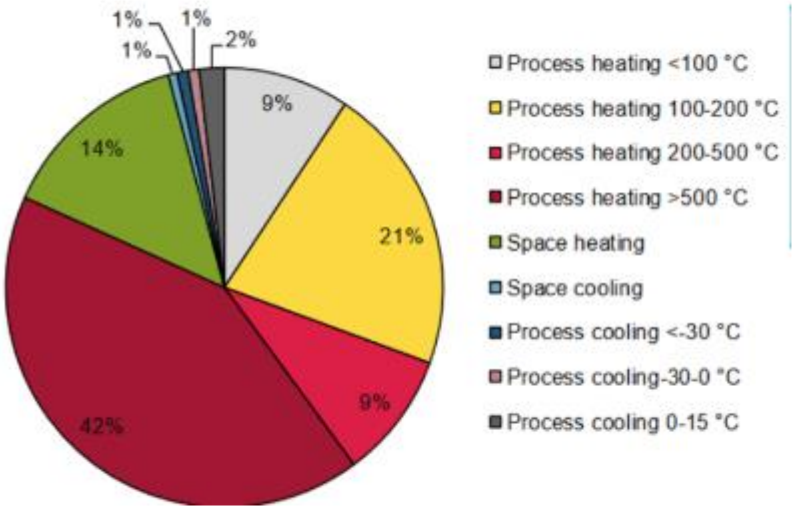
As mentioned in the CTP, in order to further reduce emissions from industry in line with the higher climate target for 2030, major changes need to be made in the way industry consumes energy and produces its products. 80% of the emissions are related to direct and indirect energy consumption (supplies of electricity and steam), with 70% of the energy demand used for heating and cooling purposes. The other 20% of emissions are due to process emissions, primarily related to the cement industry[215].

[215] The CTP modelling does not integrate the energy and emissions savings coming from the circular economy, especially in hard-to-abate sectors like cement or steel

At present, GHG emissions from energy-intensive industries are mainly regulated through the European Emission Trading Scheme (EU ETS), however roughly 30% the industrial GHG emissions and associated energy consumption does not fall under the EU ETS, and is covered under the Effort Sharing Regulation instead. Furthermore, the indicative targets set in the REDII to increase the share of renewables in heating and cooling partly target the industry sector.

Despites these measures in place, heating and cooling demand in the industrial sector is for 91% supplied with fossil fuels. Yet 50% of heating and cooling demand is low-temperature (<200 °C) for which there are ample renewable energy options.

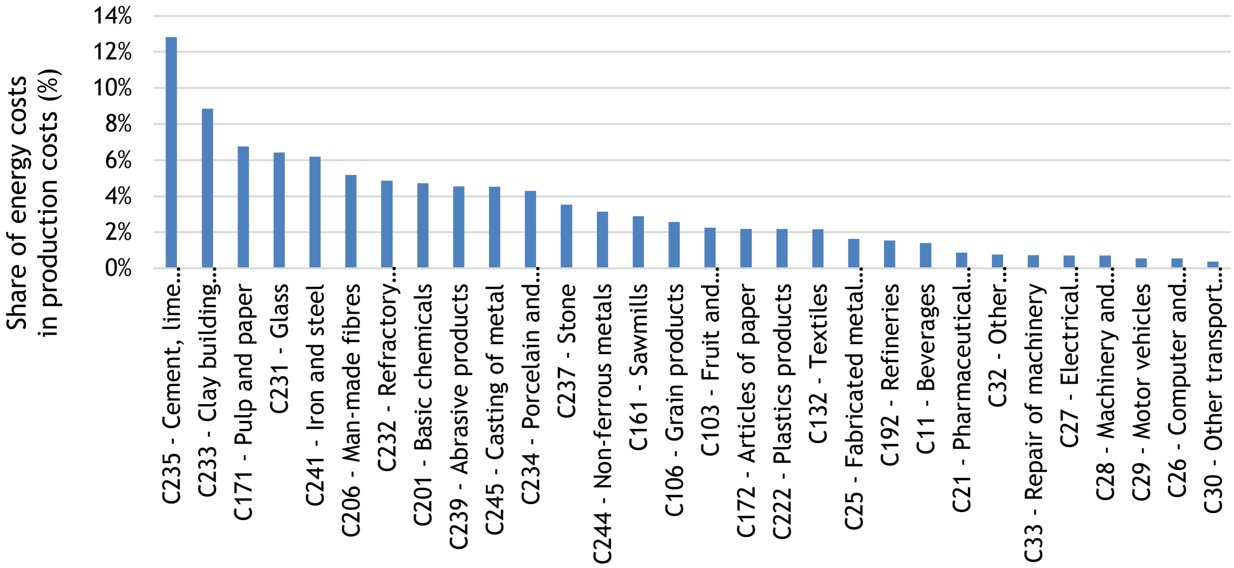
Figure 41 - Final energy demand in industry for H&C by end use (EU28, 2015); Source: Heat Roadmap Europe[216]



Industries are increasingly using corporate sourcing of renewables to directly purchase or use renewable electricity to power their facilities and processes. However, energy accounts in most cases for less than 6% of the production costs, which means that there is limited economic incentive to change energy sources. Furthermore, 90% of all industrial companies are small- and medium-size enterprises with limited ability to dedicate resources to energy issues.

[216] Heat Roadmap Europe (2017) Profile of heating and cooling demand in 2015. Available at: https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cce/2017/3-1_Profile_of_the_heating_and_cooling_demand_in_the_base_year_in_the_14_MSs_in_the_EU28.pdf

Figure 42 - Energy costs as a share of total production costs for different sectors in 2017; Source EC[217]



Despite facing strong international competition, European industry has adapted its business models and practices in line with the climate and energy ambitions of Europe, and in a viable economic manner. However, given that additional effort between 2030-2050 would be required to decarbonise when EU's climate neutrality ambition will require industry to reduce its emissions to around 90-95% compared to 1990 levels, as explained in the Long Term Strategy coupled with significant and long investment cycles in industry, increased effort is needed already by 2030.

Recent reports shows that an EU industry with net-zero emissions is possible with limited impacts on end-user/consumer costs (<1%), but with increases in near-term capital investments (an additional 25 to 60%) to invest in new production processes (ECF, 2019) in almost 80 percent of the existing industrial production sites[218] (McKinsey, 2020) However, these investments decisions need to be taken within the next decade to avoid any stranded assets.

A number of studies have identified the significant potential and need to increase the share of renewable energy in industry beyond the current 9% in industrial heating and cooling (which is primarily biomass), and beyond the current 16% across the consumption of all energy sources.

For heating and cooling, IRENA has identified a cost-effective potential to increase the renewables share to 20% without carbon prices, and to 34% assuming a CO2 price of €70/t CO_2 in 2030. In comparison, in all the CTP scenarios the share of renewables in heating and cooling only increases from 9% in 2020 to 10% in 2030, despite a carbon price of €65/tCO2. At the same time, there is a rapid growth of renewables after 2030, with all scenarios reaching at least 15% in 2040. Given the time sensitive nature of industry investments, it is important to ensure that a growth of renewable energy use is already initiated ahead of 2030 avoiding stranded assets and lock-in at a later stage.

[217] European Commission, (2020) Study on energy prices, costs and their impact on industry and households
[218] McKinsey & Company (2020) Net-Zero Europe

In all scenarios, electrification based on high shares of renewable power generation will also play an important role in decarbonising the heating and cooling demand. In the CTP, the share of electricity in industrial energy consumption is expected to grow to 40%, whilst the PAC[219] energy scenarios foresees a share of 47%. The PAC energy scenario foresees almost all low-temperature heat provided through electrification or direct use of renewables, including industrial excess heat recovery. Similarly, McKinsey foresees electrification and the use of renewables in low- and medium-temperature heat increase from 28% to 60% by 2030, and the share of renewables through electrification and direct use in high-temperature heat increase from 0% to 35% by 2030[220].

Furthermore, there exist a clear opportunity to replace the existing use of fossil-based hydrogen (produced from natural gas) as feedstock in refineries (153 TWh) and the production of ammonia (129 TWh) and methanol (27 TWh) with renewable hydrogen. The PAC energy scenarios estimates a potential of 71 TWh of direct use of renewable hydrogen to replace fossil-based hydrogen, and a potential of 68 TWh for replacing fossil fuels in steel production. FCH JU (2019) identifies a comparable value of 62 TWh of renewable hydrogen consumption in the steel sector, with fossil-based hydrogen consumption in the chemicals sector primarily decarbonised with CCS[221].

Furthermore, there are significant opportunities to increase the share of renewable electricity consumption, with the commercial and industrial sector accounting for 69% of EU electricity end-use[222]. If EU companies would acquire all newly built solar and wind power capacity in the period up to 2030, the share of renewable electricity consumption would increase from 3.5% to 28% and supports corporate social responsibility and an increasing demand from consumers for renewables-based products[223]. Other studies also indicate that a supporting regulatory framework that will promote the deployment of such technologies is necessary[224], both on the production side, but also on the side of demand, creating for example lead markets for renewable products[225].

