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IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)

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ABSTRACT ACCOMPANYING THE IMPACT ASSESSMENT

1. POLICY CONTEXT AND KEY CHALLENGES

The Energy Union framework strategy puts forward a vision of an energy market 'with citizens at its core, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected'.

The Energy Union with a sustainable, low-carbon and climate-friendly economy includes President Juncker's political ambition to become the world leader in renewable energy, the global hub for developing technically advanced and competitive renewable energies[1].

To live up to this vision, a series of legislative proposals have been prepared, following the objectives of secure and competitive energy supplies and building on the EU's 2030 climate commitments reconfirmed in Paris last year.

Renewables in Europe – good results so far

As a result of Directive 2009/28/EC (2009 RES Directive), with currently 16% of renewable energy in its final energy consumption[2], the European Union is on track to achieve its 20% renewables target by 2020. This piece of EU legislation, along with other EU and Member State complementary measures, has boosted European investment in renewable technologies at a domestic level. Renewables are now being deployed across the various sectors (electricity, transport, and heating and cooling) in all Member States. Economies of scale and innovation have reduced significantly the related costs[3].

The renewable energy sector already delivers an important dividend to EU energy security with around €20 billion saved in fuel import costs in 2014 for the whole EU. The sector also remains key to EU objectives to sustain and improve growth, employment and competitiveness. The EU renewable energy industry employed in 2014 around 1.1 million workers[4], and European companies held 30% of all patents for renewable technologies globally in 2013[5].

Taking renewables to the next level – the 2030 framework and EU leadership in renewables

The EU has set itself a target to reach, collectively, a share of at least 27 % in the final energy consumption by 2030.

While the EU is today well on track to achieve its 2020 renewables target, yet, investments in renewable have dropped by more than half since 2011 to $48.8 billion last

[1] The development of new and renewable forms of energy by means of EU energy policy is a Treaty obligation enshrined in Art 194 TFEU. EU policies promoting renewables date back to 2001 (Directive 2001/77/EC)

[2] 2014 data, Eurostat, with an estimated renewable energy share of 17% of gross final energy consumption in 2015

[3] *E.g.* solar module prices have been reduced by 80% between 2008 and 2012 (JRC, PV Status Report, 014) and wind turbine prices declined by 30% between 2008 and 2015

[4] EurObserv'ER, 15th Eurobserv'ER report, 2015 (2014 figures)

[5] OECD Statistics database

year. The EU now accounts for only 18%[6] of global total investment in renewables, down from close to 50% only 6 years ago. This calls for concrete and decisive actions to put the EU back on track in pioneering world efforts.

While the Renewables Directive, together with the Market Design and Energy Union Governance initiatives, will be a central element for the EU to pursue its ambition of a world leadership role in renewables, this political goal needs to be further supported in a holistic approach by policies and initiatives also in areas outside the scope of this package, such as financing (including ESIF and EFSI), regional development, research and innovation, international cooperation and industrial policy.

Key challenges and opportunities going forward

The costs for a number of renewable energy technologies have rapidly declined, this shifting the need for policy intervention from cost-competitiveness issues to market integration aspects - at least for most mature technologies.

The EU policy framework for renewable electricity (RES-E) has successfully turned solar and onshore wind technologies from niche technologies into central players in the power sector. However, the heating and cooling, and the transport sectors continue to rely heavily on fossil energy imports.

The move from national binding targets set by the current 2020 framework, towards an EU-level binding target for renewables for 2030, opens up new challenges, but also new opportunities for the EU to achieve the target collectively and in a cost-effective, sustainable way.

New technologies like smart grids, smart homes, increasingly competitive roof-top solar panels and battery storage solutions make it possible for energy consumers to become active players on the market and this opportunity should be harnessed.

Markets for renewable energy are opening across the world. Whilst global investments in renewable energy are growing, the investments in renewables in the European Union are declining, jeopardising the EU leadership ambition.

2. PROBLEM DEFINITION

The EU as a whole is currently on track to reach a share of renewable energy of **24.3%** by 2030, **falling short of the 2030 ambition**. This result shows that we risk following a development path that is insufficient to achieve the 2050 decarbonisation scenarios.

Several obstacles still prevent a cost-effective achievement of an at least 27% renewable energy target within the European Union in a business as usual scenario.

Investor uncertainty

For the EU, the investment needs are estimated to be around or above €1 trillion from 2015 to 2030 in renewable electricity generation alone[7]. It is unclear at which point in

[6] Frankfurter School-UNEP Centre/BNEF, 2016. Global Trends in Renewable Energy Investments 2016, http://www.fs-unep-centre.org

[7] Source: Bloomberg New Energy Finance (2014). 2030 Market Outlook; International Energy Agency (2014). World Energy Investment Outlook.

time an enhanced market design and a strengthened EU ETS, alongside other factors such as further cost reductions, will provide sufficient incentives for renewable energy investments, without any additional support to cover investment gaps. Further uncertainty for investors comes from the future evolution of rules on support schemes. In addition, the uncertainty regarding the EU sustainability criteria post-2020 is not conducive for investment in the bioenergy sector, including in advanced biofuels.

Lack of cost-effectiveness

Renewable technologies are being deployed across various sectors - electricity, heating and cooling, and transport, with different levels of cost-effectiveness. Over the past decade, a lot of emphasis was put on the development of renewable electricity. The 2030 and 2050 decarbonisations scenarios require however also accelerated renewables deployment in heating and cooling, and transport.

Renewable technologies, their cost and potentials vary significantly. Ignoring these differences might result in either underinvestment or overcompensation. There are also clear benefits to be reaped from a more Europeanised approach to renewables support, in order to facilitate cost-effective deployment of renewable electricity across the EU. Last but not least, differences in cost of capital and national approaches to other investment conditions such as grid connection fees undermine the optimal allocation of renewable electricity generation capacity across the EU.

Imperfect markets

Well-functioning internal energy markets are crucial for the deployment of renewables. However, the markets in the electricity, transport and heating and cooling sectors are at different phases of development or integration and require different measures to ensure their correct functioning. In the case of the electricity sector, where renewables are expected to reach around 50% market penetration by 2030, the electricity market should be redesigned to support the integration of renewables as proposed in the framework of the Market Design initiative. In the heating and cooling market, the challenge is to ensure access to existing infrastructure and sufficient incentives for the expansion of renewables. In the transport sector, renewable energy uptake is still hampered by a lack of clear market signals for low-carbon and renewable fuels.

Update of the regulatory framework

The renewable energy target of at least 27% is expressed as a binding target at EU level. This is a policy change from the previously binding targets at national level on which the current EU legislation and in particular the 2009 RES Directive is built. Furthermore there will be no specific sectorial targets as it is the case with the current 10 % target in the transport sector. This calls for an update of the regulatory framework so that it is adapted to the new approach.

Lack of citizen buy in

Existing rules do not sufficiently enable citizens and communities to have sufficient buy in into the energy transition. This can lead to lack of public acceptance at local level, resulting in higher development costs and slower renewable development. Empowering consumers and energy communities, and providing them with reliable information about renewables, are therefore fundamental preconditions for deploying renewable energies in a cost-effective way.

3. OVERARCHING GOALS OF THE REVISED RENEWABLE ENERGY DIRECTIVE

Renewable energy is central to the five dimensions of the Energy Union: energy security, energy efficiency, competitiveness, emission reduction, and global leadership through innovation. As such, the new EU-wide renewable energy target for 2030 set by the European Council in October 2014, based on the Commission's proposal and underpinning analysis presented in the 2030 Framework for Climate and Energy[8] and the Energy Union Framework Strategy[9], is key for achieving the Energy Union priorities.

Therefore, the ambition is to **increase the share of renewable energy consumed in the EU to at least 27% by 2030 in line with the cost-effective pathway described in the** 2030 Framework for Climate and Energy, and further reduce greenhouse gas emissions (at least 40% by 2030) and save at least 27% energy by 2030 compared to 2007 baseline projections.

The specific goals are:

First, the renewables deployment should contribute to **greenhouse gas emissions reduction** of at least 40% compared to 1990 levels, including a reduction of 30.2% of emissions in the non-ETS sector compared to 2005 levels. It should bring the EU economy closer to the required decarbonisation pathway to achieve the objective of 80-95% emissions reduction by 2050.

Second, the revised Directive should **improve energy security by diversifying the energy mix and reduce EU's dependence on imported fossil fuels,** particularly in the heating and cooling sector and the transport sector, as outlined in the 2030 Framework for Climate and Energy. Overall, the specific measures proposed for these two sectors could lead to a reduction in import dependency.

Third, renewable energies should further contribute to the integration **of the internal energy market**. The results show that a continuation of nationally-based support schemes would lead to less efficient deployment of renewable energy, a concentration of renewables investments in three countries, and a 25% increase in the average electricity prices in 2030 compared to 2010[10]. In contrast, a consolidated framework that builds upon a good market functioning, a more coordinated regional approach and addressing the costs of capital can achieve a more balanced deployment of renewables across the EU and reduce energy system costs.

Finally, the proposed options should foster innovation in renewables deployment and ensure that the EU can truly **become a global leader in renewables**. The proposed measures would strengthen both technology and market driven innovation, support the creation of flexible and integrated infrastructure, and create healthy supply chains, thereby enhancing the EU technological leadership role in this sector. With this experience, European companies will be able to position themselves to support the global transformation towards a more sustainable energy system.

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8 COM(2014)015 - "A policy framework for climate and energy in the period from 2020 to 2030", 21 January 2014

9 COM(2015)80 final - "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", 25 February 2015

10 Results based on Current Renewables Arrangement – CRA Scenario

4. INTERLINKAGES WITH OTHER INITIATIVES

The preparation of this Impact Assessment has been done in close coordination with, and is complementary to, other related Commission initiatives. First and foremost, this includes the Market Design and Energy Union Governance proposals but also the revision of the Energy Efficiency and Energy Performance of Buildings Directives, the EU ETS and the Effort Sharing Regulation, the LULUCF Regulation and the Bioenergy Sustainability Policy.

These other pieces of legislation mutually complement the Directive. However, they are not by themselves sufficient to allow the EU to reach, collectively, a share of at least 27 % in the final energy consumption by 2030 in a cost effective way and to deliver on the EU political priority of becoming the world's number one in renewables.

The **Market Design initiative** will, *inter alia*, facilitate the development of an electricity market fit for renewable energies, where short term markets are fully developed and integrated and flexibility plays a key role in enhancing the market value of renewables. This enhanced electricity market design, together with the strengthened EU ETS, will be a key foundation of the 2030 framework and will ensure that renewable energy generators can earn a higher fraction of their revenues from the energy markets. The revision of the Renewables Directive will build on this approach and complement it by introducing different measures aimed at attracting the necessary investments cost-efficiently and in a timely manner.

The **Energy Union Governance** frames the Integrated National Energy and Climate Plans, which set out national contributions to the legally binding EU-level RES target. The revision of the Renewables Directive complements the Energy Union Governance by considering different options to fill a potential gap either on ambition or delivery of the EU target. At the same time, the Governance initiative streamlines and integrates the existing planning, reporting and monitoring obligations of the energy acquis including those for renewable energy post 2020.

The **Energy Efficiency Directive (EED)** and **Energy Performance for Buildings Directive (EPBD)** aim, respectively, at facilitating the achievement of the energy efficiency target and at enhancing the energy performance of buildings. The provisions in the heating and cooling section are consistent with and complement the measures in both the EED and the EPBD, in particular by tackling existing buildings, tertiary and industry, as well as by including specific requirements on renewables.

The **EU Emission Trading Scheme (EU ETS)** will be reformed for the period after 2020[11]. Existing legislation includes the Market Stability Reserve to address the current surplus of allowances and to improve the ETS resilience to major shocks by adjusting the supply of allowances to be auctioned. The strengthened EU ETS will play an increasing role in providing a stronger investment signal for lower carbon technologies, including renewables, and will ensure that synergies between renewable energy and climate policies are better exploited. Furthermore, the proposed **Effort Sharing Regulation**[12]

[11] COM(2015)337 final - Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments

[12] COM(2016)482 final - Proposal for a Regulation of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement and amending

makes proposals for setting national binding emission reduction targets for greenhouse gases for the sectors outside the EU ETS and on Land Use, Land Use Change and Forestry (LULUCF).

The **LULUCF Regulation** aims at integrating carbon emissions credits and debits form agriculture and forestry into the EU 2030 climate and energy framework. In addition, the Bioenergy Sustainability Policy aims at guaranteing the climate and environmental benefits of EU bioenergy consumption for the period after 2020, focusing in particular on biomass in heating/cooling and electricity. The provisions in the transport sector of this Impact Assessment build and complement these approaches, by promoting higher direct greenhouse gas saving for new biofuels and bioliquid installations.

5. SUBSIDIARITY

EU level action is needed to ensure that Member States' contribute to the at least 27% EU level binding renewable energy target and that this is collectively and cost-effectively met. Common principles to govern support of renewable electricity are needed to address fragmentation of the internal market and ensure cross-border tradability. Thus also a case for common rules for transport fuel could be made.

EU-level action on heating and cooling is necessary due to the high share of the sector in energy consumption, however given the limited cross-border dimension, the options are designed with a significant degree of flexibility for Member States. Member States' shares of heating and cooling in overall energy mix may differ, as does the relative importance of heating versus cooling. However, the fundamental market failures are similar, particularly due to technology lock-in (*i.e.* existing fossil fuel heating systems) and lock-out (consumers cannot individually change fuels in collective supplies such as gas grid, district heating, etc.).

Action only at Member States' level would likely lead to a more limited deployment of renewables and create additional costs that can be reduced through complementary EU-level action. It would also lead to more fragmentation of, and distortions in, the energy internal market and put the achievement of the EU renewable energy target at risk.

6. DESCRIPTION OF POLICY OPTIONS AND ANALYSIS OF IMPACTS

The overarching goals of the revision of the Directive can only be achieved through a systematic approach, which results in renewables being deployed cost-effectively in all Member States and in all sectors.

A balanced and stable set of measures aimed at facilitating renewables investments across the electricity, transport and heating and cooling sectors in the 28 Member States will enhance regulatory certainty. They should also improve the conditions for renewables investment to take place where needed. In addition, measures oriented towards empowering and informing consumers also mobilise private capital for investments in renewable energy and increase social acceptance of renewable energy projects. Lastly, given the binding nature of the EU level target it is necessary to make sure the target is achieved in a timely manner, in a way that is complementary to the

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Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change

Governance Initiative. The latter defines the iterative process between Member States and the Commission in order to ensure the respective national contributions to the target.

6.1 Expanding renewable electricity cost-effectively

Amongst all sectors that make up our energy system, electricity is the most cost-effective to decarbonize. In 2014, 27.5% of Europe's electricity is produced using renewable energy and the modelling shows that close to half of our electricity will come from renewables by 2030. Yet, the necessary investments in renewable power generation are declining, concentrated in a small number of countries[13] with low weighted cost of capital (WACC) and policy frameworks perceived as most stable, and are insufficient to achieve the 2030 target.

Consistent with *'The vision for the EU electricity market in 2030 and beyond'*[14], the Commission's ambition for the post-2020 context is that renewable electricity generators can earn a high fraction of their revenues from energy markets. Such a market would be based on an enhanced electricity market design – where short term markets are fully developed and integrated and flexibility plays a key role in enhancing the market value of renewables – as well as a strengthened EU ETS. These are no regret solutions that need to be at the core of the decarbonisation of the power system.

However, despite such market enhancement, in some cases energy market revenues alone will remain insufficient to attract renewable investments in a timely manner and at the required scale. Where limited, specific financial support is still needed, the market – via competitive tenders – will confirm its necessity and the level of support through tender mechanisms, which will act as a natural phase-out for support measures. Ensuring regulatory certainty is paramount to ensure cost-effective deployment of renewables electricity.

The findings of the Renewable Energy and the Electricity Market Design Impact Assessments and the proposed policy options

The results of modelling work undertaken for the Electricity Market Design and Renewable Energy Impact Assessments **indicate that the improved electricity market, in conjunction with a revised ETS with a functioning Market Stability Reserve, could, under certain conditions, deliver investments in the most mature renewable technologies** (such as solar PV and onshore wind) **by 2030.** However, less mature renewable electricity technologies, such as off-shore wind, ocean energy, will likely need some form of support throughout the period. The analysis shows that the picture is dynamic, with the enhanced market design and the strengthened EU ETS gradually improving renewable electricity profitability over the 2021-2030 period. At the beginning of the period, over-capacity, the imbalance on the ETS market and low wholesale electricity market prices and high renewable electricity technology costs, make the case for market only driven investment in renewable electricity technologies more difficult. However, a stronger carbon price signal, a more flexible and dynamic electricity market and technology cost reductions gradually facilitate market investment over this period.

[13] For example, only two Member States (the UK and Germany) received over two thirds of all investments into renewable electricity new investments as well as M&A and refinancing activity in 2014 and 2015.

[14] Provided in a separate document together with the Market Design Impact Assessment

The picture also depends on regions. RES-E technologies could be more easily financed by the market in the regions with the highest potential (*e.g.* onshore wind in the Nordic region or solar in Southern Europe), while RES-E continue to largely require support in the British Isles and in Central Europe. Conditions however also depend on the cost of capital.

At the same time it has to be acknowledged that whether and at what point in time financing of renewables through markets alone will actually take off remains difficult to predict. This is because financing of capital intensive technologies such as most renewables through markets based on marginal cost pricing will remain challenging. In particular, higher penetration of renewables with low marginal cost could further reduce the market value that such renewables can actually achieve (so-called cannibalisation effect). Further flexibilisation of demand stands out as a key measure in this regards in order to further stabilise the revenue of renewables producers from the market.

On the other hand, the future capacity of renewables to be financed through the market will also depend on certain conditions outside of the market design and ETS prices, such as continued decrease in the costs of technologies, availability of (reasonably cheap) capital, social acceptance and sufficiently high and stable fossil fuel prices.

While the market reforms described above are therefore no regret options to facilitate renewables investment, support schemes will still be needed at least for a transitional period. It is therefore essential to further reform such schemes to make them as market-oriented as possible.

Against this background, the RES Impact Assessment investigates options to ensure that if and where support is needed, (i) support is cost-effective and kept to a minimum, and (ii) creates as little distortion as possible in the functioning of electricity markets.

As a first measure, the RES Impact Assessment suggests **creating a common European framework for support schemes**. The framework would be effective as it would define design principles (i) that ensure sufficient investor certainty over the 2021-2030 and (ii) require the use (where needed) of market-based and cost-effective schemes based on emerging best practice design (including principles that are not covered by the current state aid guidelines). At the same time, the framework would be proportionate by leaving actual implementation to the state aid guidelines (*e.g.* for the definition of thresholds applicable for any foreseen exemptions) and, most importantly, to the case by case, evidence-based, in-depth assessment of individual schemes by the services of DG Competition.

Importantly, the framework would enshrine in legislation and expand the requirement to tender support; it would define tender design principles, based on emerging best practice, to ensure the highest cost-efficiency gains. The framework would thus strengthen the use of tenders as a natural phase-out mechanism for support, by which a competitive bidding process determines the remaining level of support required to bridge any financing gap – such level of support being expected to disappear for the most mature technologies over the course of the 2021-2030 period.

The second measure addresses the need for a **more coordinated regional approach** to ensure a healthy investment portfolio of different renewable power generation technologies and investment locations. The results of the Impact Assessment shows that these measure would result in reduced energy system costs ranging from €1.0 billion (partial opening) and €1.3 billion (mandatory regional schemes) annually for the period 2021-2030, and renewable energy support costs paid by the consumer are reduced by 3% and 5% respectively.

The third measure proposes a **renewables-focused financial instrument** to address the high costs of capital for investments in renewable power. The risk is that overall investments may be insufficient to meet the 2020 and 2030 targets, a sub-optimal medium- and long-term deployment at EU-level, and a lack of exploitation of the renewable energy potential of countries with a higher cost of capital. Two different financial instruments have been assessed. A financial instrument that reduces the cost of capital in a number of Member States and regions will reduce energy system costs by €1.5 billion and achieves a more balanced deployment of renewables across the EU. A financial instrument that addresses only high risk projects would result in an increase of energy system costs, but could lead to technological breakthroughs in technologies like offshore wind and tidal.

The fourth measure addresses the **varying administrative costs between Member States**, which can account for around 15% of the overall development costs of wind projects. Administrative barriers bring uncertainty and delay to investors, artificially increase the costs of renewable energy projects, create distortions in the allocation of investments within the EU, and therefore hamper building a single integrated market for renewable energy and reaching a cost-effective deployment.

Building on the existing provisions on administrative procedures in the 2009 RES Directive, regulations and codes and on the TEN-E Regulation, the Impact Assessment proposes additional options to address the remaining obstacles including the introduction of a one-stop-shop and a time range for permitting procedures and facilitated procedures for repowering.

6.2 Improve energy performance and energy security with renewables in the heating and cooling sector

Heating and cooling represents the largest energy sector in the EU, consisting of around half of the European energy demand. It is made up of 75% fossil fuel and accounts for 68% of the EU's gas imports. There are currently limited heating and cooling measures across the sector in EU legislation[15], leading to slow progress, an absence of a long-term policy vision and investor uncertainty. On top of this situation, the negative externalities of the fossil fuel use in the heating and cooling sector[16] are not internalised and reflected in the energy prices for most parts of the heating and cooling sector, which hinders market uptake of highly efficient renewable energy technologies.

While the share of renewable energy in electricity has increased by more than 8 percentage points between 2009 and 2015, the share of renewables in the heating and cooling sector has only expanded by less than 3 percentage points in the same period[17]. The EU Strategy for Heating and Cooling also highlights the important impact of

[15] Contrary to electricity and transport

[16] Such as climate change and air pollution, with environmental and health consequences

[17] EUROSTAT, and “Renewable Energy Progress Report”, Öko Institute [to be published], draft preliminary figure

renewables deployment in district heating and cooling systems to reduce the costs and increase the flexibility of the EU energy system[18].

The findings of the Impact Assessment and proposed policy options

In the absence of additional and coordinated policies, the current slow rate of progress in Member States is **incompatible with a cost-effective achievement** of the EU renewable energy target by 2030[19] and long-term decarbonisation goals[20]. Given its large share in total energy consumption, measures intended to increase renewables use in the heating and cooling sector are crucial for the EU to meet its renewable target in a cost-effective manner.

The impact assessment has evaluated a number of measures – consistent with the enhanced EED - to improve the renewables deployment in the heating and cooling sector as well as in district heating and cooling systems.

For the **heating and cooling supply**, an obligation on all fuel suppliers[21] is considered to increase the amount of renewable energy that they supply. This should enable the cost-effective deployment of renewables in heating and cooling at EU-level, and reduce investor uncertainty. Two design variants are compared:

- A gradual increase in the obligation every year, or
- The obligation to reach a certain share of renewables by 2030

Given the fact that the heating and cooling sectors are very diverse across the EU, Member States would be allowed to have **significant flexibility** to design the obligation (*e.g.* choice of obligated parties, the possibility to exempt SMEs from the scheme).

The promotion of **efficient and renewable district heating and cooling** aims to address the market uptake of renewables, empower the citizens and reinforces the provisions above by:

- Making it possible for renewables suppliers to access of district heating and cooling networks through energy performance certification; and
- Facilitating consumers' choice of high performance energy supplies (be it centralized or decentralized).

These options introduce an obligation to allow open access rights to infrastructure for RES and waste heat and cold, an obligation to certify the district heating system performance using an existing standard[22], and the right for consumers to pursue higher efficiency by disconnecting from the district grid. The Impact Assessment shows that if the renewable supply increases in existing district heating and cooling systems by 20% roughly, an additional 2 Mtoe renewable heating and cooling could be delivered by 2030.

[18] An EU Strategy on Heating and Cooling, COM (2016) 51/2

[19] In absence of additional policies, the EU would only reach 24.7% renewable energy share in the heating and cooling by 2030, and due to the size of the heating and cooling sector in the overall energy consumption, and combined with absence of additional policies in other related climate and energy fields, that would result in only 24,3% overall share of renewables in 2030 – Source : PRIMES REF2016

[20] Between 2015 and 2050, the GHG intensity of the residential and tertiary sectors would be divided by 4, and the renewable energy share in heating and cooling would reach 41.6% - source: PRIMES EUCO30.

[21] With possible exemptions

[22] The CEN Standards (Comité Européen de Normalisation)

The risk of disconnection is deemed limited at the EU level, but could vary depending on the Member State. Both options result in new compliance costs linked to the certification which could not be quantified, but are estimated to be minimal if streamlined with the new provisions in the Energy Efficiency Directive.

6.3 Renewable fuels in the transport sector

Transport consumes a third of EU's total energy demand and it is almost entirely dependent on oil. While the transition to low-emission alternative energy in transport has already begun, spurred by the current Renewable Energy Directive, the sector is significantly lagging behind the other sectors. There is high potential for increasing renewable energy use in transport through electrification and development of advanced renewable fuels. It is also an opportunity for Europe to develop leadership in new bio-based products, such as advanced biofuels.

The work on the Impact Assessment has been developed in full consistency with the European Strategy for Low-Emission Mobility. This strategy already indicated that the Commission was examining how to provide a strong incentive to innovate in energies needed for the long-term transport decarbonisation by, for example, introducing an obligation for fuel suppliers to provide a certain share of renewable alternative energy.

The findings of the Impact Assessment and proposed policy options

Modelling-based analysis shows that, under the EU Reference Scenario 2016, the deployment of alternative fuels (including renewable fuels) in transport will slow down. It will be insufficient for achieving the 2030 climate and energy target and contributing to the EU's long-term decarbonisation goals. The main reasons for this under-performance include, amongst other: the high dependence of the sector on liquid fossil fuels, lack of economic viability of alternative fuels, the variable GHG emission performance of biofuels and specific barriers in aviation, waterborne (inland waterways and maritime) and heavy duty vehicles.

Against this background, this Impact Assessment analyses **four policy options to promote innovation and significant market uptake of alternative and renewable fuels in the transport sector**, including different paths to phase out food-based biofuels. These options include:

- EU incorporation obligation for renewable fuels, under the revised Renewable Energy Directive;
- EU incorporation obligation for renewable fuels, plus an EU-wide cap on the use of food-based biofuels. Two types of caps are analysed: a full phase out of food-based biofuels by 2030 or, alternatively, a phase down to pre-2008 levels. An additional sub-option consists of a faster phasing out of seed crop-based biodiesel and an increase in the direct greenhouse gas saving threshold of 70% for new installations;
- GHG emission reduction obligation, under the Fuel Quality Directive[23].

The impact assessment indicates that, under the same decarbonisation ambition, a complete phase out of food-based biofuels by 2030 would require higher shares of

[23] The Fuel Quality Directive requires Member States to oblige transport fuel and energy suppliers to reduce the GHG intensity of the fuel and the energy they supply.

advanced biofuels. This outcome would increase **annual investment costs by over 60% compared to a gradual phase out scenario**. This cost increase would be partially offset by lowered feedstock costs.

Furthermore, a complete phase out of food-based biofuels by 2030 would lead to job losses in the production facilities, and related industries such as crushing plants and refineries. This would occur particularly in the biodiesel sector where there are lower synergies between conventional and advanced biofuel production technologies. In addition, rape seed production could decline substantially. On the other hand, employment would increase in the production of advanced biofuels and fuels of non-biological origin, including technology development and use of feedstocks such as wastes, energy crops and lignocellulosic material. The net impact of the biofuels options is uncertain.

The analysis also shows that **emissions from indirect land use change (ILUC) can be significantly reduced through a gradual phase out of conventional biofuels by 2030**, focusing primarily on oil-crop based that are associated with higher ILUC impacts, combined with a higher greenhouse gas emission saving threshold for new biofuel installations.

The assessment finds that an **EU-wide incorporation obligation** would have the advantage of building on the extensive policy and administrative experience developed by Member States in implementing the Renewable Energy Directive and their national renewable fuel mandates. Furthermore, administrative burden for economic operators would be minimised, as they would continue to use mainly default values.

6.4 Empowering and informing consumers

The Energy Union Strategy places the consumer at its centre. Consumers should have the possibility to sell, consume and store self-generated energy. At the same time consumers should be informed about the energy they buy, as some might wish to purchase renewable energy and are prepared to pay a premium for such energy suppliers. Consumer empowerment could help mobilise additional private capital for investments in renewable energy sources.

However, in the absence of a European framework, Member States have addressed renewable energy self-consumption individually. This situation has led to differing degrees of consumer empowerment, unstable legal frameworks, and few incentives for citizens to invest in renewable energy sources when self-consumption is not facilitated. Equally, consumers wishing to be informed about the energy they buy must be absolutely certain that the renewable energy products are trustworthy. This requires an effective tracking system.

The findings of the Impact Assessment and proposed policy options

In line with the vision on consumers presented in the Energy Union strategy, two sets of measures have been proposed to empower consumers.

Regarding **self-consumption** three possible options are put forward:

- EU guidance on self-consumption
- Framework principles empowering consumers to self-consume and store renewable electricity

- Distance self-consumption for municipalities

The Impact Assessment finds that the option of including framework principles empowering consumers could drive PV deployment, increase the share of self-consumed electricity and might create 10 000 to 20 000 additional jobs in roof-top solar by 2030 compared to the baseline scenario. An EU guidance is unlikely to have a strong impact, whilst allowing for distance self-consumption[24] could have a negative impact on grid financing.

Regarding **consumer information**, the proposed measures aim at strengthening and extending the existing "guarantees of origin" (GO) system. Although GOs covered 45 % of all renewable electricity generated in the EU in 2015, the majority of power generation is outside of the system. Furthermore, Member States have implemented the GO system in widely differing ways[25], which increased the risk of double counting of renewable electricity.

For the electricity sector, the GO system could become the only means for disclosure of renewable electricity consumption to consumers. Furthermore, the GO system could be extended to renewable liquid and renewable gaseous fuels used in the heating and cooling and transport sectors. Such a system could be built on the existing sustainability requirements for biofuels. In addition to providing information to consumers, it would also facilitate cross border trade.

6.5 Making sure the EU will be on track on its ambitions by 2030

The new EU-wide binding target for 2030 set by the European Council in October 2014, is to increase the share of renewable energy consumed in the EU to at least 27% by 2030. In the absence of binding national targets for renewable energy post-2020, one main challenge is how to achieve this target in a cost-effective way through EU, regional and national level actions. This would need to take into account differing national capacities to produce renewable energy, whilst building on the renewable shares achieved in 2020.

In this context, Member States' Integrated National Energy and Climate Plans, to be developed as part of the initiative on Energy Union Governance, will play an important role, as they will include contributions to the EU-level 2030 target for renewable energy. Furthermore, the Energy Union Governance initiative aims, *inter alia*, via an iterative process with Member States, at addressing in first instance the possibility that contributions do not add up to the binding EU target (by means of recommendations on National Plans). However, the Governance process anticipates that further incentives for target achievement would be included in the Renewable Energy Directive should a gap in the target remain despite of the iterative process.

There are four overarching concerns that may warrant the need for additional and specific mechanisms to be included in the revised Renewable Energy Directive:

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24 For example, a municipality would be allowed to consume energy that is produced on one municipal building, for instance on the school, in another building, for instance in the swimming pool.

25 In particular, some Member States only issue GOs for electricity provided not benefiting form support schemes, whilst others issue GOs for all renewable electricity. Furthermore, some Member States have already extended the GO system to all types of electricity generated in their territory.

- How to ensure that – in line with the European Council conclusions of October 2014 – 2020 target are fully met?
- How to ensure a continued project pipeline from 2021 onwards – the year after the end of the binding 2020 requirement – to restore and maintain investor certainty?
- How to incentivise Member States to contribute appropriately and cost-effectively to the EU level binding target?
- How to ensure that Member States deliver on their contributions?

The findings of the Impact Assessment and proposed policy options

The first measure proposes the **2020 national targets as a mandatory floor** for the period 2021 to 2030, providing certainty to investors and creating a virtuous circle of higher levels of investments. This measure would need to be reflected in the requirements for the Integrated National Energy and Climate Plans set out under the Energy Union Governance, and requires a continuation of the existing co-operation mechanisms.

A **number of EU trajectories** have been examined to ensure a continued project pipeline between 2021 and 2030. The assessment suggests that there are sufficient mature technologies available to warrant a linear uptake of renewables over the 2020-2030 timeframe. This would result in a more consistent stream of investments, bring forward investments that have the opportunity to reduce the levelised cost of electricity, and has a positive impact on greenhouse gas emission reductions.

To avoid an "**ambition gap**", the proposed options include the iterative process under the Energy Union Governance, a review clause of the legislation to propose additional measures at a later stage, EU wide measures to ensure target achievement included in sectorial legislation, or other measures. The impacts of the options may vary depending on the size and the reason for the gap. The three considerations assessed are the impact of the options on investment certainty, the administrative burden and the political feasibility.

The "**delivery gap**" can be addressed with the same options considered for the "ambition gap". The key difference is that progress reporting under the Energy Union Governance will be a crucial element to detect delivery gaps at an early stage, that the options for the "delivery gap" and the "ambition gap" are consistent, and any corrective measure can be introduced effectively and without time delays to ensure investor certainty.

7. OVERVIEW OF MEASURES AND LINKAGE TO IDENTIFIED PROBLEMS

The Impact Assessment considers measures that can respond to one or more of the specific problems that prevent achievement of the overarching objectives of greenhouse gas emissions reduction, energy security, internal market, and global leadership.

As a conclusion, the table below presents a summary of the main measures considered in the impact assessment and their linkage to the identified problems.

Table 1: Overview of measures and linkage to the identified problems

	Electricity	Heating & cooling	Transport	Governance
Reduce investor uncertainty	- Consolidated framework: EU toolkit for support schemes	- Mainstream renewables: obligation on heating and cooling	- Increase renewables: obligation on renewable fuels	- 2020 Baseline - Trajectory towards 2030 target - Avoid and fill delivery gap
Improve cost-effectiveness	- Consolidated framework: tendering design principles - Reducing cost of capital - Administrative simplification	- Facilitate renewables in district heating and cooling: Energy performance		
Create functioning market	- Consolidated support framework: market-based design principles - Consolidated framework: energy communities	- Facilitate renewables in district heating and cooling: Access rights	- Increase renewables: obligation in aviation and maritime	
Update regulatory framework	- Coordinated regional approach		- Increase renewables: phase-out of food based biofuels	- Avoid an ambition gap - Avoid and fill delivery gap
Ensure citizen buy-in	- Empower consumers: self-consumption and storage-consumption - Consolidated support framework: fair tendering for small producers - Disclose information on electricity generation	- Facilitate renewables in district heating and cooling: Consumer rights - Trace origins of renewable fuels in heating and cooling	- Trace origins of renewable fuels in transport	

1. INTRODUCTION

1.1. Background and scope of the initiative

The Renewable Energy Directive[26] (the "**RES Directive**") establishes a European framework for the promotion of renewable energy and constitutes the most relevant measure to deliver on the EU's mandate to *promote the development of new and renewable form of energy* as set out in Article 194 TFEU. It has been the main driver for European investment in renewable technologies at a domestic level, economies of scale and innovation driving down significantly the related costs[27]. It has also had a spill-over effect worldwide, triggering the adoption of renewable energy policies outside the European Union[28] and helping renewables towards becoming a cost-competitive energy source.

GHG emissions reduction	Gross avoided CO_2 emissions between 380 Mt[29] and 767 Mt[30] in 2014
Fossil fuel displacement	Reduction in fossil fuels consumption by 114 Mtoe in 2014[31] (c. 10 % of total fossil fuel consumption)
Avoided imported fuel costs	Around €20bn in 2014[32,33]
Employment	EU renewable energy industry currently employs in 2014 c. 1.1 million workers[34]
Innovation and technology leadership	European companies held 30% of all patents for renewable technologies in 2013[35]

26 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance), OJ L 140/16, 5.6.2009. The RES Directive was amended in 2015 by Directive (EU) 2015/1513, in order to reduce the greenhouse gas emissions (GHG) from indirect land use change (ILUC) caused by conventional food based biofuels and from crops grown as main crops primarily for energy purposes on agricultural land and to prepare the transition towards advanced renewable fuels that can avoid these impacts.

27 *E.g.*, solar module prices have been reduced by 80 % between 2008 and 2012 (JRC, PV Status Report, 2014) and wind turbine prices declined by 30% between 2008 and 2015

28 Regulatory policies in the electricity, heating and cooling and transport sectors cover over 87%, 50% and 73% of the world population, respectively, Renewables 2016 Global Status Report, REN21, 2015

29 "Renewable Energy in Europe 2016 – Recent growth and knock-on effects", EEA, 2016, No 4/2016

30 JRC, 2016 available at: http://iet.jrc.ec.europa.eu/remea/news/third-progress-reports-renewable-energy-development- eu2013-2014

31 This figure represents the total contribution of renewables to fossil fuel savings in a given year compared with the situation in 2005. This should not be compared with 234-300 Mtoe/year figure in 2020 from the 2006 impact assessment, which has been calculated for the whole energy system.

32 “Renewable Energy Progress Report”, Öko Institute [to be published]

33 This figure represents the total contribution of renewables to fossil fuel import savings in a given year compared with the situation in 2005. This should not be compared with 50-57 billion EUR/annum from the 2007 impact assessment, which has been calculated for the whole energy system.

34 EurObserv'ER, 15th Eurobserv'ER report, 2015 (2014 figures)

35 OECD Statistics database

The RES Directive establishes, *inter alia*, national mandatory targets for the share of renewables in final energy consumption for each Member State. It also includes biennial indicative trajectories, as partial milestones to ensure that actual developments are not lagging behind in view of the achievement of the 2020 targets. A holistic approach is ensured by covering the three sectors: electricity, heating and cooling and transport, but the split of the national target and trajectories between the sectors is left to the discretion of the Member States (apart from a separate mandatory 10% sub-target for the 2020 share of renewable energy in the transport sector).

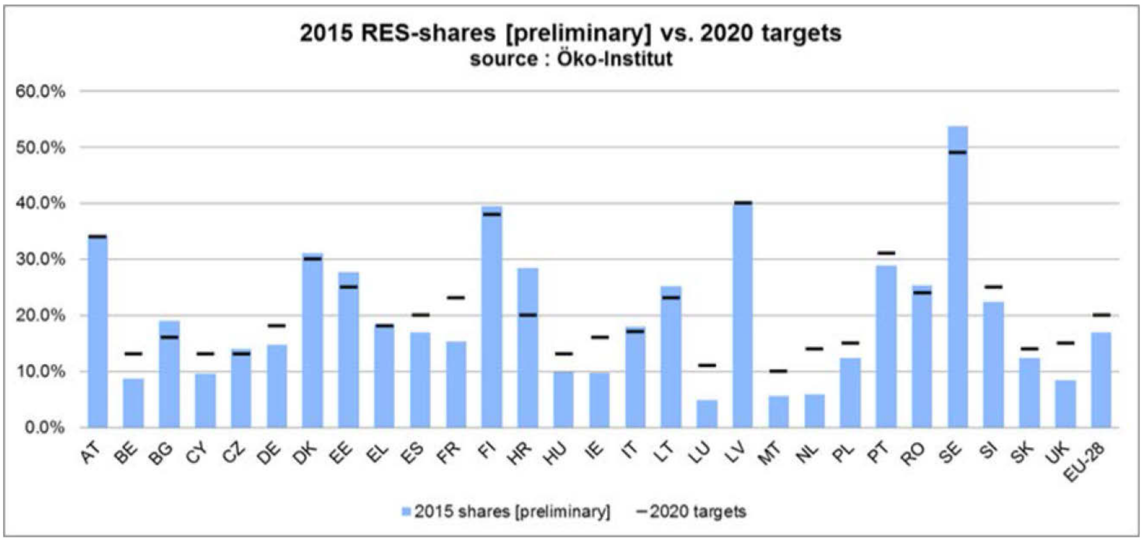

Figure 2: Based on 2016 Interim Progress Report - Oeko-Institute

With an estimated renewable energy share of 17% of gross final energy consumption in 2015[36], if the effort continues, the EU and an overwhelming majority of Member States are expected to achieve the 2020 targets set in the RES Directive[37]. More specifically, in the *electricity* sector (RES-E), 30% of the EU's power was estimated to be generated from renewables in 2015, with 11% of the total EU electricity sourced from variable renewable electricity[38]. In the *heating and cooling* sector (RES-H&C), the renewables share is estimated to reach 18,5% in 2015[39]. However, in the *transport* sector (RES-T), with a renewables share of 6,2% in 2015, the EU and the majority of Member States are still estimated at half-way towards the 10% target for 2020[40].

36 Eurostat for renewables shares for 2014, and 2015 estimates for the forthcoming 2016 Renewable Energy Progress Report. Eurostat 2014 data show a 16% renewable share in the EU
37 As highlighted in the 15th annual overview barometer, EurObserv'ER, 2015
38 Wind and Solar Photovoltaic, as % of total final electricity demand, ESTAT shares 2015
39 "Renewable Energy Progress Report", Öko Institute [to be published]. draft preliminary figure
40 "Renewable Energy Progress Report", Öko Institute [to be published]. draft preliminary figure

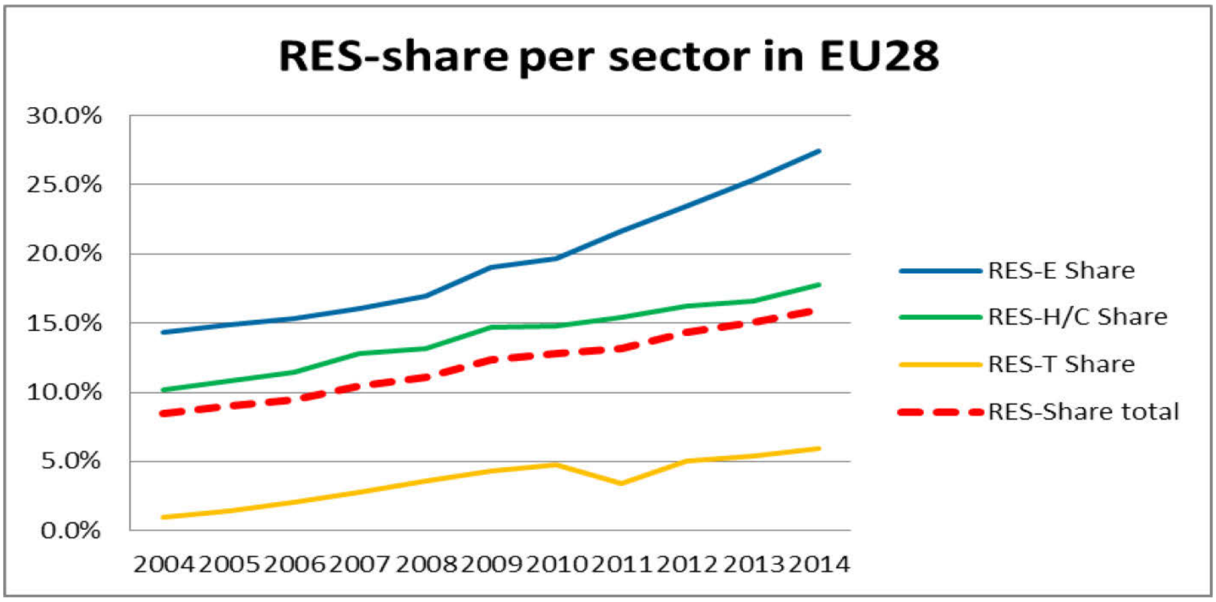

Figure 3: based on ESTAT Shares 2014

Some provisions of the RES Directive effectively end in December 2020, notably on national binding targets.

Finally the electricity sector is at this stage at an important crossroad with the Emission Trading System being reformed to address the surplus in allowances, the electricity market (including rules on generation adequacy) being redesigned and the new Energy Union Governance to be set up. The renewables electricity sector is also still recovering from abrupt, sometimes retroactive, changes that occurred in the aftermaths of the financial crisis and the biofuels sector need clarity on the post 2020 policies for biofuels. Re-establishing regulatory certainty for renewables producers and investors is therefore paramount at this point in time where the EU is falling behind global competitors in terms of absolute investments. There is equally a need to clarify the future policy on biofuels for investors in that sector.

The question this Impact Assessment aims to address is which additional measures and policies should be included in the RES Directive post-2020 to **promote the necessary long-term investments that will allow for further reduction in technology costs and the achievement of the 2030 renewable energy target[41] in a timely and cost effective way**.

1.2. Context of the initiative

The 2030 Framework for Climate and Energy[42] and the Energy Union Framework Strategy[43] establish the EU commitment to further reduce greenhouse gas emissions (at least 40% by 2030) in line with the cost-effective pathway described in the 2050

[41] As decided by the European Council in October 2014 with regard to a binding EU-level target of at least a 27% share of renewable energy consumed in the EU in 2030

[42] COM(2014)015 - "A policy framework for climate and energy in the period from 2020 to 2030", 21 January 2014

[43] COM(2015)80 final - "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", 25 February 2015

Roadmaps[44], to increase the share of renewable energy consumed to at least 27%, and to save at least 27% energy by 2030 at EU level compared to 2007 baseline projections as quantitative headline targets of the Energy Union, in particular to increase Europe's energy security, achieve a moderation of energy demand and progress in the decarbonisation of the economy.

The Energy Union Framework Strategy stated the need, *inter alia*, for an integrated governance and monitoring process, to ensure that all energy-related actions at European, regional, national and local level contribute to the Energy Union's objectives and to secure the delivery of the 2030 Framework for Climate and Energy. This is also in line with the EU commitments at the COP21 Climate Summit in December 2015, which adopted the first-ever global and legally-binding climate agreement with the aim to hold the global warming well below 2°C and to pursue efforts to limit it to 1.5°C.

Integrated National Energy and Climate Plans, together with comprehensive monitoring and reporting at the EU and national levels, and an iterative political process between the Commission and Member States on the implementation of national plans will be essential elements of such a governance framework. These provisions will be reflected in the Commission's initiative on the Energy Union Governance.

In February 2014, the European Parliament called for a 40% cut in CO_2 emissions, a 30% target for renewable energy and a 40% target for energy efficiency by 2030, under the EU's long-term climate-change policy[45]..

With a view to the period beyond 2020, in October 2014 the European Council agreed on a binding EU-level target of at least a 27% share of renewable energy consumed in the EU in 2030. Furthermore, in February 2015 the Commission confirmed the political commitment for the European Union to become the world leader in renewable energy[46].

The roadmap for delivering the Energy Union, launched in November 2015 as part of the first Report on the State of the Energy Union, foresees a new Renewable Energy Package for the period after 2020, containing a revised Renewable Energy Directive (the "**Revised RES Directive**"), and including a bioenergy sustainability policy for the period 2021-2030[47].

1.3. Links with parallel initiatives, approach taken for modelling, data gaps and other limitations

1.3.1. Links with parallel initiatives

The Commission has already tabled legislative proposals of relevance to an EU policy on renewable energy, such as the revision of the EU Emission Trading Scheme (ETS) for

44 COM(2011)112 - "A Roadmap for moving to a competitive low carbon economy in 2050", 8 March 2011 and COM(2011)885 final - "Energy Roadmap 2050 ", 15 December 2011

45 European Parliament resolution 2013/2135(INI) - "A 2030 framework for climate and energy policies", 5 February 2014, as recalled in European Parliament resolution 2015/2112(INI) - "Towards a new international climate agreement in Paris", 14 October 2015

46 COM(2015)80 final - "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", 25 February 2015.

47 The bioenergy sustainability policy for 2030 is assessed in a separate Impact Assessment

the period after 2020[48], including, *inter alia*, a Market Stability Reserve to address the current surplus of allowances and improve the ETS resilience to major shocks by adjusting the supply of allowances to be auctioned. It also made proposals as regards setting national binding emission reduction targets for greenhouse gases (GHG) for the sectors outside the ETS (the so called "Effort Sharing Regulation")[49] and on Land Use, Land Use Change and Forestry (LULUCF)[50]. In addition, legislative initiatives are being tabled as regards the revision of the directives on energy efficiency (EED)[51] and energy performance of buildings (EPBD)[52], and a policy communication was published on the European strategy for low-emission mobility[53]. Finally, this Impact Assessment has been prepared in parallel with the Impact Assessments accompanying the initiatives on Electricity Market Design[54], Governance of the Energy Union[55] as well as Bioenergy Sustainability[56]. In relation to the latter, sustainability issues associated to bioenergy, particularly in heating/cooling and electricity, are specifically dealt with in that impact assessment. This Impact Assessment addresses only issues related to the climate performance of biofuels, and in particular indirect land use change impacts of conventional food-based biofuels which are not captured by the sustainability criteria.

As regards *electricity* in particular, the failures causing an inefficient integration of renewables in electricity markets are analysed in Chapter 2 as they are closely related to renewable electricity deployment. However, for sake of completeness, it should be stressed that policy options related to (i) the priority dispatch and priority access to the grid of electricity produced from renewable sources, (ii) balancing and other market responsibilities imposed on renewable electricity generators, (iii) grid connection charges and grid access tariffs applicable to renewable electricity generators as well as (iv) network planning obligations are assessed as part of the Electricity Market Design Impact Assessment. Various measures aimed at making electricity markets fit for integrating a large share of variable renewable generation, as well as facilitating the participation of renewables in all markets and all timeframes (including as regards the provision of ancillary services) are also assessed in the Market Design Impact Assessment, whereas policy options related to the promotion of renewable electricity will be assessed as part of this Impact Assessment.

For the *heating and cooling* sector, this Impact Assessment reflects, as appropriate, the Commission's intentions included in its EU Strategy on Heating and Cooling, notably with regard to promoting renewable energy through a comprehensive approach to speed up the replacement of obsolete boilers, including by encouraging the uptake of renewable energy in heat production and increasing the deployment of renewable energy in district

48 COM(2015)337 final - Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments

49 COM(2016)482 final - Proposal for a Regulation of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change

50 COM(2016) 479 final

51 COM(2016) 761

52 COM(2016) 765

53 COM(2016) 501

54 COM(2016) 864, COM(2016) 861 and COM(2016) 863

55 COM(2016) 759

56 COM(2016) 418

heating and combined heat and power generation (CHPs), as well as supporting planning for renewable energy deployment at local level also taking into account the need to reduce emissions of air pollutants such as Particulate Matters (PM) and Nitrogen Dioxide (NO^2). In this respect, some relevant measures are included in the Commission's proposal for the revision of the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) and assessed in the impact assessments supporting these initiatives[57].

For the *transport* sector, this Impact Assessment builds on the work carried out in the Staff Working Document accompanying the Commission's communication on a European strategy for low-emission mobility and additionally takes into account the reduction of the carbon intensity of transport fuels in the framework of the Fuel Quality Directive (FQD)[58]. Furthermore it focuses on the sustainability issues of biofuels, particularly the GHG emissions.

The absence of binding national renewable energy targets as a policy tool in a post-2020 timeframe requires the exploration of other policy avenues to ensure an adequate ambition and distribution of Member States' efforts to contribute to the EU-level target of at least 27% renewable energy in 2030. The legislative initiative on the Governance of the Energy Union aims to contribute to addressing this issue together with the revision of the RES Directive. The general approach is that governance provides the framework for planning, reporting and monitoring the development of renewable energy, whilst corrective measures if required would be part of the RES Directive, which is a simple approach applied with other aspects of climate and energy policy such as the Effort Sharing Regulation and the Energy Efficiency Directive. The interaction between the governance process and the RES Directive and the specific issues to be addressed are further explained in Chapters 2 and 5[59].

1.3.2. Approach taken for modelling and limitations

Annex 4 describes in detail the models used for the quantitative analysis presented in this IA, as well as the scenario descriptions. It also presents the interactions in the modelling work undertaken for this Impact Assessment and for the other related Impact Assessments on the 2016 Energy Union initiatives.

The problem definition and the policy options assessed in this Impact Assessment build on the outcomes of energy-system modelling scenarios. More specifically, the starting point for this Impact Assessment, as for all other related Impact Assessments, is the EU Reference Scenario 2016 ("REF2016"), which provides 2030 energy-system projections, based on current trends and policies[60].

This Impact Assessment makes also use of a central policy scenario also used for the Impact Assessments supporting the proposal for a revision of the Energy Efficiency Directive (as a baseline scenario) and for the proposal on the Effort Sharing Regulation, as well as in the Staff Working Document published together with the EU Strategy on

57 COM(2016) 765, COM(2016) 761, SWD(2016) 414 and SWD(2016) 405.

58 The FQD (Article 7a) obliges fuel suppliers to reduce the GHG intensity (gCO_2/MJ) of fuels supplied by 6% in 2020 compared to 2010.

59 See especially Section 5.5.3.

60 Annex 8 describes in more detail the interaction with other policy initiatives, sensitivity scenario and renewables decomposition, with the key results of energy-system modelling scenarios.

low-emission mobility (as one of the two central policy scenarios - in both initiatives), which are in line with 2030 minimum ambition levels as stated by Heads of States and Governments in October 2014. This scenario (called "EUCO27") projects the expected developments across sectors to reach the 2030 targets and help identify the scale of the economic, social and environmental challenges to cost-effectively reach an at least 27% renewable energy share. The second policy scenario (called "EUCO30" as its only difference from EUCO27 is a more ambitious energy efficiency target of 30%) is also used in analysis of transport sector options.

Building on the REF2016 and the EUCO27 scenario, specific baseline scenarios are then prepared, which highlight the expected implications of the continuation of current policies and practices on the developments in the specific sectors subject to policy interventions, assuming that all other sectors and policies are in line with the central policy scenario.

This approach, building on a common policy scenario and then focusing on 'one issue at a time', was deemed the only operational way to assess the impacts of specific policy options in the general context of various far-reaching initiatives put forward by the Commission as part of the 2016 Energy Union initiatives.

However, this approach has some limitations. First, assumptions have to be made about what the continuation of current practices mean in each sector. Second, the implications of a failure in one sector to deliver on agreed policies or targets on other policies or sectors cannot be directly modelled. Finally, since some of the policy options presented in this Impact Assessment cannot be properly addressed in an integrated energy system model, the analysis is complemented by other modelling or analytical tools and qualitative assessment when necessary, as further elaborated in the document.

2. WHAT IS THE PROBLEM AND WHY IS IT A PROBLEM?

2.1. Evolution of the problem and need to act post-2020

The EU and the world are moving towards a more sustainable and renewable energy system. Addressing concerns about greenhouse gas emissions, local air pollution[61], cost-competitiveness, and security of energy supply are among the main reasons for this global shift.

The Lisbon Treaty enshrined in the treaties of the European Union that "*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*"[62]. In this context, the European Council in October 2014 set a binding EU-level target of at least 27% for the share of renewable energy consumed in the EU in 2030. It also invited the European Commission to further examine instruments and measures capable of reducing emissions and dependency on energy imports in the transport sector, including measures for the promotion of energy from renewable energy sources. Taking action to curb energy use and boost renewables in the heating and cooling sector would reduce EU energy costs, help cut the EU's dependence on imported fossil fuels[63] and reduce carbon dioxide emissions, especially if highly efficient heating and cooling systems replace old ones, together with district heating deployment[64].

