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PART 1/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council

amending Directive 2012/27/EU on Energy Efficiency

{COM(2016) 761 final}
{SWD(2016) 406 final}

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Glossary of acronyms and abbreviations

CA EED	Concerted Action of the Energy Efficiency Directive
CEPPI	Coordinated energy-related PPI actions for cities
CHAP	Central registry for complaints and enquiries
Commission	European Commission, unless specified otherwise
DG	Directorate-General
Directive	Energy Efficiency Directive, unless specified otherwise
EcoDesign	EcoDesign Directive (2009/125/EC)
EE	Energy efficiency
EEA	European Economic Area
EEC	Energy Efficiency Calculation Tools
EED	Energy Efficiency Directive (2012/27/EU)
EEOS	Energy efficiency obligation scheme
Energy Labelling	Energy Labelling Directive (2010/30/EU)
EPBD	Energy Performance of Buildings Directive (2010/31/EU)
ESCOs	Energy services companies
ESD	Effort Sharing Decision (DECISION No 406/2009/EC)
ESIF	European Structural and Investment Funds
ETS	Emissions Trading System
EU PDA	EU Project Development Assistance
FI	Energy agency or regulator
GRASP	Growth and sustainability policies for Europe
H2020	Horizon 2020
ICT	Information and Communication Technologies
IEM	Internal Energy Market legislation
Ktoe	kilotonnes of oil equivalent
MS	Member State(s)
MSR	Market Stability Reserve under the ETS
Mtoe	Million tonnes of oil equivalent
M&V	Monitoring and verification
NEEAP	National Energy Efficiency Action Plan
NZEB	Nearly Zero Energy Building
RAP	Regulatory Assistance Project
RES	Renewable Energy
RES Directive	Renewable Energy Directive
SME	Small- and medium-sized enterprise
SWD	Staff Working Document
TCO	Total Costs of Ownership

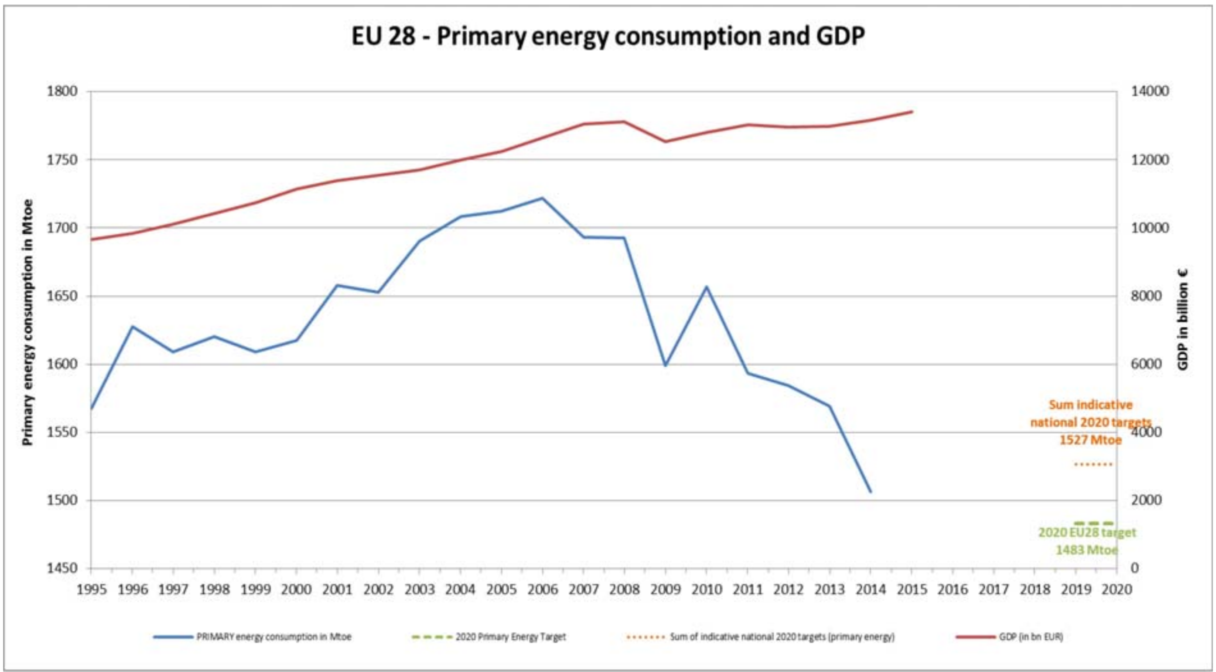
1 What is the problem and why is it a problem?