Based on these drivers, there are two general approaches that can be considered to increase the uptake of renewables in the industrial sector. A technology-push approach (options- 1) includes options to request the industry to invest in cost-effective options to increase the renewable consumption in their facilities and processes by introducing audits. A market demand approach (option 2) would allow consumers to differentiate between industrial processes and products that are produced from renewable energy.

---

[219] https://caneurope.org/building-a-paris-agreement-compatible-pac-energy-scenario/

[220] McKinsey & Company (2020) Net-Zero Europe

[221] https://www.fch.europa.eu/news/hydrogen-roadmap-europe-sustainable-pathway-european-energy-transition

[222] DG ENER (2019) Competitiveness of corporate sourcing of renewable energy. https://op.europa.eu/en/publication-detail/-/publication/8a262c4f-c486-11e9-9d01-01aa75ed71a1/language-en?WT.mc_id=Searchresult&WT.ria_c=37085&WT.ria_f=3608&WT.ria_ev=search

[223] DG ENER (2019) Competitiveness of the renewables industry.

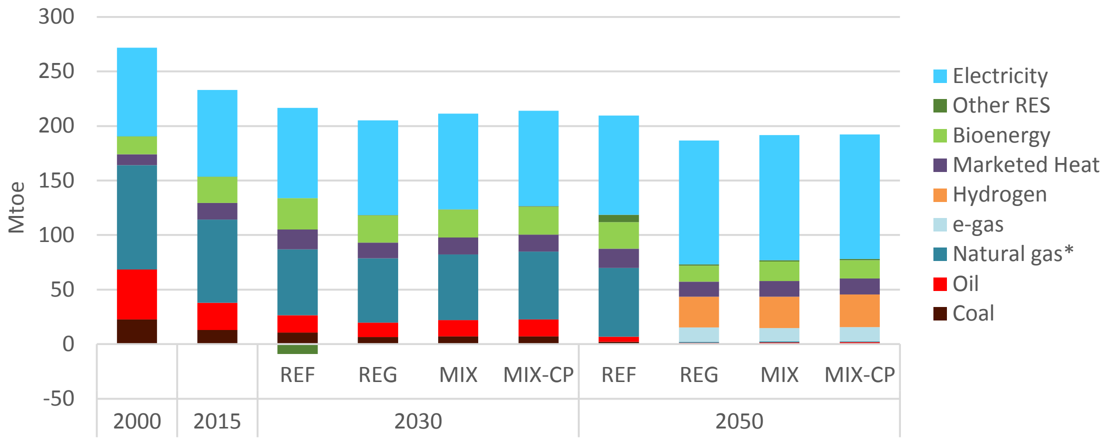
[224] Wyns et. al., (2019), Industrial Transformation 2050 – Towards an Industrial Strategy for a Climate Neutral Europe, IES

[225] CF & DIW (2020), Industrial Innovation: Pathways to deep decarbonisation of Industry. Part 3: Policy Implications

6.8.3.1. Impacts projected by core scenarios

The CTP assessed the differences in fuel consumption of the various policy scenarios against the baseline and the finds remain largely unchanged in this assessment. The figure below[226] reports these differences on the left hand side for 2030 and in the centre for 2050, while on the right side one can see the fuel mix of the REF.

Figure 43 - Final energy consumption in industry; Source PRIMES



In 2030, fuel switching will still remain limited, however a rapid uptake would be required immediately thereafter to be able to achieve the 2050 targets. Instead by 2050 significant fuel switching is displayed with associated energy savings, with almost all natural gas being replaced by low-carbon gases, i.e. hydrogen, e-gas and some biogas. There is, additionally, some more electrification, including a higher share of energy produced by CHP.

An important conclusion results from this modelling exercise. Firstly, with carbon prices increasing up to €65/tCO2, additional GHG reductions compared to 2015 are lower than other sectors except transport. The industrial sector has already significantly invested in improving its energy efficiency, mainly to address its high energy costs compared to its international competitors, however, strengthening energy efficiency policies, mainly targeting the increase of waste heat recovery, are insufficient to drive significant additional emissions reductions.

6.8.3.2. Impacts and analysis not based on modelling

The impacts of the different options can be measured at three different levels. First, there is the impact on the individual companies. For the majority of companies, the energy costs will not have a major impact on the profitability of their business today. However, the future impacts can be relative large depending on: 1) the future costs and uncertainties associated with the availability of fossil fuels, and 2) the future demand for green products and processes. As such, upfront investment decisions to support the uptake of renewables should not only be considered on the basis of the pay-back time for investments based on the cost differential between renewable and fossil fuel energy

[226] It is important to note that these figures do not include main consumers of non-energy related resources such as refineries.

alone, but also on their impact on the profitability and stability of the company, their goods and services. This impact is particularly relevant for option 1A, because it would allow companies to identify those investments that are economically competitive already today. Furthermore, it is important for option 2 as it would allow a company to remunerate its investments by putting premium value products and services onto the European market. A methodology underpinning green labels for industrial products (Option 2A) is considered to have a positive impact on consumers' behaviour, leading to possibly more responsible consumption and use of products.

Second, the use of renewable energy in industrial processes has important implications in the context of maintaining a competitive level playing field for the industry across the different EU Member States, as well as with competitors that are importing their products and services to Europe. This impact is particularly relevant for option 2A, as it will change the European market demand for products and services produced on the basis of renewable energy, and for the costs associated with the production of industrial products and services that are placed on the European market.

6.8.3.3. Effectiveness

The industrial sector accounts for 25% of EU's energy consumption, but has a relatively low share of renewables (8% of direct renewable energy use, and 22% if the renewable energy share in electricity is considered). The CTP results show that existing measures to increase greenhouse gas emission reductions, such as the EU ETS and an increased overall target for renewable energy alone, will not as such lead to significant increases in renewable energy shares in the industry sector. As there are currently no specific requirements in REDII to increase the use of renewable energy in industry, the measures assessed are considered to be effective in ensuring some level of increase in the use of renewable energy.

The introduction of energy audits under the EED (Option 1A) will be very effective in increasing awareness and identifying cost-effective options for increasing the share of renewable energy consumption in industrial processes. This is particularly relevant for low-temperature heating and cooling, which is 50% of the heating and cooling demand. Including RES as part of the audit process for energy efficiency would lead to only limited ongoing administrative costs.

Energy labels for consumer information are now a well-established and understood instrument. They have had a very positive effect on consumer choices[227], and have been effective in informing consumers and persuading them to purchase labelled products. They are shown to have a positive effect, albeit limited, and their effectiveness increase with time, as they become more established and known by the general public.

A recent research by the ITC[228] found that Sustainable product sourcing has become a top priority for retailers in key European Union markets[229]. Retailers report an increase in sale of sustainable products and expect this trend to continue. Nearly all retailers have created strategies that include provisions to increase the proportion of their sourcing that benefits the environment and the people

[227] The label had an influence in 79% of Europeans' purchase choices when buying appliances, Eurobarometer 492, 2019
[228] International Trade Centre (2019). The European Union Market for Sustainable Products. The retail perspective on sourcing policies and consumer demand. ITC, Geneva
[229] The study covered France, Germany, Italy, the Netherlands and Spain.

along their supply chains. Sixty per cent of retailers use their own-label products to meet their sustainability commitments, while other rely on other knows labels such as “organic”.

Any commitment to renewables is found only concerning the retailer’s own energy use, rather than energy used as part of production. However, these commitments are also appearing across the full supply chain, for example with more than 280 companies having a commitment towards 100% renewable energy consumption as part of the RE100 initiative[230]. This includes companies in some of the most polluting industrial sectors[231] (steel, cement) are actively considering options to reduce GHGs emissions by switching to hydrogen or renewables in their production processes.

It is important that any claims for the use of renewable energy in the industrial products and processes are consistent, and are built on robust methodologies and provide more credible claims compared to claims made on the basis of own methodology. As such, they would be a very effective instrument in creating a premium market for green products. There would be costs involved in using such a label, but as it would be voluntary, companies would be free to choose to use it or not. The voluntary nature would minimise the possibly negative impact of a labelling scheme on international trade.

In the EU and globally, there are a number of initiatives that are providing labels to provide environmental information about products (goods and services) and organisations, including a number that specifically focus on the renewable energy content[232]. A joint initiative from DG ENV and DG Just is already tackling the proliferation of inconsistent methods and initiatives, which could result in misleading environmental claims on the market, whilst the Sustainable Products Initiative is revising the Eco-design Directive to ensure products that are more durable, reusable, repairable, recyclable, and energy-efficient.

Considering that a number of companies are developing their own labels to put ‘green products’ produced from renewables on the market, it is important that such labels do not mislead the consumer. Therefore, an EU-wide methodology could be developed that companies or labelling scheme would be required to use if they want to report on the share of renewable energy used in the manufacturing of a product (or company). As such, the REDII would not propose any new labels, but ensure that any labels that are being developed are consistent and use the same criteria. Such a methodology would also be consistent with the joint initiative by DG ENV and DG JUST, and could also become part of any methodology developed under the Sustainable Product Initiative.

6.8.3.4. Administrative impacts

For the introduction of energy audits that include renewable energy assessments, there would be one-time costs of updating auditing methodologies, guidelines and reporting procedures, and operating costs to run the appropriate training on a regular basis, also considering the rapid evolution of technology developments. The cost to industry will not be high as all non-SMEs are already required to undertake such audits every four years, and adding one more element will add little to the expense.