REF2016 projects a greenhouse gas reduction of 35% in 2030 compared to 1990 and a renewable energy share by 2030 of 24.3% in 2030[65]. Although this scenario does not assume any additional dedicated renewables policies, the combination of long-lasting effects of current policies, improved cost-competitiveness associated with technological progress, and the continuation of the ETS[66], lead to an increase in renewables share even post-2020. However, this increase still falls short of the minimum share of renewables agreed, and more generally highlights the potential risk of not reaching the 2030 EU climate and energy objectives, in the absence of additional policies.

The initiatives on the ETS and non-ETS sectors, Electricity Market Design, Governance and Energy Efficiency are expected to contribute to increasing the level of renewables as a share of final energy consumed in 2030. They will also facilitate the integration of renewable energy in relevant markets, and provide economic signals for the uptake of

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61 Notably from particulate matters and NO2

62 Article 194 of the Treaty on the Functioning of the European Union

63 Although the heating and cooling sector is moving to renewable energy, in 2012 some 75% of the fuel it uses still came from fossil fuels, and heating and cooling accounted for 68% of the EU gas imports, COM(2016)51 final - "An EU Strategy on Heating and Cooling", 16 February 2016.

64 Heating and cooling is responsible for about half of the EU's final energy consumption and represents the largest energy end-use sector, ahead of transport and electricity. Meanwhile, in 2014 renewables only accounted for 17.7% of energy in the heating and cooling sector. The use of renewable energy in the industry sector is limited to biomass, despite the market maturity - at least for low temperature heat - of heat pumps, solar and geothermal. Significant potential for energy efficiency and renewable energy use remains. It is possible to reduce energy costs in industry by 4-10% by using existing technologies (see COM (2016)51 final - "An EU Strategy on Heating and Cooling", 16 February 2016).

65 EU Reference Scenario 2016, which assumes 2020 binding targets to be at least reached

66 Based on the currently applicable 1.74% linear reduction factor and the Market stability reserve. The increase of the linear reduction factor to 2.2%, as proposed by the Commission and currently in co-decision is not included in REF2016

renewable energy in line with the EU's climate and energy objectives, in the context of an improved internal energy market.

However, such initiatives cannot address the full range of specific issues that hamper the needed expansion of renewable energy in all sectors to ensure achievement of the 2030 renewables' target in the most cost-effective, proportionate and least distortive way for the ultimate benefit of the European taxpayers and energy actors, notably the consumers. Moreover, they will not suffice to provide clear signals to Member States, investors, and citizens and address President Juncker's ambition for the European Union to become "*the world number one in renewables*"[67].

Against this background, this Impact Assessment identifies the following five problem areas:

1. Investor uncertainty

2. Need to improve cost-effectiveness of renewables deployment

3. Absence of functioning markets

4. Need to update the policy framework

5. Risk of loss of citizen-buy in during transition

2.2. The problem areas and underlying main drivers

2.2.1. Problem 1 - Investor uncertainty

Investor certainty will be crucial for attracting the significant private investments needed to reach the at least 27% EU-level target. For the EU, these are estimated around or above EUR 1 trillion from 2015 to 2030 in renewable electricity generation alone[68]. As explained above, the regulatory framework is much wider than the RES Directive only, in particular for electricity.

Driver 1: Uncertainty as to when energy-only market will provide sufficient investment signals

European electricity markets were designed in the past for conventional, centralised power plants. In most Member States, electricity systems and markets are today not fit for a large penetration of variable renewable generation. Certain subsets of the electricity market are not designed to accommodate variable renewable generation. For instance, short term markets such as intraday and balancing do not run as close to real time as necessary[69] and in many cases market rules do not facilitate, or even impede, the integration of renewables (*e.g.* definition of market products). Existing rules create significant barriers to market entry, especially for new and/or small market entrants (in

67 http://juncker.epp.eu/my-priorities

68 Bloomberg New Energy Finance (2014). 2030 Market Outlook; International Energy Agency (2014). World Energy Investment Outlook

69 Gate closure time in intraday markets (where they exist) range from 5 minutes (in Belgium and the Netherlands) to 120 minutes (in Hungary). The closer to real time the gate closure, the more accurate are resource forecast for solar and wind producers, the lower are total system balancing costs, and – all other things being equal – the lower are retail prices

particular variable generation) and create a non-level playing field in favour of larger incumbents. Furthermore, system service markets are often not designed in a way that allow the participation of variable renewables, nor value and monetise the system services that distributed resources can bring. Secondly, energy systems as a whole lack the required flexibility crucial for the cost-efficient deployment of variable renewables sources. The further cost-efficient penetration of variable renewables depends on a sufficient and timely deployment of all sources of system flexibility, such as interconnectors, demand response, storage, flexible plants, electrical vehicle charging, and power-to-heat or to other energy carriers. System flexibility is crucial in limiting the renewables market value gap – by reducing the occurrence of both low/negative prices when renewables are dispatching and of high prices when renewables are not dispatching – and ensuring that adding variable renewable generation translates into net benefits to the system as a whole, *i.e.* the avoided costs minus increased costs. At the same time, it should be noted that flexibility measures also tend to suppress price spikes that could be necessary to recoup fixed costs of generating assets. These issues will be addressed in the market design Impact Assessment.

Indeed, variable renewable electricity suffers from a "cannibalisation" effect in the market based on marginal cost financing logic, creating a renewables "market value gap"[70]. Due to the merit order effect pricing mechanisms[71], prices during hours of peak production of variable renewable sources tend to be lower than average market prices. While this effect is already visible today in certain Member States[72], it is expected to become even more relevant as renewables penetration further increases[73]. As an order of magnitude, recent research suggests that, in the absence of hydro reservoirs and demand response, when its market share will reach 30% of total generation on a given market, the revenues that a wind plant can get through the market could fall to only 50% to 80% of the average market price. These factors may be reached by solar power when it reaches only 15% of total generation[74]. This is a market indication of the changes in market values of renewables as they are deployed. As renewables are further gaining market shares in the coming decade, the regulatory framework should not only incentivise the deployment of renewables where costs are low (*e.g.* due to abundant wind or solar resources), but also where the value of the produced electricity is the highest.

The Commission's ambition for the post 2020 context is that renewable electricity generators can earn an increasing fraction of their revenues from the energy markets based on an enhanced market design – where short term markets are fully developed and integrated and flexibility plays a key role in enhancing the market value of renewables – and a strengthened EU ETS.

The incentive provided by the ETS has been limited in recent years due to the large surplus of allowances on the market, resulting from the imbalance between supply and

70 The inherent variability of wind exposure and solar radiation affects the price that variable renewable electricity generators receive on the market (market value). During windy and sunny days the additional electricity supply reduces the prices. Because the drop is larger with more installed capacity, the market value of variable renewable electricity falls with higher penetration rate, translating into a gap to the average market value of all electricity generators over a given period (See Hirth, Lion, "The Market Value of Variable Renewables", Energy Policy, Volume 38, 2013, p. 218-236).

71 Also as a consequence of the priority dispatch of renewables

72 Lion, Hirth, "The Market Value of Variable Renewables", 2013

73 On the other hand, solar PV in particular helped to stabilize or even decrease daytime peak prices in countries with high air-conditioning load, or autumn prices in wind-rich countries

74 Lion, Hirth, "The Market Value of Variable Renewables", 2013

demand for allowances. A large surplus confounds the signal for investments, which are necessary for the transition towards a low-carbon economy, including energy supply. Additionally, the current behaviour of many investors on power generation markets seems to be driven by myopia looking primarily at current price levels. Overall, even though the ETS carbon price can be expected to increase as scarcity in the carbon market will resume, in the short term prevailing myopic views and the uncertainty on long term CO_2 price development may remain an impediment for investors to fully factor in future prices in investment decisions.

This imbalance between supply and credit of allowances resulted from several economic and policy factors, such as the reduction in emissions following the economic crisis and the higher use of international credits than was expected. At the same time, specific support for renewables has shown to be a strong driver for investment, and, for a given CO_2 cap in the ETS, a fast deployment of renewable electricity can contribute (among other factors) to a lower carbon price by weakening the demand for emission allowances in the EU ETS. In view of such potential impacts, various stakeholders have recently argued that there is a need to ensure that adjustments can be made in the ETS to address the full impact of general economic conditions as well as overlapping EU and national policies on the ETS price[75].

The strengthened and revised EU ETS, with a functioning Market Stability Reserve (MSR), will play an increasing role in providing a stronger investment signal for lower carbon technologies including renewables, and will ensure that synergies between renewable energy and climate policies are better reaped. However, such impact will only build up gradually.

From 2019, the introduction of a MSR will respond to major changes in the demand of allowances, regardless of whether these are the result of economic factors or due to policy developments. The architecture of the reserve is such that it automatically and in a gradual manner reduces the auction supply if there is a significant oversupply of allowances. However, as the reduction realised by the MSR will be gradual, if, for any reason (including a fast deployment of renewable electricity), the existing imbalance between supply and demand would not be reduced, it might need to be considered as part of the first review of the MSR parameters foreseen by 2021 whether this justifies a change to the parameters (*e.g.* an increased MSR feeding rate) to preserve the overall policy coherence in delivering the climate objective in a cost effective manner, as agreed by European leaders.

The ETS will provide an increasingly stronger investment signal as the scarcity in the carbon market will gradually resume and a reformed energy only market would support the integration of renewables, but ETS may in itself not ensure that all necessary investments in renewables would occur, in particular for certain non-mature technologies.

Overall, a number of elements, normally beyond the control of renewables producers, will determine the moment when "RES parity" is achieved – *i.e.* the moment when the levelised cost of electricity (LCOE) decreases to the level of the actual market value of the asset to be financed. Such conditions include: (i) continued decrease in technology costs; (ii) the availability of (reasonably cheap) capital, which is a function of many

[75] For example, see Eurelectric, Reform of the EU ETS, May 2016 http://www.eurelectric.org/media/278460/20160531_statement_on_eu_ets_reform_final-2016-030-0299-01-e.pdf

variables, including project-specific and renewables framework-specific risks, but also general country risks; (iii) social acceptance (which could impact the availability of high potential locations); (iv) sufficiently high and stable fossil fuel prices.

Additionally, the "RES parity" moment will depend on the extent to which and the speed at which the market re-design and the reformed ETS deliver on: (i) addressing the current surplus of carbon allowances that would strengthen the carbon price signal; (ii) reducing the occurrence of low or negative market prices; (iii) reducing balancing costs for renewables producers; (iv) bringing additional revenues to renewables producers in balancing and ancillary services markets; (v) ensuring a timely and sufficient deployment of all sources of flexibility limiting the renewables "cannibalisation effect"; (vi) any electricity over-capacity effectively exiting the market; (vii) renewables market integration not translating in a substantial upward pressure on renewables projects' access to and cost of capital.

Until these conditions are in place, a funding gap for investments in renewables will remain, as evidenced by both the Market Design and this Impact Assessment, and is dependent also on future price expectations that may be uncertain. This is the starting point of the this Impact Assessment, which then will consider the best way of addressing investment uncertainty against this funding gap.

Driver 2: Uncertainty over the post-2020 policy framework for support schemes

Investors, Member States and other stakeholders have called on various occasions for clarity to be provided in the revision of the RES Directive on the future framework for support schemes after 2020 by spelling out framework principles on support schemes that facilitate a Europeanised and market based approach to renewables[76].

The RES Directive allows Member States to opt for support schemes to facilitate renewables deployment and target achievement, but leaves the choice of support scheme design entirely to Member States, reflecting the consensus at time of adoption that there was no one-size-fits-all system. State aid rules set out general requirements until 2020, but for instance do not contain any principles on the design of tenders (apart from the technology-neutrality principle), nor on cross-border co-operation. They also leave an element of regulatory uncertainty as assessment is done on a case-by-case basis after a state aid scheme has been put in place.

Support for renewable energy may conflict with system-friendly and market-responsive dispatch, investment decisions and technological designs – in particular through insufficient exposure to market price signals that, together with an adequate definition of bidding zones, reflects the value of generation to the system depending on time and location. The type and level of support needed to promote emergent technologies representing a small share of the power generation mix, such as what was required to promote initial deployments of wind onshore and solar PV in the second half of the last decade, is not justified anymore when such technologies become much more mature and deployment reaches a significant scale. This is all the more true in view of the negative impact this might have on market functioning and investment incentives across power generation markets, including downward pressure on ETS prices.

[76] See, *e.g.* the conclusions of the European Electricity Regulatory Forum, Florence, 13-14 June 2016

Retroactive changes and retrospective moratoria on renewable-related support have taken place in several Member States[77]. These changes took place for several different reasons but often led to uneven fees and subsidies distribution, loss of confidence in the sector, sometimes even bankruptcies and employment losses. This insecurity in the renewables sector and the lack of access to finance for new renewables installations may similarly not only endanger achievement of the binding 2020 national renewable energy target of the respective Member State and the overall renewables target of the EU, but make it more expensive. These measures also resulted in numerous lawsuits at national, European and international level[78].

Several Member States were able to negotiate with investors a deal which diminished the amount of support provided in exchange for regulatory stability, while other Member States made changes that eventually led to a complete stop of any new investment in renewables on their territory, due to the uncertainty they created.

Rules on renewables support finally have to consider the type and nature of all categories of investors.

Renewable energy communities

A specific issue relates to the framework applicable to renewable energy communities. Renewable energy communities are entities through which citizens and/or local authorities own or participate in the production and/or use of renewable energy. With more than 2500 initiatives EU-wide[79], renewable communities have been key in triggering the energy transition in Europe. The local anchorage and ownership of such initiatives have brought substantial benefits in terms of social acceptance for renewable energy projects, especially for wind energy[80]. They have contributed not only to increasing renewable shares and to reaching the targets, but also to lowering the cost of renewable energy deployment by making available the most adequate sites and providing access to cheap capital.

In Germany for instance, where 50% of the renewable power capacity is owned by private individuals[81], the levelized cost of electrical capacity owned by energy communities and farmers is competitive with utility-owned renewables.

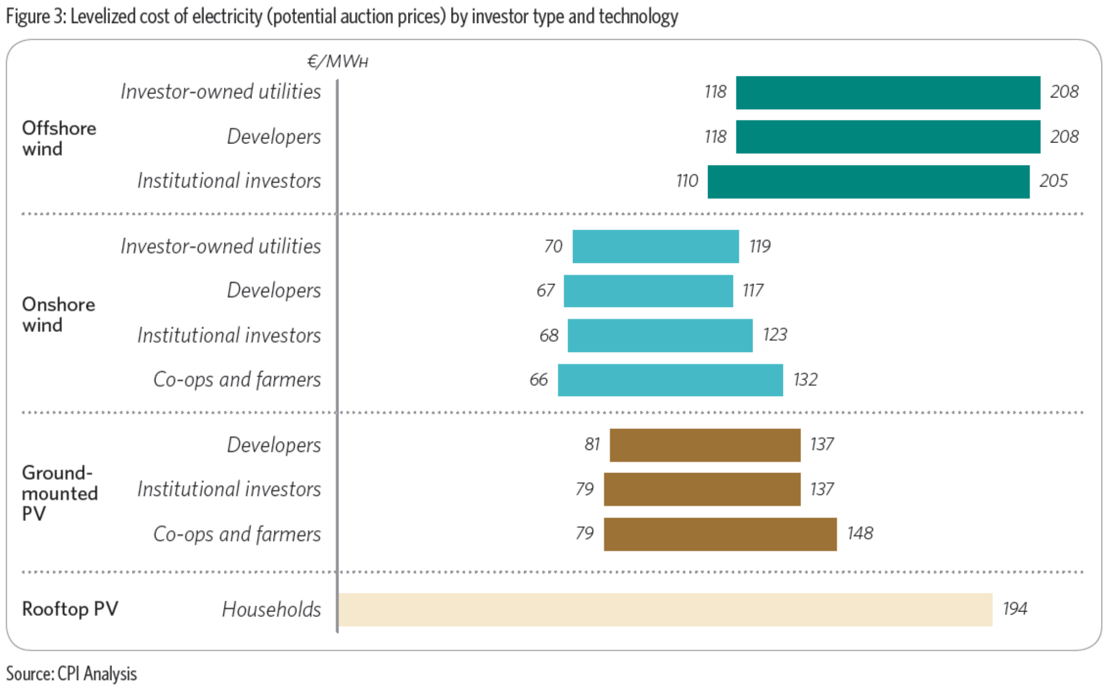
77 *E.g.* Bulgaria, Czech Republic, Estonia, Greece, Italy, Poland, Spain and the UK, Retroactive and retrospective changes and moratoria to RES support, Keep on Track!, 2015

78 Retroactive and retrospective changes and moratoria to RES support, Keep on Track!, 2013

79 *Foster social acceptance of RES by Stakeholder engagement*, ResCoop202020, 2015

80 *Inter alia, Local acceptance of wind energy: Factors of success identified in French and German case studies,* Jober et ali, 2007; *Public acceptance of renewable energies: Results from case studies in Germany*, Jan Zoellner et ali, 2008; *What drives the development of community energy in Europe*, Thomas Bauwen et al., 2015

81 German Renewable Energy Agency, based on trend: research study, 2013. 2012 figure



[82]

Figure 4: LCOE by investor type and technology

Currently, most renewables communities remain small-scale, either in terms of numbers of projects, members, turnover or capacity installed. This leads to specific issues, such as difficulties to face grid connection costs, especially for non-shallow costs[83]. In addition, some specific elements of support schemes design such as tendering support might create some barriers to the development of community-owned energy, and therefore reduce local acceptance of projects[84]. There is even a downwards tendency in the share of community-owned renewable energy in the system, mostly due to competitive tendering process where community schemes have difficulties in competing on equal footing with other projects[85].

This has been confirmed by the results of the public consultation where 31% of respondents agreed upon the fact that support schemes, levies and/or administrative procedures should be adapted to the size of local projects and access to finance facilitated to enable cooperatives to compete on equal footing with other projects in the market. This analysis was mostly shared by cooperatives (91%), NGOs (69%) and public authorities (43%).

<u>Driver 3: Uncertainty around individual Member States' contributions to the EU level renewables target and future governance</u>

Whilst currently national targets provide a clear indication on each Member State's development, it is unclear how the collective effort for post 2020 will be shared among

82 Policy and investment in German renewable energy, CPI, 2016

83 *E.g.* in UK, "Renewable Energy Progress Report", Öko Institute [to be published]

84 *Community Wind Perspectives from North-Rhine Westphalia and the World*, WWEA, 2016

85 The potentially negative influence of such processes have been underlined *e.g.* in the WWEA report Headwind and Tailwind for Community Power, 2016

Member States. The absence of binding national renewable energy targets as a policy tool in a post-2020 timeframe requires the exploration of other policy avenues to ensure an adequate ambition and distribution of Member States' efforts to contribute to the EU-level target of at least 27% renewable energy in 2030. Also detailed rules for the governance set up between the EU and Member States and monitoring are still being defined (the latter in the parallel Governance IA).

The general approach is that governance provides the framework for planning and monitoring the development of renewable energy, whilst corrective measures if required would be part of the Revised RES Directive, which is a simple approach applied with other aspects of climate and energy policy such as the Effort Sharing Regulation and the Energy Efficiency Directive. The interaction between the governance process and the Revised RES Directive and the specific issues to be addressed are further explained in Chapter 5.

Driver 4: Uncertainty regarding the sustainability rules applying to biofuels, including the role of food-based biofuels post-2020

As both the REFIT evaluation and the public consultation demonstrates, the policy discussion on Indirect Land Use Change (ILUC) associated to food-based biofuels and the prolonged adoption process of the ILUC Directive have negatively affected investments in biofuels, including in advanced biofuels. There is now a need to provide regulatory certainty and predictability concerning the role of food-based and advanced biofuels in general and, specifically, regarding the sustainability rules applying to bioenergy post-2020, including the role of conventional biofuels (see more below).

Regarding the sustainability rules, there is a need to improve the sustainability criteria and the traceability rules in order to improve their effectiveness. In this respect, the European Court of Auditors found in an audit[86] that the way biofuel sustainability is currently verified entails weaknesses for instance regarding the supervision of voluntary certification schemes. The competences of the Commission and the Member States in this area are not set out clearly in current legislation. Furthermore, some provisions of the sustainability scheme and the traceability rules have proven to be difficult to implement and may need to be improved in a view to facilitate their implementation.

Driver 5: Uncertainty regarding actions in the heating and cooling sector

Even if the situation is quite homogenous at EU-level, with 18 Member States having heating and cooling shares representing more than 40% of total energy, there is currently an absence of promotion of heating and cooling measures across the sector in EU legislation, contrary to electricity and transport. In the absence of additional and coordinated policies, the current slow rate of progress in Member States is incompatible

[86] http://www.eca.europa.eu/Lists/ECADocuments/INSR16_18/INSR_BIOFUELS_EN.pdf

with a cost-effective achievement of the EU renewable energy target by 2030[87] and long-term decarbonisation goals[88].

From the analysis of the public consultation, lack of integrated energy strategy and planning at the national and local level, lack of targeted financing and lack of supportive policies for decentralised energy, self-consumption and thermal storage in buildings and district systems are perceived as the three most important barriers to renewables expansion in the heating and cooling sector (respectively, mentioned in 84%, 80% and 74% of the public consultation replies).

2.2.2. *Problem 2 - Need to improve cost-effectiveness of deployment of renewable energy*

The importance of a transition towards fully-market based and self-eliminating support of renewables has already been addressed in the previous chapter. In addition to that, there remain substantial benefits to be reaped by adapting the way in which renewables are currently deployed in the EU.

<u>Driver 1: Projected contribution of heating and cooling and transport sector not in line with cost-effective decarbonisation path</u>

Renewable technologies are being deployed across the three sectors - electricity, heating and cooling, and transport. Over the past decade, a lot of emphasis was put on the development of reneable electricity, possibly driven *inter alia* by the parallel efforts to open up EU's electricity markets. The 2030 and 2050 decarbonisations scenarios require however also accelerated reneables deployment in heating and cooling, and transport.

<u>Heating & cooling</u>

In the REF2016, renewable heating and cooling shares fall 2.3% points short of what would be needed for an overall cost effective path to 2030. Heating and cooling currently represents the most important single energy sector in the EU, with around half of the European energy demand. As explained in Section 2.2.1, there is currently an absence of promotion of heating and cooling measures across the sector in EU legislation, contrary to electricity and transport.

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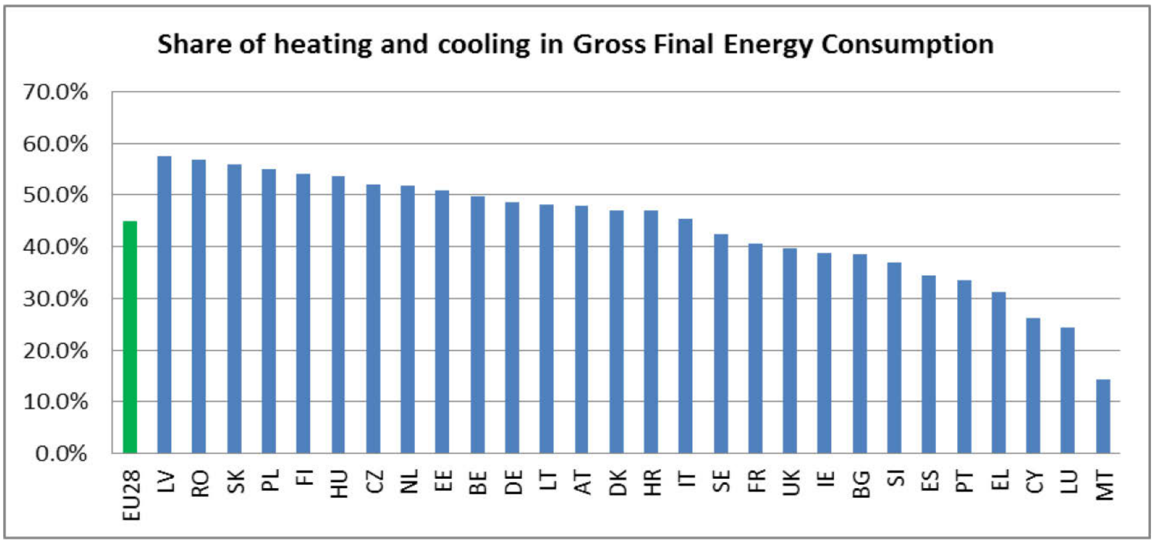
87 In absence of additional policies, the EU would only reach 24.7% renewable energy share in the heating and cooling by 2030, and due to the size of the heating and cooling sector in the overall energy consumption, and combined with absence of additional policies in other related climate and energy fields, that would result in only 24,3% overall share of renewables in 2030 – source : PRIMES REF2016.

88 Between 2015 and 2050, the GHG intensity of the residential and tertiary sectors should by divided by 4, and the renewable energy share in heating and cooling should reach 41.6% - source : PRIMES EUCO27



Therefore, while the share of renewable energy in electricity has increased by more than 8 percentage points (pp) between 2009 and 2015, the share of renewables in the heating and cooling sector has only expanded by less than 3 pp in the same period[89]. In the absence of additional and coordinated policies, the current slow rate of progress in Member States is incompatible with a cost-effective achievement of the EU renewable energy target by 2030[90] and long-term decarbonisation goals[91]. In the absence of additional policies in heating and cooling, there might also be a risk that the entire burden would be transferred to the electricity and the transport sectors, which might jeopardize the cost-effective achievement of our 2030 target.

Transport

Energy efficiency, electrification and the use of renewable energy in transports have all been identified as important elements in order to contribute towards the reduction of the EU oil import dependency and of transport decarbonisation in a cost-effective manner[92].

89 EUROSTAT, and "Renewable Energy Progress Report", Öko Institute [to be published], draft preliminary result

90 In absence of additional policies, the EU would only reach 24.7% renewable energy share in the heating and cooling by 2030, and due to the size of the heating and cooling sector in the overall energy consumption, and combined with absence of additional policies in other related climate and energy fields, that would result in only 24,3% overall share of renewables in 2030 – source : PRIMES Ref2016

91 Between 2015 and 2050, the GHG intensity of the residential and tertiary sectors would be divided by 4, and the renewable energy share in heating and cooling would reach 41.6% - source : PRIMES EUCO27

92 . Transport continues to rely nearly entirely on oil and oil products. Gasoline and diesel consumption makes up for 94% of energy use in road transport. Diesel accounts for almost the entirety of the commercial fleet, and a growing proportion of private cars. Maritime and aviation continue to rely entirely on fuel oil and kerosene, whereas in rail some further electrification has taken place in the last decade. Europe imports 87% of its crude oil from abroad, and its crude oil import bill is estimated at around €187 billion in 2015. This makes transport, and hence the wider economy of Europe, very reliant on the availability of oil and petroleum products on world markets. Road transport sector is not covered by the EU Emission Trading Scheme. The Energy Taxation Directive (ETD) stipulates minimum rates for excise duties for unleaded petrol of €359 per 1000 litres and €330 per 1000 litres for diesel (gasoil) used in transport. Excise duty rates differ between Member States. In 2011, the European Commission proposed a revision of the Energy Taxation Directive, which distinguished a CO_2-related component and an energy-related component in the excise duty. Applying this principle would have implied a minimum rate on

Modelling looking at options to achieve the 2030 climate and energy targets[93] indicates the share of biofuels in transports is projected to increase up to 7.8%[94] of total transport energy demand by 2030 (from 3.7% in 2010). Beyond 2030, modelling suggests the share of biofuels in liquid and gaseous transport fuels will need to increase significantly further, reaching around 46% by 2050 (equal to 36-37% of total transport energy demand). This also requires substitution of food-based biofuels by advanced biofuels with low effects on indirect land use change (ILUC) emissions. In particular, advanced biofuels are required to decarbonize the heavy duty, waterborne transport and aviation sectors that cannot be electrified with current technologies[95].

Respective contributions from the various sectors

As described under the EUCO27 scenario[96], the challenge for the renewable energy sector is to increase the share of renewables in all the RES-E, RES H&C and RES-T sectors, compared to 2020 levels. Compared to projected developments under the REF2016, the increased use of renewables in the electricity sector would be substantial contribution to the overall increase in renewables. Contributions from the heating and cooling and transport sectors would also be necessary in absolute terms, and are will have to take place in the context of significant reductions in final consumption in these sectors, mainly driven by improved energy efficiency. These reductions imply that increases in RES-H&C and RES-T shares will not only come from additional assets (as is partly the case for RES-E), but also from replacement of incumbent technologies that will be pushed out of their respective markets through a mix of demand reduction and fuel-switching.

In terms of evolution of energy consumption (Mtoe), this shows that: i) it is in the electricity sector that renewables consumption is projected to increase the most in absolute terms; ii) in the heating and cooling and transport sectors, in the context of an overall significant decrease in final consumption, an increase in renewables is still needed in absolute terms to reach the at least 27% target; iii) in the transport sector, the evolution presented in the table below also reflects the formula used to measure renewable energy consumption in transport, including double counting for renewable electricity for instance.

Evolution of gross final energy	REF2016	EUCO27	Diff EUCO27/ REF

diesel of €390 if the minimum rate on petrol would have been €359 per 1000 litres. The analysis accompanying this Commission proposal showed that CO2-based taxation drives consumption away from fossil energy sources. However, in 2014 the European Commission decided to withdraw its proposed revision of the Energy Taxation Directive, given that the draft compromise text was de facto void of all constituting elements of the original Commission proposal. This shows the difficulties in moving forward on taxation issues which require unanimity in the European Council

93 See scenarios analysed in SWD underpinning the European strategy for low-emission mobility; SWD (2016) 244 final

94 All shares in this paragraph are without double-counting as currently applied for RES-T calculations

95 These sectors are relying on diesel, kerosene and heavy fuel oil. Electrification of these transport modes does not seem feasible unless a major breakthrough in battery technology is achieved.

96 EUCO27 is a central policy scenario used in all Impact Assessments referred to in section 1.2 and projects energy system developments when reaching the relevant 2030 climate and energy targets. It provides an indication of the projected determinants of the changes in renewable energy necessary to reach the 27% target

consumption (total and for renewables) across sectors - Mtoe	2020	2030	Diff	2020	2030	Diff	2030
Gross Final Energy Consumption - Electricity	289	302	+13	290	302	+12	-0.4
Gross final consumption of electricity from RES	103	128	**+25**	103	143	**+40**	+15
Gross Final Energy Consumption - Heating and Cooling	540	485	-55	541	454	-87	-31
Gross final consumption of RES for heating and cooling	123	124	**+1**	124	128	**+4**	+4
Gross Final Energy Consumption - Transport	287	274	-13	287	256	-31	-18
Final consumption of energy from RES in transport	32	39	**+7**	32	46	**+14**	+7

Source: PRIMES

To conclude, this short descriptive analysis confirms that all renewable energy sectors are expected to contribute to the increased use of renewables by 2030, but in a differentiated manner, as this contribution is also influenced by the projected evolution of final energy demand.

Driver 2: RES-E support not fully responsive to different technology potential and maturity

Renewable technologies and potentials vary significantly. Ignoring these differences - *e.g.* by applying a strict technology-neutral approach - might result in either underinvestment or overcompensation.

Certain long-established (*e.g.* biomass co-firing) or fast-growing (*e.g.* onshore wind, solar photovoltaic) renewable electricity technologies have now reached a considerable share of market thanks to the inductive regulatory framework. They may be considered as technologically mature according to certain metrics, for instance being broadly commercially available and their share of total installed capacity[97]. It might however be sub-optimal for other reasons such as the energy system as a whole or land use concerns to only have these technologies as the winning tender.

Other renewable technologies, like offshore wind and concentrated solar power, are increasing their market share, or are still in an earlier stage of the innovation chain, like tidal stream energy, ocean wave energy, deep geothermal, highly performing advanced PV and building-integrated PV. The same applies to most technologies capable of storing electric power. As these technologies have the potential, in a medium- to long-term perspective, to largely contribute to a decarbonised, secure and cost-efficient energy system, the combination of public support (in line with the priorities identified in the

[97] According to Eurostat (May 2015), hydropower represented in 2013 15.7% of the total installed electricity capacity in the EU and 12.3% of total electricity generation in the EU. These figures were respectively 12.3% and 7.2% for wind and 8.3% and 2.6% for solar PV.

SET Plan and coordinated with the Member States' support) and private support is geared towards bridging the cost gap and pushing further technological and system innovation in Europe. The new renewable support framework will need to ensure that less mature technologies can continue their path towards market integration without abrupt stops.

Driver 3: RES-E support not fully responsive to different potentials across Member States/regions

There are clear benefits to be reaped from a more regional approach to renewables support.

Energy systems, and electricity systems in particular, were historically built on a national or even sub-national basis. From an infrastructure point of view, this has translated into limited interconnections between, or within, Member States. Insufficient transmission grid capacities limit the flexibility of energy systems, and hinder further renewable penetration. From an institutional and political point of view, this is one of the reasons that have contributed to policies supporting renewables being largely developed on a national basis. Financial support for renewable generation, in particular, has taken the form of national support schemes. This has led to a situation where renewables are deployed where support is the strongest and the most secure, rather than where the most cost-effective potential from an EU perspective is available. What is more, the fragmentation of markets leads to higher transaction costs, as developers and investors have to apply substantially different models for investments across Europe and build the related capacity.

The cooperation mechanisms introduced by the RES Directive allowed Member States to agree on cross-border support of renewables and to take advantage of another country's more cost-efficient potentials in renewables and achieve efficiency gains in view of their renewable energy targets. However, Member States have so far not engaged in joint support schemes with the exception of Norway and Sweden. This is due to a number of reasons ranging from administrative complexities (regarded as important or very important by 74% of respondents in the public consultation[98]) to political considerations, such as Member State reluctance to see their taxpayers money used for investments outside their country (94% - by far the most important consideration mentioned in the RES Directive public consultation[99]). In particular, it is especially difficult to ask consumers to support renewables deployment in a different country when they do not see a direct benefit out of it.

The opportunity given by the RES Directive of sharing the effort of the renewable energy targets more cost-effectively was, therefore, as of the time of this Impact Assessment, not yet utilised, despite ongoing negotiations between several Member States[100] and declared intentions to finalise these negotiations in 2016 and 2017.

However, a number of Member States are in the process of partially opening up their support schemes to cross-border participation[101]. Within the context of a reformed market design, a more interconnected and integrated electricity market, all of which are important components for the further deployment of renewables, the renewables policy

[98] By those respondents who expressed an opinion on the question
[99] By those respondents who expressed an opinion on the question
[100] Such as, for instance, Lithuania, Luxembourg and Portugal
[101] *E.g.,* Germany and Denmark

framework should facilitate a more cost-effective deployment of renewable electricity across the EU. This process of regionalisation of renewable policy is further underpinned by the political dialogue of Member States at regional level through, *inter alia*, the High Level Groups such as BEMIP and North Seas.

Driver 4: Differences in cost of capital, national approaches to grid connection fees and administrative procedures undermine optimal RES-E allocation across EU

There are significant benefits to be reaped from reducing national differences with regard to rules beyond support schemes affecting overall project cost, in the case of renewables mainly cost of capital, grid connection fees and administrative procedures. These differences can effectively undermine joint support schemes as was shown for the example of the NO-SE joint scheme in the evaluation. Addressing them for renewables specifically could be justified given the technologies' capital-intensity and linked higher risk premiums.

Cost of capital

Renewable electricity technologies face a number of factors that may make it hard for them to attract sufficient and affordable funding from investors, including but not limited to: capital intensity, resource risk, real or perceived technology risk, under-recognition of the long-term value of reducing variable fuel cost exposure. In the absence of perfect foresight (leading to myopic requirements for short term returns) and/or the presence of poor or asymmetric information or understanding (leading to overestimation of risks), renewables typically only have access to scarcer and/or more expensive capital than more conventional energy technologies. Such failures can apply to both large-scale and small-scale investors (*e.g.* households).

Additionally, in the post-2020 context with high shares of renewables and deeper market integration, renewables should be increasingly integrated into the market and face obligations similar to those of conventional generators. This entails additional costs and risks for renewables investors (balancing costs, market price volatility), as these costs have so far been transferred to other entities, which translate into higher cost of capital, higher LCOE for the individual investor, and higher renewables deployment costs – all elements to be taken into account when assessing the benefits of better market functioning[102].

Only in a limited number of Member States some of the most mature renewables technologies have today access to capital at a cost that is comparable to that of more conventional technologies, although investments conditions for fossil fuel power plants have also been affected by higher operating costs and combined effect of low carbon and low wholesale electricity prices[103]. Funding remains limited and/or costly for mature technologies in many Member States as well as for a number of less-mature technologies. As way of illustration, recent research[104] estimated that the weighted average cost of capital (WACC) of a typical onshore wind project varied in 2015 from 3.5% to 12%

102 See the Market Design Initiative Impact Assessment
103 World Energy Investment Outlook, 2014
104 The impact of risks in renewable investments and the role of smart policies, Diacore, 2016

depending on Member States[105]. Given the capital-intensity of most renewable technologies, a higher WACC significantly increases the overall cost of a given renewable project.

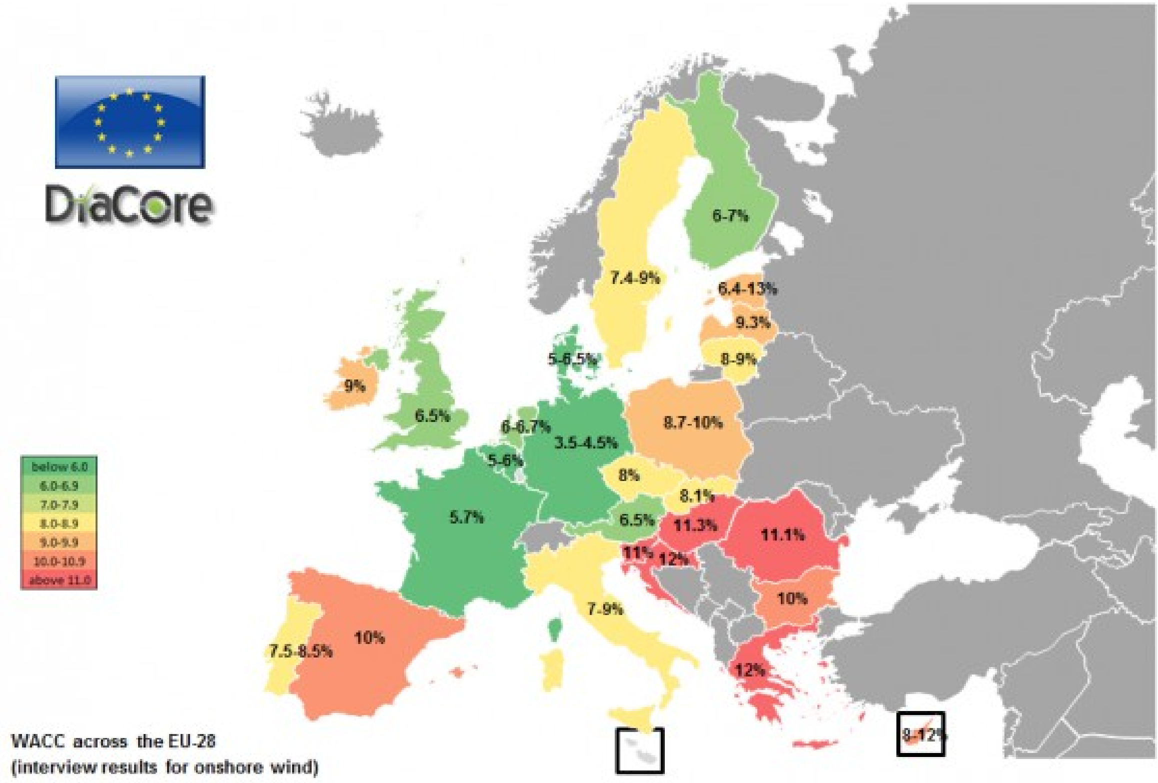


Figure 5: Diacore

Additionally, it should be noted that significant variations in the level of WACC across Europe may hamper the deployment of renewables in the EU where the economic potential is otherwise the highest. A mere 1% WACC difference can increase the total cost of the project by 5%.

Finance also typically remains scarce for the fragmented, smaller-scale renewable projects, which face high transaction costs relative to the amount of funding required – in addition to often facing split incentives between tenants and owners.

The estimation of the required amount of capital expenditure in RES-E capacity to reach European targets varies a lot depending on the source and scope of the research[106]. For instance, Bloomberg New Energy Finance estimates investments in new renewables electricity generation capacity to amount to USD 1.0 trillion over 2015 to 2030 (around EUR 57 billion per year)[107], while the World Energy Investment Outlook concludes that

105 In addition to the generic country risk, other factors affecting the difference in WACC across the EU are the policy-induced risk, hence the design and the reliability of renewable energy support, the administrative costs, the grid connection costs, etc.

106 Most of the researches have a broad scope, providing insight in the total costs of decarbonising the energy sector, including both investments in renewables, and investments in the necessary expansion and reinvestments in grid infrastructure and potential back-up facilities.

107 Source: Bloomberg New Energy Finance (2014). 2030 Market Outlook

roughly USD 1.2 trillion is required in the EU between 2014 and 2035 (around EUR 52 billion per year)[108].

Currently, there are no EU-level facilities dedicated to providing debt or equity financing to renewables generation projects only. The EU budget is supporting certain demonstration projects of new technologies under the Secure, Clean and Efficient Energy Challenge of Horizon 2020[109]. European Structural and Investment Funds (ESIF) have a strong focus on low-carbon investments in the 2014-2020 period, including support for renewable energy projects and related research and innovation, which can take the form of grants or financial instruments (*e.g.* loans, guarantees or equity). Additionally, the NER300, funded through the sale of 300 million emission allowances from the ETS, is a funding programme for the development of innovative low carbon energy demonstration projects, including innovative RES technologies in the EU[110]. For the period after 2020, an Innovation Fund would be set up through the sale of 450 million emission allowances that could fund innovative RES projects[111]. The EU is also indirectly investing in renewable generation projects via facilities such as the Marguerite Fund and the European Energy Efficiency Fund. Finally, the European Investment Bank (EIB) is providing debt and equity for renewable energy generation and grid projects, across all Member States – and the European Fund for Strategic Investments (EFSI) is providing the EIB with additional risk-bearing capacity[112].

Public support in the form of debt or equity support is mostly taking place at national or sub-national level. Some Member States have developed specific renewables financing programmes, often through their National Promotional Banks (NPBs)..

Existing funds such as the Marguerite Fund and the European Energy Efficiency Fund currently have their investment strategy defined not only by the EU, but also by their other sponsors (national public banks or private investors). EIB's renewables investments are driven by the EIB's sectorial strategies and credit policies. As for the EFSI guarantee, while renewable projects have to date represented a large share of total EFSI funding, its use is governed by the overall economic recovery-focused objectives of the EFSI; importantly, the EFSI is currently not foreseen to exist post-2020.

Costs related to administrative procedures

Administrative costs vary between Member States but non-economic barriers can be costly. They currently account for around 15% of the overall development costs of wind projects in the Member State analysed[113]. Administrative barriers[114] bring uncertainty and delay to investors, artificially increase the costs of renewable energy projects, create distortions in the allocation of investments within the EU, and therefore hamper building a single integrated market for renewable energy and reaching a cost-effective deployment. Given that the Revised RES Directive will not feature binding national

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108 Source: International Energy Agency (2014). World Energy Investment Outlook. See http://www.iea.org/publications/freepublications/publication/weio2014.pdf

109 C(2016)1349 of 9 March 2016

110 http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

111 http://ec.europa.eu/clima/policies/ets/revision/index_en.htm

112 The EIB is also managing with the Commission the "NER 300" programme for innovative low-carbon energy demonstration projects

113 “Renewable Energy Progress Report”, Öko Institute [to be published]

114 *E.g.* lengthy administrative procedures, complex licensing procedures, fragmented or unclear responsibilities, institutional overlaps, etc

targets but only a binding European target, enablers for a cost-effective deployment of renewables also at national level become more relevant.

Article 13 of RES Directive mandates streamlining, expediting and coordinating administrative procedures but more progress in the EU needs to be made. There is overwhelming support for a further reduction of administrative barriers among stakeholders. 79 % of respondents to the public consultation who expressed an opinion on the issue identified the creation of a one stop shop as the centrepiece of this simplification and 85% are in favour of fixed time limits. The REFIT Evaluation of the RES Directive found that depending on the Member State, region or technology, issuing of renewables permits can take from less than 5 weeks in one Member State to 7 years in other Member States[115]

Additionally, the current Article 13 of the RES Directive does not take into account the repowering of existing projects, which will become of key importance in the next decade, especially for wind power. As 76 GW of today’s 142GW installed capacity will need repowering between 2020 and 2030, repowering can offer a cost-effective solution and its facilitation could be sensible.

On the other hand, stakeholders' responses to the public consultation and the REFIT evaluations of both the RES Directive and the energy acquis emphasised the positive role played by the national plans for ensuring investment certainty and target achievement and the administrative cost reduction achieved by having a binding uniform template for renewables planning.

Differences in grid connection charges

Other costs applicable to renewables generators, in particular grid connection fees, may lead to investment distortions. Some Member States apply a "deep" model, where the renewables generator bears the costs of grid connection, grid reinforcement and extension. Other Member States apply a "shallow" model, where the generator only bears the costs of grid connection, while grid reinforcement and extension are built into the grid tariffs (and thus paid in the end by customers). Such differences have an impact on the costs of the projects and increase the distortion in allocation of investments across the EU. This issue will be addressed in the market design Impact Assessment.

2.2.3. Problem 3 - Absence of functioning markets

Well-functioning internal energy markets are crucial for the deployment of renewables. However, markets in the electricity, transport and heating and cooling sectors are at different phases and require different measures to ensure their functioning.

In the case of the electricity sector, where renewables are expected to reach around 50% market penetration, the market is being redesigned to support the integration of renewables. In the heating and cooling market, the challenge is to ensure access and sufficient incentives for the expansion of renewables. In some of the segments of the transport sector, new markets for renewable fuels have to be created.

Heat markets are inherently local, but across the EU are not fully functional due to the following main drivers.

115 REFIT evaluation of the RES Directive

Driver 1: External costs of competing technologies not properly internalised

Heating & cooling

The negative externalities of the fossil fuel use in the heating and cooling sector[116] are not internalised and reflected in the energy prices for most parts of the heating and cooling sector, which hinders market uptake of highly efficient renewable energy technologies at centralised (district heating) and decentralised (building) level. When the vast majority of individual heating is based on fossil-fuel solutions, out of which more than 40% on gas only, renewable alternatives are not able to compete on equal footing with existing solutions, which often leads to technology lock-in at individual level. The market, as currently designed, does not provide sufficient incentives for fuel-switching and therefore hampers the fulfilment of the objectives above.

Transport

Road transport sector is not covered by the EU Emission Trading Scheme. The Energy Taxation Directive stipulates minimum rates for excise duties for unleaded petrol of €359 per 1000 litres and €330 per 1000 litres for diesel (gasoil) used in transport. Excise duty rates differ between Member States[117]. In 2011, the European Commission proposed a revision of the Energy Taxation Directive, which distinguished a CO2-related component and an energy-related component in the excise duty. Applying this principle would have implied a minimum rate on diesel of €390 if the minimum rate on petrol would have been €359 per 1000 litres, in addition Member States would have been asked to mirror the Commission's minima in their national rates. The analysis accompanying this Commission proposal showed that CO2-based taxation drives consumption away from fossil energy sources. However, in 2015 the European Commission decided to withdraw its proposed revision of the Energy Taxation Directive, given that the draft compromise text was *de facto* void of all constituting elements of the original Commission proposal. This shows the difficulties in moving forward on relatedissues which require unanimity in the European Council.

Driver 2: Transition towards renewables can in many occasions only be done at sector/system level

Heating & cooling

The lack of an EU-wide strategy has led to very fragmented local markets, where consumers have difficulties in making choices based on their preferences and lack of regulatory policies creating incentives for decentralised energy, self-consumption and thermal storage in buildings and district systems.

At EU-level, natural gas with a share of 45% is by far the most important heating fuel. Other energy carriers are relatively equally distributed: electricity with 12%, heating fuel oil with 12%, biomass with 12%, coal with 9% and district heating with 8%. Less important are ambient heat and waste non-renewables with about 1% and solar energy, waste renewables and geothermal energy, all with below 1%.

116 Such as climate change and air pollution, with environmental and health consequences

117 For petrol, they range from just over the minimum to €766 per 1000 litres in the Netherlands. For diesel actual rates are generally lower and closer to the minimum, the highest rate reaching €674 in the United Kingdom

The picture is a lot more diverse when looking at the heating fuel mix at Member State level (see Figure 6). Member States are sorted according to their total final energy demand for heating and cooling, starting with the largest consumer on the left, *i.e.* Germany. Natural gas is the major energy carrier in many Member States, reaching up to 68% in the United Kingdom, 66% in the Netherlands and 59% in Hungary. Countries with a natural gas share of below 5% are Finland, Sweden (and Norway and Iceland), plus Malta and Cyprus. Poland has an exceptionally high share of coal with 38%, followed by Slovakia (20%) and the Czech Republic (17%). On the other side, in 24 out of 31 countries the share of coal is below 10%.

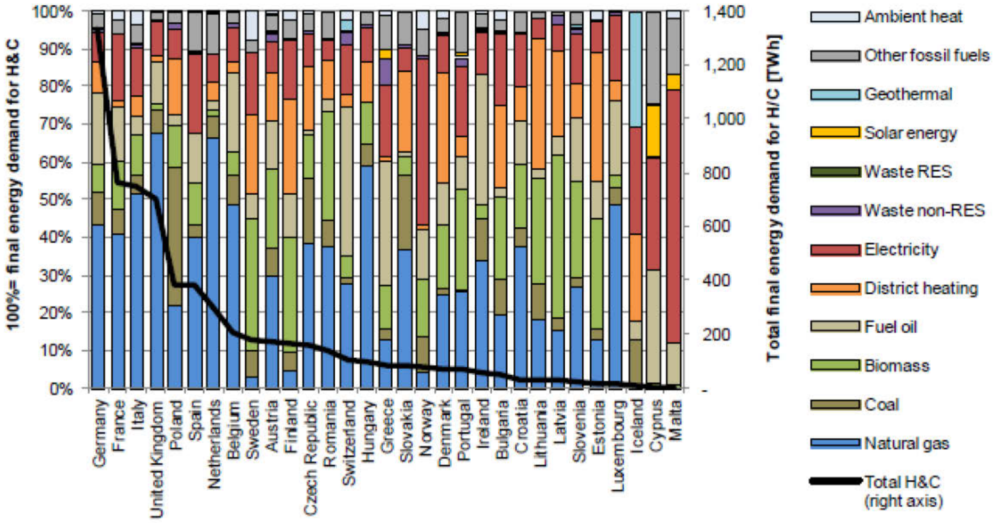

Figure 6: Final energy demand for heating and cooling in the EU28+3 countries by energy carrier in 2012 [TWh][118]

While natural gas suppliers are mostly large-scale and concentrated[119], the European heating oil market is predominantly supplied by around 12,500 small and medium-sized enterprises[120], the coal market being even more heterogeneous[121]. About 10,000 district heating systems were operating across the EU-28 for district heating in 2015[122]. However, since several district heating suppliers run more than one system, the total number of district heating systems represents the upper limit of suppliers in the EU[123].

An EU intervention in this sector might help create an integrated EU market for renewables in heating and cooling, especially for gas suppliers that represent more than 40% of the total supply.

118 Source: Fraunhofer, 2016

119 Fraunhofer, 2016. With exception for DE and IT

120 UPEI, 2015

121 Fraunhofer, 2016

122 Euroheat&Power (2015)

123 For instance in Finland the 400 district heating systems are operated by about 100 district heating suppliers (Energiateollisuus 2014). In Germany in 2014 the nearly 1400 district heating systems were operated by about 550 companies (BMWI 2016). In Lithuania about 50 district heating suppliers (33 municipal companies and 17 undertakings operating on the basis of leasing agreements) were operating about 360 district heating systems in 2013

Transport

Aviation and maritime sectors pose particular challenge as with current state of technology only biokerosene and biomethane are a viable decarbonisation pathway. These two sectors contribute an increasing share to the total transport emissions over time, going up from 19 to 23% during 1990-2014. Direct emissions from aviation account for about 3% of the EU's total greenhouse gas emissions. Furthermore, international aviation and shipping are the transport sectors where emissions of air pollutants have actually experienced the strongest increase since 1990 (except for SOx and PM from shipping). Since the start of 2012, emissions from all flights from, to and within the European Economic Area (EEA) have been included in the EU Emissions Trading System. These emissions form part of the EU's internal 20% and 40% greenhouse gas (GHG) emission reduction targets for 2020 and 2030 respectively.

The development of alternative and renewable fuels for these two sectors has been hampered by the a) lack of commercial viability of such fossil fuel alternative; coupled with b) over-supply of fossil fuel-powered shipping and aviation in recent years and the related depressed investment market. In aviation, the traditional fuel is a hydrocarbon, almost exclusively obtained from the kerosene fraction of crude oil. Fuel specifications for aviation fuels are also very stringent. In this context, advanced liquid biofuels appear to be the only low carbon option for substituting kerosene, as they have high specific energy content. However, advanced biofuels are today significantly more expensive to produce compared to the cost of kerosene today. An additional challenge in the maritime sector is given by the existence of split incentives between ship owners and operators resulting in limited motivation for deployment of clean energy solutions in this sector.

Driver 3: No incentives for district heating systems to become more efficient and no access rights to the infrastructure for new entrants (including RES)

District heating currently provides around 10% of the EU's heating, with natural gas (40%) and coal (29%) being the main fuels used for district heating, followed by 16% of biomass[124]. However, the share might be substantially higher for single Member States, as illustrated in figure 7.

[124] An EU Strategy on Heating and Cooling, COM (2016) 51/2

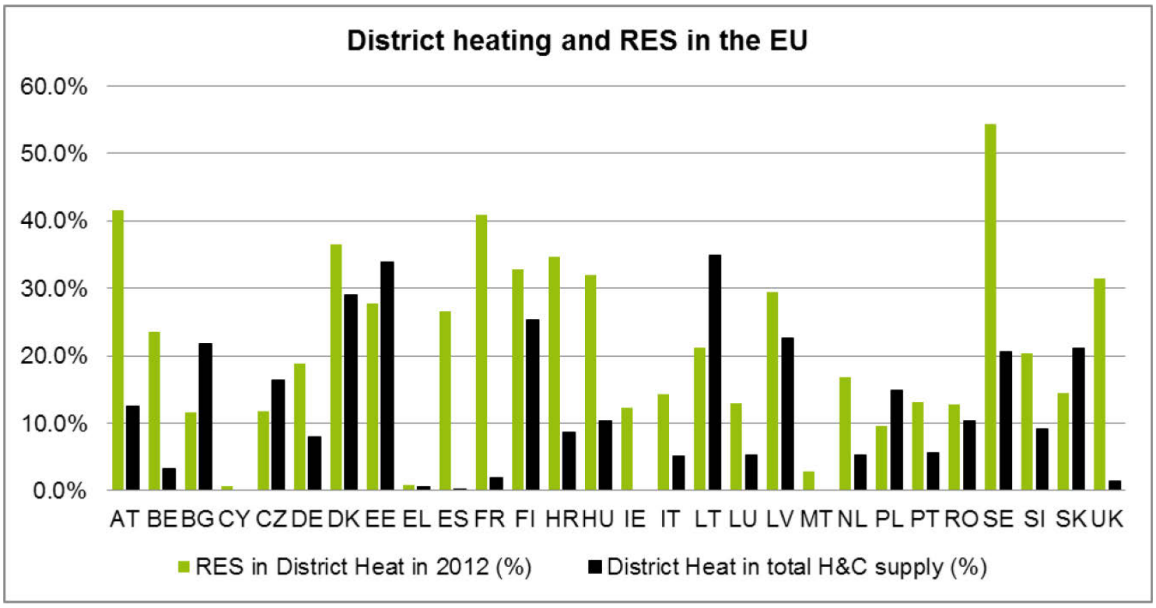

Figure 7: District Heating and renewables in the EU[125]

The EU Strategy for Heating and Cooling clearly identifies the cost reduction potential for the EU energy system, by improving the performance of district heating and cooling systems. According to Fraunhofer ISI et al. (2016), 53% of the total capacity of CHP plants exceeding 1 MW_{th} was installed before 1992; while 26% was installed between 1992-2002; and 21% after 2002. The older district heating and cooling systems must evolve to accommodate the increase of renewable energy supply.