1.1 Scene setter

The Energy Union and the Energy and Climate Policy Framework for 2030 establish ambitious EU commitments to further reduce greenhouse gas emissions (by at least 40% by 2030 compared to 1990), to increase the share of renewable energy consumed (to at least 27%), and to save at least 27% energy and to review this level "having in mind an EU level of 30%"[1], to increase Europe's energy security, competitiveness and sustainability. In December 2015 the European Parliament voted for a "40% energy efficiency target; emphasised that the post-2020 EU energy efficiency target should be binding and implemented through individual national targets […]"[2].

The EU is already achieving significant energy efficiency progress. Although the decline in energy consumption can to a certain extent be attributed to the economic crisis and its aftermath of restrained production and freight transport activity, EU energy efficiency policies have played a more significant role in decoupling economic activity from energy consumption since 2006 (see decomposition analysis for the period 2005-2014 in Annex 5).

Figure 1: Primary energy consumption in EU28[3]



Source: Eurostat

A similar trend is observed on the global level. According to the International Energy Agency (IEA), energy efficiency improvements in IEA countries accelerated considerably since 2000 and generated enough energy savings to power Japan for a full year. Even in the context of

[1] EUCO 169/14, CO EUR 13, CONCL 5, Brussels 24 October 2014.
[2] European Parliament P8_TA-PROV(2015)0444.
[3] A graph on final energy consumption can be found in Annex 5.

lower energy prices, global energy intensity improved by 1.8% in 2015. While GDP grew by 2% in IEA countries, efficiency gains led to the flattening of growth in primary energy demand. IEA countries saved an average of 490 USD per capita in energy expenditure in 2015 as a result of energy efficiency improvements since 2000[4].

However, besides the multiple benefits of energy efficiency, the level of investment in energy efficiency in Europe is still below its economic potential[5]. Energy efficient investments with a payback time of four or five years are often not undertaken in the private and public sectors. Market and behavioural barriers (see Annexes 4 and 6) hinder consumers from taking up energy efficiency measures, which would lower their energy bills and would bring other benefits for the whole society e.g. health, environmental and economic improvements.

EU energy efficiency policies and strategies focus on correcting market and regulatory failures (see Annex 3). This serves to realise energy saving potentials by triggering economically viable investments, which do not take place because of market or regulatory barriers or failures. The current 2020 energy efficiency framework is based on mutually reinforcing instruments:

1) An overall drive for a decrease in energy consumption, via the establishment of an EU **headline target** to give public and private actors confidence that this is a sector worth investing in. An indicative EU 2020 energy efficiency target was set in 2007 underpinned by indicative national targets notified in 2013 (under Articles 1 and 3 of Directive 2012/27/EU on energy efficiency[6] (EED)) [7].

2) EU policies to speed up the **rate** at which people and businesses choose to upgrade the energy performance of their buildings, systems and appliances (Article 7 of the EED and financing through European funds and assistance projects). These polices bring more energy efficient products to be traded in the **internal market**.

3) Minimum performance requirements (**depth of the upgrading**) for new buildings, buildings which undergo a major renovation, new appliances and new vehicles (Directive 2010/31/EU on the energy performance of buildings[8] (EPBD), eco-design and CO_2 standards for vehicles). Energy efficiency is an enabler for economic modernisation.

4) **Information** for consumers and industry – labels for products, certificates for buildings and consumer rights for metering and billing – to enable them to choose the

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[4] International Energy Agency (2016): Energy Efficiency Market Report 2016 (see http://www.iea.org/publications/freepublications/publication/mediumtermenergyefficiency2016.pdf).

[5] Energy Efficiency Financial Institutions Group (EEFIG) Final Report, February 2015 (see https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report%20EEFIG%20v%209.1%2024022015%20clean%20FINAL%20sent.pdf) and COMMISSION/DG ECFIN, Note to the Economic Policy Committee Energy and Climate Change Working Group (19 April 2016): INVESTMENT IN ENERGY EFFICIENCY BY HOUSEHOLDS.

[6] Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ L315/1 of 14 November 2012.

[7] Article 1 of the EED establishes the Union's 2020 20% headline target on energy efficiency and Article 3 of the EED specifies that this equals a primary energy efficiency consumption of not more than 1483 Mtoe or final energy consumption of no more than 1086 Mtoe in 2020.

[8] Directive 2010/31/EU on the energy performance of buildings, OJ L153/13 of 18 June 2010.

efficiency level that is right for them (Energy labelling, EPBD, Articles 8 and 9-11 of the EED).

5) **Research and innovation** particularly through the Strategic Energy Technologies Plan, to bring down the cost of key technologies that are currently technically but not economically viable and to bring them to the internal market.

1.2 What is the problem?

The problem for energy efficiency policy in general is that, because of market and regulatory failures, large amounts of cost-effective investments in energy efficiency will not take place. This will lead to a **level of energy consumption in 2030** which is not in line with the agreement of the European Council of October 2014 (at least 27% reduction compared to 2007 baseline[9]) and the Energy Union ambition and which does not achieve the multiple benefits related to lower energy consumption in 2030. This level is also not in line with the EU's ambition for decarbonisation by 2050 as all decarbonisation scenarios rely on a significant share of energy efficiency[10].