[230] https://www.there100.org/
[231] https://www.ft.com/content/46d4727c-761d-43ee-8084-ee46edba491a
[232] The Ecolabel index lists over 46 ecolabels globally (www.ecolabelindex.com)

For those companies that choose to use labels (Option 2A), there would be a cost to put this in place, but it can be expected that they would only do it if the advantages vis-a-vis consumers outweighed the costs.

6.8.3.5. Coherence

Increasing the use of renewable energy in industry is in agreement with the CTP, and with the principle of energy system integration, to ensure that each sector plays its part in working towards a climate neutral economy.

The introduction of energy audits regarding the use of renewable energy is fully in line with the current requirements under article 8 of the EED, which already mandates energy audits for companies with more than 50 employees, or an annual turnover exceeding €50 million and annual balance sheet exceeding €43 million. The revision of the EED proposes to implement an energy management system for enterprises with an average annual consumption higher than [100TJ, an energy management system or an energy audit for enterprises with an average annual consumption higher than [10 TJ], and to encourage energy audits for all other enterprises, including SMEs. The proposal for including renewable energy in the audits will follow the scope of the EED proposal. Expanding the energy audit to include the consumption renewable energy will not incur a substantial administrative costs, because: 1) the existing parameters for such an analysis will already be derived from any energy audit on energy efficiency, and 2) there is already an established European network of organisations and bodies conducting renewables-related audits. Furthermore, these audits could substantially improve the economic competitiveness of businesses, based on the evidence in DG ENER study on corporate sourcing of renewables (2019).

For renewable energy labels to be effective (option 2), any proliferation of inconsistent methods and initiatives used to communicate information about environmental performance of products (goods and services) would need to be avoided. Currently, two parallel but interlinked initiatives are attempting to tackle this problem. One focusses on methodologies and presentation of environmental performance claim, the other aims to help consumers to play an active role in the green transition by giving them useful information and protection from certain misleading commercial practices. To ensure consistency and effectiveness, it is envisaged that option 2 would be implemented together and broadly relying on these ongoing initiatives, so that calculation and audit requirements are consistent building on eco-design and eco-label work.

6.8.3.6. Stakeholders' Opinions

Stakeholders' Opinions

In the replies to the roadmap, very few stakeholders expressed their views on the use of RES in industry. The main point raised by these stakeholders is the increased costs for industry if the targets are increased. In the dedicated stakeholder workshop on renewable energy use in industry, 88% of the respondents (n=82) supported obligations to use a minimum share of renewables in industry.

In the OPC, a relatively high amount amongst stakeholders representing business associations, companies and public authorities think that there should not be an obligation (40%, 43% and 39% of these stakeholder groups, respectively, replied negatively). They also find financial support mechanisms as crucial for a transition in industry, while support for innovation programmes, R&D and the creation/support of industrial parks/clusters is a common suggestion across most stakeholder types, including, besides the aforementioned, academia and environmental organizations. However, one stakeholder representing a business association warns not to provide additional support measures to industrial parks/clusters since these already get enough support under existing EU and national legislation.

7. HOW DO THE OPTIONS COMPARE AND CONCLUSIONS

This Chapter summarizes the policy options assessed in Chapter 6 which were compared from several angles in line with the Better Regulation criteria:

1. **Effectiveness**: the extent to which proposed options would achieve the specific objectives of this Impact Assessment as presented in section 7.1 ;
2. **Efficiency and impacts**: Analysis of benefits versus the costs as presented in Section 7.2. Naturally, it is the level of ambition that determines the high-level economic, environmental and social impacts and consequently mainly modelling results shed light on such impacts. Scenarios capture the options on the level of ambition of targets. Other options, which concern how the preferred level of ambition should be achieved are mainly analysed in other sections.
3. **Coherence:** Coherence of each option with the overarching objectives and other EU policies
4. **Administrative burden and compliance costs**: what is the cost and additional burden due to the increased ambition
5. **Subsidiarity and proportionality:** to which extent are distributional impacts minimised

The table below summarizes the comparison of effectiveness, efficiency, coherence and proportionality of the options assessed across policy areas in Chapter 6 for the specific objectives in Chapter 4.

Table 27 - Comparison of policy options

Specific Objective	Policy Area	Policy Options	Effectiveness	Cost-Efficiency	Coherence	Proportionality
1. Development of RES to deliver the overall and sectoral shares of renewables in line with the CTP; mobilising contributio	Overall RE Target level and achievement	*Level of Target*				
		Option 1	++	++	++	++
		Option 2	++	+	+	++
		Nature of Target				
		Option 1	++	+	+	**0**
	RES-H&C	*Measures*				

n of all sectors		**Option 1**	**0**	++	+	+
		Option 2a	*	*	*	*
		Target				
		Option 3a	++	+	++	+
		Option 3b	++	-	++	-
		Option 3c	++	+	++	**0**
		Option 3d	++	++	++	++
		This would depend on MS choice of measures in fulfilling the target (as per Section 6.2.1.3)				
	DH&C	*Measures*				
		Option 1	**0**	++	+	+
		Option 2	++	+	++	+
		Target				
		Option 3a	- -	+	+	+
		Option 3b	+	+	+	+
		Option 3c	++	+	++	**0**
		Option 3d	++	-	++	-
	RES-T	*Level of Target*				
		Option 1	+	++	++	++
		Option 1A	+	++	++	+
		Option 1B	++	++	++	+
		Measures				
		Option 2A	++	+	++	+
		Option 2B	**0**	+	**0**	+

		Option 2C	++	+	+	+
		Option 2D	++	+	**0**	+

Specific Objective	Policy Area	Policy Options	Effectiveness	Cost-Efficiency	Coherence	Proportionality
2. Improve energy system integration by facilitating the reuse of waste heat, promoting RES-based electrification and use of renewable and low-carbon fuels	Mainstreaming renewable electricity in heating and cooling and transport	*RES Share Information*				
		Option 1.1	++	+	+	++
		Option 1.2	+	**0**	+	+
		Availability of intelligent infrastructure				
		Option 2.1A	+	+	+	+
		Option 2.1B	+	+	+	**0**
		Option 2.1C	++	++	++	++
		Option 2.2A	+	**--**	+	**--**
		Option 2.2B	++	+	++	+
		Access to infrastructure and information				
		Option 3.1	+	++	++	+
		Option 3.2	++	++	++	+
		Option 3.3	++	++	++	++
	Terminology and certification of renewable and low-carbon fuels	*Terminology*				
		Option 1	**0**	**0**	**0**	**0**
		Option 2	+	+	+	+
		Option 3A	++	++	+	+

		Option 3B	++	++	++	++
		Certification				
		Option 1A	++	+	++	+
		Option 2A	**0**	+	+	++
		Traceability				
		Option 1B	++	++	++	++
	Promotion of renewable and low-carbon fuels	*Extension of the scope of accounting*				
		Option 1	+	+	+	+
		Option 2	+	+	--	-
		Creation of specific sub-targets for RFNBOs				
		Option 3	++	+	++	+
		Option 4	+	+	+	+
		Option 5	+	+	--	-
		Option 6	+	+	--	-

Specific Objective	Policy Area	Policy Options	Effectiveness	Cost-Efficiency	Coherence	Proportionality
3. Ensure that the revised RED II provisions on bioenergy	Bioenergy Sustainability	**Option 1**	**0**	+	**0**	+
		Option 2	+	++	++	++
		Option 3	++	+	++	+

sustainability prevent unintended environmental impacts, in line with the ambition set in the Green Deal Strategy and Biodiversity Strategy		**Option 4**	+	-	**0**	--
		Option 4.1	+	-	**0**	--
		Option 4.2	++	+	++	+
		Option 5	+	-	**0**	--

7.1. Effectiveness

The effectiveness of the options is examined against the baseline in achieving the policy objectives identified in Chapter 4. All options assessed contribute effectively in fulfilling the policy objectives, including the flanking and enabling measures.

7.1.1 Area I: Insufficient ambition in EU and MS legislation both in 2030 and 2050 perspective

7.1.1.1 Overall renewable energy target level and achievement

As assessed in section 6.1, for the level of the target, Option 0 would provide no means of ensuring that the EU-wide, the renewable energy target is deployed to reach at least 38-40% share in final energy consumption. It would likely not be effective. Option 2 would be effective but potentially lead to, either overshooting the climate target or lack of coherence with other EU legislative instruments, thus straying from cost-effective pathway already identified in the CTP. In contrast, Option 1 is effective and has not drawbacks hence it is preferred one.

Regarding the nature of the target, national targets, requested by a majority of stakeholders, would not be more effective than the EU-level target (combined with Governance process) and could create subsidiarity issues. Thus keeping EU-level targets is the preferred option.

7.1.1.2 H&C

It would be unlikely that Option 0 of continuing with current practice would lead to the desired outcome. Option 1 builds on Option 0 but will also not trigger Member States to increase efforts in RES H&C sector to at least 1.1 p.p. increase in RES H&C share over the period 2020-30. On the other hand, translating the EU RES H&C ambition in agreement with the CTP and assessment carried out in this impact assessment into a binding uniform increased annual average share for all Member States as per Option 3b while effective, is not considered proportionate.