District heating and cooling have also the potential to contribute to balancing the electricity grid. According to Eurostat in 2013, about 72% of district heating and cooling systems were fuelled by combined heat and power plants, which means that most of heating and cooling systems are linked with the electricity network. Measures such as targeted urban planning and integrated heat mapping, which facilitate the move towards an integrated energy system approach and local heat markets, received wide support (88% of stakeholders in the public consultation[126]).

Neither the current RES Directive nor the EED directly empowers consumers to prompt district heating or cooling systems to improve their efficiency and/or increase the use of renewable energies. There is currently also no access for new entrants (including renewables) to the infrastructure in several Member States.

2.2.4. Problem 4 - Need to update the regulatory framework

<u>Driver 1: Current RES Directive built on national targets and to be adjusted to ensure collective RES target attainment</u>

Current legal provisions and monitoring set up were developed for an EU instrument underpinned by national binding targets not in order to equip the Commission with the best tools for facilitating most cost-effective collective attainment.

[125] Source: Fraunhofer, 2016. 2012 figures

[126] See RES Public consultation results: https://ec.europa.eu/energy/en/consultations/preparation-new-renewable-energy-directive-period-after-2020

The European Council concluded that the European Union needs to achieve at least a 27% share of renewable energy sources and that it will be based on an EU level binding target as opposed to the existing EU and national binding targets in the current framework.

In the absence of binding national targets for renewable energy post-2020, one main challenge is how the at least 27% share in 2030 will be delivered in a cost-effective way through EU, regional and national level actions, taking into account differing national capacities to produce renewable energy, whilst building on the renewable shares achieved in 2020.

In this context, Member States' Integrated National Energy and Climate Plans, to be developed as part of the initiative on Energy Union Governance, will play an important role, as they will include national contributions to the EU-level 2030 target for renewable energy. This part will be addressed by the parallel initiative on Energy Union Governance. However certainty for all Member States the other Member States also deliver with their post cost effective potential can be further enhanced.

Despite the approach taken under the Governance process, an ambition gap might emerge if Member States' collective contributions eventually fell short of the at least 27% target. This is a special issue requiring consideration given the fact that the target is binding at EU level. A similar issue arises in the case of a delivery gap, which would occur if the Member States do not manage to meet their planned national trajectories. The issue of ambition and delivery gaps do not arise under the current legislation that foresees national binding targets. Therefore there is no mechanism in place to avoid such gaps happening. The Energy Union Governance initiative aims, *inter alia*, via an iterative dialogue with Member States, at addressing those issues. However, there is a question on whether additional and specific mechanisms should also be included in the revised RES Directive to complement this work by providing a backstop and to make sure that the target is delivered in a timely manner. Such mechanisms should be key to ensure investors certainty as regards a continued project pipeline and also by providing Member States with the right incentives to contribute appropriately to the EU level binding target.

A specific issue in this overall context concerns the fact that, in the absence of an adequate legal framework, Member States may decide to reduce their efforts to encourage renewable energy from 2021, the year after the end of the binding 2020 requirements. This could jeopardise the collective achievement of the 2030 EU renewable energy target and it also disincentives the use of cooperation mechanisms in the form of projects rather than statistical transfer to meet the 2020 targets. It could also be in contradiction with the European Council conclusions of October 2014 which reconfirmed that the 2020 targets needed to be fully met.

Another question concerns the potential trajectory of efforts to be considered between 2020 and 2030. The RES Directive contains an accelerating, non-linear, trajectory for each Member State and at EU-level for achievement of the 2020 national targets. This implies that greater amounts of renewables need to be produced in the years close to the targets' year, relative to the early years. An accelerating trajectory at EU-level is appropriate in an era where renewable technology is fast developing and significant cost reductions can be anticipated over time. From 2021 to 2030, many renewables technologies will be mature with much smaller potential for significant cost reduction[127] potentially requiring a different approach to define the trajectory.

The options under consideration aim to create together a comprehensive framework for achieving the EU wide at least 27% renewable energy target. A framework that is transparent and which provides positive incentives for Member States to further develop renewables. It seeks to do this in a way that does not involve mandatory national targets for Member States.

Driver 2: Lack of specific RES-transport target post-2020 and uncertainty regarding future demand for alternative fuels (including renewable fuels)

The REFIT evaluation on the RES Directive and the public consultation highlighted that the uncertainty about the policy framework for renewables in transport after 2020 is a significant barrier for future investments in renewable fuels, particularly in capital intensive advanced biofuels. Without a clear and predictable EU policy framework, the required economies of scale and technology learning effects needed to bring technology costs down while ensuring robust GHG savings are unlikely to materialize within the next 15 years.

Key advanced biofuel technologies such as lignocellulose ethanol, synthetic Bio DME, Bio-Methane and pyrolysis oils are ready to be deployed at commercial scale (see box below). The EU has been investing significant funds in research and development of these innovative technologies through Horizon 2020 programme, and its predecessor the 7th Framework Programme for Research and Innovation. This has been complemented by national R&D programmes and private research performed by traditional fuel suppliers and new market entrants. As a result, in 2015 the EU accounted for 9% of global installed capacity of advanced biofuels (130.83 million litres). Current production plants of advanced biofuels are located in Finland, Germany, Italy, Sweden and the Netherlands. This capacity has to develop further and timely for transport to contribute to 2030 targets and 2050 decarbonisation objectives. Timely development at a right scale will enable to lower the costs in the long term.

Box 1: Advanced biofuels – state of play

- *Ethanol from lignocellulosics*: This value chain is the closest to achieving market deployment. There are two main reasons for this: the number of competing technologies and the technology breakthroughs achieved in the last years. However, fragmented fuel markets, lack of technical standards and lack of vehicle fleet for ethanol content higher than 10% hamper the market deployment.
- *Pyrolysis oils*: Pyrolysis oils can be fed directly into a petroleum refinery after some upgrading and be processed with oil, thus eliminating the cost of building a dedicated plant. The first of-a-kind plants have already been developed.
- *Synthetic biofuels:* Synthetic biofuels are still facing technical hurdles. The main reason behind is that the corresponding scale for first-of-a-kind-plants is larger than that of lignocellulosic ethanol (lignocellulosic ethanol plants are economically viable from a capacity range of about 100 to 120 ktons/y while synthetic biofuel plants are economically viable from a capacity range of about 175 to 250 ktons/y). Synthetic biofuels can be used for both road and air transport (*e.g.* jetfuel).

127 Solar PV cost reduction of 59% , onshore wind 26%, and offshore wind 35% by 2025, The Power to Change: solar and wind cost reduction potential to 2025, IRENA, 2016

- *Biofuels from algae:* Algae technologies are at the early stages of development, however, they are making significant advances[128]. Algae can produce a variety of biofuels and at present algal fuels produced from combined operations with waste water purification, is the preferred route. Such applications are expected to enter the market by 2020.
- *Biofuels from microbial conversion*: This value chain addresses various technologies that are at the early stages of development. However, they are very attractive since they are expected to have better efficiencies than current technologies.
- *Power to gas and power to liquid fuels.* These fuels are currently in the development phase. Fuel production from power to gas (methane) or power to liquid (methanol) is under development for application to heavy duty, maritime transport and aviation fuel[129].

Biofuels and biomethane are the main option for transport decarbonisation but other alternative energies have also role to play. Electrification of transports is, today, mainly taking place in non-road transport, most notably in rail transport. Due to recent technology improvements in batteries, the limited range of battery electric vehicles (BEV) is becoming today less of a constraint to their use. Also a minimum infrastructure coverage is to be provided under Directive 2014/94/EU, and some Member States have ambitious national strategies for the deployment of electric vehicles and dedicated infrastructure for the coming years. However, several barriers need to be addressed in order to enable widespread electrification of road transport, including improvements in battery costs, Vehicle-to-Grid communication, payment issues and broader integration of electric vehicles within the electricity grid.

The use of hydrogen in transport is today almost negligible. Major car manufacturers have announced that fuel cell propelled cars are to be produced at commercial scale in the future and few models are already available now. However, their high price and the lack of availability of refuelling infrastructure are representing major barriers for the widespread use of hydrogen in transport. It should be noted that a minimum infrastructure provision is optional under Directive 2014/94/EU, and some Member States have national strategies for the deployment of hydrogen infrastructure for the coming years. Hydrogen is currently projected to grow significantly beyond 2030 albeit maintaining a limited share of transport fuels.

Driver 3: Variable climate performance of conventional biofuels (due to ILUC)

Conventional biofuels have been promoted to both increase the EU energy security and contribute to reduce GHG emissions in transport compared to fossil fuels. According to the EU biofuels sustainability criteria (laid down both in the RES Directive and the Fuel Quality Directive), existing biofuel plants need to reduce direct GHG emissions by at least 35% and new by at least 50% compared to fossil fuels. While these criteria address only direct emissions from cultivation, transport and processing, in recent years, research

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128 In a relatively short period of time the industry was able to move to large scale demonstration and all 3 projects supported under FP7 are on 10 ha area

129 Several shipping companies and ship-engine manufacturers (MAN, Wartsila and Meyer Werft) are exploring the potential use of methanol (either bio or power to gas origin) in ferry operations. Stena is already operating a methanol powered ferry from Hamburg to Stockholm and Maersk is contracting another one. Tests have also been done with biodiesel but the preferred alternative fuel beyond LNG for the maritime sector appears to be methanol. In Nordic countries the MARINA project aims to reduce emissions and increase the use of alternative fuels in the marine sector. To do so, the project aims to create a network between key players in all the Nordic countries to identify policy and roadmap recommendations for Nordic policy and decision makers on how to increase the use of alternative fuels and reduce emissions from marine applications.

has shown that, due to market mediated effects, food based biofuels can also lead to significant Indirect Land Use Change (ILUC) emissions that can off-set their direct GHG savings (see table below).

In particular the increase in demand for crops for biofuels can contribute indirectly to growing pressure on forests and other carbon-rich ecosystems, and therefore increase emissions from land use change. Such emissions are mostly expected to take place in third countries, where the additional production is likely to be realised at the lowest cost. The GLOBIOM study[130] carried out for the Commission has indicated that ILUC emissions can be expected to be much higher for biofuels produced from vegetable oils compared to biofuels produced from starch or sugar. This is due to the specific characteristics of global vegetable oil markets, which are highly integrated. As result increasing demand for vegetable oils in Europe for biofuel production can lead to increased palm oil imports and, therefore, in an extension of palm oil plantations in South-East Asia. Typically, these developments take place on organic soils, which can result in a significant release of GHG emissions. On the contrary, research has pointed out that advanced biofuels from non-food crops have generally very low or no ILUC emissions.

Table 2: ILUC emissions from GTAP[131], MIRAGE[132], GLOBIOM[133]

	GTAP 2014[1]	MIRAGE 2011[2]	MIRAGE 2013[3]	GLOBIOM 2015[4]
Biofuel	iLUC emissions(gCO2/MJ)			
Corn Ethanol	20	10	12	14
Sugarcane Ethanol	12	13	14	17
Soy Biodiesel	29	56	56	150
Canola=Rapeseed Bi	15	54	55	65
Palm Biodiesel	71	54	55	231

To mitigate this issue, the ILUC Directive[134] has introduced a cap of 7% on the contribution of food-based biofuels towards transport energy consumption, and Member States have the ability to apply this cap to their FQD targets. Member States are also required to set out by 6 April 2017 an indicative target for advanced biofuels, with a reference value of 0.5% of transport energy consumption in 2020[135]. In addition, the ILUC Directive aims at promoting the use of other, non-ILUC renewable energy options in transport, such as biofuels not based on food crops, and renewable electricity.

The ILUC Directive also introduced the concept of "low indirect land-use change-risk biofuels and bioliquids". The idea behind this concept is that ILUC risks of conventional food-based biofuels can be avoided if measures are taken that compensate for the increase in demand for crops *e.g.* by applying measures that increase crop yields through improved inputs and management practices or by expanding agriculture on previously

130 Valin et al., 2015, GLOBIOM study http://www.globiom-iluc.eu/
131 New GTAP results in CARB website: http://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15appi.pdf
132 Laborde, 2011. Results of MIRAGE model (per crop group) are used in the 'ILUC Directive' (Directive 2015/1513); JRC, 2014
133 Valin et al., 2015, GLOBIOM study http://www.globiom-iluc.eu/
134 Directive (EU) 2015/1513
135 The following MS have adopted indicative targets: Italy: 1.2% by 2018 yearly increased to 2% by 2022; Denmark: 0.9% by 2020, France: 1.6% in petrol and 1% in diesel by 2018 and 3.4% in petrol and 2.3% in diesel by 2023

non-agricultural land with low carbon stocks and low biodiversity value. In a recent study from Ecofys a methodology for certification of low indirect land-use change-risk biofuels was developed[136]. The practical implementation of this concept, however, is still largely untested and uncertainty concerning the related costs and the robustness of approach remain. Therefore, the approach cannot be considered as a viable solution at this stage but the further exploration of the concept for instance by voluntary certification schemes could be encouraged.

In its July 2016 Low-emission mobility strategy, the Commissions reaffirms that that food-based biofuels have a limited role in decarbonising the transport sector and should be gradually phased out and replaced by low emission alternative energy, including advanced biofuels. Research suggests that advanced biofuels can lead to significant direct GHG savings of 76-95%[137] compared to fossil fuels and are not associated with significant ILUC risks[138]. Modelling work that underpins the strategy shows significant role of advanced bio-fuels, especially in achieving 2050 decarbonisation targets.

The production of biofuels from non-land using feedstocks in the EU is increasing, the majority of which is produced from used cooking oil or waste animal fat. The share of food crop-based biofuels in the EU market is decreasing. However, the biofuel industry argues that double-counting provisions have so far only assisted the deployment of inexpensive conversion of used oils and waste fats.

Furthermore, it should be recalled that the REFIT evaluation on the RES Directive and the public consultation results highlighted that regulatory uncertainty remains problematic for many stakeholders in the transport sector. In fact, the main barrier to investment in the sector as identified by industry, investors, associations and other stakeholders was the uncertainty about the policy framework for biofuels after 2020 and the long-led debate before adopting Directive (EU) 2015/1513 (ILUC Directive).

2.2.5. Problem 5 - Lack of citizen-buy in during transition

<u>Driver 1: Risk that small scale investors are disadvantaged in market-based renewables support (tendering) and thus result in lower public acceptance</u>

If renewable energy benefits from an overall positive opinion by most European consumers[139], some specific renewable energy projects face strong opposition at local level. In Wallonia for instance, in 2014, 37 wind projects, representing 215 wind mills and 592MW[140] were challenged by opponents[141]. In Denmark, there are more than 200 local groups opposing wind power[142]. In France, around one third of wind projects are

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136 Ecofys 2016: Methodologies for the identification and certification of Low ILUC risk biofuels

137 Annex V RES Directive

138 For instance, the GLOBIOM study for instance did not find significant negative impact for advanced biofuels produced from short rotation coppice, Valin et al., 2015

139 Nine in ten Europeans (90%) think that it is important for their government to set targets to increase the amount of renewable energy used by 2030, Special Eurobarometer 409, European Commission, 2013

140 For around 150MW installed in 2014

141 Propriété coopérative et acceptabilité sociale de l'éolien terrestre, Thomas Bauwen, 2015

142 What drives the development of community energy in Europe, Thomas Bauwen et al., 2015

brought to the court, creating lengthy procedure (between 6 and 8 years) and increasing costs of development[143].

This lack of public acceptance therefore leads to an untapped use of the most cost-efficient renewable potential (both in terms of locations and feedstocks), creates lengthy and uncertain procedures, increases overall cost and hinders access to cheap capital. Among the factors influencing local acceptance of renewables, lack of access to project ownership or finance, lack of information and lack of participation for local communities (including municipalities) have been identified as key issues[144].

In several Member States, the creation of energy communities has been a solution to enhance social acceptance of renewable technologies at local level[145] and diminished opposition[146]. In Germany, a case study has shown that, in the absence of local participation, negative opinions towards additional wind energy could reach 60%, while this share would drop to 12% in case of the presence of energy communities[147].

Reinforcing local acceptance, *e.g.* through the promotion of local energy communities, is therefore a fundamental precondition for deploying renewable energies in a cost-effective way[148].

However, even if local involvement of communities is proven to substantially increase public acceptance of renewables and often reduce costs as co-owners do not demand same returns as classic investors, their specific situation is currently not reflected in renewables support rules. Administrative barriers are particularly relevant for communities and prosumers, who often lack the critical mass and knowledge to overcome them. In addition, such actors may have difficulties integrating in the market or participating in competitive bidding processes, especially for energy cooperatives and small-scale projects[149].

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143 La politique de développement des énergies renouvelables, Cour des Comptes, 2013

144 Jober et al., *Local acceptance of wind energy: Factors of success identified in French and German case studies*, 2007; Jan Zoellner et ali, *Public acceptance of renewable energies: Results from case studies in Germany*, 2008; Thomas Bauwen et al., *What drives the development of community energy in Europe*, 2015; Joyce McLaren Loring, *Wind energy planning in England, Wales and Denmark: Factors influencing project success*, 2006

145 Thomas Bauwen, *Propriété coopérative et acceptabilité sociale de l'éolien terrestre*, 2015; Thomas Bauwen et al., *What drives the development of community energy in Europe*, 2015; David Toke et al., *Wind power deployment outcomes: How can we account for the differences?*, 2006; Fabian David Musall, Onno Kuik, *Local acceptance of renewable energy - A case study from southeast Germany*, 2011

146 Thomas Bauwen et al., *What drives the development of community energy in Europe*, 2015

147 Fabian David Musall et al, "Local acceptance of renewable energy —A case study from southeast Germany", 2011. Considering negative and very negative together

148 Projects with high levels of public acceptance are more likely to succeed in receiving planning permission, while projects with low levels of public acceptance are more likely to fail, Joyce McLaren Loring *Wind energy planning in England, Wales and Denmark: Factors influencing project success*, 2006

149 The upcoming auctions are expected to put a strong competitive disadvantage upon Community Wind projects. WWEA, *Community Wind Perspectives from North-Rhine Westphalia and the World*, 2016

Driver 2: Lack of consumer empowerment in the energy transition

Self-consumption of renewable electricity is expected to be the main driver for the uptake of roof-top PV. With decreasing feed-in tariffs, around 50 % of the roof-top PV capacity could be driven by self-consumption.

Renewable energy self-consumption, mostly driven by the deployment of residential solar PV, and to a lesser extent small wind power systems, has become an important trend since the implementation of the RES Directive. With an 80% drop in PV module prices in five years[150], the installed residential PV capacity has quadrupled since 2009 in the EU[151] and it is expected to continue to increase thanks inter alia to further reductions in technology costs. As a result, businesses and households, either individually or collectively in apartment blocks, could be able to produce and consume, some or all of, their own electricity, either instantaneously or in a deferred manner through decentralised storage. Passive consumers are therefore becoming active *'prosumers'* (*i.e.* producers and consumers of renewable energy).

Member States have addressed this phenomenon in different ways which has led to a fragmented market, different degrees of consumer empowerment across the Union and a high degree of regulatory instability. In particular, nine Member States do not yet have a legal framework for self-consumption[152]. In 8 Member States the regulatory framework was established within the last three years[153]; and 7 changed their rules at least once since 2013[154], in certain cases retroactively. This situation led high regulatory uncertainty among investors across the EU[155] and generates market fragmentation across the EU. In some Member States consumers are effectively not able to self-consume their own renewable electricity and it is often difficult or impossible for tenants to benefit from self-consumption. In addition, retroactive changes in regulatory and financial schemes for prosumers have led to an unreliable investment climate. This has a negative impact on the deployment of renewables at local level and its contribution to target achievement, especially because with lowering feed-in tariffs self-consumption is expected to drive 50 % of rooftop solar capacity[156].

Driver 3: Lack of clear, comparable and credible information to energy customers

Renewable energy sources are subject to significant information failures: new technologies that are applied at plant and household level (*e.g.* solar water heating, heat

150 PV Status Report, JRC, 2014
151 Bloomberg New Energy Finance 2014
152 *I.e.* Bulgaria, Czech Republic, Estonia, Finland, France, Ireland, Luxembourg, Romania, Slovakia
153 *I.e.* Cyprus, Spain, Croatia, Greece, Lithuania, Latvia, Malta and Poland
154 *I.e.* Austria, Belgium, Germany, Denmark, Italy, Hungary, and Portugal
155 Furthermore, there are different interpretations in the EU regarding the status of the self-consumer. For instance, the recent Royal Decree 900/2015 in Spain does not recognize the status of prosumer. To export surplus electricity to the grid, the residential promoter needs to be registered as an entrepreneur for which administrative barriers can deter residential investors. Similarly in case of recognition of a producer status, grid-access charge and revenue taxes are also applicable to surplus electricity unless exempted. In France, the status of prosumer is not yet defined. So far photovoltaic installation exporting to the grid can be registered under the *micro-entrepreneur* regime or a "*régime réel d'imposition*". In Germany, the Ministry of finance has published in 2014 a guidance on sales tax when there is self-consumption. As soon as there is a remuneration of part or all the production from the PV system, the fiscal regime of businesses applies.
156 *Bloomberg New Energy Finance*, 2016

pumps) can be slow to find public acceptance, and the market for installation and maintenance services is often inadequately informed and trained, resulting in technology breakdowns and a perception of unreliable technologies. In the case of biomass, users are often unaware of how to operate the heater in such a way that emissions of air pollutants are minimised.

The poor information flows can also occur during production, when energy suppliers are unaware of quality standards, regulators fail to create the right legal or institutional framework (*e.g.* municipal planning rules), and capital markets fail to acknowledge technology learning and reductions in risk. Such failures can also result in poor supply chain development.

Under Article 15 of the RES Directive, the Guarantees of Origin (GO) system provides a means of demonstrating the origin of renewable electricity to consumers. It is a virtual "book and claim" system where the renewable attribute of energy trades separately from the physical energy. With electricity such certification systems are desirable as it is not possible to track electrons from renewable sources through the power grid. Disconnecting GOs from the physical flow of electricity is a less complicated approach than tracking the supply of renewable electricity through contract based tracking and allows for trade in large volumes of renewables across the EU. The GO system is not intended to be a support scheme for encouraging new renewable generation capacity or be used as a means of achieving national renewable energy targets.

Requirements for energy companies to disclose sources of electricity, and the associated emissions and waste to consumers are contained in the existing Electricity Market Directive. Consumer bills have to include that information. However it is not mandatory in the Electricity Market Directive for energy suppliers to use the GO system for renewable energy disclosure purposes. This has led to the GO system covering less than half of the total renewable energy production. Furthermore, the GO system does not currently include data on emissions and waste.

Many electricity suppliers offer "green" contracts to consumers offering environmental benefits relative to regular electricity. When these tariffs are based on renewable energy, sometimes the renewable content is demonstrated by purchasing GOs. Corporate consumers often source renewable electricity to meet corporate sustainability objectives. This can be through direct investment in renewable electricity production, but many are increasingly focused on using such GO systems for corporate reporting purposes and to quantify their GHG emissions[157].

Evidence so far suggests that the GO and disclosure systems in place are not consistent between all Member States as the legislation provides wide discretion as to how national systems are designed and implemented[158] . Furthermore, GOs do not apply to all energy sources only to renewable energy and high efficiency CHP[159]. There have been mixed views as to the functioning of the GO systems amongst stakeholders. Many support the

157 GOs are recognised in the CDP corporate carbon accounting requirements. https://www.cdp.net/Documents/Guidance/2016/CDP-technical-note-Accounting-of-Scope-2-Emissions-2016.pdf

158 Chapter 6 of RE-DISS final report http://www.reliable-disclosure.org/static/media/docs/RE-DISSII_Final-Report_online.pdf

159 See Directive 2012/27/EC

system in principle, but some consider that the system can result in greenwashing[160], as it enables consumers to use renewable electricity far away from where it is produced. For example, there is a large trade in hydropower GOs from Norway to other parts of Europe which is seen by some as unrealistic given the distances involved. Many Norwegian consumers have typically not bought GOs to demonstrate use of renewable power. As a consequence of this, there is an effective transfer of renewables consumption in that it results in Norwegian consumers having a residual mix of fossil and nuclear power which is not popular locally[161].

With the GO system there is also a risk of double counting the production of renewables in the absence of reliable tracking systems and concerns that a poorly designed and implemented system could be susceptible to such issues[162]. This risk arises as in theory, it is possible that Member States could issue GOs for renewables under the RES Directive, but then may not require their use for disclosure purposes under the Electricity Market Directive, allowing other methods to be used. This could mean that the GOs generated are exported to another country, whilst the energy supplier is still able to claim use of that same volume of renewables under the national disclosure system.

Given some of the issues associated with the GO system, one approach could be to abolish the system entirely. Such a deregulation would mean that there would be no EU mechanism for recognising the renewable origin of electricity. In such circumstances it is likely that energy companies would continue to offer green tariffs, based on renewables, to consumers. Similarly, some businesses and corporations would still like to demonstrate publically that they consume renewables in their operations. The consequence is that parallel systems would likely develop as a way of tracing consumption of renewable energy. These could be a series of national GO system, or perhaps greater use of bilateral contracts between consumers and generators. It is possible that these systems would have no common standards and would not operate very effectively across borders; it is therefore hard to see benefits for taking such an approach in increasingly integrated energy markets.

In most Member States the GO system applies for renewable electricity only. Austria and Sweden have extended the system to all sources of power generation, including nuclear and fossil sources. Some observers have noted that the narrow scope of the system as provided by EU legislation means that the cost of disclosure is put on renewable generators only, many of which are small installations. Other less sustainable forms of electricity production, often large installations, do not participate in the energy disclosure system and therefore do not share its associated overhead cost.

The current system of GOs applies only to renewable electricity. There is no equivalent EU wide system for guaranteeing the origin of renewable gaseous fuels (in particular,

160 The expressions ‘environmental claims’ and ‘green claims’ refer to the practice of suggesting or otherwise creating the impression (in a commercial communication, marketing or advertising) that a good or a service has a positive or no impact on the environment or is less damaging to the environment than competing goods or services. This may be due to its composition, how it has been manufactured or produced, how it can be disposed of and the reduction in energy or pollution expected from its use. When such claims are not true or cannot be verified, this practice is often called ‘greenwashing’. (Guidance of the Unfair Commercial Practices Directive, SWD(2016) 163 final)

161 http://www.tu.no/artikler/industri-opprinnelsesgarantier-gjor-norsk-industri-klimafiendtlig/232980

162 See, *e.g.*, http://www.beuc.eu/publications/beuc-x-2016-002_jmu_trustworthy_green_electricity_tariffs. pdf

biomethane) that are injected into the natural gas grid, although the case is similar to electricity.

The lack of a robust tracking mechanism could be an obstacle for cross border trade of renewable gaseous fuels. Levels of trade should increase over time as European gas grids become more integrated and production of biomethane rises or if injection of renewable hydrogen becomes common. Challenges have been encountered so far with regard to cross border trade, in the implementation of the sustainability scheme for biofuels, which has proved to be complex for injected renewable gaseous fuels. This is because the rules for the mass balance system that is currently applied to ensure traceability of biofuels were developed primarily for liquids biofuels, leaving a degree of uncertainty regarding the implementation for gaseous fuels.

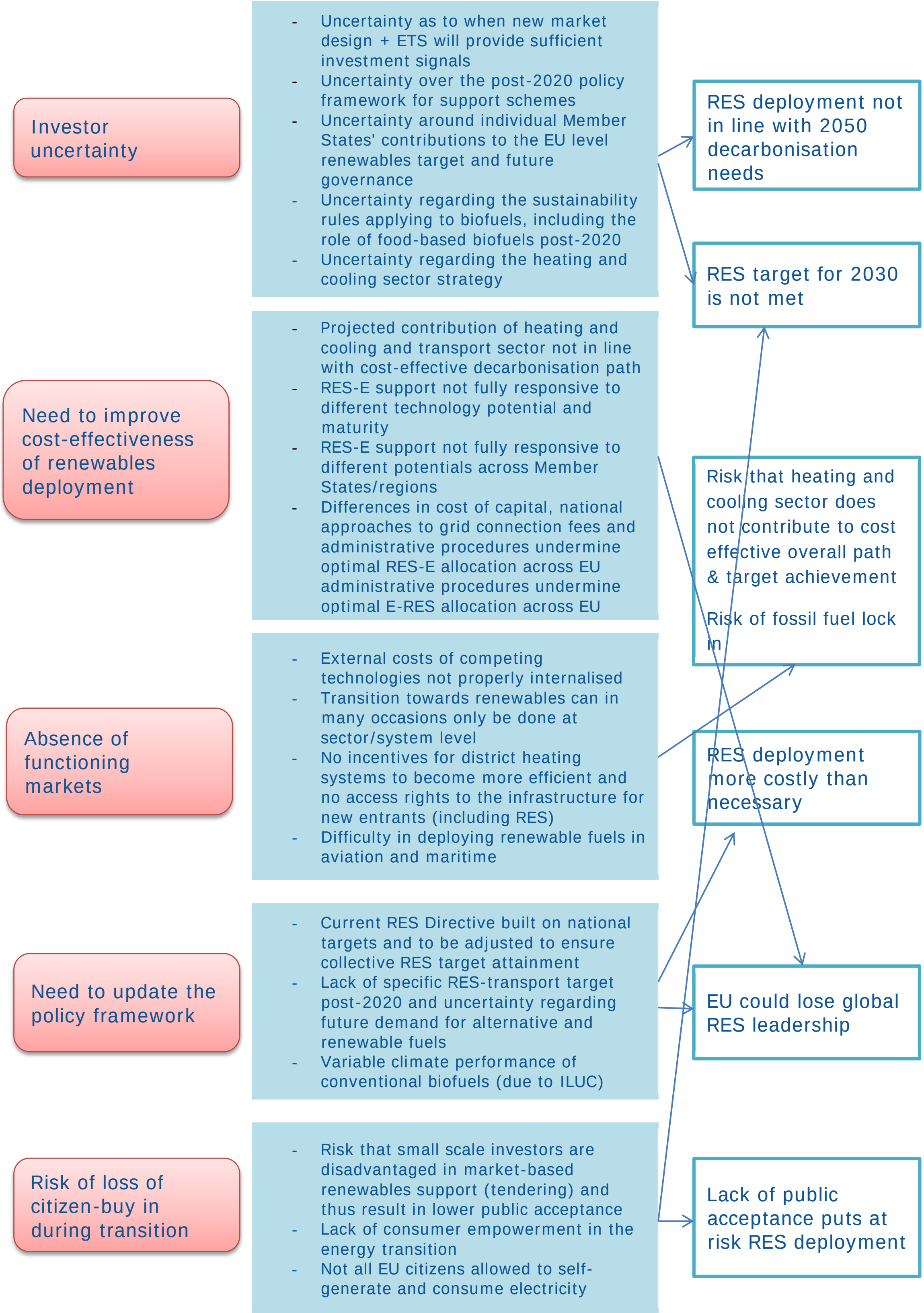
In some Member States systems that are similar to GOs have been developed for gaseous fuels partly as private initiatives. There are also initiatives to facilitate cross-border trade of biomethane by mutually recognising each other's national GO systems. A number of stakeholders are also developing an EU wide approach to design a GO scheme for green hydrogen[163].

Liquid renewable fuels are also not covered by the GO system or a similar centralised tracking system[164]. Private initiatives have also developed systems for guaranteeing the origin of liquid fuels, however they are not widely used as they are not mandatory.

The need to have in place resilient tracking mechanisms for liquid renewable fuels can be considered to increase in the future, since volumes used are likely to increase in the future. For liquid fuels the main problem is an increasing risk of fraud. There is a political agreement that the focus of the development of renewable transport fuels should shift towards non-food biofuels with a low impact on indirect land use change (ILUC) and food security[165]. However, advanced renewable fuels are initially expected to be more expensive than conventional food based biofuels but will in most cases by physically identical. In absence of a solid mechanism that allows tracing these advanced renewable fuels it cannot be excluded that economic operators make false claims on the characteristics of renewable fuels *e.g.* regarding the feedstock which was used to produce the fuel.

The following problem tree summarises the identified problem areas across all sectors their main underlying drivers and consequences:

163 CertifHy project (www.certifhy.eu)
164 Some national databases exist, such as in Austria, Belgium, Germany and Luxembourg
165 See also the State aid guidelines (point 113)



2.3. The EU dimension of the problem

As the European Union needs to achieve at least a 27% share of renewable energy sources in final energy consumption in 2030 for reasons of climate change mitigation, security of supply and competitiveness, as well as to promote the EU as a global leader in the renewables industry, this effort necessarily needs to have an EU dimension. The new framework for the post 2020 period will be based on an EU level binding target as opposed to the existing national binding targets in the current framework. This fundamental change makes the problem necessarily "European", opening new challenges and new opportunities in addressing it. And this is not only a question of ensuring a collective and timely delivery of the target but doing so cost-effectively which makes the need to address the problem at EU level even more critical.

This commitment has been re-confirmed through the EU joint submission with its Member States in the proposed contribution towards COP21 with an ambitious legally binding commitment of GHG emission reductions of at least 40% by 2030 below 1990 levels[166].

Many provisions of the current EU framework effectively end in December 2020. The uncertainty about renewable energy market volumes post-2020 in the entire Union and the support schemes for renewables may therefore lead to commercialisation problems for new capital intensive renewables technologies where investments are marked by long lead times.

Decarbonising the economy - and particularly the energy system - is crucial for the achievement of the EU-wide GHG emission reduction targets and combating the effects of climate change and renewable energy is an essential part of this effort. Additionally, the renewable energy sector contributes to the overarching goal of the European energy policy strategy to ensure secure, affordable and sustainable energy for all EU citizens and businesses by taking full advantage of the opportunities offered by a powerful internal energy market. The development of the internal electricity market and the additional deployment of renewable energy in the power generation sector are two challenges that can only be addressed in conjunction.

2.4. Who is affected and how

The Revised RES Directive (jointly with the initiative on Governance for the Energy Union) should reflect the new character of the EU-wide renewables 2030 target and the new balance established between the overall target on the one hand, and regulatory measures to achieve the target on the other hand.

Annex 6 to this Impact Assessment elaborates in detail the impact on stakeholders[167].

2.5. REFIT Evaluation of the RES Directive

A regulatory fitness programme (REFIT[168]) evaluation of the RES Directive was carried out between 2014 and 2016. The results of this evaluation are submitted in a separate REFIT evaluation Staff Working Document presented together with this Impact Assessment and are used as input for the present section on the problem definition.

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166 See the submission by Latvia and the European Commission on behalf of the European Union and its Member States - http://ec.europa.eu/clima/news/docs/2015030601_eu_indc_en.pdf

167 *i.e.* Member States, local communities, municipalities, non-renewables energy producers and suppliers, renewables projects developers, renewables technology producers, renewables installers, investors, financial sector, businesses, transmissions service operators, distribution service operators, energy consumers, energy service providers (ESCOs), aggregators, citizens at large.

168 In line with (COM(2013)685 final) - "Regulatory fitness and performance: results and next steps"

Annex 9 to this Impact Assessment illustrates in detail the conclusions of the evaluation.

3. SUBSIDIARITY AND THE DIVERSE SITUATIONS IN MEMBER STATES

3.1. Legal base

Article 194 TFEU states that "*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. […] the European Parliament and the Council, acting in accordance with the ordinary legislative procedure, shall establish the measures necessary to achieve the objectives in paragraph 1. Such measures shall be adopted after consultation of the Economic and Social Committee and the Committee of the Regions*".

3.2. Necessity of EU action

EU level action is needed to ensure that Member States' contributions to the at least 27% EU level binding renewable energy target is collectively and cost-effectively met and the Union can deliver on the commitments it made at the COP21 Climate Summit in December 2015. Experience has shown that uncoordinated actions at Member State level can lead to a more limited and more expensive renewable energy sources development and the fragmentation and distortion of the internal energy market.

An EU wide European market for renewables, set in the context of a more integrated electricity market, can facilitate the balancing of the electricity system, reduce the need for back-up capacities and encourage renewables production where it economically makes most sense. Large scale investments necessitate big markets which also justify one EU wide market. A bigger market can also better encourage development of innovative products and systems.

EU level action can help ensure achievement of the at least 27% EU renewable energy target through increasing investors certainty in an EU-wide regulatory framework. It will also enhance a consistent development of EU renewable energy policy across the EU leading to a more cost-efficient renewable energy deployment and a smooth and efficient operation of the internal energy market whilst fully considering the differing capacities of the Member States to produce different forms of renewable energy. Together with the Electricity Market Design legislative proposal, this initiative should enable the further integration of renewable energy sources into the internal energy market alongside other generation technologies.

Sole action at Member States' level would likely lead to a more limited deployment of renewables and create additional costs that can be reduced through complementary EU-level action. It would also lead to more fragmentation of, and distortions in, the energy internal market and put the achievement of the EU target at risk.

As regards the electricity sector, the EU has set up a single integrated power market where main principles, rules for common problems and rules regarding cross-border aspects are being established at EU-level. It follows that rules on renewables touching upon market functioning also need to be addressed at EU level. The same rationale applies to self-consumption, as *prosumers*, either individually or collectively, could be able to produce and consume their own electricity reducing their energy costs and participating to the electricity markets. Since Member States have addressed self-consumption adopting divergent policies, a significant number of energy consumers in the EU currently do not enjoy clear rules on production of their own electricity and self-consumption. This undermines the empowerment and increasing involvement of

European citizens, who would not be able to reap the benefits from being market players of energy markets. Moreover, lack of clear rules on self-production and self-consumption would undermine *prosumers* ability to contribute to the effort to achieve the 2030 EU target for renewables. This effect is significant as self-consumption is expected to be the main driver for the uptake of roof-top PV. With decreasing feed-in tariffs, around 50 % of the roof-top PV capacity could be driven by self-consumption.

Heating and cooling consumes half of EU's energy and 75% of the EU's fuel needs for heating and cooling still come from fossil fuels. As such, decarbonising the heating and cooling sector is necessary if the EU is to stay on the path of our long term decarbonisation objectives and improve security of supply. Heating and cooling consumption patterns are already directly affected by EU legislation, such as the EED or the EPBD Directives. In addition, the EU Strategy on Heating and Cooling[169] provided a framework for integrating efficient and sustainable heating and cooling into EU energy policies. This should focus the future EU and Member State action on stopping the energy leakage from buildings through a comprehensive approach to speed up the replacement of obsolete boilers with efficient and clean renewable energy heating and a commitment to increase the deployment of renewable energy in district heating and CHP. In this respect, EU-level action can trigger the necessary confidence of investors for a mass roll-out of heating and cooling technology cost-effectively.

Transport consumes a third of EU's total energy demand and this demand is almost entirely met by liquid fossil fuels. Whilst electrification seems a good way forward to replace fossil fuels for light duty vehicles, motorbikes and rail, current technology development pathways suggest that electrification on its own cannot address all the decarbonisation challenges, in particular as regards aviation, waterborne and heavy duty transport. Advanced renewable fuels will need to contribute to achieve our long term climate and energy objectives. The EU has heavily invested into research and technology development of advanced biofuels, which resulted in the operation of first-of-a-kind plants. Incentives for early commercialization can pull technologies further down the learning curve. National measures cannot guarantee market volumes that are sufficiently large to both achieve economies of scale and spoor manufacturing innovation. The introduction of a promoting measure at EU level is more likely to create such a market pull, while ensuring that the costs of technology innovation and development are sufficiently shared across European economies. A common EU action will also ensure that that the objectives of the policy (*e.g.* making advanced fuels cost-competitive) are achieved at least costs. An EU approach can better prevent market distortion and fragmentation, that is more likely to result from national measures.

EU-level action is also needed to remove administrative barriers[170] as these bring uncertainty and delay to investors, artificially increase the costs of renewable energy projects, create distortions in the allocation of investments within the EU, hampering to build a unified EU market for renewable projects and reaching a cost-effective deployment of renewable energy.

Member States are free to develop the renewable energy sector that corresponds best to their national situation, preferences and potential, provided they collectively reach the at least 27% target. Important national prerogatives, such as the Member State's right to

[169] COM(2016)51 final - "An EU Strategy on Heating and Cooling", 16 February 2016

[170] *E.g.* lengthy administrative procedures, complex licensing procedures, fragmented or unclear responsibilities, institutional overlaps, etc

determine the conditions for exploiting their energy resources, their choice between different energy sources and the general structure of their energy supply, remain untouched. The following graph illustrates the use of renewables in the different energy sectors.

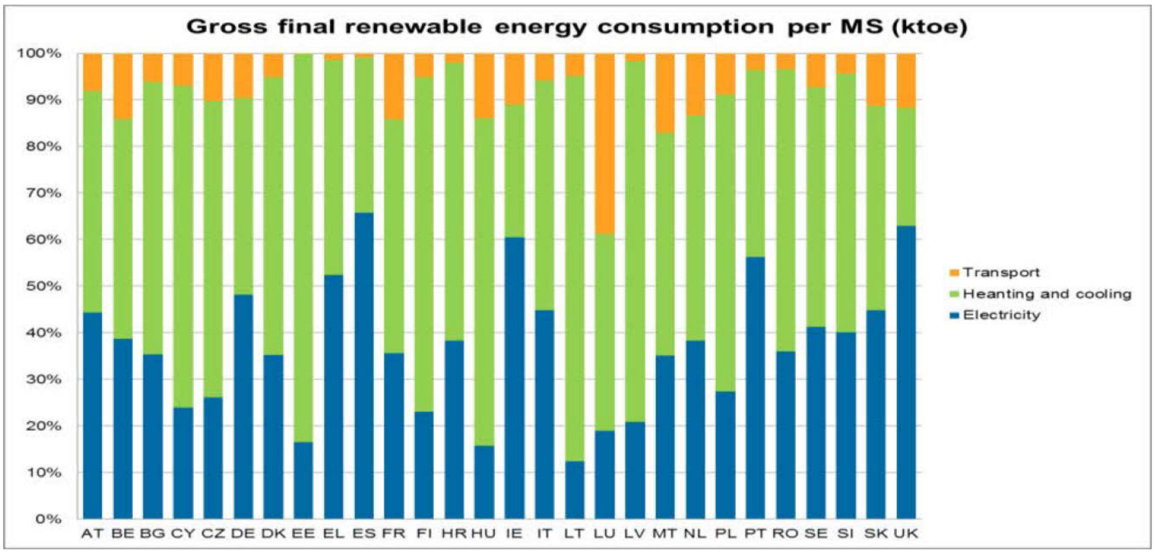

Figure 8: Gross Final Renewable Energy Consumption per sector (ktoe),
***based on* "Renewable Energy Progress Report", Öko Institute [to be published]**

Additionally, proportionality will be ensured by striking a balance between objectives of competitiveness, security of supply and sustainability, and by considering the long term benefits beyond 2030 of the proposed course of action– and not only be based on short to medium term impacts.

The level of constraint is thus proportionate to the objective aimed at.

3.3. EU added-value

In January 2014, the European Commission presented its policy framework for climate and energy in the period from 2020 to 2030 (COM/2014/015) which complements GHG reduction policies with a powerful internal energy market, a self-standing chapter on energy security of supply and reinforced emphasis on R&D and innovation. The analysis at the time indicated that the least cost pathway to achieve greenhouse gas reduction targets in 2030 and 2050 is for the entire EU to attain a share of at least 27% of energy consumed from renewable sources in 2030, without differentiating between the electricity, transport or heating and cooling sectors.

Due to the existence of specific market failures and barriers, the impact assessment that underpinned the 2030 policy framework for climate and energy[171] pointed out to the risk of not reaching this target in a business as usual scenario, and therefore not being able to reap of the economic, social and environmental benefits of renewables. Therefore the impact assessment of the 2030 framework concluded on the benefits of a specific target be set for the deployment of renewables at EU-level in 2030.

[171] SWD(2014) 15

An EU-wide energy and climate framework for renewable energy in 2030 will also contribute to steer Member States energy policies to achieve a sustainable, secure and affordable energy system for European citizens. With a predictable EU regulatory framework leading the renewables' sector towards 2030, Member States can better design national policies towards the 2020 target if EU-wide headline targets are agreed on, which ensures that renewable energy policies are coherent with other energy and climate objectives, namely the ETS, the Effort-Sharing Regulation and the EU energy efficiency target for 2030. An EU-level framework for support schemes would also provide investor certainty, which may have been impacted in the past by the stop and go policy – and sometimes retroactive measures – taken by certain Member States.

By acting at EU-level, several barriers to public and private investments (*e.g.* related to authorisation procedures) could be tackled, addressing the lack of coordination between various authorising bodies at national level and stimulating the administrative capacity to implement cross-border projects and support schemes.

The cost-effective deployment of renewables until 2030 can thus best be achieved by a combination of action at Member States-level and at EU-level. Uncoordinated renewables' support policies at Member State level bears the risk of increasing the cost of reaching at least 27% renewables by 2030 for the consumers, for the investors and for the system as a whole.

To sum up, EU level action is needed to ensure that the at least 27% EU-level binding renewable energy target is collectively met by Member States, and is met in the most cost-effective and least distortive manner.

4. OBJECTIVES

4.1. General objectives

- Contribute to "*the development of new and renewable forms of energy*" as stipulated in Article 194 TFEU, having in mind the Commission's political ambition to be global leader on renewables;
- contribute to the EU's climate change commitments in the context of COP 21;
- contribute to the energy security ambitions set out in the Energy Union strategy;
- ensure cost-effective deployment of renewables and the functioning of the internal energy market.

4.2. Specific objectives

- Address investment uncertainty, along a path that takes account of medium and long term decarbonisation objectives;
- ensure cost-effective deployment and market integration of renewable electricity;
- ensure collective attainment of the EU-wide target for renewable energy in 2030, establishing a policy framework in coordination with the Energy Union Governance that avoids any potential gap;
- clarify role of food-based biofuels post 2020;
- correct heating & cooling market failures;
- ensure citizen buy-in for the post-2020 period, empowering consumers to receive clear, comparable and credible consumer information on all energy sources and to self-consume the electricity they generate, while respecting the principle of cost-efficiency.

5. Policy options

The present chapter describes and assesses the policy options which have been developed to address the problem described in Chapter 2[172].

The options are grouped according to the following areas:

- electricity sector (RES-E);
- heating and cooling sector (RES-H&C);
- transport sector (RES-T);
- empowering and informing consumers of renewable energy;
- achievement of at least 27% renewable energy in 2030.

Each group of policy options is assessed in detail, with an analysis of the impacts in accordance to key indicators.

5.1. Options to increase renewable energy in the electricity sector (RES-E)

The table below summarizes the group of options that are discussed in this section.

Challenges	Drivers	Policy Options
Delivering a framework for cost-effective and market based support for electricity renewables	Uncertainty up until revised market design and ETS deliver adequate investment signals Uncertainty on post 2020 rules for support schemes RES-E support not fully responsive to different technology potential and maturity Risk that small-scale investors are disadvantaged in market based RES support (tendering)	0. Baseline - No specific provisions on support schemes in the Revised RES Directive (only EEAG) 1. Prohibit support schemes for Renewable Electricity 2. Clarify the principles for the use of support schemes based on market-based principles 3. Mandatory move towards Investment Aid
A more coordinated Europeanised approach to renewables support	RES-E support not fully responsive to different technology potential and maturity RES-E support not fully responsive to different	0. Baseline 1. Mandatory partial opening of support schemes to cross border participation 2. Mandatory Regional

172 For better readability, this chapter merges the chapters usually referring to the presentation of the policy options and their assessment, including an overall comparison of the options for each area of intervention.

	potentials across MS	Support Schemes
Reducing the cost of capital for renewable generation projects	Differences in cost of capital undermine optimal RES-E allocation across EU	0. Baseline 1. EU Financial instrument with wide eligibility criteria 2. EU Financial Instrument in support for higher risk projects
Reducing administrative barriers	Differences in administrative procedures undermine optimal RES-E allocation across EU • Investor uncertainty • Reduce Costs of Renewable projects	0. Baseline - Extension of current provisions (article 13.1) until 2030 1. Introduce One Stop Shop + time limits with range for duration of permitting process + facilitated procedures for repowering 2. Option2+ more stringent time limits and deadlines for permitting process + Project development manuals + compulsory simple notification for small household projects + facilitated procedures for medium size projects

The assessment of options is structured as follows:

- A starting point: the REF2016 – lessons learned for the electricity sector
- Baseline scenario: the continuation of current national Member States' policies and of currently differentiated access to capital for RES electricity projects
- Options about the potential need and design of support schemes
- Options about the potential geographical scope of support schemes
- Options about addressing the various access to capital conditions for RES-E projects
- Options aimed at reducing administrative barriers

All specific policy options are compared to the baseline scenario. Discussions on these options compared to the central policy scenario results (EUCO27) are also included. Where relevant, the implications of a 30% energy efficiency target are also presented.

Starting point	Baseline scenario	Other policy scenarios	Central policy scenario

<table>
<tr><td rowspan="9">REF2016</td><td rowspan="9">Option 0 CRA scenario</td><td>Option 1</td><td>No support to RES-E projects</td><td rowspan="9">EUCO27 scenario</td></tr>
<tr><td>Option 2</td><td>Toolkit for support schemes</td></tr>
<tr><td>Option 3</td><td>Investment aid mandatory – no more operational aid</td></tr>
<tr><td>Option 1</td><td>Mandatory partial opening of support schemes to cross-border participation</td></tr>
<tr><td>Option 2</td><td>Mandatory regional support schemes</td></tr>
<tr><td>Option 1</td><td>EU-financial instrument with wide eligibility criteria</td></tr>
<tr><td>Option 2</td><td>EU-financial instrument in support of higher-risk RES projects</td></tr>
<tr><td>Option 1</td><td>One stop shops, time ranges</td></tr>
<tr><td>Option 2</td><td>One stop shops, time limits, automatic approvals and simple notifications for small projects</td></tr>
</table>

Table 3: Interaction logic between scenarios and policy options

Starting point: the EU Reference Scenario 2016

Overall, REF2016 falls short of the overall ambition level in terms of renewable energy share by 2030. Still, some important lessons can be learned in terms of renewable electricity developments.

By 2020, renewables in power generation are projected to increase to 35.5% (RES-E indicator[173]) or 37.2% of net electricity generation, of which 52% are projected to be variable renewables – wind and solar. Beyond 2020 support schemes are assumed to be phased out and further investments in renewables are more limited (reaching 43% in 2030), driven by market forces such as the ETS and the improvement in the techno-economic characteristics of the technologies.

While renewables provide growing shares in electricity generation, the contribution of variable renewables (solar, wind as well as tidal/wave in the definition used here) remains significantly lower. These variable renewables reach 19% of total generation in

[173] Calculated according to the definitions of the RES Directive used also for the pertinent provisions of Eurostat statistics

2020, and 25% in 2030. Wind off-shore capacities stagnate, as in the absence of support schemes this technology is not projected to be competitive.

Wind provides the largest contribution from renewables supplying 14.4% of total net electricity generation in 2020, rising to 18% in 2030. A share of 24% of total wind generation is produced from wind off-shore capacities in 2020 (33GW installed capacity), but the share of offshore wind declines thereafter. Total wind capacities increase to 207 GW in 2020, and 255 GW in 2030, up from 86 GW in 2010. Wind onshore capacity and generation increases because of exploitation of new sites but also because of the progressive replacement of wind turbines with newer taller ones which are assumed to have higher installed capacity and higher load hours. Generation from PV contributes 4.8% in net generation by 2020. Beyond 2020, PV generation continues to increase up to 7% in 2030. PV capacity is projected to reach 137.5 GW in 2020 and 183 GW in 2030, up from 30 GW in 2010. Investment is mostly driven by support schemes in the short term and the decreasing costs of solar panels and increasing competitiveness in the long term, in particular where the potential is highest, *i.e.* Southern Europe. The use of biomass and waste combustion for power generation also increases over time, both in pure biomass plants (usually of relatively small size) and in co-firing applications in solid fuel plants. Biomass attains a share in fuel input in thermal power plants of 17.3% in 2020, and 22% in 2030[174]. Pure biomass/waste plant capacities (excluding co-firing) reach 51.6 GW in 2020 and 53.2GW in 2030, up from 21.7 GW in 2010. The relative contribution of hydro generation remains rather constant at 10-11% of total net generation, with small hydro slightly increasing.

The Baseline scenario: the current renewables arrangement (CRA) scenario

The first assumption that this scenario considers is that Member States continue supporting renewable electricity projects, on a national basis, with no additional provision considered in the Revised RES Directive. Potential provisions would be left entirely to the revised, post-2020 State Aid guidelines. Therefore, a continuation of nationally-based support schemes is assumed, while complying with the current State-Aid guidelines provisions. The second assumption made is that Member States support renewable electricity projects in such a way that the overall 27% RES target is achieved. The third assumption made for the preparation of this baseline scenario is that current distortions in the financing cost of renewable electricity projects across countries[175] remains in place up until 2030. Regarding other assumptions, this scenario assumes, as in the central policy scenario (EUCO27) an improved functioning of the ETS, in line with the Commission's proposal for a revised ETS for the period after 2020, as well as efficient energy market functioning[176]. In other words, this scenario differs in its design compared to the EUCO27 scenario via two main features: i/ the cost-effective incentives for renewables reflected by the use of similar RES-E values across Member States in the EUCO27 scenario is replaced by explicit, nationally-based and differentiated support schemes; and ii/ financing conditions for RES projects differ per Member State.