This **insufficient progress in energy efficiency holds back the full benefits** of lowering Europeans' energy bills, reducing Europe's reliance on external suppliers of oil and gas, helping protect the environment and mitigating emissions with negative health impacts such as particulate matter and NO_2[11]. In addition, the full potential of positive economic and employment impacts of local energy efficiency investments and decarbonising the economy remains unexploited.

Well-documented market failures and regulatory barriers include:

- Information failures;
- Split incentives;
- Short investment horizons in both companies and households;
- Lack of awareness of the "business case behind energy efficiency investments";
- High transaction costs for small projects;
- Capital market failures[12]; and
- Lack of clear signals for companies to become actors in an energy efficiency market.

[9] 2007 Baseline modelled with PRIMES energy system model projected for 2030 primary energy consumption reaching 1887Mtoe and final energy consumption 1416 Mtoe.

[10] COM(2011) 885 final.

[11] Energy efficiency is key to lowering fuel consumption. If the heat demand in housing is reduced, less fossil fuel or biomass is required for domestic heating thus lowering direct emissions of air pollutants. If more efficient electric appliances are used, less power has to be supplied by fossil fuel or biomass fuelled power plants, thus also lowering emissions. This will help reach compliance with EU air quality limit values and National Emission Ceilings, in line with the objectives of the Clean Air Policy Package (COM(2013)918 final).

[12] These have been reinforced by the short-term effects of the crisis can be summarized in two points: a progressive fragmentation of the euro area financial system, and the growing reluctance of European banks to finance high-risk investment due to the processes of deleveraging and the introduction of stricter capital and liquidity requirements.

Existing energy efficiency legislation at EU level already addresses parts of these failures. E.g. the EPBD, via Energy Performance Certificates, provides transparency with regard to the energy use of a building for a future tenant or the owner to address information failures. In addition, it provides an incentive for the owner to invest in energy saving opportunities as those investments are reflected in the rating and, often, in the rental or sale value.

Articles 7 (energy saving obligations and alternatives) and 18 of the EED create business cases for companies providing energy efficiency services. The two central failures that energy saving obligations can tackle are high transaction costs and the lack of clear signals for companies to become actors in an energy efficiency market. Without a specific regulatory signal e.g. to energy suppliers, it is difficult to imagine how one of them would be induced to help its customers to save energy and thus ultimately buy less of its services. When such an obligation is generalised and the costs of energy efficiency investments supported by the public budget/passed on to the consumer, electricity and gas suppliers can become an active agent in the transition towards a more efficient and decarbonised economy.

Against this background, this Impact Assessment tackles **three specific problems**:

1) The **need to identify the level of energy efficiency ambition for 2030** as well as its character (binding or non-binding) in order to fulfil the political mandate given by the European Council and by the European Parliament. The need for an explicit energy efficiency target for 2030 has already been agreed by the European Council and the European Parliament. The European Council of October 2014 set an "indicative target at the EU level of at least 27%" and requested the Commission to review this level by 2020 "having in mind an EU level of 30%"[13]. In December 2015, the European Parliament voted for a "40 % energy efficiency target; emphasised that the post-2020 EU energy efficiency target should be binding and implemented through individual national targets […]"[14].

   The assessment of the impact of the EU's 2020 target for energy efficiency[15] showed that the adoption of an explicit energy efficiency target played an important role as part of the policy framework for overcoming the barriers to the implementation of cost-effective energy efficiency measures. The identification of the 2030 target will lead to a revision of Articles 1 and 3 of the EED, which currently lay down only the EU 2020 energy efficiency target.

2) Article 7 has a sunset clause for 2020. However, the EED[16] also requires the Commission to assess the progress of implementation of Article 7 by 30 June 2016 and to assess whether it should be extended after 2020. Therefore, the second specific problem identified in this Impact Assessment is **the lack of long term predictability concerning provisions of Article 7 which will prevent cost-effective energy efficiency investments.** As a consequence, a substantial amount of economically viable energy savings will not be taken up.

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13 EUCO 169/14, CO EUR 13, CONCL 5, Brussels 24 October 2014.
14 European Parliament P8_TA-PROV(2015)0444.
15 COM(2014)520 final.
16 Article 24(9) of Directive 2012/27/EU

3) **Persistent information failures affecting energy consumers' ability to understand and regulate their own energy consumption**.

The EED (in Articles 9-11) and the Internal Energy Market legislation already contain provisions aimed at enabling/incentivizing energy savings through sufficiently frequent feedback to consumers about (the cost of) their energy consumption. Nevertheless many Europeans still only infrequently receive information based on their actual consumption (e.g. only once or twice a year), and often the information is unclear, incomplete or too complex/overwhelming. This is in part due to the current framework being complex and open to interpretation with regard to the nature and scope of key obligations, and in part due to the potential of new technologies in this field not being fully exploited yet.