The level of renewables in H&C needed in 2030 could also be set as a target as proposed in Option 3c but would depart from the current model and could be potentially disruptive for the already on-going implementation efforts, although it would have the added benefit of setting the end-goal in 2030 clearly. An increased flat rate target and made binding as proposed in Option 3d complements the heating and cooling baseline with an indicative EU RES benchmark for the EU building stock and industry.

Considering the assessment carried out, Option 3a combined with sector and EU RES buildings and industry benchmarks of appropriate design (Option 3d) would be effective in providing the right mix of drivers for integrated further these two sectors into the energy system. Out of the target options, Option 3a would set a minimum flat rate of RES growth by making the current indicative annual increase target of 1.1 p.p. as minimum required effort and complement it with "top-ups" redistributing the additional efforts to the desired level of renewables in 2030 among Member States along GDP and cost-effectiveness based on the level of ambition in agreement with the CTP and assessment carried out in this impact assessment for the EU RES H&C share in 2030 which would be used as benchmark. The additional Member States specific increase rates could provide a means of assessing the relative level of ambition of each Member States in the heating and cooling sector but also as a potential gap filler measure to close the gap, if other sectors than H&C would fail to deliver, the 38-40% overall RES target

In the light of the importance of the heating and cooling sector in reaching the EU GHG target and mainstreaming renewable energy, and given the fact that just over half of the Member States have put RES H&C shares in line or above the requirements specified in Article 23, making the current target of 1.1 p.p. as minimum requirement proposed in Option 3a is considered effective and proportionate. The design would include already indications for the additional average increase on top of the minimum 1.1 p.p. tailor-made according to cost-effectiveness and GDP to set clear directions/trajectories and objectives. Furthermore this design would leave each Member State free to choose the most cost-effective measures in its given context. The design of the preferred option takes into account the need to accommodate specific decarbonisation pathways suited for specific conditions in Member States while providing a clear EU framework, and would retain the existing exemptions and flexibilities for Member States to reward early action and high progress levels. It sets the overall objective and cost effective trajectories, but does not prescribe how these should be reached. Subsidiarity is ensured through the freedom left to each Member State on how to fulfil the heating and cooling target via measures in buildings, industry and district heating and cooling.

The possibility for Member States to choose between an extended list of measures as per Option 2a allows flexibility at national level and ensures proportionality, while providing a tool box of measures and guidance as regards essential building blocks that proved effective in implementing the heat transition. The design respects national and local diversities in conditions and starting points, and provide a clear framework for actors at all levels (national, regional, local) and of all types (from utilities and companies to municipalities to citizen consumers/prosumers). However should carbon pricing and revised NECPs not be sufficient, additional sector-specific measures could also proposed on the EU-level and/or increase of RES ambition in DHC, Industry and Buildings could also be proposed by the Commission to close the gap.

The design builds on current provisions in REDII and the Governance Regulation. The governance process have proved effective for Member States to develop their national overall RES contributions and provide long term signal also in heating and cooling. The proposed uniform minimum flat rate of 1.1%-point increase combined with EU-target incentivising addition (top-up) efforts for each Member State would provide criteria for Member States for developing their RES HC trajectories and the revised renewables heating and cooling contributions in the next update of the NECPs and ensure a transparent and predictable mechanism to close the residual gap highlighted if Member States deliver strictly on the 1.1% point increase compared to the level of ambition in agreement with the CTP and assessment carried out in this impact assessment, cost effectively, should this be needed if the measures or carbon pricing fails to deliver. These figures will also provide a means of assessing the relative level of ambition of the heating and cooling sector in the NECPs and contribute to ensure a cost effective and equitable outcome of the process. Overall this approach is based on subsidiarity, and allows Member States to develop the measures that are best suited to their own national circumstances.

7.1.1.3 District H&C

Out of the target options assessed in section 6.2.2, Option 3c is the preferred target design as it would provide the missing common EU framework to steer district heating developments towards integrating more renewable energy and ensure coherence with the CTP and carbon-neutrality goals, while respecting the wide variety of situations in Member States. Option 3b with an indicative EU headline target could give similar direction as Option 3c but departs from the current provisions and could be disruptive for already ongoing implementation. Option 3d would be the most effective target design, but is too stringent and leave less room for Member States as regards to which extent and how they would like to use district heating in their overall strategies for delivering higher ambitions in renewables and greenhouse gas reduction. Option 3a would make it possible for district heating to indefinitely continue with the fossil model and thus is not coherent with the review objectives.

Option 2 can be self-standing or complementary, as it gives a clearer enabling framework to transform district heating and cooling, make it into an enabler of renewable energy supply in buildings and to become a key heat decarbonisation instrument, while enhancing energy sector integration in national and EU energy systems.

Overall combining Option 2 on measures and with the preferred target design in Option 3c is the preferred option. The combination option would provide a more effective EU framework to ensure that the district heating and cooling aligns with the EGD and becomes an enabler to deliver on the CTP and ESI goals. Together with the options on overall heating and cooling and buildings, this option would make district heating and cooling an additional key instrument in the national portfolios of measures for heating and cooling decarbonisation, and would also establish a more effective enabling framework to develop and expand modern renewable based smart district heating and cooling systems.

7.1.1.4 Transport

Of the options considered under section 6.3, a combination of Option 1B with Options 2A, 2C or 2D would perform the best overall. While all options apart from Option 1 deliver on the needed level of ambition, there are substantial differences. The energy-based options may have the advantage in promoting the development and production of innovative renewable and low carbon fuels as they provide the most predictable and stable policy framework for investments into such technologies. On the other hand, the GHG-intensity based options can stimulate supply chain improvements and technology efficiency in renewable and low carbon fuels, where costs of production are higher, not limited to compliance with minimum emission reduction thresholds. This is particularly important in a complex sector with increasing technological choices available and significant innovation potential. This, however, would require applying changes to the methodology applied to determine the GHG emission intensity.

Given the early stage of development of innovative fuels such as advanced biofuels, hydrogen and hydrogen-based fuels and the important role these fuels have to play after 2030 to decarbonise transport, the ability to promote such fuels has priority over short-term cost minimisation. The strength of Option 2C compared to Option 2A and 2D relates primarily to the aspects of subsidiarity and political feasibility. The Commission had proposed in 2016 to introduce an energy-based supply obligation and the co-legislator decided to leave the choice of the right support instrument to the Member States. Option 2D (GHG based approach) combines advantages of both approaches. While Option 2C represents an acceptable outcome, would have the advantage of ensuring consistency with the approach chosen under the Fuel Quality Directive while specifically promoting innovative fuels.

7.1.2 Area II: Insufficient promotion of ESI in REDI

7.1.2.1 Measures to enhance the contribution of transport and heating and cooling to the system integration of renewable electricity

As assessed in section 6.4, Option 1.0 is not expected to reduce the GHG emissions from demand response of heat pumps, domestic batteries or electric vehicles, creating serious concerns regarding the objectives of 2030, and to achieve climate neutrality in 2050. Option 1.1 would provide an effective means to introduce market incentivising signals that relate directly to renewable penetration and carbon reduction, without any administrative burden and in coherence with existing legislation. It is therefore considered a preferred and no-regrets option. Option 1.2 would have some positive effects on consumer information, complementing the information provided by guarantees of origin, however it would otherwise bring limited added value for the near-real time integration of renewable electricity.

Options 2.1-2.3 approach different aspects of optimizing the intelligent charging infrastructure, with varying levels of positive contribution to overall implementation costs and benefits to the economy. As a first priority, it was considered necessary for all newly installed charging points to offer smart functionalities with additional deployment of charging points for purposes of integration based on assessment by the NRA (option 2.1C). With regard to bidirectional functionalities, the variations allowing implementation based on national assessment was preferred (option 2.2B), thus providing flexibility to Member States.

Options 3.1-3.3 address various obstacles in the aggregation and mobility service provision market, which hinder the development of competition. Option 3.1 is a no-regrets option which would eliminate any regulatory barriers against domestic battery systems and V2G services (it doesn’t affect intelligent charging or behind the meter discharging). Option 3.2 is necessary in setting a level playing field and its early implementation would bring positive long term effects competition, consumer choice, innovation and in the availability, quality and cost of services provided to domestic battery owners and EV users. Option 3.3 is also important to facilitate competition and consumer choice and it is expected to become increasingly beneficial as the proliferation of EVs becomes mainstream and it is recommended that it is applied on the on-set, so that infrastructure and market deployment can proceed optimally.

7.1.2.2 Terminology and certification of renewable and low carbon fuels

Based on the assessment of the portfolio of options compared with the baseline scenario, the objective of deploying an EU-wide certification system can be achieved by a combination of the policy options presented above.

Two options, based on their scores and importance, can be part of any combination of preferred options, namely extending the terminology under REDII and improving traceability of energy carriers through the Union database, combined with mainstreaming the mass-balance system supported by the Union database (Option 1B). Regarding the different options for terminology assessed the best scoring option is the option 3A/B where the extension of terminology includes low carbon fuels together with a threshold for GHG emission savings.