Under this scenario, the RES-E share reaches 49% in 2030. In terms of installed capacity, this means about 733 GW of renewables capacity installed, and 245 GW of additional

174 Calculated following Eurostat definitions, *i.e.* excluding energy consumed by Industrial sectors and refineries for on-site CHP steam generation

175 For additional details on the scenario design, see Annex 4

176 Dedicated measures necessary to achieve this efficient market functioning are assessed in detail in the Market Design Impact Assessment

installed capacity over the 2021-2030 period. In terms of investment, this corresponds to annual investment expenditures of about EUR 40 billion per year over the 2021-2030 period, higher than for the EUCO27 and EUCO30 scenarios. This can be explained by a series of factors. First, there are fewer investments in RES-E in 2020 in the baseline scenario than in EUCO27, as financing costs distortions as well as impacts of different support schemes among Member States are reflected for 2020 in the baseline scenario, as opposed to EUCO27. Therefore, a catching up effect takes place post-2020. In addition, the RES-E share in 2030 in CRA is higher than in EUCO27[177]. Finally and importantly, the RES-E generation mix changes, as continuation of differentiated nationally-based support schemes and different financing conditions lead to RES deployment that is less efficient, and therefore more costly, than in EUCO27. This scenario also implies an increase in average electricity prices, by 25% in 2030 as compared to 2010. It must also be noted that this analysis does not consider the fact that the absence of provisions on support schemes would provide less visibility to Member States and investors as to the framework applicable post-2020, with possible negative impacts on investments.

Some renewables investments can be financed without public support, while others require some. The CRA results show that 59% of renewables investments over the 2021-2025 and 51% of investments over the 2026-2030 (as measured in % of GW installed) are financed via some support covering at least a fraction of total project costs[178].This result is influenced by the initial assumption that Member States would continue supporting RES-E projects, in line with past practices. This support is reflected in final electricity prices, as it affects the power generation mix, as well as in the renewables supporting costs component of electricity prices passed on to consumers, which is estimated at 24.9 EUR per MWh in 2030.

The use of more direct support for renewables than in EUCO27 also leads to lower ETS carbon price (EUR 38 in 2030 in CRA compared to EUR 42 under EUCO27), reducing incentives for decarbonisation within the other parts of the power sector and in other economic sectors covered by the EU ETS, such as energy intensive industry, overall leading to a more costly delivery of GHG emission reductions.

The overall average increase in annual energy system costs compared to the Reference of this scenario over the 2021-2030 is estimated at €24 billion while for the EUCO27 scenario this is only €15 billion, resulting in a significant increase in costs to achieve the overall targets.

An important element of this scenario concerns the distribution of renewables deployment across Member States and technologies. First, regarding technologies, 35% of the overall RES-E generation in 2030 comes from on-shore wind, 22% from hydro, 17% from solar, 16% from biomass and waste, and 15% from off-shore wind. About 70% of the necessary investments to reach the renewables target in this scenario are investments in wind technologies; only 18% of overall investments are in solar and 8% in biomass-waste.

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177 This is mostly due to calibration issues. In fact, the intention was to maintain a RES-E share as close as possible to the EUCO27 scenario, but energy system interactions in the model made this objective difficult to achieve.

178 As mentioned in section 2 and in annex 4,this scenario takes into account the increase in the linear reduction factor for the ETS post 2020 to achieve -43% as proposed by the Commission, as well as the impact of the Market Stability Reserve.

Second, regarding the geographical distribution of investments, 67% of total RES-E investments are concentrated in three countries, while in the EUCO27 scenario this is only 47%, with investments being more widely and cost-effectively distributed across Member States. This ratio increases to 74% for wind investments. Conversely, the combined share of investments in the ten Member States investing least over the period is only 0.6% of total investments.

A set of policy options is then compared against this baseline.

Key results from the central policy scenario (EUCO27)

It is important to recall the main results for renewable electricity embedded in the central policy scenario, as it corresponds to a cost effective deployment of additional renewables investments, compared to REF2016.

This scenario leads to a lower share of renewable electricity in the overall mix than the baseline scenario. The contribution of on-shore wind is more important than under the baseline, while it is the opposite for offshore wind. The average electricity prices as well as electricity generation costs are also lower. In this scenario, the ETS carbon price is higher than in the baseline, indicating that sub-optimal direct support to RES investments has a negative impact on CO_2 prices. This would reduce profitability for all power producers as well as limiting incentives for decarbonisation within the power sector and in other economic sectors covered by the EU ETS, such as energy intensive industry. Total average annual energy system costs over the period 2021-2030 increase in the EUCO27 scenario (central scenario) by €15 billion compared to REF2016 while the baseline (CRA) sees costs increase by €24 billion.

This scenario also leads to overall lower investments in renewable electricity projects than in baseline over the 2021-2030 period. This is partly explained by the fact that in 2020 this scenario achieves a bit less RES-E in 2020 compared to EUCO27. It is also explained by the fact that financing conditions for RES-E projects are assumed to reflect more explicit existing support schemes and associated country risks in the baseline CRA projection than in the EUCO27. RES-E investments are also much more widely and cost-effectively distributed across the EU, as the share of the top 3 Member States in overall investments only represent 47% of total investments, as opposed to 67% in the baseline. Renewables supporting costs passed on to final consumers is also lower than in baseline, while industry also benefits from lower electricity prices.

Looking now at the implications of higher energy efficiency levels, it can be seen that the implications of moving to 30% energy efficiency for the electricity sector are relatively limited. Although the overall renewable energy share in electricity increases compared to the central scenario, overall investment levels remain broadly similar in the electricity sector. It has also no major implications on the renewable electricity mix or the geographical distribution of investments.

Overall, the EUCO27 scenario offers a good benchmark when testing policy options in the electricity sector, as policy options which help moving from a baseline scenario towards the central policy scenario would help achieve a cost-effective deployment of renewable electricity.

5.1.1. *Consolidating a framework for cost-effective, and market-oriented and Europeanised support to renewable electricity to promote regulatory certainty*

Option 0	Option 1	Option 2	Option 3
• Baseline - **No provisions** on support schemes in the Revised RES Directive	• **No support** for renewable electricity - investments only spurred by **market mechanisms**	• Clarifying the principles through **a toolkit for designing support schemes**	• Further market-orientation through **mandatory move towards investment aid**

➢ ***Option 0:*** *Baseline - No provisions on support schemes in the revised RES Directive*

The current approach would be kept, *i.e.* the Revised RES Directive would not include specific provisions on the design of support schemes beyond allowing the possibility for Member States to opt for having support schemes. This would be left entirely to the revised, post-2020 state aid guidelines and the 2013 Guidance (or any new guidance) for the design of renewables support schemes.

➢ ***Option 1: No support*** *for renewable electricity - investments only spurred by market mechanisms*

The Directive would contain a provision effectively prohibiting any form of operating or investment aid in support of renewable electricity projects. Member States would not be able to opt for renewable support schemes in order to foster deployment of renewables electricity. Investments would only be spurred by a revised market design and a strengthened ETS framework.

➢ ***Option 2:*** *Include strengthened market-based design principles through an EU toolkit*

Building on the principles expressed in the 2013 Guidance for the design of renewables support schemes, as well as the Guidelines on State aid for environmental protection and energy 2014-2020 (EEAG), the Revised RES Directive would provide for the 2021-2030 period a toolkit for the design of RES-E support schemes. The principles expressed would be without prejudice to State aid rules that apply to Member States.

Such European toolkit for market-based and cost-effective support would provide framework principles for Member States to use in designing support schemes including *inter alia* the possibility for Member States to use market-based support schemes, the obligation to tender support in order to achieve value for money or the technology neutrality principle for tenders unless a technology specific approach is preferable (*e.g.* for technology with long term potential).

It would also include provisions to enable the emergence of community-owned schemes in the electricity market and through competitive bidding processes, in order to fully exploit the untapped local potential for the deployment of additional renewable capacity. This would require the introduction of principles aiming at promoting renewable energy communities, including a definition with a minimal set of objective and subjective criteria, the empowerment to consume and produce renewable electricity, specific procedures and grid connexion, and the participation of energy communities in market-based supports schemes (*e.g.* tenders), including *e.g.* simplified administrative procedures enabling them to compete on equal footing with other generators.

Importantly, the framework would enshrine in legislation and expand the requirement to tender support; it would define tender design principles, based on emerging best practices, to ensure the highest cost-efficiency gains. The framework would thus strengthen the use of tenders as a natural phase-out mechanism for support, by which a competitive bidding process determines the remaining level of support required to bridge any financing gap – such level of support being expected to go to zero for the most mature technologies over the course of the 2021-2030 period.

Additionally, the Revised RES Directive would explicitly enshrine the principle that support schemes designed in line with EU indications cannot be revised in a way that retroactively impact the rights related to the level of support received by renewables projects, taking into due account the falling production costs and the need to avoid over-compensation or to address unforeseen technological developments.

The framework would be effective as it would define design principles (i) that ensure sufficient investor certainty over the 2021-2030 and (ii) require the use (where needed) of market-based and cost-effective schemes based on emerging best practice design (including principles that are not covered by the current state aid guidelines). At the same time, the framework would be proportionate by leaving actual implementation to the state aid guidelines (*e.g.* for the definition of thresholds applicable for any foreseen exemptions) and, most importantly, to the case by case, evidence-based, in-depth assessment of individual schemes by the services of DG Competition.

- ***Option 3:*** *Mandatory move towards investment aid*

In addition, the Revised RES Directive would require Member States to design support schemes in such a way that support is not linked to the amount of electricity being generated. Possible investment-based supports include (i) direct capex subsidies per MW or (ii) loan subsidy/guarantee schemes. A progressive transition could be designed, *e.g.* Member States would be required to provide a minimum share of renewables support in the form of investment aid by a certain date. Such support should also be conditional on the actual production of the capacity installed to avoid stranded assets.

5.1.1.1. Introduction to the assessment

Currently, the RES Directive leaves the choice of support scheme design entirely to Member States, subject to Article 107-108 TFUE. In practice, convergence in design occurs, as Member States learnt from each other, and as support schemes need to comply with State aid rules, in particular the Guidelines on State aid for environmental protection and energy 2014-2020[179].

The Commission's ambition for the post 2020 context is that renewable electricity generators can earn an increasing fraction of their revenues from the energy markets based on an enhanced market design – where short term markets are fully developed and integrated and flexibility plays a key role in enhancing the market value of renewables – and a strengthened EU ETS. At the same time, it has to be assessed to what extent energy

179 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XC0628%2801%29

and carbon market revenues alone will be sufficient to attract renewable investments at the required scale, in a timely manner.

It is established that a growing penetration of renewables, while not leading to a failure of energy-only markets as such, can aggravate underlying market conditions potentially detrimental to investment incentives, in two ways[180]. First, higher low-marginal-cost variable renewable shares lead to lower average prices (due the so-called "merit order effect"). Second, large shares of variable renewables increase price volatility, in particular leading to the more frequent occurrence of very high as well as very low or even negative prices.

Research also suggests that the behaviour of renewables in electricity markets – and thus their impact on market functioning – is determined by the kind of support they receive[181]. The degree of price exposure determines the trading behaviour of renewables generators, but also plant design and investment decisions[182].

Additionally, empirical evidence (of past tenders) shows that the way support is allocated impacts the cost-efficiency of support. The analysis of past auctions in eight EU-countries and four non-EU countries showed that all those auctions schemes reported efficiency gains in terms of the contracted price or discounts achieved: *E.g.* a price of €84.9/MWh was applied in the second round of the German auction (led in 2015 on ground-mounted solar PV), which is significantly below the ceiling price of €112.9/MWh.[183] Recent auctions for offshore wind in the Netherlands and in Denmark have resulted in strike prices of, respectively, €72.7/MWh[184] and €60.0/MWh[185] – yielding significant reductions in the level of support relative to support awarded in other recent comparable projects.

Against this background, the Revised Renewables Directive could set out framework principles for the design of support schemes in the post-2020 context, laying down common principles ensuring that, when and if support is needed, such support be provided in a form that is (i) cost-effective, (ii) as little distortive as possible for the functioning of electricity markets, and (iii) fosters regional approaches through greater convergence in the design of support.

180 See for instance Edenhofer et al. (2013), Rubin and Babcock (2013), Winkler (2012)

181 Winkler & al, "Impact of renewables on electricity markets – Do support schemes matter?", Energy Policy 93 (2016)

182 As shown in case studies on Latin America by Battle and Baroso (2011) and Germany by Jâgemann (2014)

183 AURES, *"Auctions for Renewable Support: Lessons learnt from International experiences"* (June 2016). The analysis of past auctions in eight EU-countries and four non-EU countries showed that all those auctions schemes reported efficiency gains in terms of the contracted price or discounts achieved: *E.g.* a price of €84.9/MWh was applied in the second round of the German auction (led in 2015 on ground-mounted solar PV), which is significantly below the ceiling price of €112.9/MWh

184 http://www.dongenergy.com/en/media/newsroom/news/articles/dong-energy-wins-tender-for-dutch-offshore-wind-farms

185 https://corporate.vattenfall.com/press-and-media/press-releases/2016/vattenfall-wins-danish-near-shore-wind-tender/

5.1.1.2. Detailed assessment

Against this background, detailed modelling work was undertaken to assess whether renewables will be able to finance themselves in the energy-only market over the period 2021-2030, *taking into account* (i) the revised ETS framework, (ii) the market re-design foreseen as part of the Market Design Initiative, (iii) expected further declines in the levelised cost of energy (LCOE) of renewables technologies, and (iv) forecasts of wholesale prices. As regards the ETS framework in particular, modelling results presented in the paragraph below assume an increase of ETS linear factor to 2.2% for 2021-30 and implementation of the Market Stability Reserve. This translates into an ETS price reaching 15 EUR/t in 2020, 25 EUR/t in 2025 and 42 EUR/t in 2030 in the EUCO27 scenario, and lower prices of 15 EUR/t in 2020, 22.5 EUR/t in 2025 and 38 EUR/t in 2030 in the baseline (CRA) scenario. Results are presented in more details in Annex 4.

Under Option 1, the implications of the absence of support schemes on the viability of investments in RES-E generation are tested[186]. First, it can be recalled that the EU Reference Scenario 2016 models, *inter alia*, renewables developments post-2020 in absence of dedicated support schemes for new projects. Under this scenario, RES-E developments are below the ones necessary to reach the overall at least 27% target by 2030. However, REF2016 does not reflect the potential impacts that reformed electricity markets, or a reformed ETS including the Commission proposal on a revised linear reduction factor, could have on renewables developments. It also does not consider additional energy efficiency policies needed to achieve 27% energy savings.

As opposed to REF2016, the EUCO27 scenario was constructed with a cost-effective achievement of the 2030 climate and energy targets in mind. This scenario suggests that under the right framework conditions, in particular a reformed ETS, good electricity market functioning, a cost effective set of energy efficiency policies, and equal financing conditions across the EU, it is possible for the majority of renewables investments to develop such that they effectively contribute to the overall achievement of the renewables target. Least cost options are selected, and all costs are recuperated. However, some support is still needed, reflected in the model by the use of RES-E values, which corresponds to a set of unspecified cost-effective incentives promoting investments in renewable electricity projects.

This scenario demonstrates that little support would be needed, and that renewable technologies may be competitive, under the right framework conditions.

It should additionally be noted that the PRIMES model simulates emission reductions in ETS sectors as a response to current and future ETS prices, taking into account, in particular, a perfect foresight of the carbon price progression in the period 2025-50.

It also assumes that investment decisions can be based on a power generation portfolio approach, where profitability of investments is assessed on a portfolio rather than a project by project basis. Because of this portfolio approach, the EUCO27 scenario may not capture that some investments cannot be recuperated when income is only dependent on wholesale markets where high renewable penetration exactly tends to lower the wholesale price.

186 Annex 5 provides a detailed analysis on viability of RES projects in absence of support schemes.

Therefore, a complementary analysis is provided below, looking more specifically at potential profitability issues for the renewables investments projected to be necessary (in the EUCO27 scenario) to reach the renewables target, when looked at on a project per project basis, and assuming revenues are only based on the wholesale market.

First, this can be assessed by making use of the results of the WESIM model. This model was used to assess investment profitability of RES projects, but did not consider implications of RES developments on other power generation technologies, which is the object of the MD IA. The analysis performed with this model concludes that the investment gap (aggregated capital expenditure for RES-E projects that are not viable without support) would amount to c. EUR 13 billion in 2020, EUR11 billion in 2025 and EUR9 billion in 2030[187]. For the whole 2020-2030 period, this means a cumulative investment gap of about EUR 116 billion. This investment gap represents the amount of investments that would require some support, in case renewable electricity projects are to only receive market revenues from the wholesale electricity market only. It does not mean that public support would need to cover all the investment costs, as it could be that only a marginal support would be sufficient to complement electricity market revenues to make those investments profitable.

More specifically, the WESIM model results show that while only 40% of investments in 2020 as projected in EUCO27 could be financed by wholesale electricity market revenues only, this share increases to 66% in 2030. Onshore and solar PV become gradually profitable and by 2030, and could be financed entirely by the markets. Conversely, technologies such as offshore wind investments cannot be yet fully financed on the markets by 2030. It should be noted at the same time that rapid penetration of renewables has a decreasing effect on both the wholesale price as well as on the CO_2 price (for a given number of ETS allowances on the market), thereby reducing the ability of the market to act as the driver for investments in both renewables and flexible generation.

Table 4: Evolution of required annual investment and investment gap over the 2020-2030 period

Required annual investment (€ bn)	Biomass	Geothermal	Hydro reservoir	Hydro ROR	Offshore wind	Onshore wind	Solar PV	Tidal	TOTAL
2020	0.48	0.00	0.26	0.04	5.54	7.21	8.09	0.24	**21.88**
2025	0.77	0.00	0.41	0.14	8.74	9.43	5.33	0.37	**25.19**
2030	0.94	0.23	0.09	0.69	9.61	8.93	6.75	0.50	**27.74**
Total investment gap (€bn)	**Biomass**	**Geothermal**	**Hydro reservoir**	**Hydro ROR**	**Offshore wind**	**Onshore wind**	**Solar PV**	**Tidal**	**TOTAL**
2020	0.48	0.00	0.23	0.00	5.54	3.55	2.91	0.24	**12.95**
2025	0.00	0.00	0.34	0.00	8.74	0.00	2.26	0.37	**11.71**
2030	0.00	0.00	0.00	0.00	8.99	0.00	0.00	0.50	**9.49**
Share of investment financed solely by the wholesale market revenues[188]	**Biomass**	**Geothermal**	**Hydro reservoir**	**Hydro ROR**	**Offshore wind**	**Onshore wind**	**Solar PV**	**Tidal**	**TOTAL**

[187] For additional details on viability gap of RES-e technology assessed with WESIM methodology, see Annex 5

[188] Even for those cases where wholesale market revenues are not sufficient to finance solely renewables, they are expected to contribute to provide an increasing fraction of the necessary revenues reducing the need for specific support.

2020	1%		12%	100%	0%	51%	64%	0%	41%
2025	100%		18%	100%	0%	100%	58%	0%	54%
2030	100%	100%	100%	100%	6%	100%	100%	0%	66%

Source: CEPA, central WESIM27 scenario

Such figures are affected by changing some key assumptions. As explained in Annex 4, removing priority dispatch tends to decrease this investment gap, as overall market functioning improves; also increased investors' confidence vis-à-vis ETS price developments decrease it. In fact, the PRIMES model simulates emission reductions in ETS sectors as a response to current and future ETS prices, taking into account, in particular, perfect foresight of the carbon price progression in the period 2025-50. Sensitivities have been performed with the WESIM model to try and capture the impact of imperfect foresight on renewables generators anticipated revenues, which results in a lower share of investments in renewables being viable without support – see Annex 5 for detailed results.

Second, the issue of whether wholesale electricity market revenues would be sufficient to finance investments in power generation is addressed in detail in the Market Design Impact Assessment. First, the MD IA simulates market revenues taking as a constant the level of investments provided by the EUCO27 scenario (PRIMES/IEM). Focusing on the most important results from a RES generators perspective, the analysis shows first that onshore wind across the EU from 2025 and solar PV in the South Europe (excluding small scale) from 2030 make profits on energy-only markets. However, this is not the case of the other RES technologies.

To complement this analysis, it is important to also look at the dynamic behaviour of markets and how markets can also provide investment signals. A different model was used, PRIMES/OM. It confirms that mature RES technologies are among the profitable technologies by 2030. Conversely, less mature technologies, such as wind offshore or solar thermal, remain unprofitable.[189].

All modelling approaches therefore confirm that support needs will gradually phase out over the 2020 decade, once sufficiently high ETS prices and better market functioning are in place, but that for some technologies, even this will not be sufficient.

Under Option 2, a toolkit for market-based and cost-effective support would be defined. These principles would be without prejudice to State aid rules that apply to Member States. The principles would include, *inter alia*, the possibility for Member States to use support schemes, the obligation to tender support in order to achieve value for money, the facilitation of participation of energy communities in the electricity system and in tendering schemes, the technology neutrality principle for tenders unless a technology specific approach is preferable and the protection for investors against 'retroactive' changes.

In particular, the framework would enshrine in legislation and expand the requirement to tender support; it would define tender design principles, based on emerging best practice, to ensure the highest cost-efficiency gains. The framework would thus strengthen the use of tenders as a natural phase-out mechanism for support, by which a competitive bidding process determines the remaining level of support required to bridge any financing gap –

[189] For additional details refer to annex 4: Wholesale electricity market revenues and investment in RES-e generation

such level of support being expected to go to zero for the most mature technologies over the course of the 2021-2030 period (see above).

Additionally, the Revised RES Directive would explicitly enshrine the principle that support schemes designed in line with EU indications cannot be revised in a way that retroactively impact the rights related to the level of support received by renewables projects.

Although the direct impacts of implementing this toolkit have not been tested via modelling scenarios, the framework is expected to be effective as it would define design principles (i) that ensure sufficient investor certainty over the 2021-2030 and (ii) require the use (where needed) of market-based and cost-effective schemes based on emerging best practice design (including principles that are not covered by the current state aid guidelines). At the same time, the framework would be proportionate by leaving actual implementation to the state aid guidelines (*e.g.* for the definition of thresholds applicable for any foreseen exemptions) and, most importantly, to the case by case, evidence-based, in-depth assessment of individual schemes by the services of DG Competition.

To support this assessment, one can make use of existing analysis. Recent research has evaluated the impact of various support scheme designs on the dispatch of renewables generators, based on the case of Germany. It found that moving from a feed-in-tariff (FIT) to schemes exposing producers to short term and long term price signals (feed-in-premia and, more so, capacity-based support) resulted in (i) higher average market prices, (ii) lower price volatility, and (iii) a higher market value of renewable – especially in markets characterised by high renewables penetration and low flexibility[190]. These three factors combined can contribute to reducing the need for support for renewables – and missing money issues in general.

At the same time, it is also well documented[191] that support schemes exposing producers to market risks translate, all else equal, into higher cost of capital and thus higher renewables deployment costs. Modelling using the WESIM model shows for instance that moving from support in the form of feed-in tariffs (FIT) to support in the form of floating feed-in premiums (FIP) increases the total cost of support by 5% to 6%, while moving from FIT to fixed FIP increases to total cost of support by 9% to 13%[192]. Overall, the net impact on both total system costs and renewables support costs is difficult to quantify. However, such an analysis does not consider the overall positive impacts on electricity market functioning, and therefore other types of power generation producers, that more market-oriented support schemes would have as opposed to fixed feed-in-tariffs.

As regards tendering, analysis of past tenders suggests that tenders can yield significant cost-efficiency gains[193] - to the extent that they are well-designed. As an increasing

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190 In a reference case scenario, moving from FIT to capacity-based support could resulted in 2030 in a c. 8% average price increase, in a 26% average price volatility decrease and an increase of market value for all renewable technologies, *e.g.* from below 20€/MWh to about 40€/MWh for solar PV. Winkler & al, "Impact of renewables on electricity markets – Do support schemes matter?", Energy Policy 93 (2016)

191 See for instance Gawel and Purkus (2013), Kitzing (2014), Klessman et al. (2008)

192 CEPA, "*Supporting investments into renewable electricity in context of deep market integration of RES-e after 2020*", Second interim report (June 2016)

193 AURES, *"Auctions for Renewable Support: Lessons learnt from International experiences"* (June 2016)

number of Member States are introducing tenders, best practice is emerging[194]. Introducing certain best practice principles would (i) support the use of efficient tender designs, while respecting the need to ensure sufficient flexibility, and (ii) through partial harmonisation facilitate the design of joint tenders. The extension of tendering to investment aid would expand such benefits beyond operating aid.

Research also suggests that the behaviour of renewables in electricity markets – and thus their impact on market functioning – is determined by the kind of support they receive[195]. The degree of price exposure determines the trading behaviour of renewables generators, but also plant design and investment decisions[196].

Additionally, empirical evidence (of past tenders) shows that the way support is allocated impacts the cost-efficiency of support. The analysis of past auctions in eight EU-countries and four non-EU countries showed that all those auctions schemes reported efficiency gains in terms of the contracted price or discounts achieved: *e.g.* a price of €84.9/MWh was applied in the second round of the German auction (led in 2015 on ground-mounted solar PV), which is significantly below the ceiling price of €112.9/MWh[197]. Recent auctions for offshore wind in the Netherlands and in Denmark have resulted in strike prices of, respectively, €72.7/MWh[198] and €60.0/MWh[199] – yielding significant reductions in the level of support relative to support awarded in other recent comparable projects.

Against this background, the Revised Renewables Directive could set out framework principles for the design of support schemes in the post-2020 context, laying down common principles ensuring that, when and if support is needed, such support be provided in a form that is (i) cost-effective, (ii) as little distortive as possible for the functioning of electricity markets, and (iii) fosters regional approaches through greater convergence in the design of support.

The RES Directive and the baseline do not open up the potential that could empower energy communities across the EU. Until today energy communities have only developed in a few countries: around 75% of all energy cooperatives are located in AT, DE, DK.

In addition to wider benefits for the local economy, energy communities could increase local acceptance of renewable energy projects and help mobilise the private capital that is needed for the energy transition.

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194 AURES, *"Auctions for Renewable Support: Lessons learnt from International experiences"* (June 2016). Best practices emerge in terms of general auction implementation, auction procedures and awards, eligibility requirements and project realisation

195 Winkler & al, "Impact of renewables on electricity markets – Do support schemes matter?", Energy Policy 93 (2016)

196 As shown in case studies on Latin America by Battle and Baroso (2011) and Germany by Jâgemann (2014)

197 AURES, *"Auctions for Renewable Support: Lessons learnt from International experiences"* (June 2016). The analysis of past auctions in eight EU-countries and four non-EU countries showed that all those auctions schemes reported efficiency gains in terms of the contracted price or discounts achieved: *E.g.* a price of €84.9/MWh was applied in the second round of the German auction (led in 2015 on ground-mounted solar PV), which is significantly below the ceiling price of €112.9/MWh

198 http://www.dongenergy.com/en/media/newsroom/news/articles/dong-energy-wins-tender-for-dutch-offshore-wind-farms

199 https://corporate.vattenfall.com/press-and-media/press-releases/2016/vattenfall-wins-danish-near-shore-wind-tender/

In order to enable energy communities to develop across the European Union, measures are considered to balance the competitive disadvantages that energy communities face in a competitive market. Often energy communities as groups of engaged citizens are less professionalised than commercial project developers. Generally, they only develop one project that could participate in public tenders for support, and by nature they are linked to one geographical location.

Therefore, energy communities might face difficulties competing on equal footing with large-scale players, *i.e.* competitors with larger projects or portfolio[200]. Such tendencies are already observed, *e.g.* for small-scale community power[201]. The trend in renewable support schemes towards market-based mechanisms is most likely to create an increasingly difficult economic environment for community energy projects, severely hampering their development conditions[202].

Measures to offset these disadvantages include enabling condition for energy communities, facilitating participation of energy communities in open, transparent and non-discriminatory tenders for support schemes, and facilitated market integration.

Such regulatory and legislative provisions require precise definitions. These should be as inclusive as possible to prevent excluding actors that should be supported, but as exclusive as necessary to prevent abuse[203]. This is made difficult by the fact that energy communities vary significantly in size and legal form which depends on the company or association laws of the Member States. For this reason the definition considered proposes a list of criteria of which a minimum number needs to be met in order to qualify as an energy community. In any case, only energy communities for energy generation are considered. Supplier cooperatives are not within the scope of these measures. The definition would be based on existing entities (such as SMEs) and for the only purposes of creating an enabling framework. Member States will still have freedom to have their own definition of energy communities.

By 2030, more than 50 GW wind and more than 50 GW solar[204] could be owned by energy communities, *i.e.* respectively 17% and 21% of installed capacity[205], bringing a substantial additional amount of local capital to renewable projects. Opening markets and creating enabling framework for energy communities could therefore help exploit this potential.

Under Option 3, the possibilities for support would be more limited and would require all future support to renewable electricity to be provided in the form of investment support (capacity-based support), not linked to production which would be fully supportive to the new market design. Such an approach would maintain the pricing signal in line with the new market design, and provides incentives for renewables production to fully support the energy market. It may however increase the need for administrative controls to avoid abuse and ensure that assets are properly maintained, and does not provide incentive to maximise renewables production – making reaching a production-based target more

200 Under the Guidelines on State aid for environmental protection and energy 2014-2020

201 Esp. in MS with already high community shares (*e.g.* DE). WWEA,"Headwind and Tailwind for Community Power", February 2016

202 “Renewable Energy Progress Report”, Öko Institute [to be published]

204 The potential of Energy Citizens in the European Union, CE Delft, 2016

205 Based on PRIMES EUCO27 scenario

difficult. It would also result in significant budgetary implications for Member States, as payments would have to be frontloaded. There is finally also little actual experience with supporting renewables through upfront investment aid.

Social impacts

Under Option 1 (prohibition of support), RES-E investments would be insufficient to reach the overall at least 27% target by 2030. It is likely that not reaching the 27% target would have negative social impacts in terms of job creations, growth and security of supply, as compared to the other policy options, and notably the baseline.

As explained above, net impacts on total costs of support are unclear under Option 2 and Option 3, making it difficult to quantify the social impacts implications of such scenarios.

Environmental impacts

In terms of environmental impact, missing the at least 27% target by 2030 will result under Option 1 to a lesser GHG reduction in the power sector from renewables than under Options 0, 2 and 3. At the same time, since the EU ETS cap sets a binding ceiling on the emissions within the sectors covered by the system, missing the RES target would not impact in absolute terms the EU level GHG emission reductions, which would be achieved in any case. It will lead to higher ETS carbon prices to achieve the overall GHG target, which will reduce emissions in other sectors.

However, some environmental impacts are to be expected depending on the type and location of RES-E power generation being deployed. A concentration of RES-E investments in specific countries or regions might create issues in terms of land availability for such projects, or could even in some cases put additional pressure on environmental protection rules for dedicated areas[206]. In the case of the baseline scenario, it projects an increase in electricity generation from biomass, notably as compared to the central policy scenario. Such results can be explained by the assumption of dedicated Member State support included in the baseline scenario. As such, this might create specific environmental issues.

Political feasibility /opportunity

Option 1 would not seem politically feasible, since the prohibition of support schemes would prevent Member States from bridging the funding gap of RES-E and seriously jeopardise the achievement of the 2030 target. Other Options seem to respect the principles of subsidiarity and proportionality.

Stakeholders' opinion

Respondents to the public consultations largely considered that support mechanisms should encourage greater market responsiveness, resulting in gradually decreasing support levels as technologies become mature. Several respondents regard regional

[206] The issue of environmental constraints for the deployment of RES power generation technologies is however reflected in the modelling, via comments received from Member States during the preparation of REF2016. For instance, if a country has an environmental legislation in place banning the deployment of offshore wind in protected areas, this is taken into consideration.

cooperation and consultation as a useful method to reduce differences and facilitate convergence amongst national support schemes.

Discarded options

Option 1 can be discarded as it would materially jeopardise the attainment of the EU-level at least 27% target by 2030, and additionally raises subsidiarity and proportionality issues.

5.1.2. A more coordinated regional approach to renewables support

Option 0	Option 1	Option 2
• Baseline - Continuation of current EU policies	• Mandatory **partial opening of support schemes to cross-border participation**	• Mandatory **regional support schemes**

- ***Option 0:*** *Baseline*

The Revised RES Directive would still leave it to Member States to decide the extent to which they want to open their support schemes to cross-border participation, and to enter into joint support schemes or joint projects. However, because such options have not been significantly used to date by Member States, the modelling work conducted in the baseline scenario makes the assumption that no use is made of such cross-border participation, or joint support schemes or projects.

- ***Option 1:*** *Mandatory partial opening of support schemes to cross-border participation*

The Revised RES Directive would make it mandatory for Member States to partially open their national support schemes to cross-border participation, up to a level to be defined but representative of the level of physical cross-border interconnections.

Under this option, the general principles for such opening would be set out, *e.g.*: (i) reciprocity, (ii) no double-compensation, (iii) cooperation agreement to allocate support towards each Member States' renewables pledges. A more detailed "blueprint" laying down possible forms of cross-border participation (joint auctions, mutually-opened auctions) could be provided in an annex to the Revised RES Directive (similar to the approach followed for capacity mechanisms).

- ***Option 2:*** *Mandatory regional support schemes*

The Revised RES Directive would stipulate that only regional support schemes are allowed and possibly define such regions.

5.1.2.1. Introduction to the assessment

The rationale for "regionalising" support schemes is that a more regional approach limits negative impacts on the energy market and can help Member States to achieve the EU target cost-effectively.

The current Renewables Directive foresees the possibility of cooperation mechanisms in the form of joint support schemes, but such possibility has not been used to date, at the exception of the joint scheme between Sweden and Norway. The current Directive also leaves it to Member States to decide to which degree they want to open their support schemes to non-domestic production. Certain Member States are however working on opening their support schemes to the participation of project developers located in neighbouring countries, also to ensure compliance with other Treaty provisions[207]. In the absence of a common framework for such cross-border access, Member States may implement different solutions, possibly leading to market fragmentation.

5.1.2.2. Detailed assessment

Two options for further regional cooperation are assessed, namely (Option 1) a mandatory partial opening of support schemes to cross-border participation (CRA_crossborder), and (Option 2) mandatory regional support schemes (CRA_regio). Both options have been modelled using as starting point the baseline (CRA) scenario. The WESIM model was also used to test the impacts of cross-border participation. The full description of these scenarios is presented in Annex 4 of this Impact Assessment, while Annex 5 presents detailed results.

This assessment is also based on results from a recent Ecofys study[208] that considers three different scenarios for the development of regional support schemes, *i.e.* (i) limited cooperation, (ii) moderate cooperation and (iii) strong cooperation[209].

Economic impacts

Fostering cross-borders cooperation could lead to a decrease of capital expenditures, thanks to geographical shifts towards better sites that require less renewables capacity to produce the same amount of electricity[210], as shown by several case studies. According to Ecofys, a joint quota system in Scandinavia, which would extend the existing joint quota system between Norway and Sweden to Denmark and Finland, could for example lead to a reduction in capital expenditures of about EUR 680 million over 2015-2020[211]. Optimisation of resource allocation in the case of a joint feed-in premium system in

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207 Article 30 and/or 110 TFEU

208 Ecofys, "Cooperation between EU Member States under the RES Directive" (January 2014)

209 In the first case, the used of cooperation mechanisms is reduced to necessary minimum, *i.e.* if a MS cannot fulfil by itself its RES-E target. The "moderate cooperation" scenario, cooperation occurs when country-specific support per MWh RES is limited to €17/MWh. In the "strong cooperation" case, difference in country-specific mechanisms is limited to a maximum of €4/MWh. Although this economic approach doesn't correspond with the three options expressed in terms of different legal frameworks, it is a good proxy to evaluate the impact of fostering cross-borders cooperation

210 Potential cost savings should be assessed against expenditures for additional grid expansion

211 Bush et al., 2014. Cooperation under the RES Directive. Case studies: Joint Support Schemes

Central and Eastern Europe could reduce capital expenditure by about EUR 325 million over 2015-2020[212].

Modelling based on the WESIM model[213] also confirmed the reduction in support costs allowed by a partial opening of support schemes to cross-border participation. The study simulated the impact of France partially opening floating feed-in premium support to Germany for projects completing construction in 2025[214]. The study finds an annual cost saving in the French auction of EUR 90 million over the fifteen-year life of the subsidy.

Comparing PRIMES scenarios, the first element to be observed concerns the change in the renewable energy mix. The 'CRA_crossborder' scenario, and even more 'CRA_regio', scenarios lead to a significant shift between offshore wind investments and solar investments. This is due to the relatively cost-effective potential, under the right framework conditions, *e.g.* financing costs, for solar investments. By further regionalising support schemes, and by harmonising the financing conditions for investments in RES-E projects within a region, more cost-effective investments can be financed, as opposed to the baseline scenario, where each Member State supports its own projects, with its own financing conditions. Yet, the impacts of these changes in the power generation mix are rather marginal when looking at the average electricity prices and average cost of electricity generation. The ETS price remains stable in CRA_crossborder while it increases in CRA_regio[215].

In terms of energy system costs, it can be observed than both scenarios lead to lower system costs than the baseline scenario. CRA_cross border leads to an average reduction of energy system costs of EUR 1.0 billion annually, for the period 2021-2030. Under CRA_regio, the reduction reaches EUR 1.3 billion annually. These benefits continue post-2030, although they slowly fade away in 'CRA_crossborder' while they keep increasing in 'CRA_regio'. Two main factors influence the results: i) first, an allocation of investments where they make more economic sense, as support to RES is harmonised within regions and therefore optimises investments over the availability of RES resources; ii) second, the creation of broad markets at regional level implies broadening the funding, procedures and guarantees at regional level, which can lead to economies of scale and slightly lower access to finance conditions.

Focusing now on the distributional issues, across countries and across technologies, the first element that can be mentioned is that 'CRA_Regio' and 'CRA_crossborder' provide a more balanced renewables power generation mix than the baseline scenario. This is notably visible in the case of 'CRA_regio', where significant solar PV investments take place, as mentioned above. The distribution of investments across Member States is also more balanced than in EUCO. The top three Member States represent 67% of investments in the baseline scenario. This share decreases to 58% in 'CRA_regio'. Conversely, the share of the smallest contributors increases.

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212 The cooperation mechanisms would involve Austria, the Czech Republic, Hungary and Slovakia. Ecofys, Cooperation under the RES Directive - Case studies: Joint Support Schemes (2014)

213 CEPA, "*Supporting investments into renewable electricity in context of deep market integration of RES-e after 2020*", Second interim report (June 2016)

214 The auction is considered technology-neutral and includes only technologies not viable without support. The study assumes an opening corresponding to 10% of the physical interconnection capacity between the host and the off-taker. In the case of France and Germany, under WESIM assumptions for 2025, 10% of the physical interconnection equals 330MW.

215 Detailed comparison tables of the main scenarios are provided in Annex 4

Finally, it can be expected – although the impact has not been explicitly quantified – that regionalisation of support would limit the "cannibalisation" effect, by allowing greater flexibility in the operation of the electricity system and thus reducing the number of low or negative hours when renewables are producing. All else equal, this would reduce the need for support for renewables.

Social impacts

Member States may be reluctant to enter into cooperation mechanisms due to – anticipated or actual – low public acceptance, in particular difficulties in explaining to national taxpayers or consumers that part of their funds may be used to support renewables projects in other countries[216]. Thus, opening schemes may lead to public acceptance issues.

On the other hand, enhancing regional cooperation would have a positive impact on the total cost of support passed on to the final customers. Support cost reduction could be tangible[217]. For instance, the Central and Eastern European joint FIP system could generate cumulative support cost savings of EUR 400 million (2015-2020)[218]. Overall, the need for support at a EU-level between 2011 and 2020 would be reduced by 5.8% in a moderate cooperation scenario and by 10,8% in a strong cooperation scenario, compared to a limited cooperation scenario[219]. This decrease in financial support would enable a decrease in the charge passed on to end-customers.

The comparison of the various scenarios performed using PRIMES does show overall lower renewables supporting costs passed on to consumers in 'CRA_crossborder', and even more so in 'CRA_regio', compared to the baseline scenario. In the case of 'CRA_crossborder, this is reinforced by the fact that the share of investments financed by the market increases compared to baseline, while it does not change significantly in the case of 'CRA_regio'. This is in part because the scenario considers that further regionalisation of support schemes lead to a reduced country risk for investors, and therefore easier access to finance for renewables project developers. However, the additional renewables investments in power generation still need to be financed, and will generally interact and compete with other power generation technologies to determine prices. In the case of the 'CRA_regio' scenario, this translates in an overall increase in electricity prices for households.

Environmental impacts

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216 See for instance the lessons learnt from the Pilot Opening auction between Germany and Denmark (AURES, "The role of auctions in the new renewable energy directive", June 2016) and the case for envisaged cooperation between the UK and Ireland which was put on hold in late 2014, according to some observers because of lack of public acceptance (Ecofys, "Driving regional cooperation forward in the 2030 renewable energy framework", September 2015)

217 NB: Depending on the design of support schemes, the existence of windfall profits at cheaper sites[217] may mean that capital expenditures savings are not fully be passed on through reduced support costs. Indeed, in a technology neutral support scheme, all the RES producers would receive the same support. The level of support is defined by the marginal technologies, *i.e.* the most expensive sites and technologies. Those who have very favourable production sites due to the geographical reallocation encouraged by regional joint support might received more support that actually needed (Ecofys, "Driving regional cooperation forward in the 2030 renewable energy framework", September 2015)

218 Bush et al., 2014. Cooperation under the RES Directive. Case studies: Joint Support Schemes

219 Ecofys, "Cooperation between EU Member States under the RES Directive" (January 2014)

Regional cooperation is likely to encourage renewables deployment in countries with large fossil fuel shares in their energy mix, resulting in a reduction of fossil fuels and CO_2 emissions in those countries. According to the Ecofys scenario[220], a strong cooperation (resp. moderate) would lead between 2011 and 2020 to a fossil fuel avoidance by 0.4% (resp. 0.3%) and a CO_2 emission avoidance by 0.7% (resp. 0.2%) in the power sector[221], without taking into account the impact of the EU ETS. Regional cooperation may also reduce pressure on environmentally protected areas, as mentioned in the previous section, by providing a larger pool of potential sites for RES investments projects than what would be possible if based on national approaches only.

Political feasibility /opportunity

Options 0 and 1 seem politically feasible as they respect principles of proportionality and subsidiarity. Due to its enlarged scope, Option 2 may be more challenging politically and may be seen as contradicting Member States' right to decide on their energy mix. Importantly, additional interconnections could facilitate the political feasibility of moving towards more regionalised support schemes.

Other impacts (competitiveness, markets, innovation…)

No significant impact on SMEs. Nevertheless, they could benefit from some positive impact if part of the projected solar deployment is based on small-scale installations.

It is possible to compare the impact of the various scenarios on electricity prices and energy costs for industry. The impacts of the various options compared to baseline are relatively marginal for industry. Although electricity prices slightly decrease for industry, the energy related production costs slightly increase.

Stakeholders' opinion

Regarding the geographical scope of support schemes, there is a wide variety of opinions across the stakeholder community. While the preferred option by stakeholders (34 %) is a gradual alignment of national support schemes through common EU rules, there is some willingness (17 %) to move further and consider a progressive opening of national support schemes to energy producers in other Member States under some conditions such as, for instance, obligation of physical delivery of the electricity, or having a bilateral cooperation agreement in place. The reasons given to sustain this position generally lie on the fact that the natural conditions of the location in terms of abundancy of the resource (wind or solar) are only one element to be looked at to minimize the cost of deployment of renewable energy (*e.g.* grid issues, market development). As for Member States, those generally believe that cross-border participation to support schemes should be on a voluntarily basis. Overall, the development of a concrete framework for cross border participation is generally welcomed.

Moving towards even further integration by introducing a EU-wide level support scheme, or a regional support scheme, is supported by 24 % and 12 % of the respondents respectively, while keeping national level support schemes that are only open to national

220 Ecofys, "Cooperation between EU Member States under the RES Directive" (January 2014)

221 At the same time, since the EU ETS cap sets a binding ceiling on the emissions within the sectors covered by the system, such change would not impact in absolute terms the EU level GHG emission reductions.

renewable energy producers is the preferred option for 13 % of the respondents. Several respondents highlight some possible risks and political sensitivities associated with schemes entailing further integration, as those could imply citizens in one Member State having to contribute to renewables' development in another Member State.

Discarded options

Option 2 may raise issues of proportionality and can be regarded as politically unfeasible.

5.1.3. Reducing the cost of capital for renewable electricity projects

Option 0	Option 1	Option 2
• Baseline	• EU-financial instrument with **wide eligibility criteria**	• EU-financial instrument in support of **higher-risk RES projects**

➢ ***Option 0:*** *Baseline*

No specific financial instrument in support of renewables generation projects. Public investment support would continue to be provided in certain Member States through national or sub-national programmes (using national and sub-national budgets and/or structural funds), and through any EU-level facilities and instruments having an investment period going beyond 2020.

➢ ***Option 1:*** *EU-level financial instrument with wide eligibility criteria*

An EU-level financial instrument would be created or, preferably, existing instruments would be prolonged post-2020 (in particular EFSI), which would support investments in renewables projects. As under current EFSI, renewables would (i) compete against other sectors for funding, and (ii) eligibility criteria for support would be defined widely and allow for a large variety of technologies and all Member States to benefit from support.

➢ ***Option 2:*** *EU-level financial instrument in support of higher-risk renewables projects*

As under Option 1, but support would go to various "high cost of capital" renewable projects, which may be (i) projects using less mature technologies, (ii) projects in Member States facing a high cost of capital, and/or (iii) projects of regional dimension. Option 2 could be stand-alone, or, preferably, come *in addition* to Option 1 – for instance through a dedicated "high risk" guarantee and different eligibility criteria.

As an optional feature, access to such guarantee could be limited to certain Member States having ambitious renewables national commitments – according to criteria to be defined.

5.1.3.1. Introduction to the assessment

Renewable electricity projects are capital intensive - they require large upfront capital investments combined with low operation and maintenance costs. Given this frontloaded cost structure, the weighted average cost of capital (WACC), which reflects the perceived risk of a project from an investor point of view, is decisive to the viability of a RE project[222]. A high cost of capital thus materially increases the overall investments required to meet a given deployment target.

WACCs of renewables projects are driven by several risk factors that could be classified into three main categories, namely (i) country-specific risk, (ii) sector-specific risk and (iii) project specific risk[223]. Significant differences in WACC for renewables projects are found across the EU. WACC of onshore wind projects, for example, were estimated in 2014 to vary between 3.5% (in Germany) and 12% (in Greece)[224]. Country-specific and sector-specific risks explain a large share of this gap.

Currently, investments in renewables tend to focus in mature renewables technologies in countries with low perceived risks corresponding to low cost of capital, with only two Member States (the UK and Germany) receiving over two thirds of all investments into RES-E new investments as well as mergers, acquisitions and refinancing activity in 2014 and 2015[225].

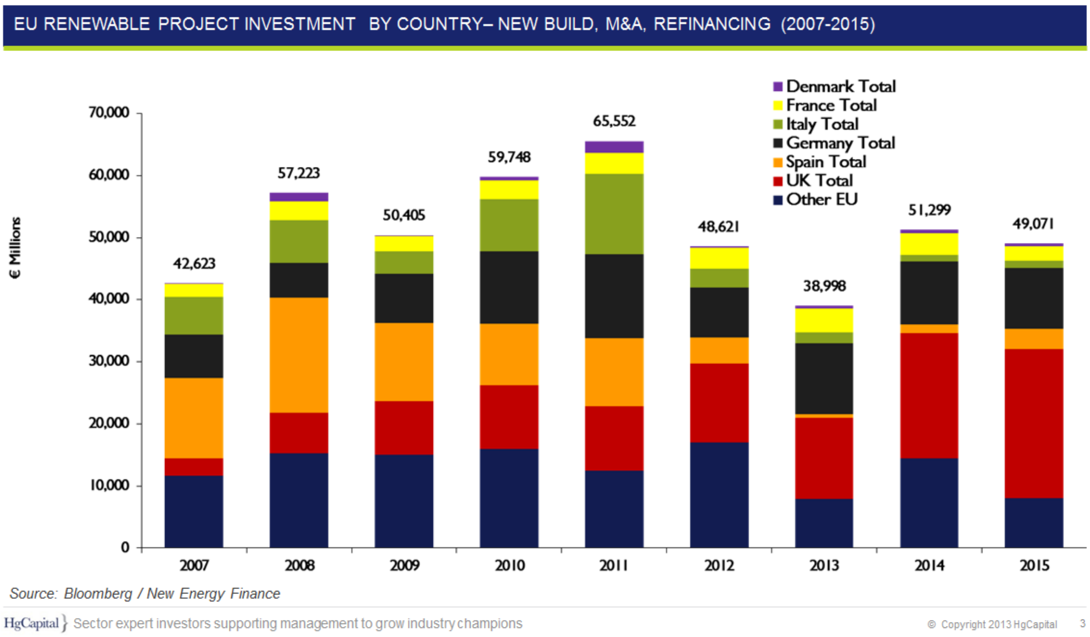

Figure 9
Source: Bloomberg New Energy Finance / Hg Capital

222 For a typical utility-scale solar PV project, financing costs represent 50% of total projects costs when the WACC reaches 9%. Source: IEA-RETD, "RE-COST Study on Cost and Business Comparisons of Renewable vs. Non-renewable Technologies", July 2013

223 REBEL, "Study on the impact assessment for a new Directive mainstreaming deployment of RE and ensuring that the EU meets its 2030 renewable energy target", Interim report (Part II), April 2016

224 Dia-core study; full report available on: http://diacore.eu/images/files2/WP3-Final%20Report/diacore-2016-impact-of-risk-in-res-investments.pdf

225 UNEP and Bloomberg New Energy Finance, "Global Trends in Renewable Energy Investment 2016"

The risk is twofold: (i) overall investments into renewables generation projects may be discouraged by high cost of capital and thus be insufficient to meet the 2030 target; (ii) and/or investments may concentrate in mature technologies in low perceived risk countries, leading to a sub-optimal medium- and long-term deployment at EU-level and a lack of exploitation of the potential of higher WACC countries.

Financial instruments can help lower the WACC of renewables projects, decreasing the overall investment cost required to meet the 2030 target. As way of illustration, a recent study found that risk-sharing schemes could reduce the WACC of offshore wind projects by 14% to 23%, depending on Member States[226] – which in turn would translate into material investment cost reductions.

Options related to the creation of renewables-focused financial instruments have been primarily assessed using variants to the baseline scenario.

5.1.3.2. Detailed assessment

Economic impacts

The impact of Option 1 (regional projects) is difficult to assess quantitatively as this may only concern a limited number of projects and installed capacity. Therefore, results would very much depend on overall funding available and on the pipeline of projects being developed. Still, projects of cross-border dimension tend to have higher administrative complexities and costs (in relation *e.g.* to environmental permitting and grid connection), typically translating into higher cost of capital relative to similar, non cross-border projects. As such, they would be expected to benefit materially from a guarantee scheme.

Option 2 considers a scenario where a subset of riskier projects (see Annex 4 for more details) can benefit from an EU-guarantee for part of the project financed through debt. It has been declined in two variants and assessed in detail via modelling work. In the first variant ('CRA_countryspec'), the modelling assesses the impacts of concentrating access to the EU financial instrument to a subset of Member States, the ones with the initial highest cost of capital for renewables projects, for all technologies. In the second variant, ('CRA_techspec') the focus is put on a limited number of riskier technologies having a high cost of capital[227], but in all Member States. In both cases, a reduction in the WACC for indivdual projects benefiting from the guarantee of 15%[228] compared to the baseline is assumed and put as an exogenous change in the model.

Regarding the power generation mix, at EU level, the changes are marginal in the 'CRA_countryspec' scenario as compared to the baseline (CRA) scenario. Average costs of electricity generation are slightly lower. The share of wind onshore and biomass slightly decreases. The decrease in the share of wind is confirmed when observing investment cost patterns, since such investments decrease as well. However, the

[226] CEPA, "Supporting investments into renewable electricity in context of deep market integration of RES-e after 2020", Second interim report (June 2016)

[227] Namely tidal, geothermal, offshore wind, biogas, biomass solid and bioliquids

[228] CEPA, "Supporting investments into renewable electricity in context of deep market integration of RES-e after 2020", Second interim report (June 2016) – the study estimates for instance a reduction in WACC through "development finance" of 14 to 23% for offshore wind

dispersion of investments across Member States is more balanced, when compared to CRA scenario.

Changes are more significant when considering the 'CRA_techspec variant'. This scenario leads to significantly more investments in wind offshore, which translate into an important increase in the overall RES-E share. However, this has no major impact on electricity prices or on average cost of electricity generation. In terms of investments, this scenario generates much more RES-E investments than the baseline scenario, in particular in the areas where dedicated support is concentrated, namely wind offshore and tidal. It also leads to much more concentration of investments in specific countries, the ones with the highest wind offshore potential. Finally, it should be noted that the ETS price is significantly negatively affected by the deployment of additional RES technologies under these conditions, if we are to keep the same overall GHG emission reductions in the ETS sector. This would limit the role of the energy-only market to drive investments in renewables.

The 'CRA_countryspec' scenario leads to lower energy system costs than in baseline. On average, energy system costs are EUR 1.5 billion lower in this scenario than in CRA. This result is also confirmed by looking at developments post-2030. Conversely, the CRA_techspec scenario translates into significantly higher energy system costs. This is the result of a combination of factors: i) a significant increase in RES-E investments compared to baseline; and ii) a concentration of such investments in more expensive technologies. It must be noted that the potential benefits of such concentration of investments on technological progress and cost reduction, notably if this leads to technological breakthrough, may not be fully captured by the model. For instance, as regards offshore wind in particular, recent tenders have cleared with a cost of support of around 80€/MWh, which is below the cost assumptions made under REF2016 and other policy scenarios conducted for this and other related Impact Assessments.

Finally, it is also worth comparing the RES-E shares across Member States between the baseline and CRA_country spec. As expected, the RES-E share increases in the countries benefitting from the support, to the detriment of other Member States with better initial financing conditions but lower renewables potential. In other words, this scenario achieves a more balanced deployment of renewables across the EU at a lower cost than continuation of purely national-based practices.

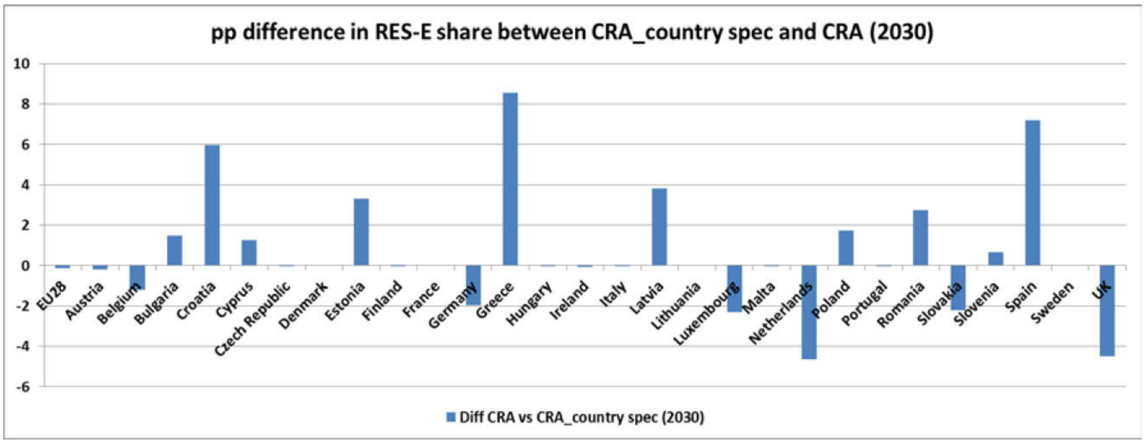

Figure 10 – Percentage points difference in RES-E share between CRA_country spec and CRA (2030)
Source: PRIMES

Under all options, it should be noted that unconditional access to financial instruments may reduce the need for Member States to improve financing conditions via better framework conditions, and would therefore question the initial assumptions considered in the modelling of a clear reduction in the WACC for all projects financed. Such underlying framework conditions are essential for the results to hold. This may imply that access to the funds is made conditional upon Member States delivering on certain measures (*e.g.* administrative procedures for renewables).

Social impacts

'CRA_countryspec' shows overall lower renewables supporting costs passed on to consumers. This is also explained by the fact that a higher share of investments can be financed by the markets. As some countries receive additional guarantee to finance investments, the need to rely on operational support becomes of course more moderate. The overall impact on electricity prices is also positive, as prices for households slightly decrease compared to the baseline. Financial tools that reduce the WACC of the project would decrease the need for direct financial support, alleviating the financial cost of support for end costumers. Net gain would however depend on the exact structure and cost of the guarantee scheme itself (capital cost of opportunity, portfolio losses, and administrative costs).

'CRA_techspec' shows overall much higher renewables supporting costs passed on to consumers. The impact is however much more limited on electricity prices, due to the overall factors influencing the electricity mix and therefore price formation.

Environmental impacts

The option of support chosen will have an impact on the renewables energy mix by unleashing investment in certain resources abundant in higher-cost of capital Member States. However, no impact can be observed on GHG emissions since all scenarios reach a 40% GHG emission reduction by 2030.

Political feasibility /opportunity

All options can be seen as respecting the principles of proportionality and subsidiarity. Political feasibility however depends on the amount of funding foreseen, without pre-empting discussions on the future multiannual financial framework of the Union.

Other impacts (markets, innovation…)

The options designed will not have a significant impact on SMEs at EU level. Nevertheless, they could benefit from some positive impact if part of the solar deployment is based on small-scale installations[229]. No significant impact was identified as regards impacts on energy costs and electricity prices for industry.

5.1.4 Administrative simplification

Renewable Electricity Directive 2001/77/EC and the RES Directive oblige Member States to streamline administrative procedures for renewable energy. However, administrative barriers remain an obstacle to the deployment of renewables. With the upcoming revision, the issue becomes even more relevant on EU level, as the Revised

[229] http://ec.europa.eu/energy/sites/ener/files/documents/1_EN_autre_document_travail_service_part1_v6.pdf.

RES Directive will not contain national targets. The options proposed in the section build on Article 13 of the RES Directive and on Article 8 of Regulation 347/2013 (the "TEN-T" Regulation) for projects of common interest. Article 13 obliges Member States to clearly define permitting procedures with transparent timetables, provide comprehensive information, streamline and expedite administrative procedures and provide facilitated procedures for small projects.

Option 0	Option 1	Option 2
• Baseline - current provisions (Article 13 (1)) apply until 2030	• Reinforced provisions with "one-stop-shop" • Introduction of time limits with a range of possible duration of permitting process • Facilitated procedures for repowering	• All of Option 2 + • Maximum time limits for permitting with automatic approval after deadline • Publication of project developer manuals • Compulsory simple notification procedures for small household-size projects • Facilitated procedures for medium-sized projects

➢ ***Option 0:*** *Baseline*

This option consists in the extension of current Article 13 (1) rules on administrative procedures (no-change) until 2030. With such an option, the subsidiarity principle will be respected, since Member State will be free to find the most effective way of streamlining administrative procedures for renewables. However, the current provisions have been too vague to be enforced effectively and administrative barriers continue to exist.

➢ ***Option 1:*** *Reinforced provisions with "one-stop-shop", time ranges and facilitated procedures for repowering*

This option consists of a reinforced Article 13(1). In addition to the current obligation to ensure that '*certification and licensing procedures … are clearly coordinated and defined, with transparent timetables*' this option proposes a maximum time range is specified after which the competent authority needs to give a decision on the application. Furthermore, this option requires Member States to designate a single administrative contact point (one-stop-shop) for permit granting similar to the provisions of the TEN-E Regulation. In order to respect the subsidiarity principle, Member States would nevertheless have the freedom to choose the most appropriate implementation rules. Moreover, this option proposes facilitated procedures for the repowering of renewable energy projects in order to ensure that assessments that have been conducted do not need to be repeated.

➢ ***Option 2:*** *Reinforced provisions with "one-stop-shop" and time limits, automatic approval, and compulsory simple notification for small projects*

This option would consist of all the elements of Option 1. However, instead of a time range for the permitting process, this option prescribes a fixed deadline. A "*defined maximum time-limit for permitting procedures, and effective consequences if deadline is missed*" as called for by 85% of stakeholders who expressed a view on this topic in the public consultation. In order to improve the enforceability of this deadline, the option also includes an automatic approval if no answer is received by the end of the deadline. The option also includes simple notification (instead of authorisation process) for household-size renewable energy projects and facilitated procedures, such as shorter time limits, for medium-size renewable energy projects.

5.1.4.1. Introduction to the assessment

Article 13 (1) of the current RES Directive mandates simplified, streamlined, expedited and coordinated administrative procedures. However, the current directive was only partly successful in reducing these barriers and streamlining the various elements of the permitting process. The REFIT evaluation and the Renewable Energy Progress Report of the European Commission found that several administrative barriers continue to exist across Member States and have a negative effect on the costs and the deployment of renewables. It is concluded that greater administrative simplification is needed.

Administrative costs contribute significantly to the overall project cost: In France, for instance, the administrative costs of a wind project account for 15% of project costs[230]. Project delays are also expensive: a one-year delay results in 50 % of additional regulatory costs and a 0.25 % increase in the cost of debt when feed-in tariffs are digressive. Reducing administrative burden through simplification (based on best practices and existing legislation) can therefore reduce the costs for the deployment of renewables.

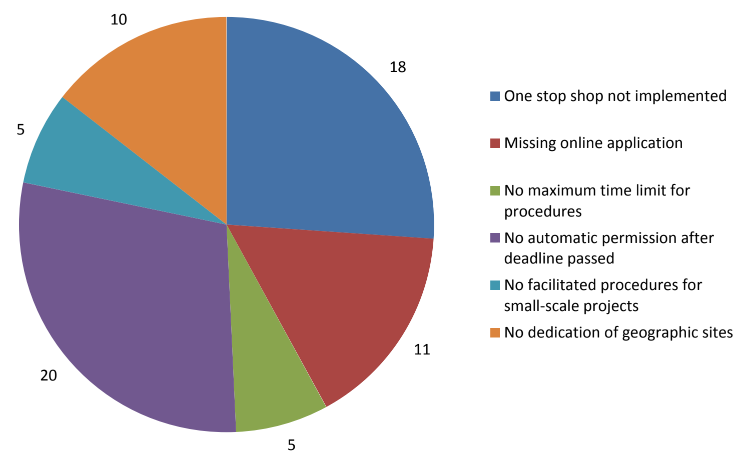

Figure 11: Administrative barriers present in European Member States in 2014[231]

[230] Interim RES Report, section 2.3.

[231] "Renewable Energy Progress Report", Öko Institute [to be published]

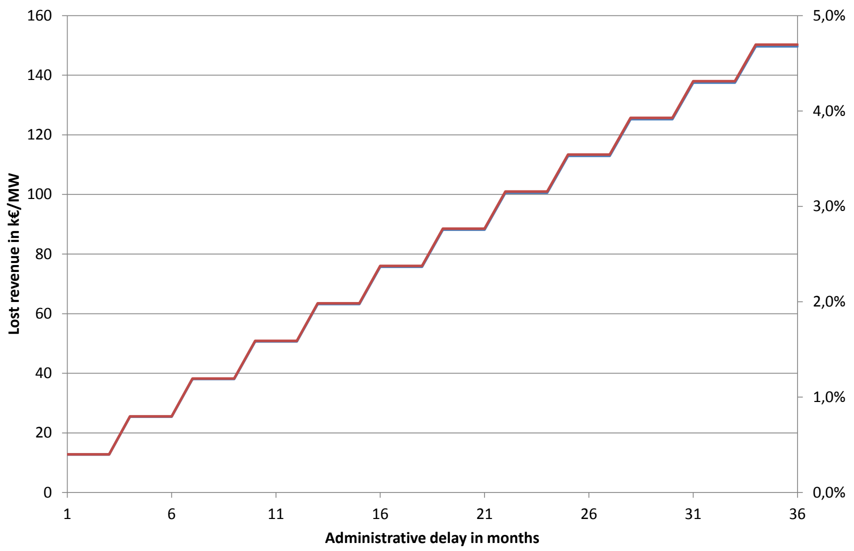

***Figure 12: Lost revenue due to administrative delay*[232]**

5.1.4.2. Detailed assessment

The proposed options precise requirements that already exist in the current article 13: it requires Member States to provide comprehensive information (addressed through development of manuals) and streamlining, coordinating and expediting the permitting process (addressed through one-stop-shops). Similar requirements exist in the TEN-E Regulation (EU) No 347/2013: Article 8.3 proposes one-stop-shops and Article 9.1 requires manuals.

Both measures are regarded as best practice for permitting procedures across sectors by other EU legislation[233] and by OECD publications[234] and are requested by stakeholders in the public consultation. Yet, several Member States have not implemented them for the permitting of renewable energy projects[235]. Manuals are a low-cost no-regret option as the knowledge required for such a manual should already exist in the administrations of Member States.

Time limits for authorisation projects exist in more than half of the Member States and are regarded as best practice for administrative procedures generally[236]. They can also be found in Article 10 of the TEN-E Regulation (EU) No 347/2013. In particular in combination with an automatic approval after the deadline, they are the most effective way to limit the time for permit granting.

232 Source: "Renewable Energy Progress Report", Öko Institute [to be published]
233 Services Directive 2006/123 EC
234 OECD, "From red tape to smart tape. Administrative simplification in OECD countries", Paris, France, p. 30: "*the one-stop shop concept has been implemented in a vast number […] combinations. There is evidence that many of the variations of this basic idea have been successful in reducing administrative burdens on businesses and the general public. These gains have been experienced as reductions in the time and cost invested in seeking information, especially on licence and permit requirements*"
235 "Renewable Energy Progress Report", Öko Institute [to be published]
236 "Renewable Energy Progress Report", Öko Institute [to be published]taken from OECD, "From red tape to smart tape. Administrative simplification in OECD countries", Paris, France, p. 11

The automatic approval under Option 2 would only be possible when it does not collide with requirements rooted in other European legislation, such as the potential need for an environmental impact assessment[237]. Even though automatic approval does not necessarily improve certainty for project developers who might see their project challenged in courts after a permit is granted automatically, such a provision would set clear performance standards for national administrations and would increase the enforceability of time limits. However automatic approval is questionable with regards to subsidiarity.

Economic impacts

The experience of introducing a one-stop-shop for so-called ICPE projects[238] in seven French regions in 2014 shows the effects of a one-stop-shop on permitting times. The one-stop-shop reduced the average permitting duration for ICPE projects to 259 days compared to 431 days for projects without this measure[239].

Simple notification for household-sized projects and tighter deadlines for medium-sized projects as proposed in Options 1 and 2 are expected to facilitate the uptake of distributed generation. The impact of these particular measures is expected to be felt in Member States that do not have measures in place for small-scale projects yet. According to the RES Report, this was the case in Bulgaria, Estonia, Latvia, Slovenia and Slovakia in 2014[240].

Simplified procedures for repowering, as proposed in Option 1 and 2, should make repowering projects less costly. According to industry estimates up to 76GW of the EU's onshore and offshore wind energy capacity will come to the end of their operational life between 2020 and 2030 (of today's installed capacity is 142GW)[241] showing that there is significant potential for the continued deployment of renewables when repowering is simplified. The business as usual option does not contain any specific provisions on repowering.

Social impacts

It is expected that a more efficient administration will not have an immediate social impact.

The maximum time limits for permit granting are not expected to have a negative social impact. Time limits already exist in 23 Member States and a limit of 3.5 years allows sufficient time to consult stakeholders also for large projects.

Environmental impacts

Administrative simplification is expected to contribute to a favourable environment for renewable energy projects. However, it is difficult to relate the direct impact of

237 Strategic Environmental assessment under the SEA Directive (2001/42/EC- OJ L 197, 21.7.2001, p. 30–37), Environmental impact assessment under the EIA Directive (2011/92/EU, OJ L 26, 28.1.2012, pp. 1-21, as amended by Directive 2014/52/EU, OJ L 124, 25.4.2014, pp. 1-18) and appropriate assessment under the Habitat Directive (92/43/EEC , OJ L 206, 22.7.1992, p. 7)

238 facilities classified in view of protecting the environment

239 "Renewable Energy Progress Report", Öko Institute [to be published]

240 RES Report, p. 41

241 Figures provided by WindEurope

administrative measures proposed to environmental results, such as the replacement of fossil fuel generation with renewable energy generation.

Political feasibility /opportunity/subsidiarity

The options are in line with existing legislation (article 13 of the current RES Directive, TEN-E Regulation) and with common practice in a number of Member States. Administrative simplification was supported by a large majority of respondents in the public consultation, including some Member States.

All options, with the exception of an automatic permit granting in Option 2, respect the subsidiarity principle. The measures do not require changing the content of the permitting process but they oblige Member States to set up coherent administrative structures at the appropriate level. This leaves Member States room to develop measures that are best suited to local circumstances while at the same time specifying the existing provisions and thus making them more enforceable.

Action needs to be taken at European level since the EU RES target for 2030 is mandatory for the EU as a whole and because the reduction of administrative burden can contribute significantly to achieving this target. The existing measures were not specific enough to be enforced effectively.

Impact on SMEs

A simpler permitting procedure is particularly helpful for small actors which have fewer resources and less experience in dealing with different administrative responsibilities.

5.1.5. Overall comparison of the options to increase renewable energy in the electricity sector (RES-E)

	Overall impact			**Key objectives**		
Policy option	Social	Economic	Environmental	Effectiveness	Efficiency	Coherence
Consolidating a framework for a cost-effective, market-oriented and Europeanised support to renewable electricity to promote regulatory certainty						
Option 0 - Baseline	0	0	0	0	0	0
Option 1 - No support for renewable electricity - investments only spurred by market mechanisms	- -	- -	- -	- - -	0	- - -
Option 2 – Clarifying the rules through a	+/-	+	0	++	++	++

toolkit						
Option 3 - Mandatory move towards investment aid	+/-	+	0	-	+	++
A more coordinated regional approach to renewables support						
Option 0 - Baseline	0	0	0	0	0	0
Option 1 - Mandatory partial opening of support schemes to cross-border participation	+	+	0	+	+	++
Option 2 - Mandatory regional support schemes	+	++	0	+/-	+	++
+,++,+++ : positive impact (from moderately to highly positive) ***0 : neutral or very limited impact*** ***-, --, --- : negative impact (from moderately to highly negative)***						
Reducing the cost of capital for renewable generation projects						
Option 0- Baseline	0	0	0	0	0	0
Option 1 - EU-level financial instrument with wide eligibility criteria	not assessed in details	not assessed in details	not assessed in details	not assessed in details	not assessed in details	not assessed in details
Option 2 - EU-level financial instrument in support of higher-risk RES projects	+	+	0	++	++	+++
Administrative Simplification						

Option 0 - Baseline	0	0	0	0	0	0
Option 1 - Reinforced provisions with "one-stop-shop", time ranges and facilitated procedures for repowering	Not assessed	++	n/a	++	++	++
Option 2 - Reinforced provisions with "one-stop-shop" and time limits, automatic approval, and simple notification for small projects	Not assessed	+++	n/a	+++	+++	+++
+,++,+++ : positive impact (from moderately to highly positive) ***0 : neutral or very limited impact*** ***-, --, --- : negative impact (from moderately to highly negative)***						

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

The table below provides an overview of the options discussed in this section.

Challenge	Drivers	Policy Options
Mainstreaming Renewables in H&C supply	Uncertainty regarding the heating and cooling sector strategy Projected contribution of H&C not in line with cost effective decarbonisation path Lack of cost internalisation: market failures due to inexistence of ETS signal for the bulk of H&C sector hence no incentive for fuel switch	0. Baseline - Continuation of Current EU policies including indirect RES measures in the EPBD and EED 1. RES H&C obligation on fossil fuel suppliers a. Gradual approach b. Universal Approach 2. RES H&C obligation on all energy suppliers a. Gradual approach b. Universal Approach

Facilitating of RES in District Heating and cooling Systems	Projected contribution of H&C not in line with the high potential of District Heating for cost-effective decarbonisation No incentive to improve performance of / grant access to to district heating/cooling system	0. Baseline - Continuation of Current EU policies 1. Continuation of current requirements with best market sharing 2. Energy Performance Certificates and creating access rights to local H&C systems 3. Option 2+ further reinforced consumer rights

5.2.1. *Mainstreaming renewables in heating and cooling supply*

Option 0	Option 1	Option 2
• Baseline - Continuation of current EU including **indirect RES measures in the EPBD and EED**	• **RES heating and cooling obligation on fossil fuel suppliers**	• **RES heating and cooling obligation on all energy suppliers**

The purpose of the proposed measures is twofold: on the one hand, address persisting market failures in the area of heating and cooling, and on the other hand, contribute as a 'gap-avoider', and ultimately (following mid-term review of EU progress towards 27% target) as a 'gap-filler', to the achievement of at least 27% renewables share at the EU level by 2030.

The following options are closely interrelated with measures on energy efficiency and energy performance in buildings, which are respectively addressed within the initiatives for the revision of the Energy Efficiency Directive and the Energy Performance of Buildings Directive. However, as detailed below, the impact of these legislations on renewable deployment has so far remained limited, and is not expected to substantially increase post-2020. Therefore a complementary initiative targeted on heating and cooling across all energy users (industrial, residential and tertiary) is deemed necessary.

➢ ***Option 0:*** *Baseline*

The RES Directive requirements with regard to renewable heating and cooling as well as information and training (Article14) are included in the Revised RES Directive and continue after 2020. The provisions of revised EED and EPDB concerning renewables as currently proposed are implemented, therefore renewable energy technologies in buildings will be indirectly promoted through legal requirements on building energy performance, including nearly zero energy buildings, methodologies for calculating the energy performance of buildings and building renovation and energy efficiency measures as included in the initiatives for the revision of the Energy Efficiency Directive and the Energy Performance of Buildings Directive.

Specific support for RES-H&C technologies that were present in 2020 at national level continue to be in place, with however a slight decrease in volume due to the absence of post-2020 targets. Renewable energy technologies will need to compete with fluctuating fossil fuel prices and distortive subsidies for fossil fuels with no corrections through ETS in this sector.

Synergies with energy efficiency initiatives and Article 13

The **Energy Efficiency Directive** requires Member States to carry out comprehensive assessments of national potentials for high-efficiency cogeneration and/or efficient district heating and cooling, updating these assessments every five years. Should these assessments identify a potential, Member States are obliged to take adequate measures for efficient district heating and cooling infrastructure to be developed and/or to accommodate the development of high-efficiency cogeneration and the use of heating and cooling from waste heat and renewable energy sources. The Directive also targets energy end use efficiency, requiring Member States to achieve annual energy savings. However, taken in isolation, these provisions of the EED do not include explicit requirements to Member States to foster renewable energy deployment in the heating and cooling sector. Member States may promote efficient district heating and cooling, *i.e.* using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat. Since district heating covers **around 8%** of the heating and cooling energy mix in the EU[242] such provisions are **not sufficient to capture the renewable energy potential** in the largest segment of the EU heating and cooling market – the individual boilers at building level, and in the industry sector, where significant potential for fuel-switching remains. Almost 50% of the EU's buildings are equipped with inefficient, fossil fuel based boilers, many beyond their technical lifetime[243].

The **Energy Efficiency Directive** also allows end –use savings generated by renewable energy sources under Article 7 (promoted by measures under the Energy Efficiency Obligation Schemes or alternative measures), as long as they trigger genuine end-use savings as required by this policy focusing on reduction of energy needs by buildings and other end-use sectors. By 2020, a proposed amendment to the Energy Efficiency Directive would allow Member States to count certain amount of renewable energy generated on/in buildings for own use as a result of new RES heating or cooling installation (as exemption subject to 25% cap) to fulfil their end-use energy saving requirement. This possibility will come on the top of the current 3 exemptions that Member States are already using and might therefore have limited impact. The expected impacts would be all the more limited as the use of exemption would be optional, and limited to 25% of the Energy Efficiency Obligation.

Under the revised RES Directive, Member States which already have designated obligated parties under the energy efficiency obligation schemes (so far put in place in 15

[242] 8% in 2013 – source : Fraunhofer, 2016

[243] An EU Strategy for Heating and Cooling, COM (2016) 51/2

Member States, but a couple more of MS intend to set the scheme in near future) in line with Article 7 of the Energy Efficiency Directive[244], will also have the possibility to define the same obligated parties in the heating and cooling obligation scheme under the amended RES Directive. While energy efficiency obligation schemes and renewable energy schemes for heating and cooling would contribute to two distinct, but mutually reinforcing objectives of reducing the overall energy end use and increasing the share of renewable energy and fuels in the heating and cooling, using existing implementation structures where they have already been established for the purposes of compliance with the EED can substantially reduce the administrative implementation burden at Member State level.

The **Energy Performance for Buildings Directive** (EPBD) incentivises building level energy performance improvements for new and deeply renovated buildings. The energy performance of building EPBD does not specifically target renewable energy promotion. The contribution of renewable energy sources to the improvement of the energy performance of buildings competes, ideally, on an equal footing with measures to reduce the energy needs (*e.g.* insulation) and to improve technical building systems' efficiency (*e.g.* switch from oil based to gas condensing systems).

In line with this principle and in order to make sure that the implementation of the EPBD simultaneously ensure the transformation of the building stock and the shift to a more sustainable energy supply, a proposed amendment in the EPBD IA will ensure that energy performance of buildings equally treats: (a) the energy from renewable sources that is generated on-site (behind the individual meter, *i.e.* not accounted as supplied), and (b) the energy from renewable energy sources supplied through the energy carrier. Fair competition of technologies will contribute to upfront cost reduction with positive impact on cost-effectiveness, resulting in a continuous tightening of minimum energy performance requirements, with positive impacts on the uptake of renewables. Under the current Article 8, the EBPD also covers existing buildings, by introducing performance requirements on the replacement/upgrade of technical building systems. When undertaken out of a major renovation, the interventions on technical building systems are limited to individual component of the system. Despite the actual improvement in efficiency, such upgrades remain in the same technology and are therefore not likely to trigger fuel-switching to renewables.

However, between 2020 and 2030, new buildings will only account for **6% of the building stock**, with the same order of magnitude[245] for deep renovations. Therefore, the majority of the residential sector, *i.e.* the existing building stock, will remain untouched over the period. Since buildings only represent around 55%[246] of all heating and cooling consumption, the EPBD would at very best tackle between 6% and 10% of the heating and cooling demand[247]. Dedicated complementary measures to support the development of RES and the relevant industrial sector are therefore needed.

In addition, **Article 13(4)** of the renewable energy directive requires Member States, where appropriate, to define minimal levels of renewables for new and deeply renovated buildings. As of February 2016, 22 out of 28 Member States had minimum renewables

[244] Directive 2012/27/EU

[245] 6% to 14%, EC draft calculation

[246] Included commercial buildings, Eurostat 2016

[247] Considering EBPD will only address heating and cooling, which is very unlikely. These figures should therefore be considered maxima.

requirements in their national building regulations[248]. However, requirements vary between building types, renewables technologies and compliance thresholds[249]. Additionally, on all aspects of Article 13, given its still fragmental application and the lack of research, it is difficult at this stage to assess the additional impacts from the RED in terms of effectiveness[250].

The **Ecodesign and Energy Labelling directives**[251] create an enabling framework for the uptake of more efficient products on the market, by establishing minimum energy efficiency standards for manufacturers and by helping consumers choose energy efficient products (*e.g.* a heat pump or condensing gas boilers vs. a traditional gas boiler). While these measures prevent the most inefficient boilers from being placed on the market and contribute to raise consumer awareness, they do not *per se* accelerate the market uptake of renewable energy based heating and cooling systems.

- ***Option 1:*** *Renewable energy obligation on fossil fuel and fossil fuel based energy suppliers for heating and cooling*

A renewables heating and cooling obligation could be included in Revised RES Directive, requiring that each Member State oblige their designated energy suppliers who sell fossil fuels or fossil energy for heating and cooling to achieve a mandatory share of renewables in the total fuel/ energy sales volume for heating and cooling.

However, given that energy and fuel suppliers who already have renewables in their portfolio would not be required to be part of this obligation, this could lead to fictive renewables share claims in order to gain exemption from the obligation scheme. Eventually this might not lead to increased renewables consumption volumes in a given Member State as energy and fuel suppliers who already partially sell renewables and could trade their renewables component with fossil fuel suppliers would not necessarily be motivated to continue to expand their renewable production or deployment.

If the renewables heating and cooling obligation addressed only the non-renewable part of the heating/cooling market, about 83%[252] of the total EU final energy demand for heating and cooling (excluding electricity) could be potentially covered.

- ***Option 2:*** *Renewable energy obligation on all fuel and fuel based energy suppliers for heating and cooling, including those already supplying renewables*

A renewables heat and cooling obligation could be included in Revised RES Directive, requiring that each Member State oblige their designated energy suppliers for heating and cooling to achieve an increase in the share of renewables in their total annual sales volume by 2030. Unlike in Option 1, in Option 2 every supplier would in principle be obliged with the exemption of those supplying 100% renewables.

If all non-renewable and mixed portfolio (including renewable fuel and technology) suppliers would be covered in the renewable energy obligation scheme, about 98%[253] of the EU heating and cooling market (excluding electricity) could be potentially addressed.

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248 Concerted Action on Energy Performance of Buildings and ECOFYS, 2014

249 CE Delft, *Mid-term evaluation of the Renewable Energy Directive*, 2015

250 source : Refit Study, 2015, CE Delft

251 Respectively, Directive 2009/125/EC and Directive 2010/30/EU

252 Data and calculations from Fraunhofer ISI et al. 2016 and Oeko-Institute et al. 2016. This estimate is a maximum and excludes potential exemptions for small-scale suppliers

For both options, two variants of this obligation could be envisaged:

- ***Variant 1 Gradual obligation***: fossil fuel or fossil fuel based energy suppliers would be required to ensure that each year from 2021 to 2030, an additional share[254] of the fossil fuel part of the energy sold or distributed to end-consumers for heating and cooling come from renewables;

- ***Variant 2 Universal obligation:*** fossil fuel or fossil fuel based energy suppliers would be required to ensure that by 2030 at least a certain[255] share of the energy sold or distributed to end-consumers for heating and cooling comes from renewables.

Under both approaches, energy suppliers in Member States could comply with these obligations either through:

(i) physical incorporation of renewable energy, including bioenergy made from waste, in the energy supplied for heating and cooling[256],

(ii) direct mitigation measures such as installation of highly efficient renewables heating and cooling systems in buildings and/or renewable energy use for industrial heating and cooling processes or

(iii) indirect mitigation measures proven by tradable certificates (carried out by another economic operator such as independent renewable technology installer or ESCO providing renewable installation services).

With natural gas representing more than 40% of the total EU heating and cooling supply in 2012[257], the physical incorporation option (i) would allow suppliers to gradually increase their share of biogas injected into the network and tackle the untapped potential of the sector.

For the technology implementation options, a methodology is required to calculate the amount of heat a RES-H&C installation is delivering into the obligation scheme. The mechanism applied must ensure that the calculated or metered output of a RES-H&C installation is accurate, replicable and not open to abuse. This will be vital for protecting the scheme from gaming and fraud.

<u>Mitigation of the impact on obligated parties (esp. SMEs)</u>

In order to reduce the burden on small-scale operators, Member States would also benefit from a range of mitigation measures:

(i) the possibility to designate as obligated parties either retail or wholesale suppliers, which latter are typically large-scale;

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253 Data and calculations from Fraunhofer ISI et al. 2016 and Oeko-Institute et al. 2016. This estimate is a maximum and excludes potential exemptions for small-scale suppliers

254 To be determined based on EU cost-effective deployment – see 5.2.1.1.

255 To be determined based on EU cost-effective deployment – see 5.2.1.1.

256 *E.g.* through integration of renewable energy in district heating or feed-in of biogas in natural gas grids and renewable electricity in the electricity used for heating and cooling needs

257 Fraunhofer, 2012

(ii) the possibility to exempt SMEs from the scheme, as long a minimal share of the supply is represented. The small-scale supplier exemption should be designed to mitigate the impact on SMEs while avoiding to put disproportionate burden on the remaining eligible ones. Considering these elements, 50% of the total heating and cooling supply could be exempted from the obligations;

(iii) the possibility for obligated parties to jointly deliver on the scheme as one single obligated party, therefore enabling a "critical mass effect" among energy suppliers;

(iv) the possibility for obligated parties to comply with the obligation on a 3-year average basis rather than a yearly mandatory increase.

5.2.1.1. Introduction to the assessment

With the current legal requirements as set out in Articles 3(1) to (3), 4, 13(3) to (6) and 16(11) of the RES Directive, the EU is expected to achieve around 22% of RES-H&C share by 2020.

In EUCO27 scenario, a cost-effective level of RES-H&C deployment by 2030 is projected to be around 27%. Under a continuation of current practices, including additional renewables-at building level (option 0), the EU might only reach around 25% renewables in H&C in 2030[258]. The assessment of potential impacts on renewable energy deployment of Option 0 is based on REF2016, on which the contribution of EPBD measures in the field on renewables has been added. On the basis of the assessment presented in 5.2.1., RES-related measures in the EPBD could potentially tackle between 6% and 10%[259] of the total heating and cooling supply.

Energy efficiency can also play a role in increasing the share of renewables in heating and cooling by lowering the overall demand. However, energy efficiency alone will not be sufficient to reach a cost-optimal share of renewable in heating and cooling in the residential sector[260]. Between 2021 and 2030, energy efficiency could tackle around 50% of the additional effort needed to reach cost-efficient renewable deployment in the heating and cooling sector[261]. Energy savings should mostly affect non-renewable heating, while the overall consumption of renewables in final heat should remain constant. The rest of the effort will be supported mostly by heat pumps. Therefore additional measures will be needed to ensure that renewables will gradually replace fossil fuels in heating and cooling, and address the untapped potential in terms of electrification and heat pumps deployment. The role of heat demand savings would obviously increase in case of more ambitious energy efficiency target, as explained in Annex 4. However, the influence of a 30% target in energy savings by 2030 would not substantially change the cost-effective share of renewables to be reached by 2030[262], therefore the level of suppliers' obligation should not be affected.

The proposed renewable energy heating and cooling obligation scheme (HCOS) will therefore provide additional incentives to fuel-switching from fossil to renewable energy mostly at the building level and also at the industrial, currently not sufficiently stimulated

258 Based on PRIMES REF2016
259 Draft estimations based on available data
260 PRIMES EUCO27 scenario
261 PRIMES EUCO27 scenario
262 26,3% in heating and cooling by 2030 according to EUCO30 scenario

by the EU energy efficiency framework. The total intended volume of the obligation should result in 27% renewables share in the heating and cooling at EU level, which is deemed the most cost-effective deployment to reach the at least 27% overall renewables target by 2030[263].

Level of the obligation

In order to determine the required level of the obligation to reach a cost-effective target of 27% renewables in heating and cooling by 2030, the following methodology was used:

- For variant 1, the share of renewables in heating and cooling would have to increase by 5%[264] between 2021 and 2030. Given that 50% of the heating and cooling supply could be exempted; the remaining eligible parties would have to increase their RES-shares by 10% in 10 years, *i.e.* by 1 percentage point (pp) every year[265].

- For variant 2, the EU as a whole will have to reach 27% renewables in heating and cooling by 2030. Taking into account, on the one hand, early achievers[266], and on the other hand, exempted parties, the level of the obligation would be 27% by 2030 for each obligated party.

5.2.1.2. Detailed assessment

Important note

In the following assessment, all renewable energy shares and deployments have been measured at EU- and Member State-level in comparison with the EUCO27 scenario. This has been performed in order to measure the distortion (in terms of additional effort at member-State level) vs. the cost-effective scenario. The impacts of options 0 (continuation of current practices) are mostly elaborated on in the introduction above.

The below assessment uses the REF2016 as the starting point in terms of projected renewables shares in heating and cooling for 2020 for each Member State, on the basis of the overall legal obligation for each Member State to reach their national target for 2020. It implies for a number of countries an acceleration of renewables heating & cooling deployment before 2020. Under the assumption that a number of Member States could not reach their target, or could reach their targets by additional efforts in other sectors, extra efforts towards meeting the EU 2030 target would be larger, and this could also have consequences for the heating & cooling sector. Notably, the level of obligations post 2020 needed to reach 27% RES-H&C might need to be higher.

Social impacts

Impact on small-scale suppliers

263 Based on PRIMES EUCO27 results

264 From 22% to 27% based on EUCO27 results

265 These levels have been calculated assuming (i) non-obligated parties keep their H&C shares constant between 2020 and 2030 (ii) at national level, the sum of suppliers will reach at least PRIMES Ref scenario level by 2030

266 *I.e.* Member State where suppliers are – on average – already reaching 27% or above

Due to the extremely fragmented nature of the heating and cooling supply across Europe, the mitigation of the impact on small-scale suppliers is one of the priorities when considering the design of different options.

In order to simplify the analysis, our calculation assumes all natural gas suppliers are large-scale and 50% of coal, gas, district heating and biomass are small-scale[267]. Electricity and heating and cooling generation at residential level (solar thermal, geothermal and heat pumps) are not eligible under the obligation schemes. Since option 1 only includes fossil fuel suppliers, the share of potentially eligible parties is lower than in option 2.

In order to minimize the impact on small-scale suppliers, each option introduces the possibility for Member States to exempt parties from the obligation as long as these exempted parties do not exceed a 50% of the heating and cooling supply.

With these assumptions, the heating and cooling supply profile can be broken down as shown on Figure 14 and Figure 15. These figures represent the assumed breakdown of heating and cooling suppliers in terms of shares of total heating and cooling supply.

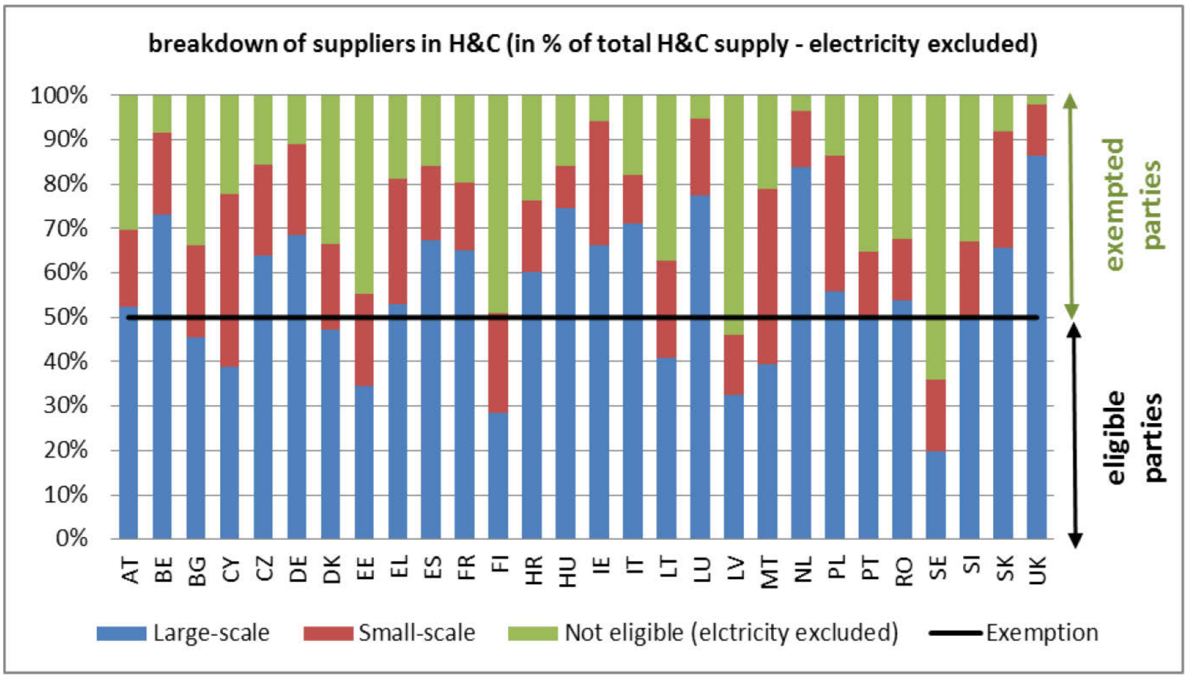
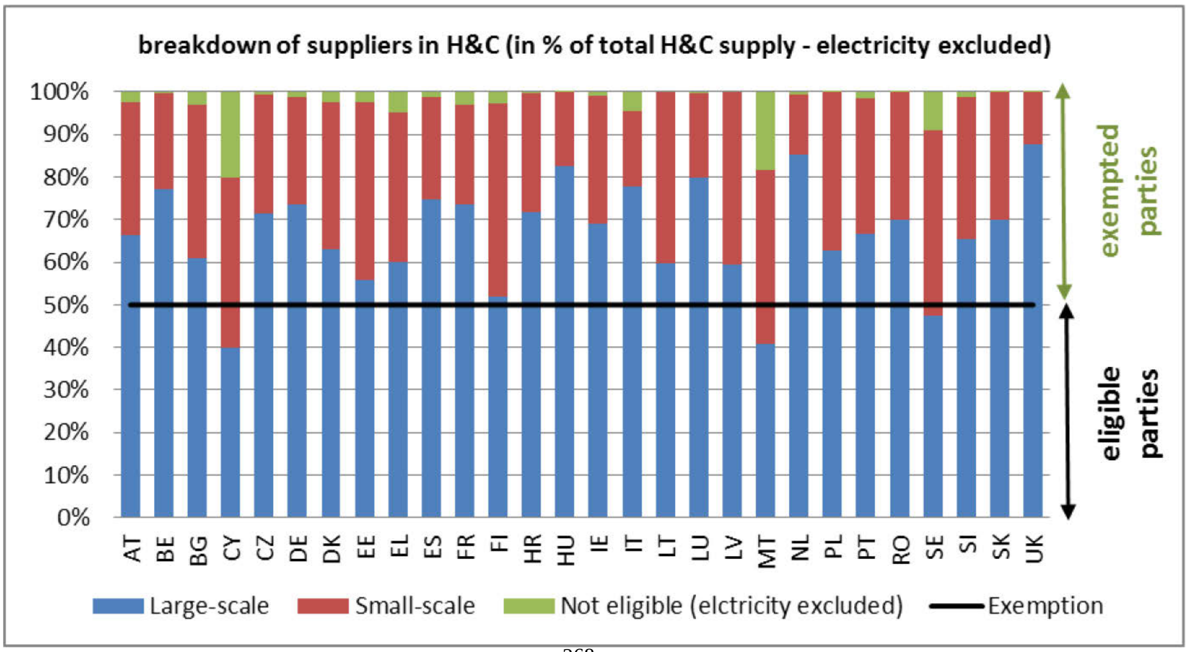


Figure 14: breakdown of suppliers in H&C (Option 1: fossil fuel only)

267 Based on Fraunhofer, 2016. In the absence of more precise breakdown of heating and cooling suppliers at EU and Member States- level



[268]

Figure 15: breakdown of suppliers in H&C (Option 2: all suppliers)

From the figures above, it clearly appears that Option 1 (fossil fuel only) could have a substantial impact on small-scale suppliers, where for some Member States, potentially all or the majority of small-scale suppliers might fall under the obligation[269].

Considering all of the above, and even factoring in possible exemptions, it is likely that the potential burden of Option 1 would be too high compared with the expected results, therefore this option will not be considered in the rest of the analysis.

On the contrary, Option 2 (all suppliers) could have a more limited impact on small-scale suppliers. Under this option, the most impacted Member States would be Malta and Cyprus, due to a small and oil-dominated market. The overall impact across the EU should however remain limited, all the more as Member States will benefit from a range of mitigation measures, as described above.

<u>Impact on retail prices</u>[270]

Another potentially important impact of additional measures in heating and cooling would be the energy prices for households. A first analysis on the expected evolution of energy prices at household level shows an overall increase of energy prices between 2021 and 2030 (around 19% on average[271] - see Figure 16). This increase is partially due to market developments, and partially due to climate and energy policies. In order to insulate the effect of heating and cooling measures, we have to assume constant energy prices from 2021 onwards.

268 Given data availability, for option 2, all renewable heating and cooling suppliers have been considered and not only suppliers whose RES-shares are below 90%.
269 EE, FI, LV, SE
270 Even though the industry and tertiary might be also affected, the focused has been put on household, which represent better individual consumers.
271 Based on PRIMES EUCO27 results – non-weighted average of electricity, biomass, diesel oil, natural gas and solids

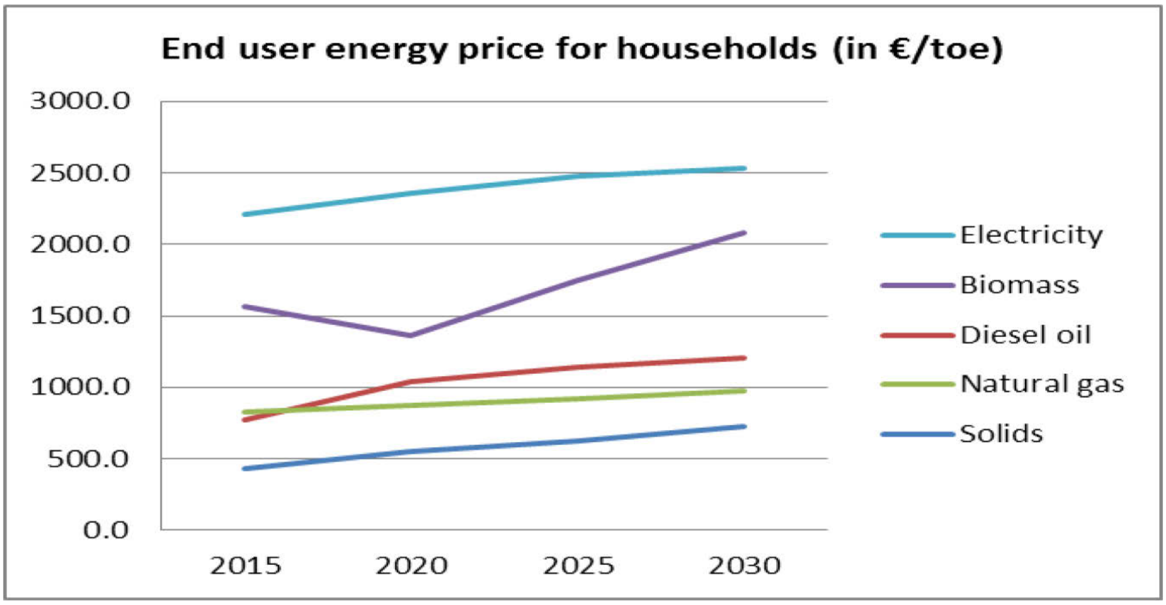


Figure 16: end user energy prices for households (based on PRIMES EUCO27 results)

With this assumption, the overall impact of measures has been assessed by multiplying the energy price by the final energy consumption of household per energy carrier. The positive influence of energy efficiency has also been eliminated, by considering the overall energy consumption of households constant between 2020 and 2030. With these assumptions, the change in fuel mix (assumed to be triggered by measures in the heating and cooling sector) will be the only driver of price evolution. The result is the overall energy expenditures per household as shown in Figure 17.

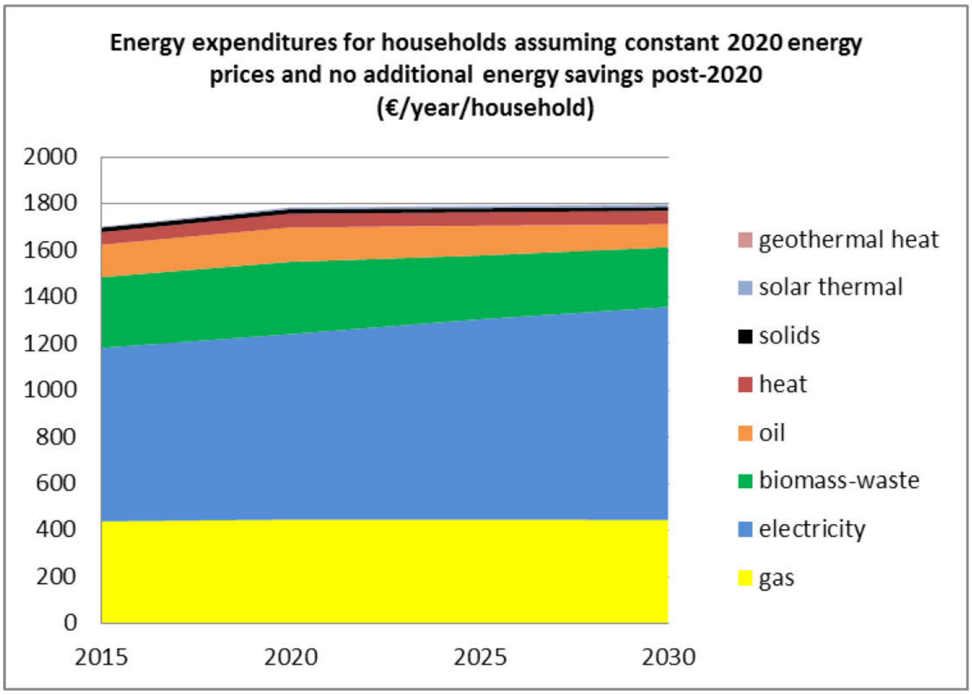


Figure 17: energy expenditure for households[272]

As shown in Figure 17, if prices are assumed constant and if energy efficiency measures are eliminated, the impact of additional renewables on household energy expenditures

[272] Based on PRIMES EUCO27 scenario and EC own calculations

would remain limited (+ EUR 11/year/household between 2020 and 2030). In this case, the increase of electricity expenditures due to higher electrification is compensated by the decrease in fossil fuel use. However, if we consider an increase in fuel and electricity prices as expected[273], the impact on household expenditures would be higher, but mostly due to external factors.

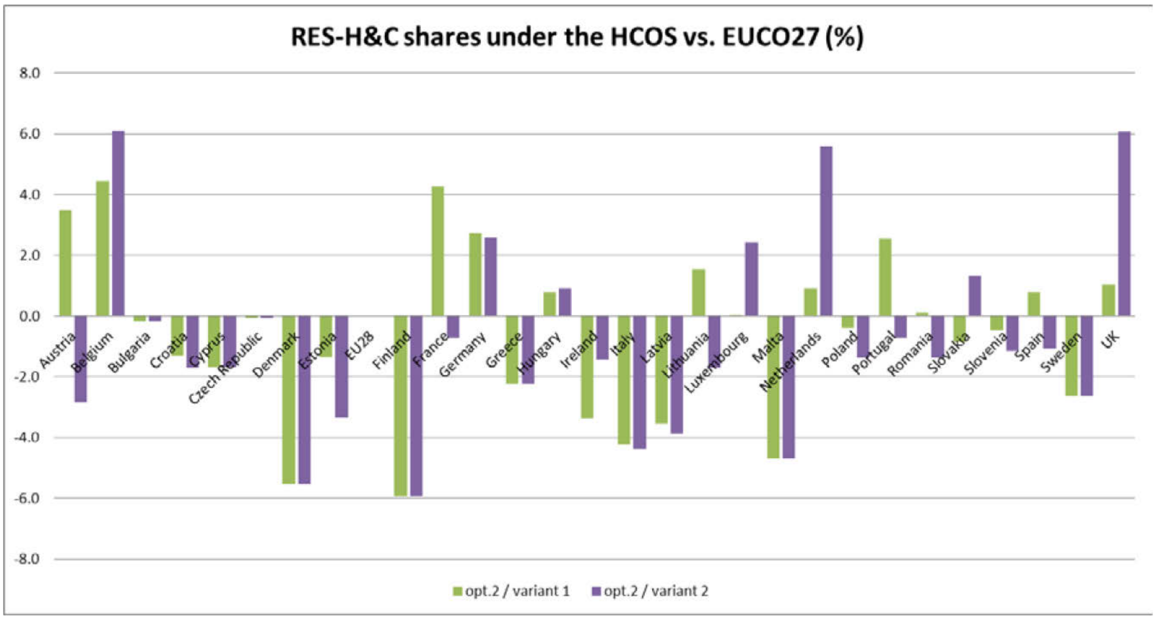
Economic impacts

In the absence of a detailed modelling of the heating and cooling supply chain[274], the economic impacts have mostly been measured assessing the gap between heating and cooling deployment at EU-and Member State-level triggered by the obligation scheme, and cost-effective deployment[275], outcome of the main scenarios used in this Impact Assessment.

For this assessment, the focus has been on the progression of additional RES-H&C deployment at Member State level (as renewables share in the total H&C consumption) compared to cost-effectiveness, and especially the standard deviation of additional effort in terms of RES-H&C shares at Member State level compared to the central scenario, *i.e.* how the obligation could divert from a balanced approach across Member States.

The following two figures illustrate the modelled impact of 2 variants of proposed Option 2 of HCOS (option 1 has been disregarded for the reasons stated above). The following options and variants are assessed:

- Variant 1 stands for yearly increase of 1% of addition renewables for each supplier by 2030,
- Variant 2 stands for universal obligation of 27% renewables share in the total volume of heating and cooling fuel/energy sold to end consumers in 2030.



[273] Based on PRIMES EUCO27 scenario

[274] The PRIMES model does not fully capture all the diversity in companies along the heating and cooling supply chain

[275] As measured by PRIMES EUCO scenario

Figure 18: Renewable heating and cooling shares under the HCOS vs. EUCO27

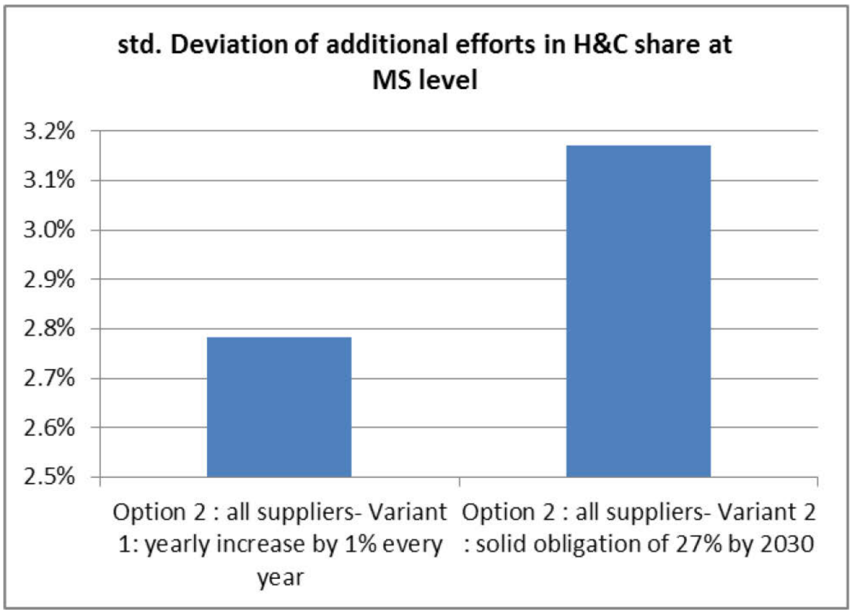


Figure 19: Standard deviation of additional effort in H&C share at MS level[276]

The analysis of the figures above shows that variant 2 (universal obligation of 27% of RES-H&C in 2030 for each supplier) is the most distortive approach. This is explained by the absence of inclusion of any starting point: in variant 2 obligated parties will have to reach 27%, regardless if their share in 2020 is 0% or 20%. Therefore option 2 would be detrimental to suppliers with a low starting point[277], and variant 1 (gradual increase) will guarantee higher proportionality and cost-effectiveness compared with variant 2.

On the other hand, the impact of variant 1 on early achievers[278] (*i.e.* Member States that were already above EU average in 2020) would be higher than in option 2. This is explained as the gradual obligation (variant 1) would apply to every supplier equally, *i.e.* the renewable energy share in heating & cooling would have to increase by 1% between 2020 and 2030 independently from the starting point. On the other hand, a universal obligation (variant 2) would have no effect on suppliers which are already reaching 27% of renewables in heating and cooling. Figure 20 below summarizes this distributional effect.

276 Vs. PRIMES EUCO27, based on EC calculations
277 See *e.g.* Figure 18 for BE, DE, LU, NL, UK
278 AT, BG, CY, DK, EE, FI, FR, EL, LV, LT, MT, PT, RO, SI, ES, SE

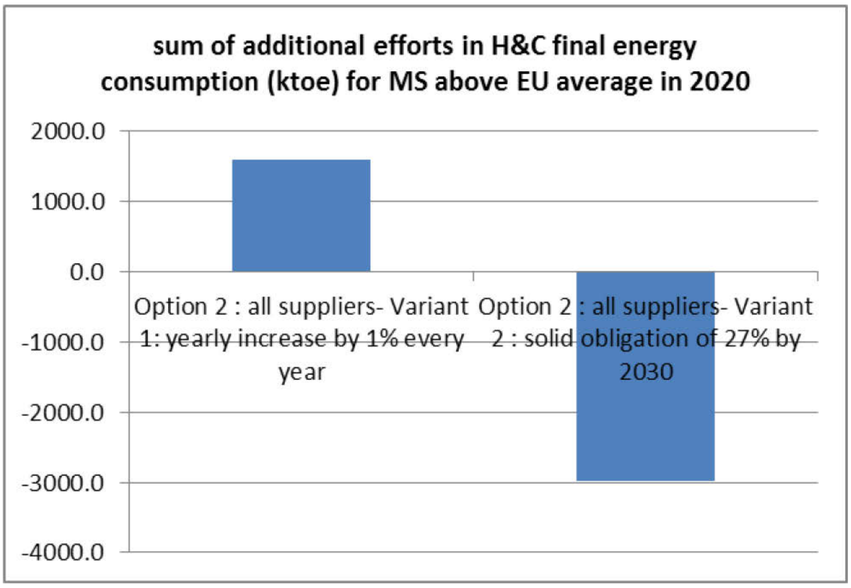


Figure 20: Sum of additional efforts for early achievers

On the top of it, additional administrative costs may occur, including costs for the management of potential funding programs, motivation campaigns to incentivise RES-H&C installations, costs for audits and verification or costs associated to establishing regional networks delivering RES-H&C installations. Since a certain share of the administration costs are fixed costs that are independent from the size of the obligated company, small companies might have a systematic competitive disadvantage. This fact justifies an exemption for small scale companies. For the variable administrative costs large companies might have a further competitive advantage due to potential scaling effects, *e.g.* regarding the search for eligible RES-H&C projects.