Two alternative options have been assessed, regarding the way the certification system can be deployed. Option 1A assessed the extension of the current certification system to new fuels, while option 2A assessed the further development of the content and harmonisation of standards of the existing GOs system in order to transform it into a certification system fit for purpose.

Extending the existing certification system may entail some additional costs for economic operators, which however can be expected to be outweighed by the future economic returns of entering the market of sustainable fuels through certification. While a similar result can be expected by transforming the existing GOs system, it would come with a much higher effort and administrative burden on the side of the Member States. This could be expected to be a major negative barrier. In addition, option 1A would have good potential to achieve a positive synergy in combination with Options 1B and 3A/B (terminology), making a good contribution to strengthening the system, avoiding any risks of double counting by solving the issue of co-existence of a certification system, based on a mass balance with a GOs system. A political decision will need to be made whether to address the certification of low-carbon fuels for coherence reasons or in a separate legislative proposal such as the Hydrogen and Decarbonised Gas Market Package.

7.1.2.3 Promotion of renewable and low carbon fuels

Promoting the use of renewable fuels is fully in line with the Energy System Integration Strategy and the Hydrogen Strategy as well as the CTP especially if considering post-2030 perspective. Taking the analysis further, this IA shows that a realistic sub-target for RFNBOs for the transport and industry sectors would support their large scale development post 2030. All options on target setting or accounting are equally effective but the choice remains on their scope.

7.1.3 Area III: Ensure bioenergy sustainability

The impact assessment identified a number of key biodiversity and climate risks (harvesting in primary and highly biodiverse forests, unsustainable biomass sourcing (e.g. wholetree harvesting), and impacts on the forest carbon sink) which could be linked to the increased use of forest biomass for energy.

Option 1 is supported by some Member States and sectoral industry stakeholders and would facilitate the implementation of the REDII sustainability criteria. However, this option would not include additional safeguards to address the identified risks.

Option 2 would provide the most direct safeguard against the risks of production of forest biomass in highly biodiversity areas, such as primary forests - in line with the Biodiversity Strategy and the LULUCF review. It would also introduce additional safeguards promoting optimal lifecycle GHG emission saving and avoiding inefficient biomass use in the power sector.

Option 3 would further add to the effectiveness of option 2 by regulating a larger amount of biomass use for energy in the EU. This option would reduce the potential risk of leakage (i.e. unsustainable biomass is diverted from large to small scale uses to avoid sustainability compliance). It would also help improving public monitoring on biomass production and use – in line with the JRC report recommendations.

Building on options 2 or 3, options 4, 4.1 and 4.2 would also address the potential risk of increased use of stemwood for energy - in line with the Biodiversity Strategy goal of minimizing wholetree harvesting, with 4.2 focusing on public support schemes for bioenergy. However, option 4 and 4.1 could also lead to indirect negative effects on forest-based industries. In addition, the verification/tracking of high quality stemwood use would be rather complex. Therefore, options 4 and 4.1 would result in relatively higher administrative burden for economic operators and public authorities – depending on the implementation by Member States. The administrative complexity and costs would be significantly lower under option 4.2. These options would not respond to the opinion by sectoral industry to keep the regulatory framework as set by the RED II.

Option 5 would take up the wish expressed by NGOs and the citizens participating in the Public Consultation to limit the use of forest biomass, and would lead to a strong reduction of identified risks associated to increased forest bioenergy demand. However, it could make it more difficult to reach future climate and energy targets cost-effectively, especially after 2030.

7.1.4 Flanking and enabling measures

Promotion of Cross-border cooperation

As assessed in Section 6.8.1, given the gradual increase of the required cross-border cooperation over the options, their effectiveness can be summarized as low (option 1) to moderate/high (options 2 and 3) and high (option 4), with option 2 expected to be more politically acceptable.

Promotion offshore renewable energy deployment

Given the binding nature of Option 1, this option would be very effective to ensure a joint planning and target setting per sea basin. However, the effectiveness would depend on the actual binding nature of the measure (obligation to agree on a common target, vs obligation to enter into an agreement to cooperate). Option 2 can be expected to have good effectiveness of facilitating permitting of cross-border offshore renewables projects.

Industry

As assessed in section 6.8.3, Option 0 is not expected to increase the share of renewable energy consumption in the industry sector, creating serious concerns regarding the objective to reduce greenhouse gas emission reductions by 2030, and to achieve climate neutrality in 2050. Option 1A would provide an effective means to introduce industrial actors to existing cost-effective solutions to switch to renewable energy, without any administrative burden and in coherence with existing legislation.

Option 2A provides an effective means to create a uniform and coherent market for those companies that are placing products and services produced from renewable energy on the market. However, a mandatory labelling would create concerns regarding compatibility with WTO and would possible lead to a proliferation of labelling requirements.

Options 1A and 2A would be complementary and would all be effective options.

7.2.Efficiency and impacts

As explained Chapter 5, the level of ambition for policy options has been derived from the core scenarios: REG, MIX and MIX-CP, building on analysis in CTP IA, fine-tuned to the newest Baseline and key policy options considered in all "Fit for 55" initiatives. Modelling tools and their underlying assumptions are explained in Annex 4. The key policy options in this Impact Assessment do not concern the level of ambition (which is considered as agreed based on the CTP analysis) but the ways of implementing this level of ambition.

It is, however, the level of ambition that determines the high-level economic, environmental and social impacts and consequently it is only the core scenarios that can shed light on such impacts – they are presented in the table below. **MIX scenario is the central one:** carbon pricing is covering most of the sectors and works in synergy with energy policies that address market failures in a targeted manner. The **REG and MIX-CP scenarios are extreme outlooks** showing the impacts of relying too much on only regulatory measures or only carbon pricing, respectively. With a certain degree of simplification, low ambition policy options consisting of additional guidance would likely lead to the results of the MIX-CP scenario. Conversely (and again with certain degree of simplification), the most ambitious regulatory options would yield results similar to the REG scenario with carbon price likely at very low levels.

Importantly, the core scenarios show the impact of all "Fit for 55" initiatives and not just the revision of RED. This is why the variant MIX-LD is also contrasted with the central MIX scenario in the table to show the impacts of the absence of the revision of RED.

Table 28 – Efficiency and impacts of core scenarios and MIX-H2 variant; Source PRIMES, GAINS models

2030 unless otherwise stated		**REF**	**REG**	**MIX**	**MIX-CP**	**MIX-H2**
	metric					
Key results						

2030 unless otherwise stated		REF	REG	MIX	MIX-CP	MIX-H2
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%	53.3%
Overall RES share (current formula)	%	33.2%	39.7%	38.4%	37.8%	40.2%
Overall RES share (proposed new formula) **	%	-	39.1%	37.8%	37.2%	38.8%
RES-E share	%	58.5%	64.8%	64.8%	65.2%	68.0%
RES-H&C share	%	32.8%	41.1%	38.0%	36.4%	37.8%
RES-T share	%	21.2%	28.8%	27.7%	27.2%	28.0%
PEC energy savings	% reduction from 2007 Baseline	33%	39%	39%	38%	38%
FEC energy savings	% reduction from 2007 Baseline	30%	37%	36%	35%	36%
Environmental impacts						
CO2 emissions reductions (intra-EU scope, excl. LULUCF), of which	(% change from 2015)	-30%	-43%	-42%	-42%	-43%
Supply side (incl. power generation, energy branch, refineries and district heating)	(% change from 2015)	-49%	-62%	-63%	-64%	-63%
Power generation	(% change from 2015)	-51%	-64%	-65%	-67%	-65%
Industry (incl. process emissions)	(% change from 2015)	-10%	-23%	-23%	-23%	-24%
Residential	(% change from 2015)	-32%	-56%	-54%	-50%	-54%
Services	(% change from 2015)	-36%	-53%	-52%	-48%	-51%
Agriculture energy	(% change from 2015)	-23%	-36%	-36%	-35%	-35%
Transport (incl. domestic and intra EU aviation and navigation)	(% change from 2015)	-17%	-22%	-21%	-21%	-23%
Non-CO2 GHG emissions reductions (excl. LULUCF)	(% change from 2015)	-22%	-32%	-32%	-33%	-33%
Reduced air pollution compared to REF	(% change)			-10%		
Reduced 2030 health damages and air pollution control cost compared to REF - Low estimate	(€ billion/year)			24.8		
Reduced 2030 health damages and air pollution control cost compared to REF - High estimate	(€ billion/year)			42.7		
Energy system impacts						
Primary Energy Intensity	toe/M€'13	83	75	76	76	76
Gross Available Energy (GAE)	Mtoe	1,289	1,194	1,198	1,205	1,206
- Solids share	%	9%	6%	5%	5%	6%
- Oil share	%	34%	33%	33%	33%	32%

2030 unless otherwise stated		REF	REG	MIX	MIX-CP	MIX-H2
- Natural gas share	%	21%	20%	20%	21%	19%
- Nuclear share	%	10%	11%	11%	11%	11%
- Renewables share	%	26%	31%	30%	30%	31%
- - Bioenergy share	%	13%	13%	12%	12%	12%
- - Other Renewables than bioenergy share	%	13%	18%	18%	18%	19%
Gross Electricity Generation (TWh)	TWh	2,996	3,152	3,154	3,151	3,359
- Gas share	%	14%	12%	13%	14%	10%
- Nuclear share	%	17%	16%	16%	16%	15%
- Renewables share	%	59%	65%	65%	65%	68%
Economic impacts						
Investments (excl. transport) (2021-30)	bn €'15/year	297	417	402	379	419
Investments (excl. transport) (2021-30)	% GDP	2.1%	3.0%	2.9%	2.7%	3.0%
Additional investments to REF	*bn €'15/year*		120	105	83	123
Investments (incl. transport) (2021-30)	bn €'15/year	944	1068	1051	1028	1073
Investments (incl. transport) (2021-30)	% GDP	6.8%	7.7%	7.6%	7.4%	7.7%
Additional investments to REF	*bn €'15/year*		124	107	84	129
Additional investments to 2011-20	*bn €'15/year*	285	408	392	368	415
Energy system costs excl. carbon pricing and disutility (2021-30)	bn €'15/year	1518	1555	1550	1541	1555
Energy system costs excl. carbon pricing and disutility (2021-30)	% GDP	10.9%	11.2%	11.15%	11.1%	11.2%
Energy system costs incl. carbon pricing and disutility (2021-30)	bn €'15/year	1535	1598	1630	1647	1634
Energy system costs incl. carbon pricing and disutility (2021-30)	% GDP	11.0%	11.5%	11.7%	11.8%	11.7%
ETS price in current sectors (and maritime)	€/tCO2	30	42	48	52	45
ETS price in new sectors (buildings and road transport)	€/tCO2	0	0	48	80	45
Average Price of Electricity[233]	€/MWh	158	156	156	157	153
Import dependency	%	54%	52%	53%	53%	51%
Fossil fuels imports bill savings compared to REF for the period 2021-30	bn €'15		136	115	99	134
Energy-related expenditures in buildings (excl. disutility)	% of private consumption	6.9%	7.5%	7.5%	7.4%	7.6%
Energy-related expenditures in transport (excl. disutility)	% of private consumption	18.1%	18.1%	18.3%	18.5%	18.3%

[233] Price for for all final demand sectors, including refineries and energy branch

GDP impacts			GEM-E3 projections: - A small positive effect on GDP if assuming favourable financing conditions. Compared to Reference projections, GDP is 0.52% higher in 2030. - If assuming crowding out of investments, GDP in 2030 is 0.2% below the Reference level.	
Employment impacts			GEM-E3 projections: - A small positive effect on employment if assuming favourable financing conditions. Compared to Reference projections, employment is 0.36% higher in 2030. - Assuming crowding out of investments, employment in 2030 is 0.3% below the Reference level.	

Notes:

*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[234].

** Proposed new formula for accounting RFNBOS with their actual amounts (and thus where they are consumed) rather than electricity to produce them in the overall RES share. The sectoral shares are, however, not adjusted to this new accounting.

As an alternative approach, the MIX-LD (MIX-Lost Decade) variant was developed that aimed to assess impacts of the absence of revision of REDII. This variant removed all drivers representing REDII revision while "freezing" all other policies (in particular carbon pricing) at their level of ambition/stringency as modelled in MIX.

The differences between scenarios MIX (with REDII revision) and MIX-LD (without REDII revision) are summarised and interpreted in the table below.

[234] 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 29 - Differences between scenarios MIX and MIX-LD capturing RED revision; Source PRIMES, EC calculations

2030, EU unless otherwise stated	metric	MIX	MIX-LD	Difference MIX vs MIX-LD illustrates impact of drivers representing revision of RED working together with other "Fit for 55" proposals	RED revision brings:
					Benefits
					Costs
GHG emissions reductions (incl intra EU aviation and maritime, excl LULUCF)	% change from 1990	-53.3%	-52.1%	1.2	1.2 p.p. of necessary GHG reduction compared to 1990
Overall RES share	%	38.4%	36.3%	2.1	2.1 p.p. bigger share of total RES in final energy consumption in 2030
RES-E share	%	64.8%	62.1%	2.7	2.7 p.p. bigger share of RES in electricity in 2030
RES-H&C share	%	38.0%	35.1%	2.9	2.9 p.p. bigger share of RES in H&C in 2030
RES-T share	%	27.7%	27.2%	0.5	0.5 p.p. bigger share of RES in transport in 2030
PEC energy savings	% change from 2007 Baseline	-38.9%	-38.2%	0.6	0.6 p.p. bigger primary energy savings in 2030
FEC energy savings	% change from 2007 Baseline	-35.7%	-35.0%	0.6	0.6 p.p. bigger final energy savings in 2030
Investment expenditures (excl transport) av annual (2021-30)	bn €'15/year	402	384	18	Average annual investment needs higher by € 18bn
Energy system costs incl carbon pricing and disutilities av annual (2021-30)	bn €'15/year	1630	1626	4	Average annual system costs higher by € 4bn
ETS price in current sectors (and maritime)	€/tCO2	48	48	0	no significant change - level of carbon price was frozen between MIX and MIX-LD
ETS price in new sectors (buildings and road transport)	€/tCO2	48	48	0	no significant change - level of carbon price was frozen between MIX and MIX-LD
Average Price of Electricity	€/MWh	156	156	0	no significant change
Fossil fuels imports bill savings compared to REF2020 for the period 2021-30	bn €'15	115	100	15	Savings on fossil fuels import bill are higher by 15 bn
Energy-related expenditures related to buildings as % of private consumption (excl disutilities)		7.5%	7.4%	0.1	Energy-related expenditures related to buildings as % of private consumption are 0.1 p.p. higher

Energy-related expenditures related to transport as % of private consumption (excl disutilities)		18.3%	18.3%	0.0	no change

7.3. Coherence

The REDII is a, well-established, cross-sectoral instrument promoting the uptake of renewable energy by targeted measures covering electricity, H&C and transport sectors. In H&C and transport, the Directive incentivises mostly the national action while the European component is stronger in the electricity sector. Detailed assessment on the coherence of the specific policy options are elaborated in detail in Chapter 6.

The REDII incentivises action in two respects:

- addressing market failures/non-market barriers (e.g. in terms of infrastructure, development of innovative technologies, creation of lead markets or increasing consumer acceptance and uptake)
- ensuring that the overall renewables target is met via national contributions through the Governance process (including an indicative formula representing the objective criteria as a basis for the Commission's assessment of national ambition).

The increase of the overall renewable energy target to the levels recommended in the Climate Target Plan (38-40%) and confirmed by the preferred option in this IA will guide the overall efforts to increase renewables uptake.

The revision of RED and the revision of the ETS are complementary and mutually reinforcing in driving accelerated fuel switch to renewable fuels. Targeted regulatory measures under RED are necessary for local renewables uptake through planning and capacity building, for further ESI (notably through direct electrification of end use sectors) and for the uptake of innovative renewable fuels such as advanced biofuels and/or RFNBOs. Without such policies, a very high carbon price signal would have to be put in place to deliver the necessary GHG reductions[235].

The revision of RED is also a *precondition* for fulfilment of increased ESR national targets. The Member States will need to deploy much more renewables in the heating, cooling and transport sectors in order to meet the increased national ESR targets. The RED revision is expected to contribute to further mainstreaming of RES in heating and cooling and in transport, as projected in highlighted in Chapter 5.

In the transport sector, the revision of RED will increase the overall renewable energy consumption in transport, including sub-targets for advanced biofuels and RFNBOs. The revision of RED will work in synergy with the CO_2 standards for vehicles: vehicles regulations will push the deployment of electrified road transport while the RED will addition provide the push on the energy supply side

[235] 68€/tCO2eq in 2030 in MIX-CP scenario in the extended scope of the ETS and this still without significant impact on innovative renewable fuels uptake (that are essential for achievement of carbon neutrality.

by introducing a credit mechanism facilitating the participation of electricity providers and incentivising public recharging infrastructure.

A targeted strengthening of the EU bioenergy sustainability will bring co-benefits for other land-related policy objectives, such as biodiversity conservation and protection of the forest carbon sink, thus being coherent with the LULUCF revision.

The preferred policy options for renewables promote electrification and waste heat use that work in synergy with energy efficiency measures – as both instruments aim to deliver on the integrated energy system envisaged in the Energy System Integration strategy. Moreover, deployment of renewables (other than bio-energy) helps to achieve energy efficiency in primary energy consumption. Electricity-based H&C and transport technologies can also help to accommodate higher shares of variable renewable energy in power generation as demand can be better synchronised with power supply.

The preferred options of RES in H&C provide an opportunity for fuel switching especially in buildings, local heat planning and efficient district heating and cooling, aligned with the revision of the EED and EPBD and contributing to the Renovation Wave.

7.4.Administrative and monitoring impacts

The administrative and monitoring impacts of the specific policy options have been assessed in dedicated sections in Chapter 6. The revision of RED II would maintain the current framework for monitoring the Renewable Energy deployment in the EU and Member States progress through the Governance. Hence, in general, the administrative and monitoring impact for the options appear limited.

The impacts on administrative burden of the assessed options related to targets and benchmarks will be limited as there would be no recurring administrative requirements as for all policy these can be generally monitored through official statistics which are already readily available at national level and from Eurostat. However, limited resources at the level of Member States to develop new official statistics, combined with the absence of a formal legal basis for countries to report data on the share of renewables to Eurostat, may be an obstacle to monitoring renewable energy improvements in detail as mentioned in Section 9.