Environmental impacts

The HCOS have been considered to have no or very limited influence on the rest of the energy system. This assumption allows isolating the impact of the HCOS while every other parameter is being kept equal.

However, a potentially significant environmental impact of the HCOS – together with other measures targeted at renewable heating and cooling – is biomass deployment. Depending on the technologies used, biomass might have potential adverse impacts *e.g.* on air quality, that should not counterbalance the benefits in terms of renewable energy deployment and GHG reduction. In order to assess the impact of the set of RES-H&C-targeted policy options[279] on biomass deployment, we have used the EUCO27 scenario, which mirrors cost-effective deployment of renewables in heating and cooling at Member States and EU-level.

The focus has been put on the final energy use for heating and cooling demand in the residential sector, given its importance in overall heating and cooling consumption. Figure 21 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 mostly due to additional energy efficiency measures and overall electrification in the heating and cooling sector. On the top of it, without prejudice to the

[279] *I.e.* HCOS, measures for district heating and measures at building level

outcome of the bioenergy sustainability initiative, the remaining biomass used for heating and additional post-2020 might need to comply with enhanced sustainability criteria.

Hence, the overall combined impacts of policies targeting heating and cooling on the environment is expected to be positive.

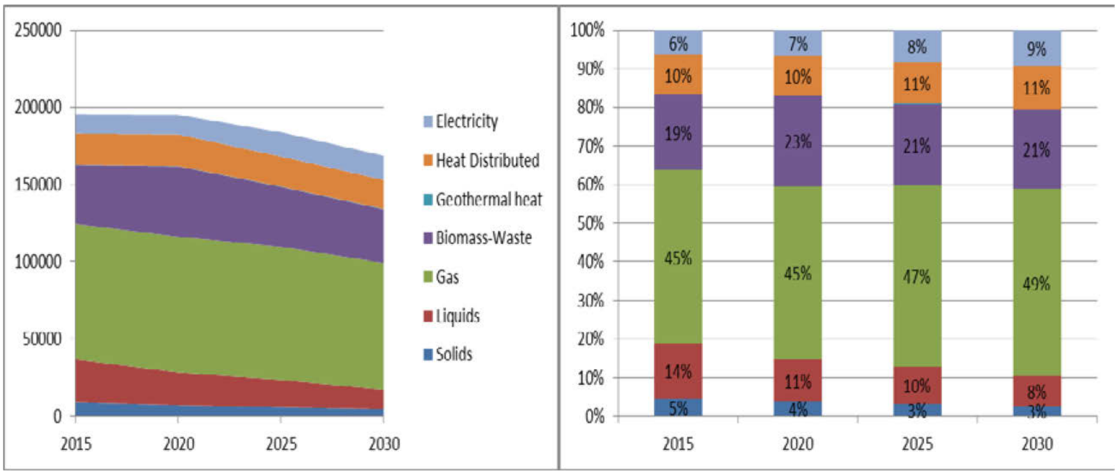


Figure 21: Final Energy per energy use (Ktoe)
in residential heating and cooling demand – EUCO27 scenario
Source: PRIMES

Political feasibility /opportunity

The subsidiarity is ensured through the freedom left to each Member State to define obligated parties, as long as they encompass a certain share of the heating and cooling supply. For this reason, there will be no EU-wide obligation scheme: each MS will have the possibility to design its own scheme, as long as the design corresponds to the minimum set of common principles defined at the EU level. Also the obligation leaves it up to the Member State/obligated party to choose the most cost-effective measure in its given context, hence the instrument adapts to specific conditions. The possibility for Member States to choose between a range of mitigation measures also allows flexibility at national level and ensures proportionality through the mitigation of impacts on smaller suppliers. However, each option will have different effect on the RES-H&C deployment at MS-level. As assessed in the *economic impacts* section, variant 2 (universal obligation) has a higher impact at Member State-level than a gradual obligation, especially on Member States with a low starting point in 2020.

Of the options under consideration, it is difficult to see how Option 0 of continuing with current practice should be selected. Given the importance of the heating and cooling sector in reaching the EU target for renewable energy, a measure accompanying the increase in the renewable share in the sector is desirable.

5.2.2. Facilitating the uptake of renewable energy and waste heat in district heating and cooling systems

As elaborated in 5.2.1, most of the district heating suppliers at EU-level are considered small-scale, and therefore might not fall under the heating and cooling obligation scheme. This option is therefore considered complementary to the HCOS.

Option 0	Option 1	Option 2	Option 3
• BASELINE - Continuation of current EU policies	• Continuation of current requirements, **with best practice sharing**	• **Energy performance certificates** and creating **access rights to local H&C systems**	• Option 2 + further **reinforced consumer rights**

➢ ***Option 0:*** *Baseline*

The RES Directive requirements with regard to RES-H&C are not included in the Revised RES Directive and expire in 2020. Member States decide individually if and how they wish to promote the increase of renewables in the district heating and cooling systems. Financial support, if put in place at national level, will need to comply with State aid rules. Renewable energy technologies will need to compete with fluctuating fossil fuel prices and distortive subsidies for fossil fuels. The obligations under Article 14 EED will remain.

➢ ***Option 1:*** *Continuation of current requirements, with best practice sharing*

The RES Directive requirements on promotion of urban planning and renewables integration in the district heating and cooling infrastructure (*e.g.* Articles 13(3) to (6) and 16(9) and (11)) are extended to 2030. Best practice sharing on measures facilitating integration of renewables in the urban heating and cooling infrastructure, integration of local electricity and heating and cooling systems and best practice in financing of sustainable urban energy projects is further encouraged.

➢ ***Option 2:*** *Energy performance certificates and access rights to local H&C systems*

The RES Directive requirements on promotion of renewables integration in the district heating and cooling (DHC) infrastructure (*e.g.* Articles 13(3) to (6) and 16(9) and (11)) would be reinforced and amended, requiring Member States to subject their district heating systems to energy performance assessment[280] thus supporting the energy performance framework developed to support EPBD and RES Directive implementation. A European standard for district heating systems is currently under approval by the CEN[281]. This methodology should be used, to the extent possible, for district heating performance assessment. This performance assessment should be made available to end-consumers.

Open access rights to local heating and cooling systems for residual/waste heat/cold and for producers of renewables heating and cooling (as appropriate also from variable renewable electricity producers especially for balancing purposes) would be established, along with such rights for third parties acting on their behalf (*e.g.* aggregators, traders). Temporary exemptions could be considered for new district heating or cooling systems with a high energy performance. National Regulatory Authorities would be tasked to oversee access rights. These reinforced provisions would also require Member States to oblige district heating/cooling companies, electricity and gas DSOs and providers of

280 A European standard for district heating systems is currently under approval by CEN
281 Comité Européen de Normalisation

infrastructure for electric mobility (if relevant) to make common investment plans (or consult each other on investment plans). National Regulatory Authorities (NRAs) would be tasked to ensure that investment plans of DSOs and district heating and cooling's are optimised in terms of overall costs, result in increase of renewables and improvement of overall energy (system) efficiency (*e.g.* by using district heating/cooling systems to help balancing variable renewable electricity production). In case no district heating/cooling is in place, the DSO shall, based on the assessment according to Article 14 EED, analyse the business potential for a district heating and/or cooling network.

- ***Option 3:*** *Option 2 + further reinforced rights for consumers*

As described in Option 2. In addition, consumers would have a right to disconnect from the district heating and cooling system if the system's energy performance is lower than what a consumer could achieve by alternative means *e.g.* renewables on-site or through energy communities formed in neighbourhoods. The comparison should be allowed by disclosure of district heating performance assessment to the end-consumer. This would allow neighbourhoods or individual owners of buildings to take responsibility for their own sustainable heat/cold supply. Reinforced provisions would propose a strengthened role of NRAs in ensuring that renewable and waste heat based suppliers have non-discriminatory access to the district heating/cooling network and the protection of consumers, in particular in relation to connection to and disconnection from networks. Consumers would have the right to fair and competitive prices/tariffs in line with the potential energy performance of the system while incentivising investments in highly efficient district heating and cooling and fuel switching from fossil to renewable energy.

5.2.2.1. Introduction to the assessment

District heating and cooling represent around 8-10% of the total H&C energy supply, out of which around ¼ are renewables[282]. The situation varies substantially across Member States, as illustrated by Figure 22.

282 Fraunhofer, 2016. 2012 figure

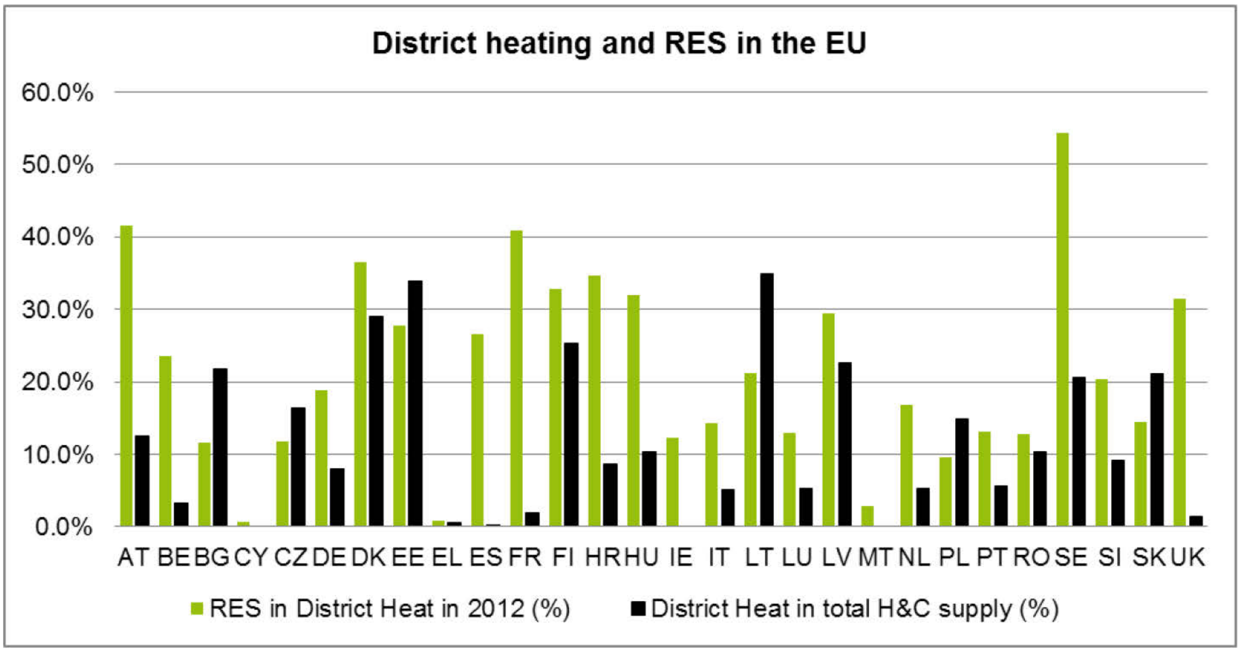


Figure 22: District Heating and renewables in the EU[283]

<u>Option 0</u> relies on the Directive on Energy Efficiency[284], which requests Member States to carry out, by 31 December 2015, a comprehensive assessment of the potential for efficient district heating and cooling, which is defined as ‘a district heating or cooling system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat". These assessments need to be updated every five years and Member States are requested to include strategies, polices, and measures to realise the potential.

The rationale for option 1 to 3 is to support action at EU-level. The rationale for option 1 is to allow for collaboration and information sharing among Member States regarding the opportunities to support higher shares of renewable energy and waste heat in district heating and cooling systems. For option 2 and 3, the rationale is to develop an enabling framework for consumers and energy suppliers that would complement the provisions of the EED by allowing effective fuel-switching at district level.

Figure 22 shows the large variations across Member States in terms of heating and cooling shares in the district heating sector. Based on market shares of district heating and cooling and the level of renewables in district heating and cooling, Sweden, Denmark, Finland and the 3 Baltic States are frontrunners in renewables deployment in the district heating and cooling. On the other hand, a number of Member States have less than 5% of renewables in their district heating and cooling systems.

<u>Option 1</u> is a continuation of the current requirements upon Member States to assess the need to build new infrastructure for renewable district heating and cooling in their national renewable energy action plans and provide guidance to relevant actors to consider the optimal combination of renewable energy resources, including those provided through district heating and cooling, in the planning, design, building and renovation of industrial or residential areas. As outlined in the EU strategy on Heating

283 Source : Fraunhofer, 2016. 2012 figures
284 Directive 2012/27/EU

and Cooling[285], option 1 could be strengthened by promoting sharing experiences and best practices across Member States, support for local authorities in preparing strategies for heating and cooling, and setting up a website with price comparison tools on lifetime costs and benefits of heating and cooling systems. Some small initiatives to exchange best practices are already on their way[286].

Option 2 consists of the introduction of district heating and cooling Energy Performance Certificate compliance requirement and creating open access rights to local district heating and cooling infrastructure. The rationale is that district heating and cooling network infrastructure provides an opportunity to integrate heating and cooling from independent renewable energy producers (incl. biomass, geothermal, solar thermal), waste heat from industry and municipal waste, renewable electricity (through heat pumps), in a flexible way. Furthermore, flexible district heating and cooling systems provide a cost-effective option to integrate the heating and cooling sector witht he electricity sector. Requirement for district heating and cooling system operators to certify the energy performance of their district heating system, using a CEN standard[287], will provide additional incentives to district heating and cooling system operators to improve the energy performance and reduce the CO_2 emissions from their district heating system, through improved system efficiency and higher share of renewables in the district heating and cooling fuel mix.

The requirement of district heating and cooling energy performance certificates for district heating and cooling operators would be particularly relevant for improving the overall energy system efficiency and promoting circular economy by engaging independent renewables and waste heat producers, industry and industrial clusters located in vicinity of urban areas with high heating and cooling demand. Industrial clusters often foresee energy efficiency and renewable energy programmes as part of overall sustainability and circular economy objectives. The requirement for district heating and cooling operators to certify their district heating and cooling systems, based on standard methodology included in the CEN standard for district heating and cooling energy performance[288] that is currently in approval stage, would contribute to increased competition on the local heating and cooling markets and provide transparent and comparable data on energy performance of district heating and cooling systems, enabling households and industry to make informed choice on most appropriate energy solutions for their heating and cooling needs.

District heating and cooling energy performance certificates would also provide the financing sector with a benchmark to support the upgrading, expansion or construction of the most efficient district heating and cooling systems. This would also complement the national strategies for efficient district heating and cooling developed under the energy efficiency directive, by providing more granular data on the opportunities for increasing the share of renewables at a local level.

Option 3 would support a more active role of consumers in promoting high shares of renewable energy in district heating and cooling through consumer right to compare the district heating and cooling energy performance data (based on district heating and cooling energy performance certificates) with building level energy performance

285 COM(2016)51
286 http://www.smartreflex.eu/
287 CEN/TC 228 standard prEN 15316-4-5
288 CEN/TC 228 standard prEN 15316-4-5

certificates, and disconnection rights from district heating and cooling at building level. This option is relevant for incentivising the competition between most efficient energy performance solutions at the energy system or building level. Such competition is increasingly relevant as consumers are encouraged to invest in local renewable heating solutions, such as solar thermal systems, wood-pellet systems or heat pumps, under the energy performance of buildings directive[289]. These local solutions could be complemented with renewables-based district heating and cooling systems to provide additional flexibility.

5.2.2.2. Detailed assessment

Economic impacts

Given the fragmented markets of the district heating and cooling supply in Member States, the main concern regarding potential economic impacts will be the effect of the options on small-and medium-scale suppliers and the overall cost-efficiency and business case for district heating investments . While option 1 would leave progress up to the discretion of local and regional administrative bodies, options 2 and 3 might affect local district heating and cooling suppliers and district heating and cooling system operators, either through the integration of new generation (technical adaptation costs, competition between independent producers and incumbent district heating companies and owners of the district heating and cooling network, business case for new investments and upgrades of existing district heating and cooling networks) under option 2 or through potential disconnections (loss of revenues, questionable incentives for investments) under option 3.

Regarding the integration of new generation, considering the rather long lead times for planning and licensing new district heating and cooling systems and high upfront investment costs, in the short-term the impact of the measure would be restricted to existing district heating and cooling systems which make up for about 10-15% of the current European heat market for buildings in the residential and service sector while the corresponding market share for the industrial sector is about 9%. Assuming that the measure would trigger the renewables increase in existing district heating and cooling systems to be increased by 20 % roughly in 10 years, additional 2 Mtoe RES-H&C would enter the heating and cooling market by 2030[290].

Regarding potential disconnections, the estimate of the potential impact of introducing a district heating and cooling disconnection right is mainly based on data provided by Fraunhofer ISI et al. (2016), Eurostat and Euroheat&Power, although there are considerable differences between the figures provided by these sources.[291]

- According to Fraunhofer ISI et al. (2016) in 2012 district heating and cooling was contributing about 480 TWh to the final energy demand in the heating sector, corresponding to a district heating and cooling share of about 7.6% of the total heating and cooling market[292];

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289 Directive 2010/31/EU

290 Öko Institute, draft interim results

291 A discussion of the differences can be found in the WP1 report of ISI et al. (2016), *Mapping and analyses of the current and future heating/cooling fuel deployment* (2016).

292 8,6% including electricity

- According to Eurostat in 2013 about 28% of all district heating and cooling was produced by heat only plants while the remaining 72% were contributed by CHP;
- According to Fraunhofer ISI et al. (2016) 53% of the total capacity of CHP plants > 1 MW_{th} was installed before 1992 while 26% of the capacity was installed between 1992-2002 and 21% after 2002.

Since no data is available on how different district heating and cooling systems can be distributed among different efficiency categories (incl. the efficiency of production in the heat only and CHP plants as well as the efficiency of the distribution) and the CEN methodology only provides a standard calculation methodology, but does not include minimum energy performance thresholds, we need to do an assumption on how many district heating and cooling systems would fall in the category of low performing district heating and cooling systems and could thus be affected by wave of disconnection requests. For reasons of simplification we assume that all heat only plants and all CHP plants that have been installed before 1992 (these plants are now older than 24 years) would underperform. This would correspond to a maximum disconnection potential in the range of 320 TWh.

If we further assume that per annum about 1% of all customers that are connected to district heating and cooling systems that underperform will use their right to disconnect in favour of a more efficient decentralised heating system, in the first year in principle a heating and cooling volume of about 3.2 TWh could potentially be open to be replaced by on site-building level RES-H&C solutions. Between 2020 and 2030 this potential would sum up to 32 TWh.

If we finally assume that about 25% of all disconnected costumers will decide for a RES-H&C technology (*e.g.* a heat pump or wood pellet boiler instead of a gas or fuel oil boiler), this would result in additional RES-H&C of about 0.8 TWh (= 0.07 Mtoe) in the first year. Between 2020 and 2030 this would sum up to 8 TWh (0.7 Mtoe) additional RES-H&C compared to a scenario without disconnection right[293].

The total estimated ratio of such disconnections shall therefore remain below 2% of total district heating supply in the EU, which is deemed limited at the EU level, but could vary significantly at the Member State level. Higher disconnection risk and impacts could be expected in those Member States that proportionally have higher district heating and cooling market shares and lower energy efficiency of such systems[294]. In comparison, district heating and cooling networks will be proportionally more affected by the reduction in final heat demand that have been envisioned under the EED. The creation of flexible district heating and cooling systems is therefore important for both the future of district heating and cooling systems as well as renewable energy integration.

To conclude, the much higher economic impacts and higher upfront investment costs on district heating operators are therefore assumed due to integration of renewable generation at district level (option 2 and 3) rather than from the possible fuel-switching and therefore loss of revenue form the disconnected district heating and cooling customers. However, the magnitude of this impact shall be counterbalanced by the positive effects at energy consumer level, most notably in resulting reduction in heating

293 Based on Öko-Institut, draft interim results

294 Based on Öko-Institut, draft interim results

and cooling prices and enhanced energy consumer choice and possibilities to require better quality service.

Social impacts

In a number of Member States, more than 50% of the citizens are connected to district heating and cooling systems[295]. At the same time, low awareness of alternative RES-H&C systems and lack of transparent and comparable data and energy performance indicators of such systems with district heating and cooling energy performance prevent energy consumers and other relevant stakeholder groups such as installers, builders, architects from making informed choices on best performing, most suitable and least cost heating and cooling solutions. Options 2 and 3 would engage both potential suppliers of heat and consumers, and provide them with the relevant information to make informed decisions about the use of district heating and cooling to support higher shares of renewable energy. Availability of transparent energy performance data will become increasingly important as district heating and cooling network systems move towards higher fl**e**xibility and integration within the overall energy system, integrating multiple renewable heating sources, and residual heat and renewables electricity from buildings. Option 3 will also enable consumers at building level to make a choice between producing their own renewable energy at the building level or relying on efficient and renewable energy based district heating system.

In cities, the planning of key infrastructure is rarely coordinated with other urban planning aspects that could be used to deploy renewable energies and energy efficient heating and cooling, *e.g.* when building refurbishment programmes are implemented and/or new district heating and cooling and electricity distribution system investments are being undertaken. Sustainable energy programmes targeting the decarbonisation and energy efficiency of buildings and the heating and cooling supply are often overlooked during the urban planning and design phase. Also decisions on investments in infrastructures and buildings at municipal or commercial levels may take place in an isolated manner without any consideration of the feasibility of long term sustainable solutions and without performing a life cycle cost analysis to assess the long-term cost-competitiveness of a portfolio of options. In addition, new built and refurbishment rate of buildings are low, around 1% and 1.4% per annum, respectively, which is not conducive to a more rapid diffusion of these technologies.

Environmental impacts

The proxy used to measure the potential environmental impact is the influence on RES-H&C deployment. The main trigger to enhance RES-H&C deployment is the disconnection from fossil-fuel based district heating and cooling to individual renewable solutions.

One other potentially significant environmental impact is the effect of measures targeted at renewable heating and cooling on additional biomass deployment. The assessment of the overall combined impacts of policies targeting heating and cooling on the environment has been presented in 5.2.1.2.

Political feasibility /opportunity

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[295] Euroheat, 2015. Country by Country Statistics Overview 2015. http://www.euroheat.org/wp-content/uploads/2016/03/2015-Country-by-country-Statistics-Overview.pdf

Option 0 has no additional administrative burden, and Option 1 could actually make the accounting requirement at a Member State level more efficient by disseminating the information to the relevant stakeholders.

Options 2 and 3 would rely on the requirement for district heating and cooling system operators to certify their systems based on standard CEN methodology. Obtaining such energy performance certificates and regularly renewing them will result in compliance costs for establishing such certification scheme and carrying out regular system audits. However, there are possible synergies in linking the energy performance certification with existing systems for energy performance certificates for buildings. This would substantially reduce the administrative burdens.

Of the options under consideration, Options 0 and 1 should be discarded, as they would have a negligible to minor impact on the effort to make district heating and cooling part of the cost-efficient renewable uptake leading to 2030 EU-wide target.

5.2.3. Overall comparison of the options to increase renewable energy in the heating and cooling sector (RES-H&C)

	Overall impact			Key objectives		
Policy option	Social	Economic	Environmental	Effectivness	Efficiency	Coherence
Mainstreaming renewables in the heating and cooling supply						
Option 0-partial continuation of current RED requirement + EPBD + EED	0	0	0	0	0	0
Option 1-RES H&C obligation for fossil fuel suppliers	--	+	++	++	+	+
Option 2-RES H&C obligation on all fuel suppliers	-	+	++	++	++	+
Facilitating the uptake of renewable energy and waste heat in DHC systems						
Option 0-baseline	0	0	0	0	0	0
Option 1-continuation of current requirements, with best practice sharing	+	0	0	-	0	0
Option 2-Energy performance certificates and creating access to local H&C	+	-	+	+	0	+
Option 3-Option 2 + reinforced consumer rights	++	-	+	++	-	+
+,++,+++ : positive impact (from moderately to highly positive) 0 : neutral or very limited impact -, --, --- : negative impact (from moderately to highly negative)						

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

The table below provides an overview of the options discussed in this section.

Challenge	Drivers	Options
Increase deployment of advanced renewable fuels in transport		Option 0: Baseline – No additional EU Action on renewables in transport
	Projected deployment of renewables that is not cost-effective. Lack of internalisation of external costs of transport Lack of specific RES transport target post-2020 Uncertainty regarding future demand for renewable fuels Investors' uncertainty over future role of biofuels	Option 1: Building on baseline, EU incorporation obligation for renewable fuels (including advanced biofuels and electricity)
	Variable climate performance of conventional biofuels (due to ILUC)	Option 2: EU incorporation obligation for renewable fuels plus phase-out of food-based biofuels Three sub options on speed of phase-out
	Difficulty in deploying renewable fuels in aviation and maritime sectors.	Option 3: Option 2 plus a specific EU incorporation obligation for renewable fuels for aviation and maritime
	All of the above	Option 4: GHG emission reduction obligation (under FQD) Different sub-options on the share of advanced biofuels

Option 0	Option 1	Option 2	Option 3	Option 4
• ***Baseline- No additional EU action (business as usual)***	• ***EU incorporation obligation for renewable fuels***	• ***EU incorporation obligation for renewable fuels, plus phase-out of food-based biofuels*** • Three sub-options for the phase out food based biofuels	• ***Option 2 plus a specific incorporation obligation for renewable fuels in aviation and maritime***	• **GHG emission reduction obligation (FQD)** • Three suboptions besides baseline: • 4B) Excludsion of upstream emissions reductions and non-waste fossil fuels • 4C) Focus on advanced fuels and electricity • 4D) Focus on advanced biofuels, electricity, and lower GHG conventional fuels

5.3.1.1. Introduction to the assessment

The baseline scenario (REF2016) shows that national action alone will lead to some deployment of renewable fuels in the transport sector which will be, however, insufficient to reach the EU 2030 RES target and the 2050 decarbonisation objective. National measures cannot guarantee market volumes that are sufficiently large to both achieve economies of scale and spur manufacturing innovation to further lower the costs. The introduction of a binding measure at EU level is more likely to create such a market pull, while ensuring that the costs of technology innovation and development are sufficiently shared across European economies and market fragmentation is avoided.

The promotion of renewable energy in the transport sector can be pursued through two alternative policy instruments:

- *A renewable energy incorporation obligation*, such as those introduced already by 25 Member States in order to meet the 10% renewable in transport target set by the RES Directive. According to the REFIT evaluation report, the 10% target has been very effective to increase the share of renewable energy in the transport sector which reached 5.9% in 2014.

- *A GHG emission reduction obligation*, such as the one implemented thus far only by one Member State (*i.e.* Germany) in order to meet the Fuel Quality Directive requirement, according to which Member States shall require fuel suppliers to reduce the GHG intensity of the fuel they supply by 6% in 2020.

In the public consultation on the revised renewables Directive, the majority of stakeholders expressed the view that energy obligations are effective, or very effective, in promoting renewable fuels in transport and in increasing the uptake of electric vehicles. NGOs did not support an incorporation obligation including conventional biofuels. Furthermore, a number of industrial stakeholders and Member States highlighted that, in the period after 2020, the increase of low-carbon and renewable energy in transport should be promoted through only one EU-wide policy instrument, with the view to avoid double regulation and minimize administrative burden.

In this Impact Assessment, apart from option 0 (baseline) which is common to both instruments, options 1, 2 and 3 would be implemented through the Revised RES Directive, while option 4 would be implemented through the revised FQD approach.

Description of identified policy options

➢ ***Option 0:*** *No additional EU action (Baseline)*

This Option foresees that the 2030 EU climate and energy targets are achieved. The renewable transport target expires in 2020 and so it does the double-counting rule, currently applied to electric vehicles and advanced bio-fuels. The 7% cap for contribution of food-based biofuels in the overall national renewable "contribution" continues. Similarly, the FQD GHG intensity reduction target would not be prolonged post-2020. Member States would decide individually if and how to promote renewable energy in transports, in compliance with the relevant EU state aid rules. The EU biofuels sustainability criteria continue to apply post-2020. The EU research and innovation policy would continue to support non-mature technologies, along with national programmes. This option is described by the EUCO30 scenario (see Annex 4).

Energy-based policy options (1-3)

➢ ***Option 1:*** *EU incorporation obligation for advanced renewable fuels*

Option 1 foresees the introduction of an EU-level incorporation obligation, whereby Member States oblige fuel suppliers to include a minimum share (*e.g.* 4% by 2030[296]) of renewable fuels, including advanced biofuels, renewable electricity use din road transport and CCU and e-fuels in the fuels they place on the market[297]. As fuel suppliers would be best suited to supply electricity at the pump or along roads the contribution of renewable electricity is limited to road vehicles charged at publically accessible charging points. The obligation would increase over time and would be tradable. In case of non-compliance, Member States would apply financial penalties on fuel suppliers. In order to support advanced biofuels and electro-mobility, technology banding would be applied[298]. Apart from the 7% cap and the sustainability criteria, policy on food-based biofuels would be left to the Member States.

➢ ***Option 2:*** *EU incorporation obligation for advanced renewable fuels plus phase-out of food-based biofuels*

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296 The policy options included in the impact assessment vary with regard to their ambition level. Options 1, 2A and 2C and 3 aim to increase the level of advanced biofuels to approx. 4% of all liquid and gaseous transport fuels while Option 2B foresees with a share of 6.8% advanced biofuels a complete replacement of food-based biofuels. The sub-options under Option 4 also remain in this range. The level of ambition remains in the scope of what is considered feasible by the Sub Group of Advanced Biofuels (SGAB) of the Sustainable Transport Forum (STF) and other recent scientific work such as the report "Wasted Europe's untapped resource"

297 The contribution of the electricity would be still limited in 2030 taking in account low energy consumption of electric road vehicles (2.2% of transport energy consumption of which approx. 50% is of renewable origin). In modelling, the electricity was not included in mandates. Likewise e-fuels and CCU fuels are expected to play limitedrole in 2030 and they were not modelled

298 All policy options except the business as usual scenario make a distinction between different types of fuels. The contribution from biofuels produced from waste oils such as used cooking oil and CCU fuels would for instance be limited to take the state of technological development into account and to promote in particular innovative renewable fuels with a high potential. Otherwise fuel suppliers would aim to fulfil the obligation only with the cheapest fuels available on the market and the policy would likely fail to achieve its innovation objective

Option 2 would imply an EU-level incorporation obligation for advanced renewable fuels that is structured in the same way as Option 1 but would ensure the gradual replacement of food-based biofuels by an annually decreasing cap. This option includes three variants:

A. *Partial phase-out:* the cap for food-based biofuels is gradually reduced to pre-2008 level, by 2030.

B. *Full phase-out:* the cap on food based biofuels is reduced to zero by 2030.

C. *Hybrid approach***:** option 2A plus a faster phase-out of vegetable oil biofuels and a higher GHG savings threshold (*e.g.*70%) for new biofuel installations, respectively in order to reduce ILUC emissions and increase direct carbon savings. Furthermore, the existing EU sustainability criteria are streamlined and improved[299].

➢ ***Option 3:*** *Option 2 plus a specific incorporation obligation for advanced renewable fuels suitable for aviation and maritime*

Option 3 would consist in Option 2 plus a specific EU-level incorporation obligation on renewable fuels consumed in aviation and maritime such as biokerosene and biomethane [300]. These sectors need a dedicated approach given that it is more costly and complex to replace fossil fuels.

Emissions-based option (4)

➢ ***Option 4:*** *GHG emission reduction obligation*

Option 4 would imply a continuation of the current approach of the FQD where Member States oblige transport fuel and energy suppliers to reduce the GHG intensity of the fuel and the energy they supply[301]. After 2020 a narrower approach would be taken to the fuels that are supplied, with different variations (described below) depending on which objective is maximised. Under all of the variations Upstream Emissions Reductions (UERs), LNG and CNG would be excluded.

a) Option 4 A: No additional EU policy (same as option 0);

b) Option 4 B: Continue the approach of the current FQD, supporting liquid and gaseous fuels and electricity.

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299 In particular, the clarity of the provisions concerning sustainability and traceability are improved and the competences of the Commission with regard to the supervision of voluntary schemes are strengthened in order to ensure a harmonised implementation of the sustainability framework with a low administrative burden

300 The option was modelled with a specific incorporation obligation as this provides the highest assurance that renewable fuels will be consumed. Other options such as promoting the consumption of renewables in these sectors via specific incentives such as a higher weight for the fulfilment of the obligation can achieve similar outcomes

301 The current FQD (Article 7a) requires suppliers of fuel/ energy to reduce the GHG intensity of fuel/energy they supply by 6% in 2020 (relative to the 2010 baseline) and a number of fuels can contribute. A number of elements can currently contribute to the target including: biofuels from food crops, biofuels from wastes using commercial technologies, 'advanced biofuels', electricity, other renewable fuels and waste fossil fuels

This option consists of continuing the current approach of the FQD while narrowing the focus by excluding the contribution of lower GHG fossil fuels and Upstream Emissions Reductions (UERs)[302].

c) Option 4 C: *Continue the approach of the current FQD with a focus on advanced fuels and electricity*.

These options seek to maximise the achievement of objectives on driving innovation, supporting the uptake of electric vehicles and avoiding ILUC. They seek to maximise the support for innovation and electrification by focusing the mandate on 'advanced fuels' as defined by Annex IX(a) of the RES Directive (as amended by the ILUC Directive), including electricity. Three sub-options were assessed, 4C1, with a 2% GHG reduction and 4C2 and 3 which have a 2% GHG reduction but also allow Member State levels mandates for food based biofuels at 6% or 3% respectively. Within these options, option 4C3 was selected as the preferred option as 4C1 was too restrictive, while 4C2 allowed a very high contribution of crop biodiesel with high ILUC risks.

d) Option 4 D: Continue the approach of the current FQD with a focus on advanced fuels, electricity and low GHG first generation fuels when ILUC impacts are taken into account.

These options seek to maximise the achievement of objectives on driving innovation, supporting the uptake of electric vehicles and avoiding ILUC by focusing the mandate on 'advanced fuels' as defined by Annex IX(a) of the RES Directive (as amended by the ILUC Directive), including electricity and on those biofuels from food crops believed to have the lowest ILUC emissions, *i.e.* crop ethanol, while biodiesel is excluded. 4 D1 has a 2.5% overall GHG reduction target, 1.6% GHG reduction sub-target for advanced fuels, while 4 D2: 3% overall GHG reduction target, 2.3% GHG reduction sub-target for advanced fuels. 4D2 was selected as the preferred option as it has a higher level of ambition which is needed to drive the uptake of advanced fuels.

5.3.1.2. Detailed assessment

The following modelling tools have been used to assess the impacts of energy-based policy options 0, 2 and 3 (see further information in Annex 4):

- The PRIMES model was used to model impacts of options 0, 2 and 3. Option 1 was not quantitatively modelled as the outcome would depend on the policy choices of the Member States regarding food based biofuels. PRIMES is an energy model used for modelling all policy elements of the RES Directive included in this Impact Assessment and also *e.g.* Market Design Initiative and Energy Efficiency Impact Assessments.

302 UERs and non-waste fossil fuels (LNG, CNG) are excluded from the options. This is to ensure the options focus on delivery of the policy objectives above and provide a focused objective on delivery of advanced fuels to meet 2030 targets. Currently UERs are not required to take place within the EU and as the 2030 GHG reduction target is domestic for the EU, this approach changes the scope of the mandate to match this. In addition, the focus is on increasing the supply of fuels, increasing certainty for suppliers and reducing the complexity of the FQD mandate. As UERs are expected to be cheaper to deliver than fuels, removing them from the mandate sends a clearer signal to suppliers

- The GLOBIOM model[303] was used for assessing the ILUC impacts of the sub-Options 2A and 2C *e.g.* a gradual or full phase out of conventional biofuels. GLOBIOM is a global recursive dynamic partial equilibrium model with a bottom-up representation of agricultural, forestry and bioenergy sectors used also in the Impact Assessment on Bioenergy Sustainability.

- Bespoke analysis undertaken by the ICCT[304] was used to assess the impacts of Option 4 based on a GHG saving obligation.

Due to the significant differences in the assessment tools and underlining assumptions, the results are not directly comparable and therefore the impacts of options 0 to 3 (energy obligation) are presented separate from the assessment of option 4 (GHG reduction obligation).

Energy impacts of options 0 to 3

Under Option 0, by scenario construction, advanced biofuels would reach a 1.9% share of all liquid and gaseous fuels by 2030, compared to approx. 1% in 2014[305]. Under Options 2A, 2C and 3 (gradual phase out of food-based biofuels), advanced biofuels would reach respectively approximately a 4.0% share by 2030 (approximately 12 Mtoe). This would represent a significant increase compared to the projected level in 2020. Option 2B (full phase out of food-based biofuels) would require a quite significant growth in the deployment of advanced biofuels, which would increase to 21 Mtoe to reach a share of 6.8% of all liquids and gaseous transport fuels by 2030.

The share of biofuels has a direct impact on the amount of oil products consumed in transport. A decrease in oil imports of almost 2.0% is projected under the energy-based Options 2A, 2C and 3 and 0.9% under Option 2B. While renewable fuels can be both produced in Europe and imported, the economic modelling indicates high potential for the domestic production of ligno-cellulosic stocks used for advanced renewable fuels. As oil prices are assumed to grow steadily in a long-term perspective, savings in oil consumption would have increasingly beneficial effect for the European economy.

Table 5: Impacts on EU energy demand of options 0-3

303 GLOBIOM is a global recursive dynamic partial equilibrium model with a bottom-up representation of agricultural, forestry and bioenergy sectors. The model effectively represents the world's agricultural and forestry sectors and most relevant economic and demographic indicators and trade relations. GLOBIOM is an equilibrium model, meaning that the supply and demand sides of the agricultural and forestry sectors are represented, with supply and demand being equal at a certain price level. It was used in previous studies in order to quantify ILUC effects: https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf

304 "Service contract for technical assistance facilitating implementation of Art. 7a of the fuel quality directive 98/70/EC", contract no 340201/2015/706549/SER/CLIMA.C.2. with ICCT - International Council on Clean Transportation Europe

305 This includes mainly biofuels produced from waste oils such as used cooking oil which are produced with conventional technologies but a treated as advanced biofuels because they are produced from waste. The potential of such 1G waste based biofuels is limited though due to limited availability of the feedstock

	2030				
	Option-0	Option-2A	Option 2B	Option 2C	Option-3
Consumption of liquid and gaseous fuels(Mtoe)	308.7	307.7	307.2	307.7	307.8
Total consumption of renewable fuels(Mtoe)	20.4	24.8	21.0	24.7	24.8
Oil consumption in Option-0(Mtoe)/ % change in policy scenarios	279	-2.0%	-0.9%	-2.0%	-1.6%
Total share of renewables fuels	6.6%	8.1%	6.8%	8.0%	8.1%
share of food-based bio-fuels	4.7%	4.3%	0.0%	4.0%	4.1%
share of advanced RE fuels	1.9%	3.8%	6.8%	4.0%	4.0%
share of bio-methane	0.2%	0.2%	0.2%	0.2%	0.6%
share of bio-kerosene	0.0%	0.0%	0.0%	0.0%	0.7%

Source: PRIMES, 2016

Energy impacts of option 4

Figure 23 shows the share of renewable fuels under option 4 according to the ICCT analysis. The 4C sub-option examines the impact of a focused advanced fuel target at EU level, with and without Member State mandates that would support biofuels from food crops. The different sub-options of 4D examine the impact of supporting biofuels with lower ILUC emissions. These options exclude crop-based biodiesel but allow crop-based ethanol. As a result both options show a significant proportion of advanced fuels and electricity.

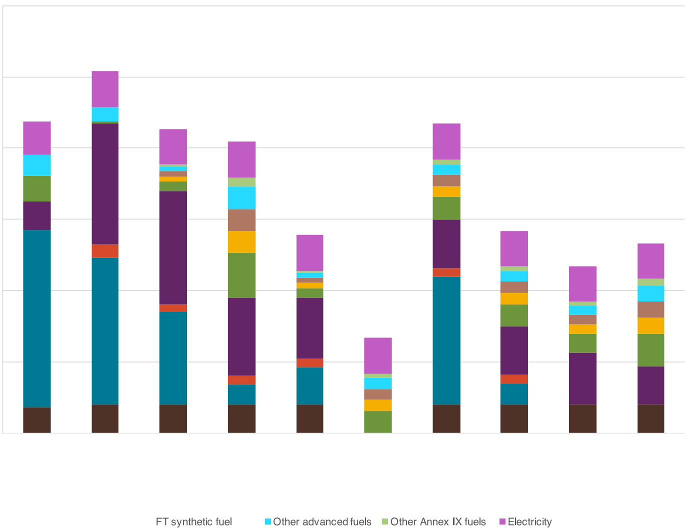

Figure 23: Share of total road transport energy by alternative fuel type under option 4

Environmental impacts

The environmental impact of the policy options is assessed according to their Climate performance taking into account both direct emission savings and indirect effects

Direct GHG emission impacts of options 0 to 3

Table 6 shows the impacts on WTW GHG emission savings of options 2 and 3, compared to the baseline. Options 2A, 2C and 3 have similar direct GHG savings (around 1.5% reduction compared to the baseline). This is due to the same overall share of biofuels.

Option 2B (rapid phase out of food based biofuels) has a lower share of biofuels. However this option still leads to under 1% reduction in direct GHG emissions compared to the baseline due to higher savings of advanced biofuels (in production and processing).

Table 6: Direct GHG emissions (% change vs EUCO30 scenario)[306]

	2030				
Emission savings	Option-0	Option-2A	Option 2B	Option 2C	Option-3
WTW Co2 emissions(Mt) /% change compared to Option-0	970	-1.5%	-0.8%	-1.5%	-1.6%

Source: PRIMES

Indirect GHG emission impacts of options 0 to 3

The Table below and Figure 24 show the GHG emission impacts of Options 2A and 2C (gradual phase out of all food based biofuels and biodiesel respectively), compared to option 0 (baseline)[307], as modelled by GLOBIOM[308]. The results indicate that maintaining food-based biofuels at the level of 2020 as projected in Option 0 would not address ILUC as it would cause additional emissions even after 2020. These emissions mainly come from peatland which was drained to produce palm oil in order to satisfy the additional feedstock demand stemming from biodiesel production. Production of palm oil on this land will continue to cause massive carbon emissions as, due to the drainage of the land, the soil itself, the peat, is slowly s oxidising. This effect would risk eliminating all GHG emissions achieved by biofuel production.

In contrast Option 2A (gradual phase out of food based biofuels by 2030) can significantly reduce ILUC emissions lowering the average ILUC factor from 64 to 27 g gCO_2/MJ. After 2020, ILUC impacts associated to peat land oxidation and natural vegetation conversion could be expected to cease. However, the balance of emissions remains positive due to lower carbon sequestration as result of less palm plantations (which mirrors the increase before 2020). Still, under this scenario the phase down of conventional biofuels would avoid unintended effects associated to biofuel growth, while resulting in significant direct GHG savings.

Option 2 C could be even more effective in addressing ILUC than Option 2A as it involves a more rapid phase out of vegetable oil based biofuels – associated with the highest ILUC emissions. It would reduce the average ILUC factor from 64 to 17 g gCO_2/MJ. In addition, this option implies a 70% GHG emission savings target for new installations – that, with a few exceptions, only advanced biofuels will be able to comply with.

The full phase out of food based biofuels under option 2B is projected reduce ILUC emissions further, as it would make additional land available to meet the growing demand for food and feed stemming from other sectors. However, the effect can be expected to be less pronounced as not only biodiesel, but also bioethanol (with much lower ILUC emissions) would be phased out. Furthermore, it should be noted that the amount of indirect emissions will also depend on the scale of biodiesel consumption in EU. Smaller quantities can be expected to result in lower indirect land use change

306 Direct emission do not include indirect land use change emissions

307 The scenarios were compared to a baseline representing the biofuel mix in 2008 which was also used in the GLOBIOM study from 2015. Keeping the same baseline ensured that the result remain comparable with previous studies on ILUC.

308 Valin et al., 2015, GLOBIOM study http://www.globiom-iluc.eu/

impacts because they can be met largely through domestic feedstock, while with increasing demand more imports are necessary and the related ILUC risks increase.

Finally, it should be noted that a GHG emission reduction obligation (that incentivises operators to maximize direct emission savings) could have the unintended effect of promoting the use of those biofuels that also have very high ILUC impacts. This would be the case of palm oil biodiesel which has higher direct GHG savings than, for instance, rape seed biodiesel (62% compared to 45%) but it is associated with much higher indirect GHG emissions[309].

Table 7: ILUC effect of options 0, 2A and 2C

Scenario	Biofuel demand of EU 2020 policy	Total emissions 20 years ($MtCO_2$-eq)[a]	Gross ILUC value of EU 2020 mix (gCO_2/MJ)[b]	Repaid CO_2 debt 2020-2030 (gCO_2/MJ)	Net effect (gCO_2/MJ)
Baseline (Option 0)		330		0	64
Phase down food based biofuels (option 2A	6.2 Mtoe (261 PJ)	140	64	-37	27
Phase down biodiesel (option 2C)		90		-47	17

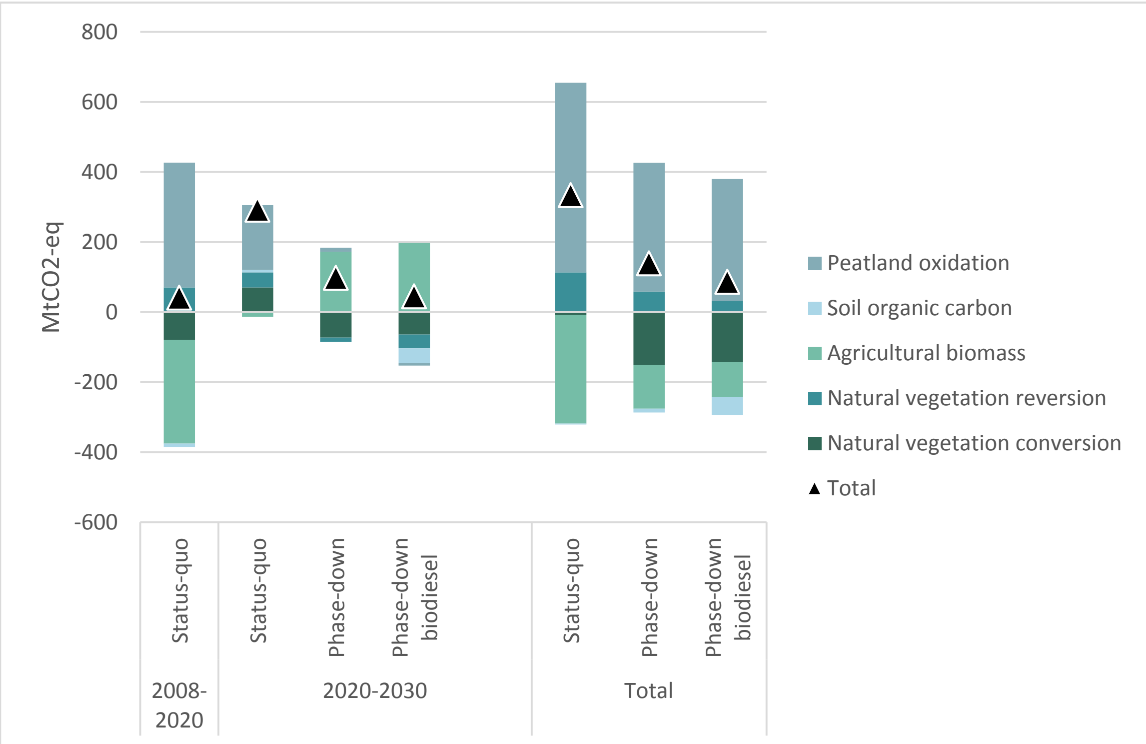

Figure 24: Cumulated GHG emissions of phase out of food-based biofuels (2008-2020, 2020-2030, $MtCO_2eq$)
Source: GLOBIOM

309 See Valin et al. 2015, Globiom report

Direct and indirect GHG emission impacts of option 4

The relative GHG impacts of Option 4 and related sub-option are shown in Figure 25. No dedicated GLOBIOM model runs were undertaken for this policy Option, instead the feedstock specific ILUC factors obtained from the GLOBIOM study (Valin et al. 2015) were used. These have been presented in order to demonstrate the relative GHG impact of the Option 4 sub-options. These ILUC factor values were derived by determining the increase of ILUC emissions that result from an increase of biofuel consumption by 1% against the 2008 baseline (3.2% biofuel use in the EU). It should be noted, however, that this simplified approach assumes that the scale of production has no effect on the ILUC risk, *e.g.* that replacing 1% of transport fuels with food based biodiesel has the same effect as increasing the share from 3% to 4%.

In each scenario under Option B, the GHG reduction targets and reportable reductions would be fairly high (4-7%), but a much lower GHG reduction would be achieved when accounting for ILUC due to the very high estimated ILUC emissions associated with using oil crops for biofuel.

In contrast, the scenarios under sub-Options 4.C and 4.D, which exclude crop biodiesel, would deliver real GHG savings similar to or above their targets of 2-3%. In sub-Options 4.C2 and 4.C3, actual GHG reductions achieved would be higher than reported under the FQD because national mandates would contribute some GHG savings through conventional biofuels. If first generation fuels are included in the same target as advanced fuels, competition with first generation fuels may to slow investment in the advanced fuel industry. Option 4D3, which includes a sub-target for advanced fuels, would help mitigate this uncertainty.

Figure 25: GHG impacts of sub-option 4 (% difference to the GHG reduction target, 2030)

Source ICCT 2016

Economic impacts

Economic impacts include investment costs which need to be compared against the savings on fossil fuel imports. Additional economic impacts can result from the impact of the policy options on global fuel prices.

As shown in Table 8 Options 0 to 3 will require significant increase in investment in advanced biofuels and construction of a sizable number of bio-refineries across the EU. This will also lead to an increase in capital costs. The unit capital cost of such bio-refineries is higher than that of conventional ones. However, increased production of advanced renewable fuels drives a reduction in the unit capital costs of these installations over time, as a result of learning effects.

In particular, given that advanced facilities have higher capital costs than conventional facilities, Option 2B (full phase out of conventional biofuels) would lead to the highest additional (compared to the baseline) capital costs, in the range of €1.5 billion per year. This would correspond to the installation of 200 additional advanced biofuel plants, assuming an annual production capacity of 100 Ktoe[310]. For Options 2A, 2C and Option 3 (gradual phase out of conventional biofuels) additional investments costs are reduced by more than 40%, down to € 0.9 billion/year.

Table 8: Annual capital costs (€ billions/yr) and capacity needs (Mtoe/yr)

	2030					
Advanced biofuels production chains	REF 2016	Option-0	Option-2A	Option 2B	Option 2C	Option-3
Average annual investments in bio-refineries for advanced RE fuels in REF/ additional investments for policy scenarios (bn €'13)	1.8	0.1	0.9	1.5	0.9	0.9
Capacity needs for advanced RE fuels bio-refineries in 2030	6.5	0.1	8.2	20.9	8.7	8.2
capacity (Mtoe/yr) available in 2030	6.5	6.6	14.3	27.4	15.2	14.7

Source: PRIMES

Impact on fuel prices of options 0- 3

Table 9 shows the impacts on fuel prices of the Options 0 to 3. Option 2B would result in the highest fuel costs in 2030 due to the significantly higher share of advanced biofuels, which are assumed to remain significantly more costly in the medium term (2030) than food based biofuels. On the other hand, the price increase is lower in Options 2A and 2C, reflecting a more gradual phase out of conventional biofuels. All scenarios show that, the fuel costs in Options 2 and 3 decline by 2050, compared to the baseline (as the learning effects lead to lower costs of advanced biofuels).

Under Option 3, jet fuel prices slightly increase in 2030 due to the higher cost for bio-kerosene, that fuels suppliers would be obliged to incorporate. In return the increase in costs for petrol and diesel (which include costs for blended biofuels) is less pronounced. By 2050 kerosene prices decrease in all scenarios compared to the baseline due to the fact that bio-fuels enable to avoid purchasing of ETS emission allowances which price is projected to grow steeply in all decarbonisation scenarios. Furthermore, it can be observed that the decreasing prices of feedstocks for bio-methane over the long term would also contribute to offset the initially higher fuel prices in the heavy duty and maritime sectors.

310 The capacity of biofuel production plants will vary significantly depending on process technology and feedstock availability.

Table 9: Fuel price impacts (% changed to the baseline)

	2030				
Impact on fuel costs (€ per ton and changes compared to Option-0)	Option-0	Option-2A	Option 2B	Option 2C	Option-3
Petrol prices 2030	2101	1.6%	3.6%	2.0%	1.0%
Diesel prices 2030	1836	2.1%	3.0%	2.1%	1.6%
Jet fuel prices 2030	994	0.0%	0.0%	0.0%	2.0%
Petrol prices 2050	2363	-0.3%	-0.7%	-0.4%	-0.5%
Diesel prices 2050	2061	-0.7%	-0.5%	-0.6%	-0.7%
Jet fuel prices 2050	1244	-1.1%	-0.9%	-1.0%	-1.1%

Source: PRIMES

Impacts of fuel prices of option 4

The relative costs of option 4 and its sub-options are shown in Figure 26. These costs represent the difference in fuel price between alternative fuels and fossil fuels (petrol and diesel) for the entire volumes that would be achieved in each scenario.

This analysis assumes that operating costs are higher for advanced facilities compared to conventional facilities – partly due to the costs of higher employment. Major cost savings of advanced facilities compared to conventional facilities are related to lower fuel costs compared to conventional biofuels and to a credit for valuable co-products from advanced processes (*e.g.* lignin). While cost estimates assume technological improvements that reduce the cost of advanced biofuel production over time, it should be noted that cost estimates for the year 2030 are used in this analysis.

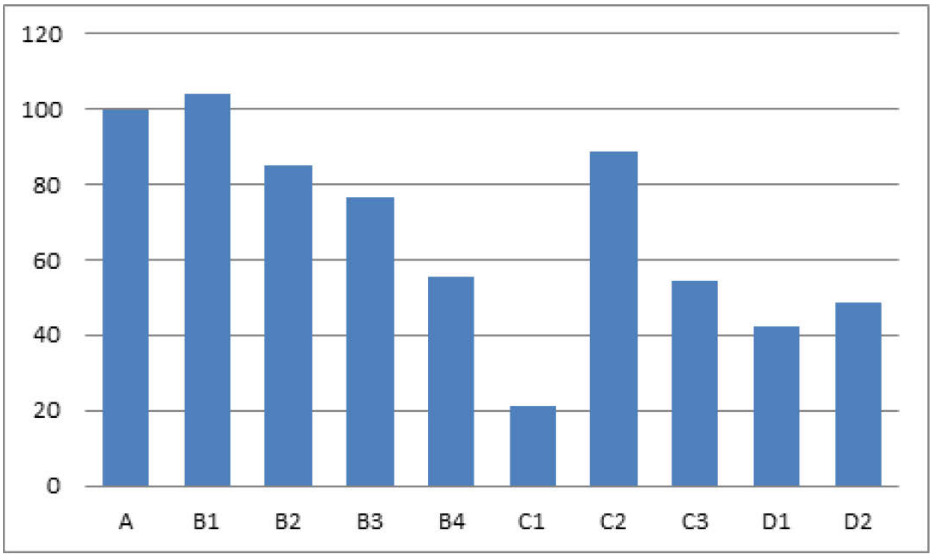

Figure 26: Relative total costs of option 4 (relative to the policy baseline A, euro billions)
Source ICCT0 2016

Social impacts

Employment impacts of options 0 to 3

As the models used are not covering employment impacts, the following analysis is qualitative.