In terms of policy choices, for heating and cooling this also depends on Member States choice of policy instruments to comply with implementation of REDII framework especially when certification and audits are required, as explained in Chapter 6 and Annex 7.

The same applies for bioenergy in particular on the options of national caps on stemwood were Member States would need to improve the statistics and monitoring systems in order to set up and enforce this option, and take them into account when setting up support schemes for bioenergy. Option 4.2 would offer an alternative solution which would be easier to implement.

7.5.Subsidiarity and proportionality

All options assessed are all in line with the intervention logic and all options are based on the already existing instrument, the REDII and its architecture as already established. This includes the overall target, how it is delivered by national contributions via governance process, sectoral targets and their supporting measures or enabling conditions. The exceptions are RFNBOs targets and measures promoting electrification for transport, which would be new elements of revised REDII but are essential in the light of Hydrogen and Energy System Integration strategies and the need to promote innovative fuels needed for carbon neutrality.

In terms of **proportionality**, the initiative is limited to REDII adjustment needs that are commensurate with increased climate target and the cost-effective deployment of renewables that goes together with it as already established in the CTP. A number of enabling conditions is also analysed that can be brought forward in order to make deployment of renewables easier for economic operators and consumers.

Additional costs for consumers and economic operators due to the increased level of ambition of the REDII together with other "Fit for 55" initiatives are expected to be kept to a minimum, given that regulatory measures such as those envisaged under REDII revisions address market failures/non-market barriers while the carbon price incentivises emissions reduction by operators with the lowest abatement costs.

To conclude, all options analysed for revision of REDII are considered proportional as they do not go beyond what is necessary to achieve the objectives as set out in the intervention logic. Enabling conditions are not essential for could help make deployment of renewables easier for economic operators and consumers.

The conformity of options in terms of **subsidiarity** could vary. The options that bring uniform obligations on Member States, especially at national or local levels, would have allowed no flexibility in terms of implementation and would have had rather detrimental impact on subsidiarity.

Based on the assessment of final NECPs, it can be established that the current REDII (with flexibilities provided to Member States) is effective in achieving the EU-level renewables target as the Reference scenario shows the EU slightly exceeding the 32% target for 2030. While the overall level of ambition has to be increased commensurate with the increased climate target and the current measures in REDII need to be reinforced, there is no need for reduction of Member States flexibilities to the detriment of subsidiarity.

Heating and cooling will carry the largest effort in terms of renewables deployment. As indicted in Chapter 3.2, action at EU-level in combination with action at Member State level is needed and is the most effective. The preferred options are thus articulated around (1) locking-in a minimum cost-effective deployment of renewables in all Member States and (2) adding to the existing list of measures in REDII.

As discussed in Section 7.1.1.2 the targets for RES H&C could be effective but with diverse subsidiarity and proportionality issues. Although Option 3b would be the most effective, it would raise proportionality, distributional and cost-effectiveness concerns given the wide diversity in Member States' starting points and situation. Option 3a in combination with option 3d is proportionate, as it entails incremental change building on the current target and leaves freedom for Member States to choose their measures.

The list of measures already exists in REDII and has been extended in the IA to give a broader choice in view of the different national circumstances in Member States, but also to provide additional guidance to Member States in a sector which is very fragmented and covers several subsectors. Member States can choose from these building blocks according to their national circumstances to address the most pertinent non-market barriers and to help them reaching the proposed binding minimum annual increase in renewable heating and cooling. With no specific obligation to implement specific or a number of expanded list of measures full flexibility has been granted to Member States. Depending on Member States choice of measures the extended measures listed, is an effective means to not only achieve the average annual increase in renewables but aims to overcome non-market barriers and complement carbon price signals by strengthening aspects of REDII with measures covering clearer and credible information to energy customers or reducing the risk for more local renewable energy sources deployment through a risk mitigation framework. On top of that, one of the measures to be chosen Member States could be any other policy measure with an equivalent effect, to reach the annual increase, including fiscal measures, support schemes or other financial incentives. This option further adds a great deal of flexibility in how they fulfil the target.

Subsidiarity aspect was also assessed for the options concerning sustainability of bioenergy. Although different Member States have different traditions in terms of bioenergy harvesting and use, the need to preserve forest biodiversity is a Europe-wide, indeed global, issue. It is also an issue that attracts a high level of public attention, see for example the 38,000 replies to the OPC. It is therefore appropriate for the revision of REDII to propose measures to further protect primary forests and highly biodiverse forests which may affect how Member States manage their forests

The preferred options in Chapter 8 are considered to strike the correct balance between the need to increase level of ambition commensurate with increased climate target and the need to leave flexibility to Member States to decide which measures are best suited and the most effective for them. Overall this approach is based on subsidiarity, and allows Member States to develop the measures that are best suited to their own national circumstances.

8. PREFERRED OPTION AND CONCLUSIONS

When proposing its updated 2030 greenhouse gas emissions reduction target of at least 55%[236], the European Commission 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 RED could effectively and efficiently contribute to the delivery of the updated target as part of a wider “Fit for 55” policy package.

[236] Communication on Stepping up Europe’s 2030 climate ambition - Com(2020)562

8.1. Methodological approach

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

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

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

8.2. 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[237] 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 carbon pricing and medium intensification of regulatory measures in the economy, while also reflecting the COVID-19 pandemic and the National Energy and Climate Plans, confirmed these findings.

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

At the aggregate level, these impact assessments provide considerable reassurances about the policy indications adopted by the Commission in the Communication on Stepping up Europe's 2030 climate ambition. This concerns notably a stronger and more comprehensive role of carbon pricing, energy efficiency and renewable energy policies, the land sector, and the instruments supporting sustainable mobility and transport. These would be complemented by a carbon border adjustment

[237] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331

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 achieving the increased climate target.

Various elements of the analyses also suggest that parts of the revenues of a strengthened and extended ETS should be used to counter any undesirable distributional impacts such a package would entail (between and within 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.

8.3.Preferred policy options

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 RED focusing on key measures to ensure the achievement of the 55% GHG reduction objective, including for Heating & Cooling and Transport, as well as to strengthen biomass sustainability criteria. This will be accompanied by additional flanking measures to foster renewables in electricity and in industry.

Building on Chapter 7 the preferred option is a package of measures. In line with a coherent approach across policies, the preferred option for an increased Union Renewable Energy Target is at least 40% which falls in the range indicated by the Climate Target Plan (38-40%) and confirmed also by the core scenarios. Such an increased target should be binding at EU level, with national contributions as currently required under REDII and the Governance Regulation.

Increasing renewables ambition in the Heating and Cooling sector is a central piece for delivering the overall RES ambition given that heating & cooling constitutes around half of the EU's final energy consumption covering a wide range of end-use applications and technologies in buildings, industry and district heating and cooling. Here, the preferred option is an expanded list of measures that cover also enabling measures for district heating and cooling and buildings. This will go together with an obligation for an annual average 1.1 p.p. increase at Member State level (reflecting the current indicative figure under REDII) and an indicative Member State-specific top-up (catering for the increased ambition under the CTP and confirmed by the modelling work carried out in this impact assessment). For district heating and cooling, the current indicative target in REDII will be increased to 2.1%. EU indicative benchmarks for RES of in buildings of 49% and in industry of 1.1% average increase per year will also be introduced to guide Member states efforts and monitor progress.

Increasing renewables ambition in transport is also crucial taking into account the wider policy context and the fact that transport is the only sector where GHG emissions have increased: the preferred option is to increase the overall ambition level for renewables in transport in agreement with the Climate Target Plan and the modelling work carried out in this impact assessment. This includes sub-targets for advanced biofuels of 2.2%[238] and RFNBOs(see below) set out in a consistent way with the aviation and maritime fuel initiatives. The overall transport target and the sub-targets

[238] Without multipliers in all transport modes, including international aviation and international marine bunkers

for innovative fuels as well as RED sustainability criteria will frame and support the dedicated obligations set out in these sectoral initiatives.

In order to pursue the objectives of the Energy System Integration Strategy, further mainstreaming of renewable electricity in transport and heating and cooling is needed and here the preferred options are: information on RES content of the electricity made available to all users, smart charging functionality in all charging pointswith the possibility of additional deployment based on NRA assessment, non-discriminatory participation of small and/or mobile storage devices to the electricity system, open access to battery information and open access to charging infrastructure unless it is for own use.

Also in line with ESI strategy, the terminology and certification of renewable fuels needs to be improved and extended. The preferred options are: extension of the scope and content of the current terminology to include all fuels covered by REDII and this being the basis for the EU certification system; include in REDII the definitions of all renewable fuels in REDII, and develop a single information and tracing system (Union database). As to the certification of low-carbon fuels, the importance of which has been underlined in the Energy System Integration Strategy, a political decision should be made whether such fuels should be addressed in this review or in a separate legislative proposal such as the Hydrogen and Decarbonised Gas Market Package.