Employment impacts include direct impacts in biofuel generators and supporting industries (*e.g.* engineers and plant operators, employees in marketing and distribution of biofuels, researchers and technology developers of technology and innovation, etc.), and indirect impacts in agriculture and forestry for feedstock production (farmers and forestry workers, etc.).

In 2014, the European conventional food-crop based biofuels industry had a turnover of EUR 13.4 billion and work force of around 110,000 jobs (direct and indirect)[311]. These job levels could be maintained under Option 0 as the production of conventional biofuel can be extended to continue unchanged. Option 2B (full phase out of food based biofuels by 2030) could lead to losses in direct jobs in conventional biofuel production in the short term. However, a transition from food based to advanced biofuels could lead to the creation of new jobs and economic activity in the production chain of advanced biofuels. Under Option 2A and similarly options 2C and 3 (a partial phase out of food based biofuels), any potential job losses in the food-based biofuel sector could be lower, and may not occur, as there would be more time for industry to re-structure.

When assessing the employment impacts of the phase out of conventional biofuels, one important element to be considered is the feasibility of converting a part of the current production capacity to produce advanced biofuels. Significant synergies for bioethanol sites exist through co-location of the new separate second generation plant adjacent to the first generation facility and through retrofitting by altering an existing first generation production line for producing advanced alongside conventional biofuels. In this way, existing jobs are preserved and new jobs are created while generating 40% CAPEX savings which represents roughly a 20% total cost reduction.

On the contrary, fewer synergies for biodiesel sites exist as the retrofitting of renewable diesel HVO sites to ones using second generation feedstock is less attractive. Moreover, integration of first and second generation biodiesel sites faces a rather limited technical feasibility.

Employment impacts of option 4

Table 10 shows the employment impacts of option 4 as calculated by ICCT. This table presents permanent direct jobs that would be supported by alternative fuel production under the various sub-options.[312]. In all scenarios, most jobs that would be supported by alternative fuel policy are in feedstock production and collection, with fewer permanent jobs supported in facility operation.

The cultivation of food crops tends to require more labour than collection of crop residues. However, cellulosic feedstocks such as wheat straw that are used for biofuel are much more likely to be produced entirely in the EU, supporting EU jobs. We note that the number of feedstock production jobs in Option 4B1 (152 000) is fairly close to the number (190 000) predicted in a JRC study modelling a similar biofuel scenario [313].

Table 10: Employment impacts of option 4 (1000, 2030), Source ICCT 2016

Source ICCT 2016

311 EurObserv'ER 2015

312 These estimates do not fully account for all jobs that would be created through transportation of feedstock and fuel, waste collection, and energy crop production. They do not include temporary construction jobs

313 De Santi, 2008

	Option 4 A	Option 4 B				Option 4 C			Option 4 D	
Impacts	Ref.	B1: 7%, no cap	B2: 6%, 6% cap	B3: 6%, 3% cap	B4: 4%, 3% cap	C1: 2%	C2: 2%, 6% national mandates	C3: 2%, 3% national mandates	D1: 2.5%, 1.6% sub-target	D2: 3%, 2.3% sub-target
Feedstock production jobs (thousands)	88	122	101	82	55	17	93	51	39	43
Facility operation jobs (thousands)	21	22	20	25	14	10	23	16	13	17
Total direct permanent jobs (thousands)	109	144	121	107	69	26	116	68	53	60
Jobs per 1,000 tCO_2 abated	3.4	3.9	3.0	2.0	2.3	1.3	3.1	1.9	1.6	1.5
Jobs per million Euros of policy cost	11.2	14.4	14.5	13.9	12.6	12.4	13	12.5	12.5	12.5

Impacts on rural development

The impact on rural development depends on trends in demand and supply of agriculture feedstock. It should be noted that in 2015, 61 % of oilseed and 3.7 % of cereal cultivated in the EU were used for the production of conventional biofuels. In the same year, 13% of domestic sugar beet was used for the production of ethanol, of which virtually all was used for biofuels[314]. A complete phase out of food-based biofuels by 2030 is expected to have significant impacts on the rape seed production which would decline substantially and also sugar beet producers would also be impacted negatively. On the contrary, impacts on cereal producers are expected to be limited, given that only a fraction is used for the production of biofuels and the impact of European bioethanol production on commodity prices is very limited (1-2% impact on cereals prices[315]). Positive impacts are expected from the production and mobilization of feedstocks for advanced biofuels (including wastes, energy crops and lignocellulosic material).

On the other hand, it can be expected that a more gradual reduction of crop-based biofuels would allow the European agricultural sector to adjust, for instance, by shifting crops and by changing rotation plans, as well as through increase in production of lignocellulosic feedstock from dedicated energy crops (*e.g.* miscanthus or short-rotation coppice), provided that existing information and technical barriers are overcome.

Impact on third countries

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314 EU agriculture Mid-Term Overview 2015

315 Renewable Energy Progress report 2015

Impact of third countries depends on how the policy options would biofuels/feedstock international trade flows. It is estimated that in 2014 the EU consumed between 1.6 and 3.2 Million tonnes of palm oil for its biodiesel production, corresponding to a share between 2.7% and 5.3% of the global palm oil production in the same year. Under REF2016, net EU imports of vegetable oil, mostly palm oil, are projected to amount to 2 Mtoe by 2030. This would correspond to approx. 20% of all vegetable oil used for biodiesel production in the EU in that year.

Under option 2B (full phase out), these imports of crop-based biofuels are expected to be discontinued, with resulting negative impacts in the short term on trading partners in Latin America (Argentina, Brazil) and Asia (Indonesia, Malaysia). On the other hand, a more gradual reduction of crop-based biofuels would allow the agricultural producers in third countries to adjust to the new market reality.

Administrative burden

It is expected that the administrative burden for public authorities would be similar for an energy based obligation and a GHG based obligation. However, the majority of Member States[316] has already introduced energy based incorporation obligations to promote renewable transport fuels along with other support mechanisms, such as tax measures. Therefore, the administrative changes and additional burden stemming from an EU-wide obligation would be somewhat limited because it would be implemented by the same public authorities that are currently implementing national measures.

Under the FQD Member States are required to implement a GHG emission reduction obligation before 2020, although so far only Germany has implemented it. In any case both options would be implemented by the Member States in a similar manner. Differences would mainly affect the economic operators. Furthermore, reporting requirements under the Fuel Quality Directive with regards to reporting on fuels origin and place of purchase will be streamlined and overlaps with other existing reporting requirements will be avoided.

Options 1 to 3 are expected to reduce the administrate burden for economic operators operating across the EU. Under these options, producers of advanced biofuels could simply apply default values to demonstrate compliance with the sustainability criteria avoiding an excessive administrative burden.

Under a GHG emission reduction obligation –which incentivises the calculation of the actual emission savings– significant simplifications could be obtained by a modification to the EU GHG calculation methodology. For instance, the option to calculate actual values could need to be limited to those parts of the life cycle – chiefly processing and transport – that can be effected by the biofuels producers.

Changing the methodology, however, could be criticised as the pre-calculated values would not reflect the situation in different regions or countries and economic operators could no longer adjust the figures according to their individual situation. As some types of feedstock are grown exclusively or mainly in Third countries, assumptions on the related emission could be challenged in the context of international trade obligations. Furthermore, a simplification could also have an impact on the feasibility of the current GHG emission savings thresholds.

[316] See Annex 7

Subsidiarity assessment

Implementation of an obligation on fuel suppliers is justified by the competence the EU has in the field of energy and climate policy. The political will of the Member States to act collectively on this matter was confirmed in the conclusions of the October 2014 European Council which established new energy and climate targets including a binding EU target for renewable energy of at least 27% by 2030.

A minimum EU wide energy based supply obligation for advanced renewable fuels is such a measure that promotes the increase of renewables in the transport sector, thus contributing to ensure that the binding renewable target is met. Given the environmental impacts of food-based biofuels, their contribution to the EU 2030 renewable energy target would be capped to a maximum of 7% of transport fuels. However Member States could set lower caps in case they wish to do so.

5.3.1.3. Overall findings

As discussed in the above analysis, both the RES Directive and FQD could contribute to the objective of increasing the share of renewables in transports and help decarbonizing this sector, albeit in a different way.

One first policy choice concerns the cap on food based biofuels for the period after 2030 as a means to address ILUC emissions. This includes a complete phase out by 2030, or a partial phase out. The analysis above points to the following considerations:

- Under the same decarbonisation ambition, a complete phase out of food crop biofuels by 2030 would require high shares of advanced biofuels and other renewable fuels and would likely require significant increased public support in order to deliver the needed technology and economic development in the advanced biofuel industry.

- Reducing the share of food-based biodiesel by 2030 combined with a higher GHG emission saving threshold and measures to incentivise advanced fuels would be effective for reducing ILUC emissions and promoting higher direct savings.

- A complete phase out of food based biofuels by 2030 would primarily lead to job losses in the production facilities, particularly in the biodiesel sector where there are lower synergies between conventional and advanced biofuel production technologies. These losses could be compensated by increased employment in the production of advanced biofuels, although the net impact is uncertain.

- The impacts on indirect jobs in agriculture and forestry are also uncertain, with some modelling suggesting potential positive impacts associated with the production and mobilization of feedstocks for advanced biofuels (including wastes, energy crops and lignocellulosic material).

A second key element of the analysis concerns the choice of policy instrument for increasing the share of renewable energy in transport. This objective can be pursued either through an energy-based incorporation obligation or, alternatively, through a GHG emission reduction obligation. Both approaches have their strengths and weaknesses. The analysis above points to the following considerations:

An energy based obligation would:

- Promote greater penetration of biofuels on the basis of the energy density of fuels relative to cost, and ensure GHG savings based on minimum, possibly increased, emission saving thresholds;

- Build on the extensive policy and administrative experience developed by Member States in implementing the RES Directive and their national renewable fuel mandates;

- Minimize the administrative burden for economic operators, which would continue to use mainly default values and not requiring a change in the EU GHG saving methodology.

A GHG intensity reduction obligation would:

- Incentivize fuels with the greatest direct GHG reduction relative to costs, as well as the continuous improvement in the GHG efficiency of fuels throughout the whole period up to 2030 as the instrument is optimised to GHG reduction.

- Continue the FQD policy approach currently being implemented by the Member States for the period up to 2020, thus ensuring policy continuity.

- Allow fuel suppliers compliance choices depending on costs. Where this is economically advantageous it is expected to encourage suppliers to report actual GHG values, instead of GHG default values, in order to maximise the GHG savings of their fuels.

Among the energy-based options (options 1 to 3) Options 0 can be discarded as it could not ensure that food based biofuels are gradually replaced by more advanced biofuels.

Among the options based on the Fuel Quality Directive (option 4), option 4A and option 4B can be discarded on the basis of the preceding analysis. These options maintain a mandate for food-based biofuels up to 2030, which significantly lowers their GHG performance.

5.3.1. Overall comparison of the options to increase renewable energy in the transport sector (RES-T)

	Overall impact			Key objectives		
Policy option	Social	Economic	Environmental	Effectiveness	Efficiency	Coherence
Option 0 - Baseline	0	0	0	0	0	0
Option 1 - EU incorporation obligation for advanced biofuels	+	-	+	0	+	+
Option 2 - EU obligation for all biofuels consumed in transport						
Option 2A partial phase out food based biofuels by 2030	0/+	-	++	++	++	+
Option 2 B: total phase out food based biofuels by 2030	+	- -	+++	++	+	+

Option 2C: faster phase out of food based biodiesel and higher GHG savings by 2030	**+**	**-**	**+++**	**++**	**++**	**++**
Option 3 - EU obligation for biofuels consumed in aviation and maritime	+	-	+	++	++	+
Option 4 – GHG reduction obligation						
4B- overall fuels and electricity GHG reduction obligation	+	- -	+	+	+	+
4C- advanced fuels and electricity GHG reduction obligation	+	-	+++	++	++	+
4D-: advanced fuels, electricity and crop-ethanol GHG reduction obligation	+	-	+++	++	++	++
+,++,+++ : positive impact (from moderately to highly positive) ***0 : neutral or very limited impact*** ***-, --, --- : negative impact (from moderately to highly negative)***						

5.4. Options to empower and inform consumers of renewable energy

The table below provides an overview of the options discussed in this section.

Challenges	Drivers	Policy Options
Empower Consumers to generate, self-consume and store renewable electricity	Overall lack of consumer empowerment in the energy transition • Investment uncertainty due to absent, unstable, or constantly changing legal frameworks for self-consumption in several Member States • Not all EU citizens are enabled to self-generate and consume • Unleash potential of self-consumption for solar deployment	0. Baseline - No EU intervention 1. EU Guidance on self-consumption of renewable energy 2. Empower citizens to self-consume and store renewable electricity 3. Distance Self Consumption for municipalites
Disclosing Information on the sources of electricity generation	Lack of clear and consistent information provided to consumers on renewable electricity sources • Scope for improvement of the GO system	0. Baseline - Continuation of EU current policies 1. Improve functioning of GO system 2. Option 1 + make GOs mandatory for disclosure 3. Option 2 + extend GOs to all sources of electricity generation
Tracing Origins of renewable fuels used in	Lack of clear and consistent consumer information on sources of renewable	0. Baseline - Continuation of EU

H&C sector	fuels • Lack of a robust tracking mechanism on renewable sources of liquid and gaseous renewable fuels • Lack of information inhibiting cross border trade of renewable fuels	current policies (no GOs for renewable fuels) 1. Extend GOs to renewable gaseous fuels 2. Extend GOs to renewable liquid and gaseous fuels 3. Develop alternative tracking system for renewable liquid and gaseous fuels

5.4.1. Empower consumers to generate, self-consume and store renewable electricity

Option 0	Option 1	Option 2	Option 3
• Baseline - no EU intervention	• EU guidance on **self - consumption of renewable energy**	• Empower citizens to **self-consume and store renewable electricity**	• **Distance self-consumption** for municipalities

➢ ***Option 0:*** *Baseline*

Under this option, no EU policy framework for self-consumption of renewable energy is developed. Member States decide individually if and how to promote renewable energy self-consumption systems. Support schemes will have to comply with the State aid rules. The regulations in some Member States discourage self-consumption and would continue to be in place.

➢ ***Option 1:*** *EU guidance on self-consumption of renewable energy*

Under this option, the Commission would develop a revised non-binding guidance on self-consumption, building on and further expanding the Staff Working Document (2015)141. Given the non-binding nature of the guidance, it is uncertain that this option would address existing legal barriers to renewable energy self-consumption effectively, with the risks of different levels of consumer empowerment across the EU.

➢ ***Option 2:*** *Empower citizens to self-consume and store renewable electricity*

The Revised RES Directive would set out framework principles enabling consumers to generate renewable electricity for their own use without their supplier's permission, and would limit the administrative burdens of doing this. This option responds to the concerns of 79 % of stakeholder who expressed an option on the matter in the public consultation and believed that there are administrative barriers to self-consumption. More specifically, this option would include the following provisions:

- Introduce a EU-wide definition of renewable energy prosumers;

- Empower consumers (below a certain capacity threshold) to generate and store renewable electricity for their own use, without requiring the supplier's permission, and limit the administrative burden by requiring a simple notification to the DSO;
- Enable consumers to sell excess renewable electricity and to participate in all relevant energy markets either directly or through market aggregators.

At the same time, there are a number of aspects relevant for self-consumption that will need to be addressed in the Market Design Initiative, such as ensuring that consumers who generate their own renewable energy electricity have access to wholesale and balancing markets through aggregators and that wholesale market rules do not discriminate against renewables, in particular small-scale producers. In addition, grid tariffs should reflect the cost-benefits of self-consumption systems for the electricity network and incentivise cost-effective consumer behaviour from a system point of view.

➢ ***Option 3:*** *Distance self-consumption for municipalities*

Option 3 would further expand Option 2 by enabling also distant self-consumption of renewable energy, specifically for municipalities, *i.e.* renewable plants installed in one municipal building could provide electricity for other municipal buildings. This option would help municipalities fully engage in the energy transition.

5.4.1.1. Introduction to the assessment

Thanks to the drop of PV module prices, decentralised generation of solar energy has reached grid parity in most Member States, *i.e.* self-generated electricity is as cheap as or even cheaper than electricity from the grid, at retail price. In many Member States this new trend allows consumers to actively engage in the energy transition while saving on their electricity bill.

Self-consumption (*i.e.* the simultaneous generation and consumption of electricity) can provide benefits to the entire electricity system, chiefly when there is a good match between renewable electricity generation and consumption. This is for instance often the case for commercial buildings and supermarkets when the generation profile of solar panels matches the consumption pattern (day consumption) or when air conditioning is used during sunny days. At the same time, the wide-spread deployment of self-consumption can bring a challenge in terms of adaptation of grid tariffs. To the extent that grid costs are passed on to consumers through volumetric billing of the grid (as opposed to capacity-based charging), the increase in self-consumption rates may reduce revenues for grid operators, which in turn may need to recoup these losses via increased charges on traditional consumers. Once the levelised costs of rooftop solar reach the level of wholesale market prices, it can compete on the electricity element of the retail electricity price. Until then, investments in distributed solar generation depend on the pricing regime (*e.g.* on gird tariffs, RES levies or taxes). In the absence of support schemes, self-consumption is economically only viable in those Member States where distributed generation can produce at least at retail level prices[317].

As the RES Directive does not contain any specific provisions on self-consumption, Member States have developed different legal frameworks that led to a high degree of

[317] European Commission (Report on Investments in investments in solar panels in the residential sector in EU Member States, to be published in Q4 2016)

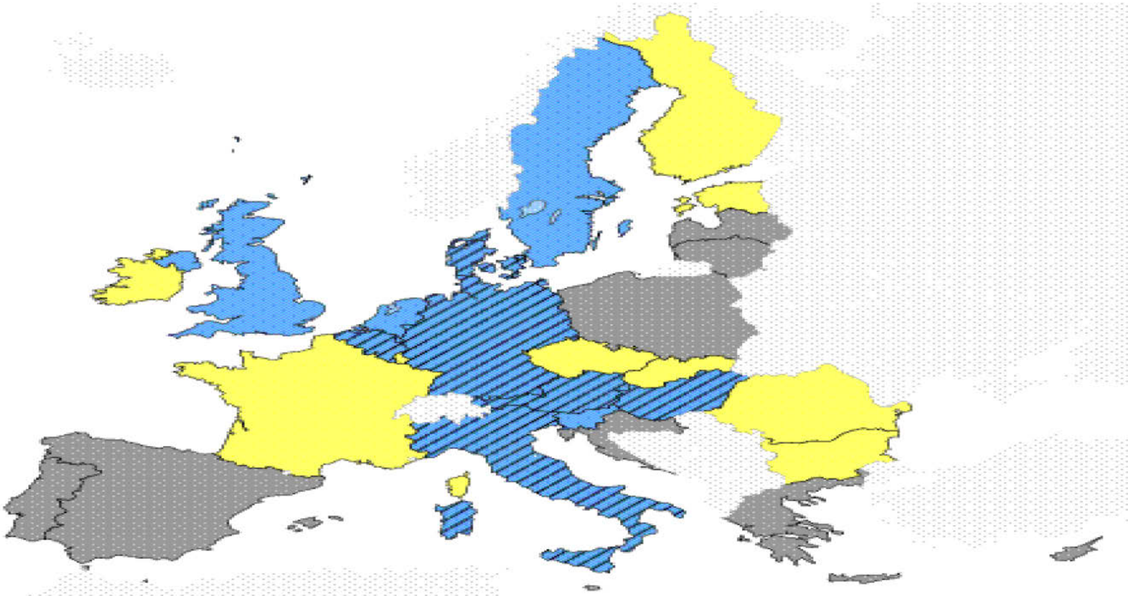
fragmentation and different levels of consumer empowerment in Europe. Some Member States put in place feed-in tariffs, such as Bulgaria, Denmark, Germany, Estonia, France, Greece, Croatia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Slovenia, and Sweden. The level of these feed-in tariffs varies and is sometimes below the levelised costs of electricity. The UK offers an export tariff and Romania works with Green Certificates. Denmark put in place an hourly net metering scheme, in other Member States it is annual but with lower price for electricity which is fed in to the grid. An overview of different degrees of consumer empowerment is provided in the graph below.

Table 11: Overview of self-consumption schemes in Member States

	Net metering	Grid fees	Taxes and levies	Support scheme
BE Wal	Yes	No	No	Yes
BE Bru	Yes	No	No	Yes (Green Certificates)
BE Fla	Yes	Yes - prosumer tariff	Yes - prosumer tariff	No
BG				
CZ				
DK	Yes	No	No	No
DE	No	No	Yes (but for PV>10kW)	FiT for excess electricity
EE				
IE				
EL	Yes	No	No	No
ES	No	Yes – prosumer charges	No	No
FR	No	No	No	FiT for excess electricity
HR	No	No	No	FiT for excess electricity
IT	Yes	Yes (>20 kWp)	No	No
CY	Yes	No	No	No
LV	Yes	Yes	Yes	No
LT	Yes	Yes	No	No
LU				
HU	Yes	Yes	No	No
MT	No	No	No	FiT for excess electricity
NL	Yes	No (below 5000 kWh)	No	No
AT	No	No (below 25 MWh)	No	Private Purchase Agreement for excess electricity

PL	No	No	No	FiT for excess electricity
PT	No	Yes (above self-consumption level in PT > 1%)	No	Yes (Wholesale price - 10% for grid fees) for excess electricity
RO				
SI	No	No	No	Yes (FiT)
SK				
FI				
SE	No	Yes (fixed part, only variable part exempted)	No	Green certificates for excess electricity
UK	No	No	No	Yes (FiT + export tariff)

Furthermore, in the absence of European legal framework national regulations have been highly unstable[318], which significantly reduced investor certainty in many Member States and led many respondents to the public consultation, in particular from the renewables industry, NGOs and cooperatives, to call for a clear European framework and a European vision on self-consumption. In the figure below (map), the Member States with a dotted line have made changes to their national framework since 2013 and the Member States in yellow only established a legal framework after that year.



318 9 Member States do not yet have a legal framework for self-consumption (Bulgaria, Czech Republic, Estonia, Finland, France, Ireland, Luxembourg, Romania, Slovakia) and the legal framework changed at least once in 15 Member States over the past three years (Austria, Belgium, Croatia, Cyprus, Denmark, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Spain).

Figure 27: Regulatory frameworks for self-consumption

Source: European Commission (Report on Investments in investments in solar panels in the residential sector in EU Member States, to be published in Q4 2016)

Blue: Member States with a regulatory framework established before 2013
Yellow: Member States with a regulatory framework dating after 2013.
Dotted line: Changes to a regulatory framework existing before 2013 and implemented after 2013
Grey: Member States that do not have a dedicated support framework for self-consumption, although self-consumption can be allowed

5.4.1.2. Detailed assessment

In the future, it is likely that the uptake of small-scale solar will be mostly driven by decision taken at household and business levels looking to offset retail power tariffs and reduce costs[319]. Based on this assumption, this impact assessment tries to assess the gap of renewable energy generation that would result from a support phase-out and that would have to be filled by self-consumption. According to the model, growth will first take place in small-scale solar designed for self-consumption during daytime. With storage becoming more widely and cheaply available, a higher level of self-consumption throughout the day and larger solar panels will be installed.

In order to assess the impact of the different options, this Impact Assessment focuses on the deployment of rooftop solar PV generation[320] as well the share of self-consumed electricity among overall rooftop PV generation. For this, the following PRIMES scenarios and assumptions are used:

- For Option 0 and Option 1, REF2016 was used to assess the continuation of current practices in the absence of enabling framework at Member State level. Within these options, the self-consumption ratio[321] ranges between 33% and 64%[322].
- For option 2, EUCO27 has been used, mirroring cost-effective deployment of renewables within a harmonized enabling framework. The self-consumption ratio ranges between 37% and 67%[323].
- For option 3, EUCO27 has been used, mirroring cost-effective deployment of renewables within a harmonized enabling framework. The self-consumption ratio ranges between 41 % and 72 %. The increased self-consumption ratio is an illustrative draft estimation assuming an additional 9 % of energy potentially self-consumed at municipal level[324].

Based on these assumptions, the solar PV generation by 2030 would break down as below:

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[319] Bloomberg's New Energy Outlook, 2016
[320] Rooftop solar PV capacity and generation based on PRIMES is to be consider indicative
[321] Corresponding to self-consumed electricity vs. overall rooftop PV production
[322] Based on EC analysis, resp. without or with batteries deployment
[323] Based on EC analysis, resp. without or with batteries deployment, and factoring the possibility to self-consume within multi-apartment blocks
[324] 9% is the estimated share of locally produced energy in municipal energy consumption of selected municipalities, based on EC, The Covenant of Mayors in Figures, 2015.

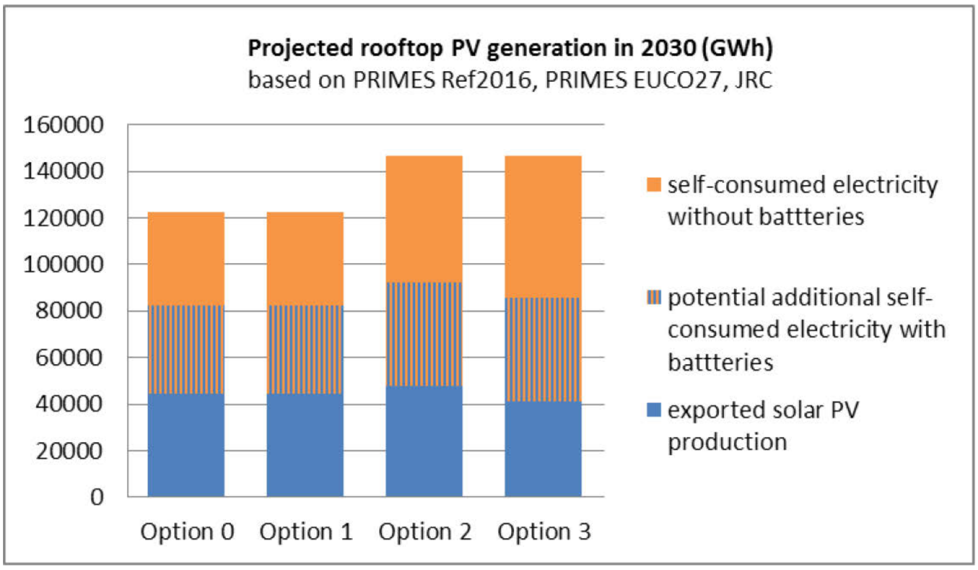

Figure 28: projected rooftop PV generation in 2030

The effect of the enabling measures under Option 2 and Option 3 is, as depicted in Figure 29, twofold:

- An increase in overall rooftop solar PV deployment, driven by self-consumption. By 2030, this increase is expected to be 20% compared to options 0 and 1, and 50 % compared to 2020.
- An increase in self-consumed electricity. By 2030, the maximal increase (assuming no battery deployment) is 26 % to 34 % compared to options 0 and 1. This increase could be however substantially higher[325] when compared to 2020, mostly due to a possible uptake of batteries.

However, all of these options will have a relatively moderate impact on the electricity consumption and generation pattern at EU-level, as shown in Figure 33.

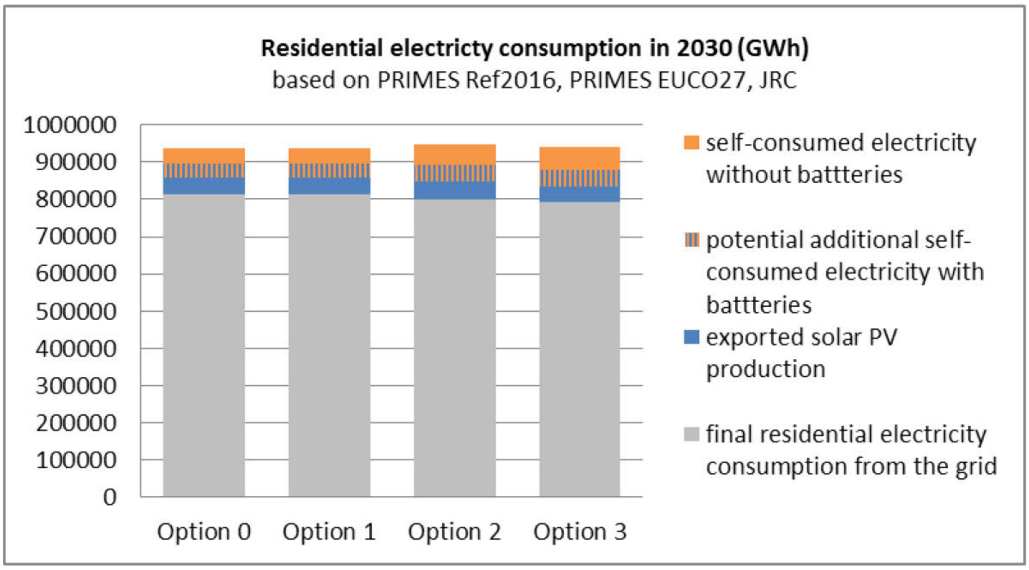

Figure 29: residential electricity consumption in 2030

325 Around +200%

Economic impacts

Self-consumption allows consumers to lower their electricity bill. With an average self-consumption rate of 30 % a consumer a four-person household with a 4 kWp PV system and with an average annual electricity consumption of 3 600 kWh could save almost € 320 a year due to self-consumption[326].

These savings are partly due to self-produced electricity which does not have to be bought and to a lesser extent due to the grid charges that are saved. This has led to concerns about lost revenue for the TSO that might impact the grid charges to be paid by other users that do not self-consume. However, due to the low self-consumption rates this problem is of theoretical nature today. Although today no statistics are available regarding self-consumption in the EU, German statistics for PV self-consumption indicate that it represents about 2.5 TWh (or 0.5 % of the final German electricity consumption) and seems to remain constant overtime from 2012 -2016. The same report assumes that even if the maximum potential of roof top solar according to PRIMES is used for self-consumption, the reduction amounts to 7.2 % of the 2013 distribution revenues and 1.1 % of the total electricity revenues. This calculation is based on the current rate design. Further analysis can be found in the MDI Impact Assessment, according to which on the one hand, a potential 'flight from the grid' could see the remaining connected ratepayers bear an increasing share of the burden of contributing to public finances and financing the electricity network. On the other hand, grid costs may actually fall as distributed generation and storage assets enable network operators to more efficiently manage the grid and connect remote customers. Cost-reflective distribution tariffs, *i.e.* tariffs that allocate the costs of the grid fairly amongst system users, are analysed in the MDI Impact Assessment.

Option 0 is expected to have the lowest impact on additional self-consumption of solar electricity, as business as usual continues. Option 2 and 3 are expected to have the largest impact because more actors are enabled to resort to solar generation. However, under Option 3, municipalities would be allowed to consume electricity that was produced on one building in a municipal building in another location, in order to better match their own production and consumption and increased their self-consumption ratio. By increasing the distance between the points of production and consumption by using the distribution grid, potential benefits of self-consumption for grid demand and grid losses would diminish, especially when the consumer is supplied via the distribution grid. It could however motivate municipalities to invest in renewable energy sources but it seems doubtful that this solution would be cost-efficient.

Option 0 and Option 1 would have the smallest impact on revenues. However, they would also fail to empower consumers. Option 3 appears to be most costly because it does not provide the potential benefits of self-consumption but reduces financing and tax revenues.

Social impacts

The Energy Union places citizens at its core. This includes giving consumers a wider choice of action when choosing their participation in energy markets and enabling them to generate and consume their own energy under fair conditions in order to save money,

[326] European Commission Staff Working Document SWD (2015)141, "*Best practices on Renewable Energy Self-consumption*"; ECFIN paper, "*Investments In Solar Panels in the Residential Sector in EU Member States*", to be published Q4 2016

help the environment, and ensure security of supply. Engaging consumers can also help mobilise private investments for the energy transition and increase the sense of ownership. As the large number of petitions at the European Parliament on self-consumption show[327], the business as usual scenario fails to achieve that objective in at least some Member States.

Option 1 is unlikely to improve the situation in all Member States as guidance would remain voluntary. Option 2 is likely to improve the situation across the EU as a European legal framework could establish a minimum degree of consumer empowerment in all Member States. Option 3 would indirectly involve a very large share of the population in self-consumption if municipalities started to install solar panels for virtual self-consumption on schools, swimming pools and other public buildings. However, virtual self-consumption over the grid would raise new challenges with regards the financing of the grid.

In addition to consumer empowerment, enabling self-consumption could also create new jobs. In 2014, the PV sector in Europe represented nearly 110.000 full-time jobs most of which in the installation and maintenance sector[328.] Yearly installed capacities in Europe have a significant impact on job creation as there is a direct impact on and services needed. Rooftop solar creates nearly three times as many jobs as ground-mounted installations. As self-consumption is likely to be a key driver for the uptake of solar (and other renewable) energy generation, this would also be the driver for new jobs. Option 0 and Option 1 are not expected to have a strong impact. Option 2 and 3 could trigger higher investments in the sector and thus contribute to higher job creation. Options 2 and 3 might create 10 000 to 20 000 additional jobs[329] in roof-top solar by 2030 compared to the business as usual scenario.

Grid defection from households that can cover their entire energy needs through self-produced electricity is not expected. In Northern Europe, this would require seasonal storage in order to match the consumption peak in winter with the production peak in summer. Even in Southern Europe, it is questionable if self-sustainable prosumers would choose to disconnect from the grid as this would prevent them from using electricity from the grid when their own generation does not function (*e.g.* for rooftop panels when the sun does not shine) and from selling excess electricity to the market (*e.g.* in times of long sunny periods). Should a prosumer however wish to disconnect from the grid, it would be fair if he does not contribute to the grid costs as he does not use it. This question is analysed more substantially in the MDI Impact Assessment.

Environmental impact

Environmental impacts are mostly influenced by the additional renewable energy generation in the system. In this case, the difference in rooftop PV generation between options 0 and 1 and enabling option 2 and 3 is 24 TWh, *i.e.* around 1.4 % of all renewable electricity by 2030[330]. Therefore these options are expected to have an overall moderate but still positive impact on renewable electricity deployment.

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327 In June 2016, the PETI Committee of the European Parliament discussed 16 petitions linked to self-consumption.

328 Solar Europe and EY, “Solar Photovoltaics Jobs & Value Added in Europe”, November 2015

329 Based on average figures per MWp and GWh from Wei, Patadia, and Kammen, 2010, and PRIMES results

330 PRIMES EUCO27 scenario

5.4.2. Disclosing information on the sources of electricity generation

Option 0	Option 1	Option 2	Option 3
• BASELINE - Continuation of current EU policies	• Improve functioning of GO system	• Option 1 plus make GOs mandatory for disclosure	• Option 2 plus extend GOs to all sources of electricity generation

- ***Option 0:*** *Baseline*

There would be no change in the current system, it would continue to function as presently designed.

- ***Option 1:*** *Improve functioning of GO system*

Improvements are made to the functioning of the GO system by making current good practice approaches of Member States in the operation of the system a mandatory part of the legislation. This would create a better single EU market for GOs from renewable energy.

- ***Option 2:*** *Option 1 plus GOs mandatory for disclosure*

In addition to improving the functioning of the system, GOs become the only means for disclosure of renewable electricity consumption to consumers. Energy suppliers would therefore need to use GOs if they are to make any claims about the renewable content of the electricity. The disclosure requirements set out in the Electricity Directive may need to be amended accordingly for this purpose. For this more comprehensive approach to work, Member States would need to issue GOs for electricity subject to a national support scheme in a way would not provide these generators with additional compensation.

- ***Option 3:*** *Option 2 plus extend GOs to all sources of electricity generation*

The GO system is expanded to provide a system of full disclosure of all energy sources, so enabling the origins of fossil and nuclear energy to be tracked in the same way. This would also mean that data such as CO_2 emissions from electricity consumption could be reported to consumers in a consistent way. In addition to making cancellation of GOs mandatory to energy suppliers, this option could also make issuance of GOs mandatory to all electricity producers, requiring all such energy sources to have GOs issued for them. However, such an expansion could be implemented in a voluntary manner, where Member States issue GOs to such electricity producers only at their request. There would be no obligation for GOs to be issued if the electricity generator does not want them.

5.4.2.1. <u>Introduction to the assessment</u>

The guarantee of origin (GO) system helps to disclose to consumers the share or quantity of energy from renewable sources in an energy supplier's energy mix. It provides a pan-European information system for the final consumer as to the origin of electricity, so enables producers to demonstrate the share or quantity of electricity produced from renewable sources and from high efficiency CHP[331].

GOs may be used for energy mix disclosure requirements by energy suppliers (*e.g.* set out under the Electricity Market Directive 2009/72/EC), but their use is not compulsory under this legislation.

GOs are electronic certificates that prove that energy is generated from renewable sources or CHP. The key features are:

- GOs prove that a certain amount of renewable energy was produced somewhere in Europe – they do not prove that a certain amount of renewable energy has been physically consumed by the purchaser;
- The legislation creates a single market for GOs - they are traded separately from the physical power so they can move around Europe;
- A GO represents 1 MWh of energy; GOs need to be used and cancelled within 12 months; each GO has unique identifier which gives standardised information on factors such as: date and country of issue, date of energy production, age of installation, location;
- Member States have to recognise GOs issued by another Member State.
- A common hub has been developed to enable such electronic transfers by the Association of Issuing Bodies (AIB). Refusal to recognise a GO from another Member State is possible, in case of doubts about its quality, in which case it must be notified to the Commission.
- Each Member State has a national competent body for electronic issuing, transfers and cancellations of GOs:
    - they must be issued upon request to producers of renewable and high efficiency CHP electricity[332];
    - it is optional for Member States to issue them for renewable heating and cooling;
    - it is possible for Member States to only issue GOs to renewable electricity not receiving support under any other national support mechanism. This was to avoid concerns as to double subsidy of renewable energy.

In theory, a book and claim approach for GOs is an efficient system enabling renewable energy to be produced in more cost efficient locations and consumed remotely. They are low cost and efficient relative to other certification models and fit well with diverse supply chains across multiple countries. However, to retain credibility, it is essential that such an approach has well-functioning systems for issuing and retiring GOs and that the central registry is robust. In addition, the system can be more vulnerable to fraud and gain a poor reputation with consumers if the systems are not resilient[333].

331 In some European states the GO system is applicable to all other sources of electricity generation (*e.g.* AT, CH and SE) and similar national or privately initiated systems for renewable fuels (*e.g.* bio-methane in AT, DE, DK, FR, UK and CH).

332 Article 14(10) of Directive 2012/27/EU on energy efficiency that creates guarantees of origin for high efficiency co-generation but does not prescribe a use for them.

333 Characteristics of book and claim systems described in: "Sustainability Journal - Certification of Markets, Markets of Certificates: Tracing Sustainability in Global Agro-Food Value Chains –Mol and Oosterveer"

Use of GOs is growing over time. Figure 30 shows that increasing volumes of GOs have been issued and cancelled over recent years. In 2011, GOs were issued for about 22% of the renewable electricity generated in the EU. By 2015 issuance had grown to covering around 45% of the renewable electricity generated.

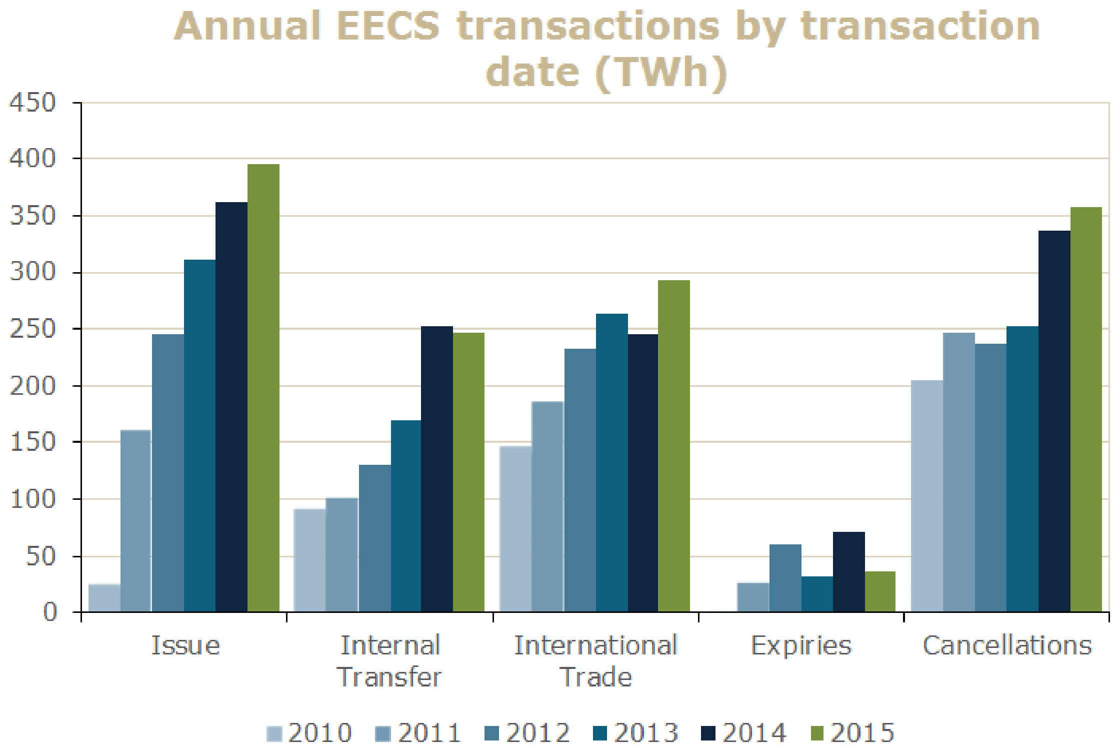

Figure 30: Total volume of GOs using EECS standard transacted through the AIB hub[334]

Although an increasing amount of renewable electricity is covered by GOs, Figure 31 shows that the majority of power generation is outside of the GO system.

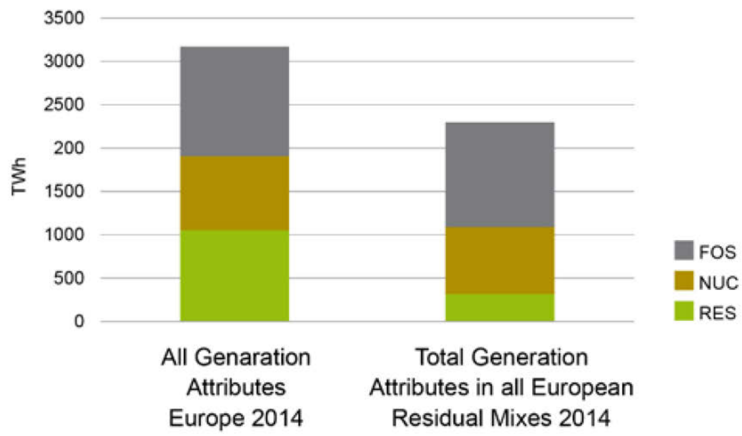

Figure 31: Total Generation (left) and non-tracked generation (right) in 2014[335]

The trend for increased use of GOs demonstrates that there is strong and growing consumer demand for green energy products in recent years. Green electricity tariffs

334 The Association of Issuing Bodies – Annual Report 2015

335 RE-DISS II Final Report

based on renewables and backed by GOs are common in many Member States. The growth in the issuance and cancellation of GOs suggests that abolition of the system could be counterproductive, possibly resulting in the need for alternative mechanisms to be developed. Furthermore, it was notable that there was little call for such an approach in the public consultation.

Growth in demand for GOs has also come from corporate consumers seeking to satisfy corporate environment, social and governance (ESG) requirements. Indeed one important driver of the GO market is the recent recognition of GOs by the main corporate carbon accounting standard organisation CDP (formerly Carbon Disclosure Project). Their technical guidance now states: *"you can reflect specific policies on contracting renewable energy into your disclosure on emissions performance, namely if your […] emissions have reduced as a consequence of buying RECs or GOs you can consider that as a emission reduction activity"*[336]. The endorsement of GOs by such a body is likely to increase demand from the corporate sector for GOs over the coming years as they start to implement the latest guidance. The guidelines also demonstrate that a core demand for the GOs from these corporate consumers is for CO_2 accounting reasons, rather than the renewable character of the energy itself. The GO is valued primarily for the reason that it represents low carbon energy.

The most developed case of such renewable consumption can be found in Luxembourg, where it is reported that the number of 'green' electricity contracts accounts for 100% of the retail market[337]. In the Netherlands 63% of all contracts are now green[338]. This high level of consumption, contrasts strongly with the low renewable energy generation. In 2014, just 5.9% of the electricity produced in Luxembourg was from renewable sources and 10% in the Netherlands demonstrating significant imports of the GOs from other countries[339].

As a consequence of this, Norway which generates virtually all of its electricity from renewable sources and exports the associated GOs ends up importing a residual mix of electricity from fossil and nuclear power generated in other parts of Europe. In accordance with the principles of the Electricity Market Directive, this resulting mix is shown to consumers on their bills.

GOs have a relatively low value, generally trading for under a Euro for each MWh of electricity. Finding prices of GOs is not straight forward as there are no published indices since most GOs are traded over the counter. One publically available source is the results of the auctions made by GME which sells GOs on behalf of the Italian Government[340]. Prices achieved in the three 2016 auctions averaged between 15-29 cents per MW/h.

The data on the GME website shows that prices have remained low over time, suggesting that there is little scarcity in the market, *i.e.* supply through issuance has grown at slightly higher rate than the demand for cancellation. However, there have been cases reported of certain specific types of GOs selling at much higher prices (*e.g.* anecdotal evidence that

336 https://www.cdp.net/Documents/Guidance/2015/Accounting-of-scope-2-emissions.pdf
337 BEUC Mapping Report - Current practices in consumer-driven renewable electricity market, January 2016, p. 17
338 BEUC Mapping Report - Current practices in consumer-driven renewable electricity market, January 2016, p. 17
339 Eurostat, 2016.
340 http://www.mercatoelettrico.org/En/Esiti/GO/EsitiGOAste.aspx

GOs from wind energy generated in the Netherlands has sold at over EUR 2 a MW/h). Such prices are likely to be driven by consumers expressing demand for certain types of renewables in certain locations.

It is apparent that there are differences across the EU in the way in which Member States have implemented the GO system. A 2014 consultant's report for DG Energy on progress in renewable energy[341] found that:

- There were considerable differences between the national systems due to different approaches to implementing the requirements;
- Not all Member States had decided to join the Association of Issuing Bodies (AIB) which provides a standardised system for the exchange of GOs between Members;
- 2 Member States did not have an electronic registry;
- Practices for fraud avoidance varied, many Member States have put in place a system of verification; and
- Only 3 Member States had decided to introduce GOs for heating and cooling, however neither seemed to have any activity in that sector.

Some of the variations in the implementation of the system between Member States, reflects the flexibility inherent in the legislation. Many of these differences persist. For example, at the end of 2015, AIB had a total of 18 EU and EEA-EFTA countries as members[342]. Whilst membership of the AIB is voluntary for Member States, it provides a convenient and robust means for the trade of GOs. The absence of some Member States from the AIB indicates differences in implementation of the GO system around the EU and an incomplete internal market.

A key variation is the relationship between GO issuance and national support schemes. In line with an option in the Directive, many Member States restrict issuance of GOs to electricity not benefiting from support schemes to avoid double compensation to electricity producers. As a result, GOs are only issued for the unsupported part of the renewable electricity production. Other Member States issue GOs for all renewable electricity. For example, Italy auctions the GOs associated with supported electricity. This ensures full issuance of GOs for all renewable electricity, but prevents double compensation for energy generators who already received payment from the national support scheme.

As described in the problem definition section, the current legal structure risks double counting of renewable electricity, as use of GOs is not required for disclosure purposes. To prevent such risks, the hub system developed by the AIB for exchange of GOs across the EU has at times disconnected some Member States[343] from trading GOs with other countries, if risks of double counting are perceived in the structure of national legislation related to GOs and disclosure.

From a consumer perspective, there have been concerns about misleading green claims and "greenwashing" by the GO system given the risk of double counting and also as it enables imports of renewable electricity across the whole of the EEA. For example, renewable electricity from Norway can be consumed in Greece, when in reality it is

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341 Renewable energy progress and biofuels sustainability – Ecofys et al, November 2014

342 AIB Annual Report 2015

343 *e.g.* Czech Republic

unlikely to travel that far. In essence this is a criticism of the use of "book and claim" systems for certification purposes, rather than credibility of the GO system itself. Clearly robust implementation of the system across the EU should help build confidence in the system and allay concerns that the origin of the electricity is not double counted in any way.

The partial use of the GOs for just renewable electricity means that residual mix calculations need to be carried out each year to calculate the consumption of non-renewable sources as a result of the GO transfers. This is quite a complex statistical exercise and cannot be as accurate as the tracking function provided by a well-designed GO system.

The current system design means that in effect those covered by the GO system generate the data for disclosure and effectively pay for the residual mix calculations. As a consequence, fossil and nuclear generators do not directly contribute towards producing data for disclosure that is produced through the GO system. This also means that the system applies to smaller generation sites, but not to some of the large ones, as renewable installations have a much smaller average output compared to large thermal power plant. Data for the UK[344] shows that in May 2015, 78% of the electricity generation installations operating were renewable (362 installations including co-firing, excluding small scale) and 12% were purely fossil or nuclear (100 installations). In 2014, 19.1% of the UK's electricity generation was from renewable sources.

There are also variations in the scope of the GO system. Austria, Sweden and Switzerland[345] have extended a GO system to all types of electricity generated in their territory. Data from some of these states shows that extension to large thermal generators has modest additional administrative impact as both countries have a relatively high share of renewable generation. In Austria, fossil plants represent about 1% of the total installations on their registry, but represent around 30% of electricity production. Similarly in Switzerland, fossil and nuclear generation represents about 10% of the number of installations, but over 40% of the total power generated.

Evaluation work[346] by consultants was carried out to support the REFIT assessment of the RES Directive. The conclusions and recommendations included:

- Continue to stress the importance of Member States to move towards a GO system based on the European Energy Certificate System (EECS) operated by the Association of Issuing Bodies (AIB). Also, continue to monitor progress, to ensure full implementation of this aspect throughout the EU;
- Assess the benefits of following the Best Practice Recommendations formulated by RE-DISS[347], such as streamlining the use of tracking mechanisms at Member States level and clarifying the relation between support schemes and the tracking systems used for purposes of disclosure;

344 https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

345 Switzerland is not part of the GO system that operates across the EEA, but has enacted similar legislation

346 Mid-term evaluation of the Renewable Energy Directive – CE Delft et al, April 2015

347 The RE-DISS projects (Reliable Disclosure for Europe) funded by Intelligent Energy Europe sought to provide guidance to competent bodies and legislators implementing the GO system.

- Investigate the possible extension of the use of GOs beyond RES-E and high-efficient cogeneration to all types of power generation *i.e.* including electricity from fossil and nuclear generation.

These recommendations are captured by the options under consideration.

5.4.2.2. Detailed assessment

Economic impacts

Increasing issuance and cancellation of GOs will result in changes in financial flows. The overall economic impacts are likely to be low as GOs trade at very low prices relative to the price of electricity.

- The economic impact of the option for improving the functioning of the existing system will be negligible relative to a business as usual scenario, as it may not shift the supply and demand balance for GOs very much.
- Making the system mandatory will increase supply and demand for GOs, and may result in more financial flows to generators. However, if a consistent approach is adopted to prevent double compensation, say by Governments auctioning GOs associated with supported electricity, then the impact should be neutral. Especially if the auction revenues are returned to those who pay for the support scheme in the first place.
- With a system of full disclosure, the additional financial flows are likely to be minimal as GOs from fossil and nuclear sources may trade at very low prices as they could have little value to energy consumers. Nuclear may have more value than fossil GOs due to it low carbon character, so nuclear electricity generators may benefit more than those producing electricity from fossil fuels.

Improving the functioning of the single market for GOs should make the market more efficient and less costly. The different options under consideration should improve the coordination and robustness of the schemes and create a liquid, functional market. They should bring in more consumers to a properly functioning GO disclosure market, so should make green energy purchasing a more effective consumer driven market. This would be expected to improve the responsiveness of energy companies to green consumer preferences. It could help supplement or possibly in the longer term supersede public support for renewable energy. This should result in system based on green consumer pricing which is less distorting and more efficient.

Improving the functioning of the system also seems to be preferable to abolition. It is difficult to see how abolition could create a more efficient outcome and more reliable information to consumers and producers as to preferences for renewables.

The administrative costs of changing the scope of the system should be moderate. All Member States currently have the administrative infrastructure in place from the existing GO system, so extra administrative costs will be incremental. The highest additional administrative costs would result from expanding the system to fossil and nuclear generators. These costs would increase further if CO_2 emissions data from power plants is included in some way in the GO system.

Social impacts

The ultimate impact of the GO system is that it as a means to provide reliable data to consumers as to the sources of the electricity that they consume. The more reliable and comprehensive the data provision, the bigger the social impact. A poorly designed and implemented system could have negative impacts on consumers by reducing levels of trust in the information that is provided to them and raising suspicions of misleading green claims and "greenwashing".

Compared to the business as usual option, improving the functioning of the GO system should have positive social impacts, in that it should improve levels of trust and confidence in the mechanism through creating a more transparent system. The impacts should be larger with the more ambitious options. Making the system mandatory for disclosure purposes should therefore have a bigger positive impact, as the system would cover the whole range of renewable electricity generation sources. Positive impact should come from extending the system from only renewables to all sources of electricity.

Abolition of the system would also seem to make the quality of the information provided to consumers worse.

Environmental impacts

The environmental benefits of the improving the GO system relate to consumers being empowered to make more informed choices regarding their energy consumption. An improved and more comprehensive GO system could have the effect of increasing the demand for renewable and low carbon energy by enabling consumers to express more clearly their willingness to pay for different types of electricity.

The options of making the system mandatory and that of expanding its scope to other energy sources could both result in larger environmental benefits relative to a business as usual approach. Improved information about the character of energy consumption, may increase demand for greener tariffs. It is possible therefore possible that there could be an increase in price of GOs and result in more renewable energy brought to the market. The incentive impact is likely to be small given the very low prices at which GOs trade relative to wholesale market prices. However, the reported much higher prices paid for specific types of renewable technology in specific locations indicate that there could be a more pronounced impact for certain types of projects.

There should also be other positive environmental impacts from expanding the system to fossil and nuclear plants, as this would enable emissions data to be attached to GOs. Consumers would therefore be able to choose with greater confidence electricity supply tariffs with low CO_2 emissions (*e.g.* nuclear and renewables) in addition to pure renewables based tariffs. In particular, this would help satisfy the growing demand for such products from the business sector. The additional price incentive that this provides to power generators is likely to be very small given the price that GOs trade for, however at the margin it would create a small amount of additional revenues for low carbon electricity.