Going beyond certification, the promotion of renewable fuels is a necessary aspect of the 'Fit for 55' package and, even more so for achieving carbon neutrality in 2050 (for which innovative renewable and low carbon fuels are indispensable). Here the preferred options are: extension of the scope of RFNBOs accounting beyond transport, including heating & cooling and industry together with the creation of specific sub-targets for RFNBOs in hard-to-decarbonise sectors such as transport of 2.6%[239] and in industry of 50% of fuels of hydrogen used in industry as feedstock and in final energy consumption. The target applies for those Member States that consume hydrogen as feedstock or direct use. The option to specifically support low carbon fuels beyond the inclusion into the certification scheme has been discarded as REDII should remain an instrument to support renewables.

Bioenergy represents an important share of sources of renewable energy needed to reach climate neutrality and it is projected to increase in line with the Climate Target Plan, notably after 2030. To comply with the higher biodiversity ambition of the European Green Deal and taking also into consideration the review of the LULUCF Regulation, a targeted revision is necessary to respect the do-no-harm principle. The preferred options are: extending the existing agricultural biomass no-go areas also to forest biomass, applying the existing GHG saving criteria to new heat and power installations, applying the EU sustainability and GHG saving criteria to small-scale biomass-based heat and power installations equal or exceeding 5 MW, and to require Member States to design their support schemes for bioenergy in a way that minimises the energy use of high-quality stemwood.

While deployment of renewables in the electricity sector is expected to become increasingly cost-competitive through lowering costs of technology and higher carbon prices, an enabling framework is required to ensure the significant scale up in additional renewable power generation required in the period up to 2030 to achieve the targets. This includes fostering cross-border cooperation on

[239] Without multipliers in all transport modes, including international aviation and international marine bunkers and hydrogen consumed in energy branch)

renewables through setting up pilot projects within the next 3 years. In addition, specifically for harnessing the potential for offshore renewable energy, there is a preferred package of options including an obligation for Member States to define and agree to cooperate on the amount of offshore renewable generation to be deployed within each sea basin by 2050, enhanced cross-border cooperation on offshore energy projects (guidance, cost-benefit-analysis, Union renewable energy financing mechanism), and the proposal to set-up one-stops shop for permitting of cross-border offshore wind projects per sea basin.

The industry sector is currently only covered by RES H&C actions. Additional actions are needed and the preferred options are: introduction of renewable energy use in the audits required under the EED, developing a common EU methodology for green industry labels, and the introduction of an EU benchmark for renewable energy consumption in industry to monitor progress, together with a dedicated target for RFNBOs (see above).

8.4.Investments underpinning the preferred policy option

Increased GHG ambition entails significant investments in energy efficiency and renewable energy. Against this background, the policy options highlighted above for the RED aim at facilitating investments, reducing their perceived risks, increasing the effectiveness in the use of public funding and helps mobilise private financial resources, in line with the priorities identified in the European Semester, National Energy and Climate Change Plans (NECPs), and Just Transition and Recovery Plans.

8.5.Ensuring coherence in the finalisation of the package

The final step of the sequential approach outlined above for the coherent design of the “Fit for 55” proposals will be carried out on the basis of the analysis of this and the other impact assessment reports. The choices left open for policy-makers will be taken, measures fine-tuned and calibrated, and overall coherence ensured. Until that stage, all indications of preferred measures are to be considered preliminary as preserving overall effectiveness, efficiency and coherence may require adjustments as the final package takes shape.

In general, emissions trading can achieve GHG emissions reductions cost-effectively and provides a sound price signal that influences the decisions of operators, investors and consumers. However, carbon pricing does not address all non-market barriers to the deployment of renewable and low-carbon solutions and therefore additional policy actions are necessary to ensure that other obstacles to investments in clean energy technologies and infrastructure are removed and that investors are thereby provided with additional incentives. Thus, while carbon pricing and renewables policies both work towards fuel switching, renewables policies put in place more specific enabling measures for local uptake of renewables (e.g. capacity building, consumer information and local heat infrastructure planning for more locally integrated renewable solutions) and for the uptake of innovative renewable fuels such as advanced biofuels or RFNBOs. Both tools are thus complementary and mutually reinforcing.

The interaction between the approach to energy efficiency and renewable energy shows broad coherence, reflecting the fact that both instruments can promote electrification in line with ESI strategy and stronger efforts on energy efficiency are necessary for a cost effective deployment of renewable energy in view of meeting both energy and climate targets.

Carbon price signals contribute to the penetration of renewable energy in the power sector as confirmed in the last years, demonstrating full synergies of both regulatory and market instruments. If the political decision is to not extend the ETS to other sectors (e.g. buildings and transport), further strengthening of regulatory measures, including in the field of renewable energy, would be needed to increase the main decarbonisation efforts.

The measures considered under ReFuel EU Maritime and under the Refuel EU Aviation initiatives have been fully considered in this IA and would contribute towards the achievement of the target for renewable energy in transport. If these measures were not adopted, the promotion of renewable fuels and low carbon fuels in the aviation and maritime sectors would depend largely on the RED. In absence of the uplift obligation considered under the Refuel EU aviation initiative, the effectiveness of a dedicated supply obligation for sustainable aviation fuels, however, would be negatively affected, at least in the long term. It should therefore be considered to continue with the use of multipliers to incentivise the uptake of renewable fuels in both the aviation and maritime sectors.

In addition, a continued accountability and action by Member States for national emission reductions in these sectors, incentivised by national targets under the ESR, would be even more important as an ultimate safeguard. The synergies between the ESR and renewables regulatory tools would become even more important.

Generally, a targeted strengthening of the EU bioenergy sustainability criteria can bring co-benefits for other land-related policy objectives, such as biodiversity conservation and protection of the forest carbon sink, and it is therefore coherent with the parallel revision of the LULUCF Regulation and the ETS. In particular, the measures considered under the review of the LULUCF Regulation have been fully considered in this impact assessment and would contribute to a better protection of areas of high carbon and biodiversity values, such as primary forests and old grown forests. As such, a targeted strengthening of the REDII bioenergy sustainability criteria and a more ambitious LULUCF Regulation are mutually supportive and reinforcing in protecting carbon and biodiversity rich areas, while ensuring sustainable harvesting levels and contributing to enhancing the LULUCF sink.

A complementary document to the full set of individual impact assessments looking at the effectiveness, efficiency and coherence of the final package accompanies the “Fit for 55” proposal.

8.6.REFIT (simplification and improved efficiency)

Given its relatively recent adoption, this review of REDII is limited to what is considered necessary to contribute in a cost-effective way to the Union’s 2030 climate ambition, and is not a full revision of the Directive. Identified possibilities for simplification of legislation and reduction of regulatory costs are:

REFIT Cost Savings – Preferred Option(s)		
Description	***Amount***	***Comments***
Renewable energy target for transport	Low	Overlaps between FQD and REDII should be eliminated, leading to greater efficiency and lower costs for administrations.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

Monitoring and evaluation of progress towards the policy objectives should be done using, to the greatest extent possible, existing instruments and data already available from Eurostat. In addition, new official statistics will need to be developed to monitor renewable energy in areas covered by the revision of REDII such as renewable cooling, renewable energy in buildings, industry, RFNBOs, hydrogen, trade of bio-methane and biofuels and Member States should ensure they can produce high-quality statistics. Additional monitoring requirements can be covered through other means, including the Energy Union governance framework.

Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action established an integrated energy and climate planning, monitoring and reporting framework, which allows monitoring progress towards the climate and energy targets in line with the transparency requirements of the Paris Agreement.

Under the Governance Regulation, Member States had to submit to the Commission their integrated national energy and climate plans by the end of 2019, covering the five dimensions of the Energy Union for the period 2021-2030. For renewable energy, the plans had to contain information on progress towards the Union's overall 2030 target of at least 32%, estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling and transport sectors as well as information on their policies and measures to achieve the targets.

The Commission assessed the plans and concluded that collectively, they achieved the EU binding target for renewable energy[240]. The assessment of the individual plans led to the issuing of specific recommendations to the Member States[241]. In addition the Commission can, if need be, propose further Union level measures to ensure targets are collectively achieved[242].

Member States must report biennially on the progress made in implementing the plans, including on climate, renewables and energy efficiency. In addition, by 30 June 2023 they must notify the Commission of their draft updates of the plans, with the final updates due on 30 June 2024. This update would cover any new targets agreed in the revision of REDII.

The reporting system under the Governance Regulation is considered to have been effective in monitoring Member States' progress towards the Union and national level renewable energy targets. The Governance Regulation also gives the Commission tools for dealing with both an 'ambition' and a 'delivery' gap which are considered adequate.

The transposition and implementation of the Directive will followed up by the Commission after the transposition deadline, through checking the notification of national measures and whether they correctly transpose the provisions of the Directive, with infringement procedures launched if necessary.

[240] 2020 report on the State of the Energy Union pursuant to Regulation (EU) 2018/1999 on Governance of the Energy Union and Climate Action, COM(2020) 950 final

[241] https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans/individual-assessments-and-summaries

[242] Article 31 Regulation(EU) 2018/1999

In addition the Commission will work with the Member States through the Concerted Action on the Renewable Energy Directive which provides a structured dialogue on transposition as well as providing a forum for the exchange of best practice.

10. LIST OF TABLES AND FIGURES

List of tables

List of figures