Political feasibility /opportunity

Further development of the GO system is compatible with the development of broader European energy market and the objectives of the Energy Union. As cross border flows in energy increase with greater interconnection and more coupled markets, the need for a robust systems to track production and consumption of renewable electricity will increase. The need for, and benefits of, an effective pan European GO system should increase over time. Abolition of the system would have a negative effect of reducing the potential for trade for renewable energy across Europe.

Other impacts (markets, innovation…)

The current system just applies to renewable generators. Most renewable energy generation sites are owned by large corporations, however it is possible that some of these installations are small, so could be owned by SMEs. Expansion of the system to large thermal power generation plants will result in further coverage of mainly larger energy generators and companies.

Of the options under consideration, it is difficult to see how Option 0 of continuing with current practice should be selected. Given the increases in the amount of renewable energy that is generated, the greater cross border trade in renewables and the growing interest in disclosure, an improved system of guaranteeing the origin of renewable electricity is desirable.

5.4.3. *Tracing origins of renewable fuels used in heating and cooling and transport*

Option 0	Option 1	Option 2	Option 3
• BASELINE - Continuation of EU current policies (no GOs for renewable fuels)	• Extend GOs to renewable gaseous fuels	• Extend GOs to renewable liquid and gaseous fuels	• Develop alternative tracking system for renewable liquid and gaseous fuels

➢ ***Option 0:*** *Baseline*

No change from the current legislation, the requirements for a mass balance system to be used for sustainability criteria for biofuels and bioliquids remain and no additional EU wide system of guaranteeing the origin of renewable fuels is implemented. Some Member States may choose to continue with or develop national GO systems.

➢ ***Option 1:*** *Extend GOs to renewable gaseous fuels*

In addition to continuing the approach towards sustainability criteria for biofuels and liquids which ensures sustainable feedstock is used, an EU wide system for guaranteeing the origin of renewable gaseous fuels is developed. This would primarily concern developing a mechanism for tracing biomethane that is injected into the European gas grid from the point of injection to the point of consumption. It could also concern other pathways such as the production of gas from renewable electricity and renewable hydrogen.

➢ ***Option 2:*** *Extend GOs to renewable liquid and gaseous fuels*

An EU wide system for guaranteeing the origin of gaseous fuels under Option 1 is expanded to liquid fuels, covering such fuels from the point of production or import to the final consumer. This would primarily concern bioethanol and biodiesel for road transport, but could also cover heating oils and fuels in aviation and maritime transport.

➢ ***Option 3:*** *Develop alternative tracking system for renewable liquid and gaseous fuels*

An EU wide system for tracing the origin of gaseous and liquid renewable fuels is developed that builds on the existing mass balance requirements for sustainable biofuels to enable more visibility and cross border trade. This could comprise economic operators entering data about the movement of gaseous and liquid renewable fuels into an electronic registry when documenting compliance with the sustainability requirements.

5.4.3.1. Introduction to the assessment

For biofuels and bioliquids there are requirements in the RES Directive related to the sustainability of the fuels and the obligation for Member States to implement a mass balance system as a means of providing a chain of custody. These systems provide a means of tracking the sustainability of fuels all the way from feedstock to final consumers. Such systems are considered stringent and effective means for meeting sustainability requirements[348].

However, beyond these sustainability requirements implemented at a national level, there are no EU wide systems in place for guaranteeing the origin of renewable gas (*e.g.* biomethane injected into the gas grid) or for renewable transport fuels to energy consumers. Such a system could be beneficial when there is significant trade in such sustainable fuels across borders. It would not replace the sustainability requirements, but act in a complimentary manner and build on the systems in place to provide consumers with additional information.

With volumes of renewable fuels being introduced onto the European market likely to increase in the coming years, the desirability of having such systems should be considered. These could take the form of an EU wide guarantee of origin system being implemented, similar to the system for renewable electricity, or alternative systems that facilitate the provision of information to consumers and enhanced cross border trade.

Table 12: Growth in biogas forecast in selected Member States[349]

Country	Current situation (TWh)	National plans or targets (TWh)			Technical realisable potential (TWh)
		2 020	2 025	2 030	
Denmark	1.5	4.7			44.9
Finland	0.6		~2.6		42
France	5.4	6-8		70	100
Germany	78.1	123			264
Italy	2.1	3.2			9.5
Netherlands	3.2	6.7		30	

348 Report on the operation of mass balance verification method for biofuels and bioliquids SEC(2011) 129 final

349 Sources: 1. Greengasgrids, 2015. Market platform country overview, www.greengasgrids.eu; 2. IEA Bioenergy Task 37 Country Reports Summary 2015., www.iea-biogas.net; 3. http://www.biogasheat.org/wp-content/uploads/2012/10/2012-10-18_D.2.1_WIP_EN_Final.pdf; 4. EurObserv'ER (2014). Biogas Barometer 2014. http://www.eurobserv-er.org/biogas-barometer-2014/

Sweden	1.6			15	69-74
UK	21				37

Tracking systems and GOs for gaseous renewable fuels

The existing sustainability requirements in the RES Directive already require Member States to implement a system for ensuring the sustainability of biofuels and bioliquids. These systems should enable consumers to have good assurance as to the origin and quality of the renewable fuels that they buy.

A key issue going forward for renewable gaseous fuels is likely to be the functioning of such systems across national borders. This issue will be most significant with biomethane injected into the grid, where tracing the origin of the fuel from the point of injection to the offtake by final consumer will be important. With the increasing interconnection of the gas grids across Europe and an increase in cross border trade flows, the desirability of having an EU wide tracking system for biomethane that is injected into the grid will increase. This system should be capable of transmitting information about the nature of the biomethane that is distributed.

A robust system would enable consumers to be provided with accurate information regarding the renewable content of their gas taken from the grid. Acting in a similar manner to the electricity GOs, a EU defined GO system for biomethane could stimulate consumer demand for green gas and enable energy suppliers to develop new consumer energy products based on biomethane. It would also provide an EU wide means of assuring the quality of existing green gas products that are marketed to consumers today.

In the short term, the main focus should be on biomethane which is already injected into the European gas grid. Power to gas injected into the grid should also be capable of being included, if the electricity used is of renewable origin. Furthermore, other pathways such as hydrogen could become increasingly important and would benefit from a GO system. Indeed initiatives to design such a system are already under way[350]. The rationale for extending the system to biomethane that is not mixed into the grid is lower, as the issues of determining origin of the fuel and cross border trade are not the same.

There are already a range of national initiatives in place that help guarantee the origin of biomethane. Austria, Denmark, Germany, France, Italy, Netherlands, Poland, Slovakia, Sweden, and the UK are developing or have already introduced national GO style certification schemes for biomethane. These national certification schemes have mostly been set up through private initiatives, although some are regulated by public institutions. The existence of national systems demonstrates that much infrastructure for an EU wide system already exists. Furthermore, some of the platforms developed for the electricity GOs may be suitable for use by a system covering renewable fuels.

The desirability of having cross-border recognition of national guarantees of origin is already apparent. Some of the national systems (Germany, France, UK, Austria, Denmark and also Switzerland) have already agreed to mutually recognise each other's

[350] http://www.certifhy.eu/

GO systems for biomethane[351] to facilitate cross-border trade and disclosure. This demonstrates the need for mutual recognition of national GOs in the era of connected gas markets and that further action at a European level could be justified to create a single market for such certificates.

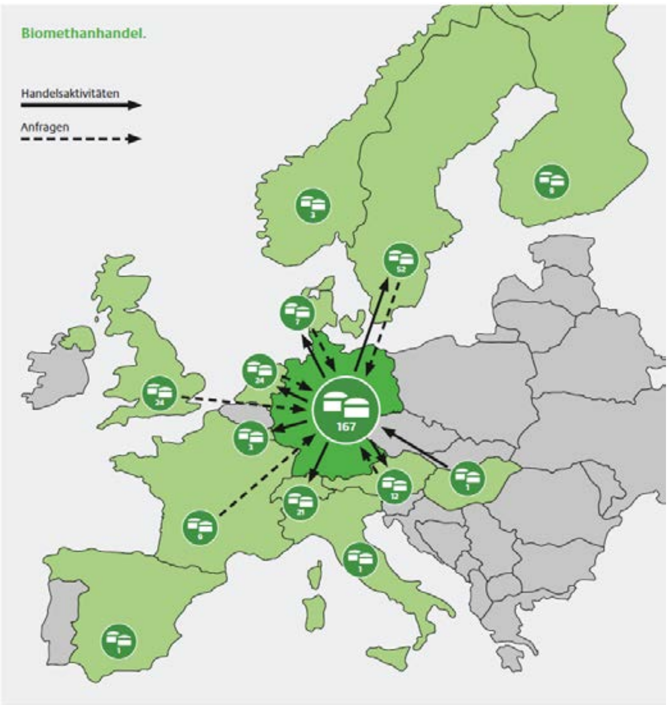

Figure 32: Biomethane trade between Germany and other countries in Europe in 2014[352].

The national registration schemes adopted a mass balance approach[353] reflecting the sustainability requirements in Article 18(1) of the RES Directive This means that they do not allow the separate trade of the physical gas and the guarantee of origin when the gas passes a boundary between balancing zones. These balancing zones are frequently aligned with national boundaries, so could increase the cost and complexity of cross border trade.

There are a number of issues that need to be taken into consideration for an EU-wide system. First, uniform quality standards for gaseous renewable fuels are a necessary condition to support cross-border trade[354]. The RES Directive, the Fuel Quality Directive and the Communication on Biofuels and Bioliquids Sustainability Scheme[355] already provide sustainability criteria for biomethane used as transportation fuels[356]. Furthermore, the Directive on the Deployment of Alternative Fuels Infrastructure[357]

351 http://energinet.dk/SiteCollectionDocuments/Engelske%20dokumenter/Gas/Letter%20Of%20Intent%20Biomethane%20registries.pdf

352 Source: DENA (2014). Zukunft Biomethan http://www.biogaspartner.de/fileadmin/biogas/Downloads/Broschueren/20150521_15-14-89_Broschuere_Zukunft_Biomethan_WEB.pdf

353 For example, the registries in Austria, Denmark, France, Germany, Sweden, the UK as well as Switzerland

354 IEA Bioenergy (2014).

355 2010/C 160/01

356 BIOSURF, 2015. Guideilnes for creating the European Biomethane Guarantee of Origin.

357 2014/94/EU, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=EN

already references quality specifications[358] for the injection of biomethane into the natural gas grid. As long as these sustainability criteria are adhered to in the creation of Guarantees of Origin for gaseous renewable fuels, no additional sustainability verification is required for cross-border trade.

Another consideration is the relationship with sustainability verification covering the transportation up to the release of the fuels for consumption[359]. In the RES Directive, Member States should use a mass balance system for biofuels and bioliquids to track sustainability verification from the point of production to the point of use by the end-user. A review of the mass balance system for biofuels concluded that the mass balance system was a fair compromise between administrative burden and effectiveness in monitoring sustainability [360].

With network supplies of biomethane such sustainability information needs to capable of being transmitted across national borders, from the point that the gas is injected into the grid to the point of consumption. This would require mutual recognition between Member States of the biomethane registered in another Member State, enabling consumers to easily purchase in one Member State and consume in another. For this to work effectively under the current approach, all Member States would need to establish GOs for biomethane. Furthermore, these national GO certification systems would need to recognise the whole European gas grid as a single mass balance system and be able to properly account for biomethane in another national registry to avoid double counting. Further developing the mass balance approach would mean that GOs for biomethane could not be traded in isolation from the physical gas.

An alternative system is to replace part of the current mass balance approach for network supplied biomethane with a "book and claim" system, as used for cross-border trade of Guarantees of Origin of renewable electricity. This system would only function from the point of injection into the grid to the point of consumption. It would not replace the mass balance sustainability tracking system which would continue to operate from the point of injection all the way back to the original feedstock. Indeed, information on the sustainability characteristics of the biomethane gas introduced onto the grid should feature in the information provided on the GO.

In such a book and claim model, Member States would issue GOs to those actors introducing biomethane into the gas grid. The GOs would trade separately from the physical gas, so they can therefore be sold to final consumers as a way to demonstrate the consumption of biomethane. Such GOs issued in one Member State would need to be recognised in another. Such an EU wide book and claim model would enable transfers of biomethane GOs to take place across Europe in a relatively simple way, so is compatible with the further development of the single energy market. In theory, it should also be cheaper and more efficient to operate than a mass balance approach. Like all book and claim systems, it is important that it is robust and well enforced to retain credibility.

In summary, to facilitate cross border biomethane trade within the European gas grid, a functional system of information transfer between national systems for registering

358 Specifications developed by the Technical Committee CEN/TC 408

359 COM 2010/C 160/01

360 Ecofys, 2012. Analysis of the operation of the mass balance system and alternatives. https://ec.europa.eu/energy/sites/ener/files/documents/2013_task_1_mass_balance_and_alternatives.pdf

biomethane seems desirable. This system could build on and complement the existing national systems established under the RES Directive for compliance with the sustainability criteria. A core building block could be to ensure that all Member States issue a guarantee of origin for biomethane introduced into the gas grid and that these GOs would be mutually recognised by other Member States. The design of the EU GO system for biomethane could continue to develop the mass balance approach applied for the sustainability criteria, though this would be more complex to make operational. The GOs would not trade in isolation from the physical gas and the EU gas network would need to be considered as a single mass balance system. Alternatively, the GOs for biomethane could follow the approach used in electricity, where once injected into the grid, the GO trades separately from the biomethane. Such systems have lower administrative costs, but need to be robust to retain credibility.

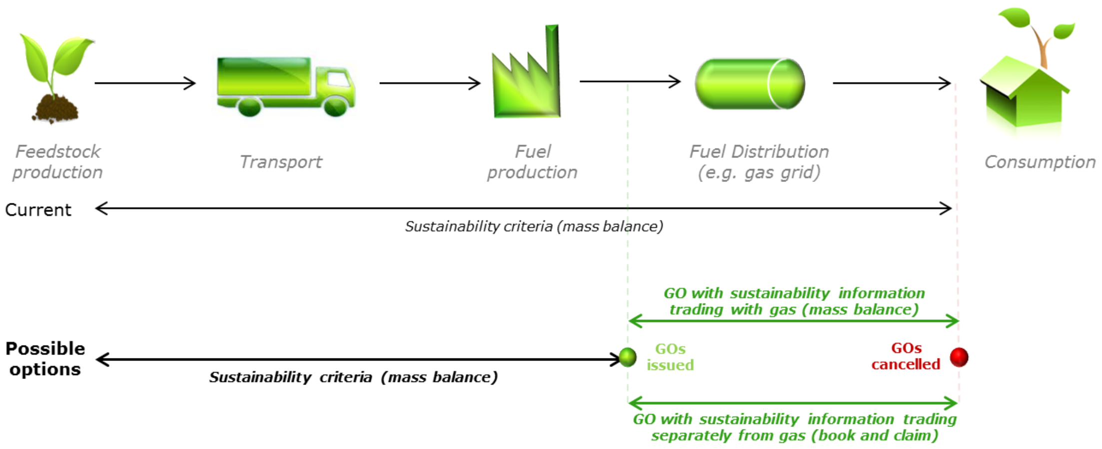

Figure 33: Characterisation of options identified for tracking grid injected biomethane

Tracking systems and GOs for liquid renewable fuels

A tracking system for renewable liquid fuels would primarily concern bioethanol and biodiesel used in transport and renewable heating oils. It would also cover advanced renewable fuels introduced in the future as technology and markets develop. Similar issues would apply to biogas that is not injected into the grid.

Many renewable fuels are chemically identical, so distinguishing between sustainable and non-sustainable variants can be difficult once the fuel is blended and distributed through the supply chain. A robust tracking mechanism should help prevent fraud and the associated risk that consumers are mis-sold unsustainable fuel products and increase confidence in the products being sold.

A core issue with renewable fuels is sustainability. As with biomethane, these liquid fuels are covered by the sustainability criteria that apply to biofuels and bioliquids in the RES Directive, which requires the use of a mass balance system by Member States.

The issues associated with tracing the origins of such fuels are different from biomethane, in that the fuels are not mixed into a network with other fuels for distribution purposes. Therefore it should be simpler for final fuel customers to rely on the system developed for the sustainability criteria to understand the origins of their fuel and for the certification of the fuels to be attached to trades in the physical product. The need for a guarantee of origin system for such fuels is much less clear, especially one based on a book and claim approach as applied to renewable electricity.

With these national systems, a key question is the ease to which cross border trade between entities in different Member States can take place for sustainable biofuels. Is the sustainability information of the fuel that is inherent in the national systems transferable along with the fuel?

So far, it seems that five Member States have implemented four national electronic registries which store such sustainability data, these are Austria, Germany, the UK and a shared system between Belgium and Luxembourg, These systems provide a means to have a clear overview of the volumes of fuel produced. It is understood that the Austrian, German and the Belgium/Luxembourg systems are capable of transferring data between them to reflect cross-border trades in sustainable fuels.

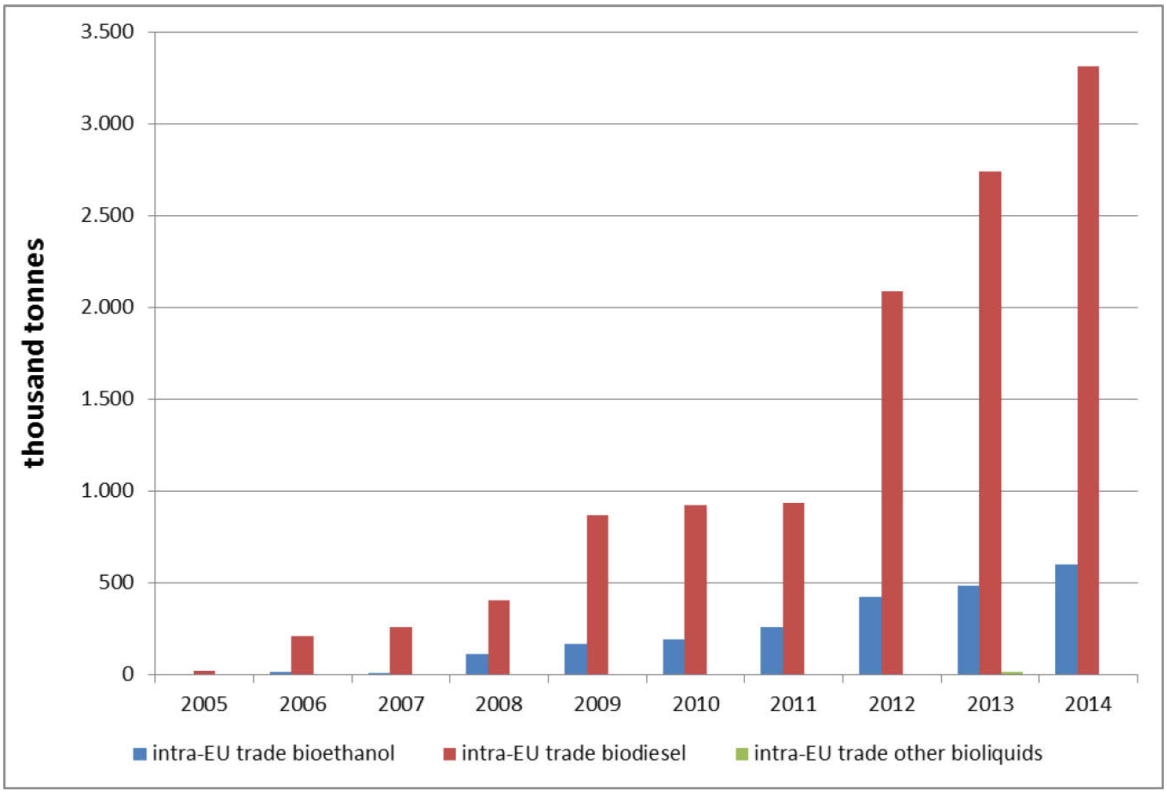

Figure 34: Intra EU trade in biofuels

To facilitate further trade is sustainable fuels, an EU wide system could reflect current good practice and require all Member States to ask economic operators to enter data about the movement of such renewable fuels into a national electronic registry when documenting compliance with the sustainability requirements. Moreover, there it would be necessary for registries to accept transfers with other registries when fuels are transferred across borders. This should create a robust tracking system.

Producers and traders of biofuels are currently obliged to keep thorough documentation of the amount and the sustainably characteristics of the biofuels they source and sell. However, given the variations in the level of support for different types of biofuels there is a concern that some operators could be tempted to make false claims about the sustainability characteristics (*e.g.* whether they are advanced biofuels or produced from food crops). Currently, these claims are verified by sporadic audits of the mass balance documentation. An approach of requiring data to be visible in a national database and the linking the databases to enable cross border transfers should improve the robustness of the information on the sustainability characteristics of biofuels. It could improve the consistency of sustainability information across the EU. Therefore the system would not only provide customers with better information but should support Member States in enforcing the implementation of any support schemes for renewable fuels in particular advanced biofuels.

5.4.3.2. Detailed assessment

Economic impacts

From an economic perspective the three options will have benefits in terms of reducing the risk of fraud occurring in the production and sale of biofuels. A reliable system of guaranteeing the origin of fuels would help provide greater transparency to the market and consumers. Fraud is a concern in relation to fuels as sustainable renewable fuels can be chemically identical to fossil and non-sustainable equivalents, so having a system of guaranteeing the origin of these fuels will be a benefit. A more robust system for fuels may help to reduce slightly the risks associated with investment in advanced fuels, if the system provide more certainty that the market is less susceptible to fraud.

There will be additional administrative burden from such systems as opposed to the do nothing option. Experience in Germany and the Netherlands suggest a typical transaction costs for a cycle of issuance, trading action, and cancellation of 1 MWh of biomethane (based on a mass balance system) are higher than 1 MWh of electricity (based on a book and claim system). In the Netherlands, the costs are EUR 0.067 for renewable electricity and EUR 0.246 for biomethane in 2014. In Germany, the costs are roughly EUR 0.04 for green electricity and EUR 0.16 for biomethane.[361] The higher administrative costs for biomethane trading are not only due to the different system being used, but more importantly relate to the volume of trade.

Administrative costs on an EU wide GO system for biomethane based on a mass balance approach would be expected to be lower than the costs reported in Germany and the Netherlands. In a number of countries these administrative costs will not be additional as they already exist for national GO systems or with private initiatives. In other Member States much infrastructure for GOs exists in relation to renewable electricity, the on-cost of extending the system to renewable fuels will be reduced as there will be some synergies with the renewable electricity system.

There is also evidence that the market price of GoO for biomethane in the German and Dutch markets is providing additional revenue in the order of EUR 4-8 per MWh. As these GOs trade with the physical gas it can be difficult to identify that value that consumers place on the renewable attributes of the fuels.

Costs of developing an electronic registry for biofuels are difficult to estimate. A number of Member States already have such systems developed, so the on costs for these Member States should be minimal.

361 Spijker et al. (2015). A level playing field for the European biogas and biomethane markets. http://jin.ngo/images/jin/publications/final_report_interreg.pdf

Social impacts

A key social impact will be to increase the choice for consumers in relation to the fuels that they use, as highlighted by some of the submissions during the stakeholder consultation. Currently in many Member States it is not so easy for consumers to express a preference for such renewable fuels in the natural gas and transport fuels markets. A robust EU-wide approach should help build consumer confidence in the renewable character of gaseous and liquid fuels.

The development of a robust system for GOs related to renewable natural gas will enable green tariffs for such fuels to be developed as well as facilitating cross border trade. Similarly such tracking systems should enable a wider range of transport fuels products to be sold to consumers.

Furthermore, the biogas industry has resulted in a large number of additional jobs. In Germany alone, jobs associated with biogas technology (including electricity production) increased from 30,900 in 2009 to 50,600 in 2011[362].

Environmental impacts

The main environmental impact of the options will be to increase the level of confidence in the sustainability of renewable fuels. The impact will be positive across all options relative to the do nothing option. Increased confidence in the system and a reduced risk of fraud should ensure that the environmental benefits of sustainable fuels can be counted with more certainty. At the margin, these policies may also encourage greater consumer demand for such fuels by providing greater assurance as to the quality of the fuels being consumed.

This impact is likely to be of biggest significance for the options related to the liquid transport fuels, where sustainability concerns with feedstock are most common. Option 3 is likely to have the biggest impact in this respect, as the tracking system would be clearly linked to the existing sustainability criteria used for biofuels.

Political feasibility /opportunity

The options under consideration involve creating an EU wide approach to guaranteeing the origin of renewable gas and enabling greater visibility as to the nature of the liquid fuels. The options are in line with the further development of a European energy market and enabling greater cross border trade in renewables. The preferred options for renewable gas and fuels would build on the national systems that exist in a number of Member States.

Other impacts (markets, innovation…)

The requirements will apply equally to all renewable fuel producers, irrespective of their size. It is possible that some producers of biomethane which is injected into the grid will be small and medium sized businesses so they would be impacted by the system. However, the GO system for electricity shows that GOs from renewables attract a positive price premium so they should represent an additional source of income for

362 http://www.greengasgrids.eu/fileadmin/greengas/media/Downloads/Documentation_from_the_GreenGasGrids_project/Biomethane_Guide_for_Decision_Makers.pdf

SMEs. The renewable fuel industry is understood to have a structure where more key market players are larger organisations, so small companies may not be impacted as much.

With the likely growth in renewable fuels, the option of continuing without an EU wide tracking system does not appear attractive. The benefits of implementing such systems for gas and liquid fuels seem to outweigh the costs. On that basis Option 0 can be discarded.

5.4.4. Overall comparison of the options to empower and inform consumers of renewable energy

	Overall impact			Key objectives		
Policy option	Social	Economic	Environmental	Effectiveness	Efficiency	Coherence
Empower consumers to generate, self-consume and store renewable electricity						
Option 0 - No EU intervention	0	0	0	0	0	0
Option 1 - EU guidance on self -consumption	+	-	-	-	-	+
Option 2 - Empower citizens to self-consume and store renewable electricity	++	-	+	+	+	0
Option 3 - Distance self-consumption for municipalities	++	-/---	+	++	0	0
Disclosing information for renewable electricity						
Option 0 - BASELINE	0	0	0	0	0	0
Option 1 - Improve functioning of GO system	+	0	+	+	+	
Option 2 - Option 1 plus GOs mandatory for disclosure	++	+	+	++	+	
Option 3 - Option 2 plus extend GOs to all sources of electricity generation	++	-	+++	++	-	
Tracing renewable fuels used in heating and cooling and transport						
Option 0 - BASELINE	0	0	0	++		
Option 1 – Extend GOs to renewable gaseous fuels	++	+	+	+		
Option 2 – Extend GOs to renewable liquid and gaseous fuels	+	+	++	+		
Option 3 - Develop alternative tracking system for renewable liquid and	+	+++	+++	+		

gaseous fuels	
+,++,+++ : positive impact (from moderately to highly positive) *0 : neutral or very limited impact* *-, --, --- : negative impact (from moderately to highly negative)*	

5.5. Options to ensure the achievement of at least 27% renewable energy in 2030

The table below summarizes the group of options that are discussed in this section.

Challenges	Drivers	Policy Options
Baseline of 2020 targets	Uncertainty around individual MS contributions to EU level RES target Current policy framework & monitoring designed for national targets, not collective attainment	0. BASELINE - 2020 targets lapse 1. Make 2020 national targets the basis for further increases in RES through to 2030
EU Trajectory 2021 - 2030 for achievement of the EU renewables target	Uncertainty around individual MS contributions to EU level RES target Current policy framework & monitoring designed for national targets, not collective attainment	0. BASELINE- No trajectory 1. Linear trajectory towards the 2030 target 2. Non-linear trajectory towards the 2030 target
Mechanism to avoid an "ambition gap" to the EU renewables target	Uncertainty around individual MS contributions to EU level RES target Current policy framework & monitoring designed for national targets, not collective attainment	0. BASELINE - No EU mechanism 1. Require Member States to revise ambition of national plans under the Energy Union Governance 2. Include a review clause to propose additional EU level delivery mechanisms at a later stage 3. Increase the ambition of proposed EU wide measures or introduce additional EU wide measures 4. Introduce binding national targets

Mechanism to avoid and fill a "delivery gap" to the EU renewables target	Uncertainty around individual MS contributions to EU level RES target Current policy framework & monitoring designed for national targets, not collective attainment	0. BASELINE - No EU mechanism 1. Require Member States below their pledge level to revise the delivery of their plan under the Energy Union Governance 2. Include a review clause to propose additional EU level delivery mechanisms at a later stage 3. Increase the ambition of EU wide measures proposed in the legislation 4. Introduce binding national targets

5.5.1. *Baseline of 2020 targets*

Option 0	Option 1
• BASELINE - 2020 targets lapse	• Make 2020 national targets the basis for further increases in RES through to 2030

➢ ***Option 0:*** *BASELINE*

The 2020 national targets lapse from 2021 onwards. The existing legislation encourages Member States to increase their share of renewable energy beyond the 2020 target, but it contains no requirement that they provide a minimum floor for national renewables policy.

➢ ***Option 1:*** *2020 national targets as basis for further increases*

The 2020 national targets will be mandatory as a floor for the period 2021 to 2030 in line with the collective efforts needed. They would therefore provide a clear threshold for which the national share of renewables could not fall below. These thresholds would need to be reflected in the requirements for Integrated National Energy and Climate Plans set out under the Energy Union Governance.

This would mean that the co-operation mechanisms contained in the current Directive would need to continue. These mechanisms provide flexibility in the ways in which Member States can meet their target similarly to the non-ETS sector flexibility.

5.5.1.1. Introduction to the assessment

As there are no national targets after 2020, a key question is what should be the status of these targets in period up to 2030. Two options are under consideration, either allowing the targets to lapse, or continuing the targets as a backstop through to 2030.

The question on whether the 2020 Member State specific target should be considered as the minimum renewables share to be achieved by all Member States over the 2020-2030 period can be illustrated by looking at the EU Reference Scenario results.

In the 2016 EU reference scenario, Member States are assumed to achieve their binding 2020 target (including through use of cooperation mechanisms), and no dedicated additional policies are modelled post-2020. The results show that for all but one Member State, the renewables share in 2025 is projected to increase compared to 2020 levels. This means that as long as Member States make sufficient efforts to reach their 2020 targets, it should be possible without excessive additional cost to at least maintain this share post-2020. Some investments will still need to take place, as illustrated by the table below. However, the modelling suggests that such investments could take place without additional dedicated policy intervention in terms of support schemes.

This impact assessment uses the EU Reference Scenario 2016 as the starting point for projecting renewable energy shares in 2020 for each Member State, on the basis of the overall legal obligation for each Member State to reach their 2020 national target. This implies that for a number of countries an acceleration of RES deployment before 2020 is needed. Without this accelerated deployment, there might be a risk that some Member States would fall below their 2020 targets. In the situation where some Member States would not reach their 2020 target, the extra effort needed for meeting the EU 2030 target would be even larger.

Table 13: Investments in renewables required under REF2016

Investment indicators (2030)	**Ref2016**
Investment expenditures in renewables (average annual 2021-2030 period)	14516
Investment expenditures in wind (average annual 2021-2030 period	9324
Investment expenditures in solar (average annual 2021-2030 period	4406
Investment expenditures in biomass-waste (average annual 2021-2030 period	527

Source: PRIMES

5.5.1.2. Detailed assessment

Economic impacts

The economic impacts of retaining the target could be positive relative to the alternative option of no obligation in that regard. The 2020 targets are already mandatory under EU law, so this policy provides more certainty to investors that renewables policies in Member States will need to be sustained. Lower policy risk could reduce the cost of capital for new renewables investment relative to a scenario where the targets disappear. Lower cost of capital provides a better investment climate for renewables, so could help create a virtuous circle of higher levels of investment. Improving the overall cost effectiveness of achieving our renewable energy goals. Not retaining any obligation in this regard might disincentive Member States to meet their 2020 targets if they know that efforts will not need to be sustained post-2020.

Social impacts

The social impact of the policy options are expected to be limited. There should be limited distributional impact between consumers from the two options.

Environmental impacts

The environmental benefits of the retaining the target are better than having no carry-over of the target. This is because it provides a stronger guarantee as the level of renewable energy that will be produced in the EU. Not carrying over the target risks a lower level of renewables and an associated reduction in environmental benefits. Emissions of greenhouse gas emissions and local air quality pollutants could be higher under this scenario, especially if the renewable energy was displaced by fossil fuels.

Political feasibility /opportunity

The 2020 targets have been agreed politically, so continuation of the targets beyond 2020 as a baseline should be acceptable to most parties. It should also provide a mean to transition from the old system of national targets to the EU wide target approach, helping overcoming political concerns from some quarters that the new approach will not be as robust. In addition, this measure is needed to ensure that 2020 targets are fully met as reconfirmed by the European Council in October 2014.

Other impacts (markets, innovation…)

The option of keeping the 2020 target as a baseline should provide more market certainty to investors as it provides assurance that national policies in place to deliver the 2020 targets will be sustained for some years afterwards. It may also benefit SMEs which are active in the renewable energy market.

5.5.2. EU Trajectory 2021 - 2030 for achievement of the EU renewables target

Option 0	Option 1	Option 2
• BASELINE- No trajectory	• Linear trajectory towards the 2030 target	• Non-linear trajectory towards the 2030 target

➢ ***Option 0:*** *BASELINE*

This option would mean that there would be no trajectory at EU level for the EU renewables target from 2021 to 2030. Such an outcome would make tracking progress towards the 2030 target difficult and it would mean that little if any advance action could be taken to ensure that the target is achieved.

➢ ***Option 1:*** *Linear trajectory*

A simple linear EU trajectory would be set out in the Revised RES Directive as a means to track progress across all Member States in increasing from 20% renewables in 2020 through to at least 27% renewables in 2030.

- ***Option 2:*** *Non-linear trajectory*

A more complex non-linear EU trajectory is developed as part of the Revised RES Directive following the iterative process with Member States through their integrated national energy and climate plans for the Energy Union Governance. This would probably result in less renewable energy being needed to be added in the early part of the decade, with more coming on stream closer to 2030.

5.5.2.1. Introduction to the assessment

The simplest option would be to have no overarching EU trajectory for the target from 2021 to 2030. However, such an option would make monitoring progress towards achievement of the 2030 target very difficult, as there would be no way of assessing if the EU is on track towards the target. Any additional measures that should be implemented to ensure target achievement would therefore be back loaded and implemented after 2030 data has been collated. This could make achieving the target in 2030 very difficult to ensure.

A fixed EU wide trajectory would help with monitoring progress and enable appropriate rectifying measures to be implemented. The potential trajectory towards reaching the 27% target is available in PRIMES for a five year period. The projected evolution in the share of renewable energy across the whole of the EU shows quite a linear increase. In fact, total EU renewable energy is projected to increase by 14% between 2020 and 2025 in EUCO27 (14% in EUCO30) and by 12% between 2025 and 2030 (13% for EUCO30). This suggests that there is no real need to consider an exponential increase in renewables developments towards the end of the period, as was done in the RES Directive. There are sufficient mature technologies available for the gradual uptake of renewable energy in the early 2020s, in line with the achievement of the 2030 target.

5.5.2.2. Detailed assessment

Economic impacts

Setting out an EU wide trajectory for achieving the 2030 targets is likely to have positive economic impacts. It will provide greater certainty to the renewable energy industry as to the likely build out of new renewable energy capacity. Providing a long term signal on capacity needs reduces uncertainty and increases investor confidence. It should enable longer term investment decisions to be made due to the lower risk of change. Such signals could be important in driving down the cost of deploying certain types of renewable energy, where economies of scale are important.

A linear trajectory should have more positive impacts compared to a non-linear trajectory that results in an acceleration of capacity in later years. The linear approach will result in a more consistent stream of investment across the time period, rather than back loading it to a later point in time. The linear trajectory should help bring forward investments that have the opportunity to reduce the levelised cost of energy, so result on cost reductions sooner than with a non-linear approach.

Social impacts

The social impacts of the EU wide trajectory options are likely to be limited. There should be limited distributional impacts on consumers. A trajectory may have positive benefits to consumers if it results in more stable renewable energy policies and reduces risks of significant change close to 2030 compared to the option of no trajectory. Similarly, the linear approach may be better if it provides a more consistent framework than a non-linear approach that results in more activity closer to 2030.

Environmental impacts

Providing a trajectory should result in environmental benefits as it provides more certainty to the build out of new renewable energy capacity. The linear trajectory should have high environmental benefits than a back loaded trajectory as it introduces low emission energy technologies to the EU at an earlier point in time.

Political feasibility /opportunity

Defining an EU wide trajectory should help Member States in preparation of national commitments as it will provide a consistent signal by which progress can be measured. It should result in adjustments being made to national renewables policies at various stages through to 2030, rather than risk a lot of changes towards the end of the period.

The linear EU wide trajectory should be politically feasible as compared with the 2020 target, renewable energy technologies are mature, so there is little benefit from a steeper trajectory close to 2030.

Other impacts (markets, innovation…)

As with the analysis of the economic impacts, the trajectory approach should be beneficial for renewable energy companies. It should be beneficial for small and medium sized enterprises active in the market.

Overall, the option of not defining an EU wide trajectory does not look very attractive as it will make monitoring progress towards the 27% target more subjective. The risk of undershooting the target is therefore higher.

5.5.3. Mechanism to avoid an "ambition gap" to the EU renewables target

Option 0	Option 1	Option 2	Option 3	Option 4
• BASELINE - No EU mechanism	• Require Member States to revise ambition of national plans under the Energy Union Governance	• Include a review clause to propose additional EU level delivery mechanisms at a later stage	• Increase the ambition of proposed EU wide measures or introduce additional EU wide measures	• Introduce binding national targets

➢ ***Option 0:*** *BASELINE*

The existing legislation related to the Energy Union Governance and renewable energy has no relevant provisions for this issue. This option would therefore be that no action is taken in response to a gap in ambition, either under the Energy Union Governance process or the Renewable Energy Directive.

➢ ***Option 1:*** *Revise ambition of national plans*

This option would implement, as foreseen by the initiative on Energy Union Governance, a dedicated iterative process of review by the Commission of draft national plans and subsequent resubmission by Member States. This process would include resubmission of revised national contributions on renewables so that the EU wide target can be collectively met. This option could include criteria for Member States to apply when developing their contributions to the renewables target in their national plans.

➢ ***Option 2:*** *Review clause to propose additional EU level delivery mechanisms at a later stage*

This option would build on Option 1 with the additional inclusion of a review clause to be included in the Revised RES Directive to support the governance process. The clause would state that a review would be carried out by the Commission after the national plans have been finalised in order to assess if additional measures are needed to correct any remaining ambition gap. As a result of the review, if it was decided necessary, additional EU-level delivery mechanisms would be proposed by the Commission.

➢ ***Option 3:*** *Increase the ambition of EU wide measures*

This option would also build on Option 1 and seek to address any remaining ambition gap after finalisation of the national plans through measures contained in the Revised RES Directive:

(i) further use of EU wide measures contained in the Directive (*e.g.* obligations developed for transport and heating and cooling, respectively) or

(ii) specific measures developed especially for filling any ambition gap (*e.g.* EU wide auctions for renewable electricity support based on an EU-level fund financed by Member States contributions replacing the need to comply with measures under (i) above as a further flexibility, or a supplier obligation for renewable electricity).

The ambition level of these measures would be automatically increased to fill any resulting gap to the target that can be seen after the national plans have been finalised. A means of distributing the required increase in ambition between the measures applying to electricity, transport and heating/cooling would need to be defined. For any measure involving EU funding, provision would need to be made under the MFF.

➢ ***Option 4:*** *Introduce binding national targets*

This option would build on Option 1 by addressing any remaining ambition gap through the introduction of binding national targets for renewable energy in 2030 consistent with the EU-level target of 27%.

5.5.3.1. Introduction to the assessment

The default option would be to have no mechanism in place for avoiding the ambition gap. This would mean that there would be no action taken if Member State policies commitments are insufficient to deliver the 2030 target. In effect the result would be that the at least 27% renewable energy target would be aspirational rather than mandatory.

The Energy Union Governance process will be an important foundation for achieving the renewables target. It is likely to result in a review process of national plans and one iteration to be completed by 2019 to improve the ambition of the plans. This review should provide a useful first step in avoiding a gap emerging. However, there is no guarantee that such a process will definitely deliver the EU wide renewables target; it is still possible that an ambition gap remains once this has been completed. In this case, further measures may need to be considered.

In order to provide correct incentives for the national commitments and to strengthen the effectiveness of the governance process, the revision of the RES Directive could include criteria for Member States to use when developing their contributions to the renewables target in their national plans and/or potentially including a formula to calculate those. They could provide a means of assessing the relative level of ambition of each national plan and contribute to ensure a cost effective and equitable outcome of the process.

A further option would be to have a review clause in the Revised RES Directive that requested the Commission to come forward with a proposal for corrective measures in the event that a gap is detected once the plans produced in the governance process are complete. The impact of such an option is difficult to assess at this stage, as it is not clear as to what type of measures would be proposed and then agreed by the co-legislators. Furthermore, there could be some time lag between detecting an ambition gap, then developing, negotiating and implementing corrective measures. In this case such a mechanism may only come into effect some years after the national plans have been finalised by the governance process so its applicability and effectiveness for solving an ambition gap is unclear.

There are additional gap filling measures that could be implemented in the Renewable Energy Directive in the event of such an ambition gap emerging from the Energy Union governance process. One option would be to automatically increase the impact of any EU wide policy measures contained in the Revised RES Directive according to a formula set out in the legislation. For example, this could include increasing the level of EU wide measures for heating and cooling as well as transport. Additional finance could be considered to invest in electricity generation capacity, however a source of finance would need to be identified either coming from the EU budget or through mechanisms allowing Member States to contribute. If such a mechanism is to involve EU budget, then this would need to be discussed under the framework of the preparations for the next MFF.

In addition, this option could also be designed to implement specific policy instruments developed purely for filling the ambition gap. This could include for example an EU fund to tender renewables support for new electricity generation. Such measures could in principle be relatively cost effective if they focus on the lowest cost forms of renewable energy generation. However, such a mechanism is dependent on funding being made available to ensure that it can function appropriately.

An alternative option to having gap filling instruments would be to return to a system of binding national targets for Member States. This would ensure target achievement. However, the political agreement was not to have national targets in 2030 so this option does not seem a viable solution.

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. Table 14 illustrates the overall renewables shares across all Member States for a range of different scenarios based on modelling together with those emanating from the application of different criteria for Member States to use when developing their contributions to the renewables target in their national plans (using the RES Directive method and an alternative approach).

Table 14: Renewables shares per Member State under various criteria

	2020 Target	REF2016	EUCO27	RED-I method (50% flat rate, 50% GDP)	Alternative method 50% flat rate, 25% GDP & 25% land area
Belgium	13	16	17	19	18
Bulgaria	16	28	31	22	25
Czech Republic	13	15	18	19	19
Denmark	30	39	44	38	38
Germany	18	21	23	26	24
Estonia	25	28	31	30	34
Ireland	16	18	22	25	25
Greece	18	30	34	26	28
Spain	20	27	31	28	28
France	23	26	26	30	30
Croatia	20	25	28	27	30
Italy	17	24	28	25	24
Cyprus	13	18	20	20	21
Latvia	40	42	46	47	54
Lithuania	23	25	27	30	34
Luxembourg	11	8	10	18	17
Hungary	13	14	15	19	20
Malta	10	13	14	19	17
Netherlands	14	16	16	21	19
Austria	34	37	41	41	41
Poland	15	18	20	21	22
Portugal	31	38	42	39	40
Romania	24	30	33	31	34
Slovenia	25	28	30	31	32
Slovak Republic	14	15	16	20	20
Finland	38	49	53	44	49
Sweden	49	61	66	55	60
United Kingdom	15	17	20	23	22
EU	**20**	**24**	**27**	**27**	**27**

The impacts of the options may vary depending on the reason for the gap in the first place and the way in which it is corrected. For example, if the gap is due to a reduced level of investment in renewable electricity than originally projected, then the gap filler could have an impact if it results in corrective measures elsewhere, such as shifting the burden to heating and cooling and also to transport. There may also be cost implications if for example the EU measure in transport focuses on advanced renewable fuels which are generally more expensive than other forms of renewable energy. Increasing such a mandate would therefore increase the cost of achieving the target.

From an administrative perspective, the options increasing the EU wide obligations may be simplest. They are legal provisions that require no finance. Finance for any such gap filler would need to be identified for such a measure to be realistic.

5.5.3.2. Detailed assessment

Economic impacts

The options that are most likely not to correct the ambition gap should result in the largest economic impact on the renewable energy industry, as volumes of investment will be lower than anticipated.

There are economic impacts associated with the ineffective gap filling measures. Lower than forecast levels of renewable energy could have economic impacts in terms of likely reductions in energy security, increases in import dependency and a lower rate of decarbonisation.

The impact of the individual options are difficult to distinguish at this stage as it is not clear precisely how some options would operate in practice and which exact measures would be introduced. With the option that involves automatic increase in the stringency of EU-wide measure, then the specific economic impacts would be those associated with the measure in question.

Social impacts

All of the options under consideration should have limited social impacts. If successfully implemented, all of the options should be able to ensure that the EU remains on track to achieve its 2030 targets. The social impact of the precise policy measures may vary, however these are discussed in other sections of the document.

The social impact may be greatest from any options that result in the ambition gap not being corrected. In this case, lower renewable energy than anticipated would be produced, with associated impacts on energy imports, security of supply and a slower rate of decarbonisation. All of these factors could have negative social impacts.

Environmental impacts

The biggest environmental impact will come from ensuring that the at least 27% renewable energy target is delivered. Divergences from the target will have environmental impacts as energy will be sourced from other sources, so this will result in an increase in emissions when the other sources include fossil fuels. The most stringent options (such as Option 4) are likely to have the smallest negative environmental impact.

Political feasibility /opportunity

Regarding ambition level, it is worth noting that a number of Member States (such as France, Germany and Sweden) have introduced ambitious binding targets in national legislation for the period after 2020.

Option 4 which introduces national targets in event of an ambition gap, is not considered politically feasible given the move away from such targets in the 2030 climate and energy framework.

Furthermore, option 3 that could rely on EU financing does not seem feasible in advance of discussions over the EU budget. These options could also comprise of increasing the stringency of EU wide measures agreed in the Directive. It is not clear yet that increasing the stringency of such measures will be feasible at this stage.

Other impacts (markets, innovation…)

There are no specific impacts on SMEs apparent with these options.

Overall, the Option 0 and Option 4 cannot be considered favoured options. Option 0 would provide no means of ensuring that the EU wide renewable energy target is met, while Option 4 includes national targets that have been rejected politically.

5.5.4. Mechanism to avoid and fill a "delivery gap" to the EU renewables target

Option 0	Option 1	Option 2	Option 3	Option 4
•BASELINE - No EU mechanism	•Require Member States below their pledge level to revise the delivery of their plan under the Energy Union Governance	•Include a review clause to propose additional EU level delivery mechanisms at a later stage	•Increase the ambition of EU wide measures proposed in the legislation	•Introduce binding national targets

➢ ***Option 0:*** *BASELINE*

The existing legislation related to the Energy Union Governance and renewable energy has no relevant provisions for this issue. This option would therefore be that no action is taken in response to a delivery gap.

➢ ***Option 1:*** *Revise delivery of national plans*

This option would implement, as foreseen by the planned initiative on Energy Union Governance, a dedicated iterative process of the Commission reviewing Member States' integrated national energy and climate progress reports. Under this approach, a Member State would be legally required to implement revised policies and measures on renewables if it was below the trajectory it originally planned to achieve. The requirement would need to be defined in such a way that any updated plan and revised policies should make good any previous under delivery so as to ensure that the original pledge is met.

➢ ***Option 2:*** *Review clause to propose additional EU level delivery mechanisms at a later stage*

This option would comprise a review clause to be included in the Revised RES Directive. This clause would require that a review of progress in delivering national plans would be carried out after 5-7 years in order to assess if additional measures are needed to correct any delivery gap. The timing of the review should be aligned with the governance cycle of the Energy Union. As a result of the review, if it was decided necessary, additional EU-level delivery mechanisms to correct the delivery gap would be proposed by the Commission.

- ***Option 3:*** *Increase the ambition of EU wide measures*

This option would address the delivery gap through measures contained in the Revised RES Directive, such as:

(i) further use of EU wide renewables measures contained in the Revised RES Directive (*e.g.* obligations developed for transport and heating and cooling, respectively) or

(ii) specific measures especially for filling any delivery gap (*e.g.* EU wide auctions for renewable electricity support based on an EU-level fund financed by Member States contributions replacing the need to comply with measures under (i) above as a further flexibility, or a supplier obligation for renewable electricity).

The ambition level of these measures would be automatically increased to fill any emerging gap. A means of distributing the required increase in ambition between the measures applying to electricity, transport and heating/cooling would need to be defined. It may also be appropriate to vary the intensity of the increase in the measures between Member States to avoid incentives for free riding. For any measure involving EU funding, provision would need to be made under the MFF.

- ***Option 4:*** *Introduce binding national targets*

This option would address the delivery gap through the introduction of binding national targets for renewable energy in 2030 consistent with the EU-level target of 27%.

5.5.4.1. Introduction to the assessment

The Energy Union Governance process will be central for detecting any delivery gap. The possibility of delivery gap arising would be measured periodically under the reporting made for the Energy Union Governance process. In the event that a gap is detected, there are a number of possible options for dealing with this.

If no action were to result, the gap would persist. This would risk achievement of the binding 2030 target.

The Energy Union Governance process will provide a first check on the situation. This process is still to be agreed politically so it is uncertain as to what exactly it will comprise. However there should be an assessment every 2 years and recommendations would be made if any gaps in delivery are apparent. If following the recommendations there remains insufficient collective action to correct the gap, further provisions in the Revised RES Directive could be considered.

A further option would be to have a review clause in the Revised RES Directive that requests the Commission to come forward with a proposal for corrective measures in the event that a gap is detected. The impact of such an option is difficult to assess at this stage, as it is not clear as to what type of measures would be proposed and then agreed by the co-legislators. Furthermore, there could be some time lag between detecting a delivery gap, then developing, negotiating and implementing corrective measures. In this case such a mechanism may only come into effect close to the target achievement date and provide little time to correct any under achievement.

As discussed in the context of the ambition gap, the delivery gap could also be corrected by an increase in magnitude of EU wide measures, specific EU measures or binding national targets. In such a case similar considerations apply as in the section above on ambition gap measures. Therefore a series of specific measures contained in the Revised RES Directive could provide a meaningful response.

A key issue for the design of the legislation is how to provide sufficient incentives for continued delivery of national commitments and also sufficiently ambitious pledges in the first instance. Without correct incentives there is a risk of free riding by Member States, who may choose to do little and instead rely on the efforts of others. The revised Renewables Directive could include criteria or formula for Member States to use when developing their contributions to the EU renewables target in their national plans in order to provide a positive incentive framework.

A positive incentive could be provided for high national commitments, by introducing a system that in the case of failure to deliver of one Member State against a high commitment results in corrective measures being applied across the EU. On the contrary, a delivery gap that emerges in relation to a low initial national commitment would result in corrective measures being applied in that Member State only. In such a system, the criteria (and/or formula) selected for Member States to use when developing their contributions to the EU renewables target in their national plans would be used to assess the ambition level of the initial commitment. This would help to determine which type of corrective measures should apply.

Gap filling measures based on EU finance would need to be structured so that there is no incentive for Member States to have less ambitious plans. Reliance on such measures may be limited under the Directive as there is no guarantee at this stage that suitable EU budget will be available.

5.5.4.2. Detailed assessment

Economic impacts

There are economic impacts associated with the ineffective gap filling measures. Lower than forecast levels of renewable energy could have economic impacts in terms of likely reductions in energy security, increases in import dependency and a lower rate of decarbonisation than is cost-effective in meeting the EU's climate and energy objectives.

The impact of the individual options are difficult to distinguish at this stage as it is not clear precisely how some options would operate in practice and which exact measures would be introduced. With the option that involves automatic increase in the stringency of EU-wide measure, then the economic impacts would be those associated with the measure in question.

Social impacts

All of the options under consideration should have limited social impacts. If successfully implemented, all of the mechanisms should be able to ensure that the EU remains on track to achieve its 2030 targets. The social impact of the precise policy measures may vary, however these are discussed in other sections of the document.

The social impact may be greatest from any options that result in the delivery gaps not being corrected. In this case, lower renewable energy than anticipated would be produced, with associated impacts on energy imports, security of supply and a slower rate of decarbonisation. Factors which all could have negative social impacts.

Environmental impacts

The most significant environmental impact will result from options that do result in any delivery gap being corrected. Not achieving the 2030 renewable energy as planned would result in increased emissions from other energy sources. This would include both greenhouse gas emissions and local air quality pollutants if less renewable energy production results in increased use of fossil fuels.

It is difficult to distinguish significant differences between the options if they all meet the objective of correcting the delivery gap. The stronger the gap filling measure is, the more certainty there is that the environmental impact will be positive. Options that are less certain risk a high environmental impact.

Political feasibility /opportunity

The option related to reintroducing national targets does not seem feasible politically. This is because the whole structure of the 2030 climate and energy targets is for no national targets for renewables should be included.

The option that involves automatic introduction of enhanced EU measures could also be politically difficult, as it involves activation of new mechanisms and instruments at the EU level.

Other impacts (markets, innovation…)

There are no specific impacts on SMEs apparent with options under consideration.

Overall, Option 0 and Option 4 cannot be considered favoured options. Option 0 would provide no means of ensuring that the EU wide renewable energy target is met, while Option 4 includes national targets that have been rejected politically.

5.5.5. Overall comparison of the options to ensure the achievement of at least 27% renewable energy in 2030

	Overall impact			Key objectives		
Policy option	Social	Economic	Environmental	Effectiveness	Efficiency	Coherence
Baseline of 2020 targets						
Option 0 - BASELINE	0	0	0	0	0	0

Option 1 - 2020 national targets as basis for further increases	0	+	+	++	++	++
EU Trajectory 2021 - 2030 for achievement of the EU renewables target						
Option 0 - BASELINE	0	0	0	0	0	0
Option 1 - Linear trajectory	++	++	++	++	+	++
Option 2 - Non-linear trajectory	+	+	+	+	++	+
Mechanism to avoid an "ambition gap" to the EU renewables target						
Option 0 - BASELINE	0	0	0	0	0	0
Option 1 - Revise ambition of national plans	+	+	+	0	0	0
Option 2 - Increase the ambition of EU wide measures	+	++	++	++	+	++
Option 3 - Introduce binding national targets	+	++	++	++	+	+
Mechanism to avoid and fill a "delivery gap" to the EU renewables target						
Option 0 - BASELINE	0	0	0	0	0	0
Option 1 - Revise national plans	+	+	+	0	0	0
Option 2 - Include review clause to propose additional EU level delivery mechanisms at a later stage if needed	+	+	+	0	0	0
Option 3 - Increase the ambition of EU wide measures	+	++	++	++	+	++
Option 4 - Introduce binding national targets	+	++	++	++	+	+
+,++,+++ : positive impact (from moderately to highly positive) ***0 : neutral or very limited impact*** ***-, --, --- : negative impact (from moderately to highly negative)***						