This Impact Assessment tackles only the three above mentioned specific problems because the main transposition deadline of the EED was in June 2014, and it is considered too early to carry out a full review of the remaining provisions.

As required by Article 24(8) EED, the Commission carried out an evaluation of Article 6 on public purchasing of energy efficiency products and services. The findings showed that it is premature to review Article 6 at this stage as Member States are still putting in place the necessary measures for its implementation. Thus, it is not analysed in this Impact Assessment. The evaluation report can be found in Annex X.

The legal proposal that this Impact Assessment accompanies also includes a modification to Annex IV of the EED, revising the default coefficient applied to savings in kWh electricity – the so called Primary Energy Factor (PEF). Article 22 of the EED empowers the European Commission to review this default coefficient via a delegated act. However, in this particular occasion of the revision of other provisions of the EED through a co-decision process, the review process for Annex IV is included into the legal proposal for the sake of efficiency and reduced administrative burden. The proposed revision of the default coefficient follows three meetings with Member States and stakeholders conducted in accordance with the rules for the preparation of delegated acts. A summary of the process that concludes the revision procedure of the default coefficient can be found in Annex 9 to this Impact Assessment.

1.3 Drivers of the problem

The drivers of the problem are the market and regulatory failures that have not been fully tackled by existing energy efficiency legislation. Therefore, large amounts of cost-effective investments in energy efficiency will not take place.

a) *Regulatory barriers: incorrect/sub-optimal/delayed implementation of the 2020 policy framework might lead to insufficient savings in 2020, having a negative impact on 2030 target and the decarbonisation of the economy in 2050*

The EED has not yet been completely transposed by all Member States which might prevent energy savings to be exploited by 2020. However, positive progress can be observed in recent months, with the majority of Member States having fully transposed it. The incomplete and slow legal transposition and implementation is partly due to lack of political commitment for energy efficiency policies in some Member States as it is in particular the case for Article 7, something which might have negative implications in view of the achievement of the 2020 target. A gap towards the 2020 target has implications for the 2030 target as more savings would then have to be achieved in the period post-2020.

Delayed implementation may be partly due to missing political commitment or Member States underestimating the transposition needed for the obligations of the EED[17]. The Commission's services initiated infringement procedures for non-communication of all necessary measures of transposition against those Member States which did not declare full transposition of the Directive by the transposition deadline on 5 June 2014 to ensure that the complete legal framework enabling energy savings is in place at national level.

b) *Short-term perspective*

The expiration after 2020 of one of the key provisions in the EED, namely Article 7 on savings obligations, will deepen the uncertainty for investors and have a negative effect not only on the long-term planning of national energy efficiency policies, but also on investment decisions made by obligated parties, other market actors and public administrations. Long-term energy efficiency measures will continue to have some effect post 2020. However, without new measures required by legal obligations energy savings will diminish as time goes by. In the absence of a post-2020 framework, preference might be given to short-term measures towards the end of the existing obligation period. In particular, if the energy saving obligation is not continued, electricity and gas suppliers might not continue investing in energy efficiency projects for their customers and hence opportunity will be lost for an innovative and profitable new business segment, also for new energy efficiency service providers.

c) *Current EU framework on metering and billing is complex and open to interpretation with regard to the nature and scope of certain key obligations*

An evaluation of the existing EU provisions on metering and billing[18] has identified a number of problems or gaps which limit their effectiveness in guaranteeing adequate provision of information on energy consumption.

As regards electricity and gas, this notably arises from the fact that metering and billing is regulated both in the EED and in the Electricity and Gas Internal Market Directives. This could be addressed by consolidating and updating the provisions in the Internal Energy Market legislation and will be done in the context of the forthcoming proposals under the Market Design Initiative. Consequently, the present Impact Assessment only considers metering and billing of thermal energy.

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[17] Depending on their constitutional structure, some Member States have been able to transpose the Directive with secondary legislation, whilst others have used primary legislation. Countries with federal and regional structures have needed to adopt legislation at different levels. The amount of necessary new legislation also varies greatly, from 2 to 140 instruments per Member State, which means that for some Member States the sheer volume of legislation necessary has led to delays. It should be noted that very few of these cases concerned full non-transposition – in the majority of Member States a certain amount of the EED requirements had been transposed, but not all. After a dialogue with the Member States, new legislation has been adopted and the vast majority of cases have been closed, or are going to be closed.

[18] SWD (2016)/XXXX.

For thermal energy (heating, cooling and hot water), the existing EED provisions lack clarity in particular as regards their application in the case of sub-metered consumers (that occupy/use individual units in multi-apartment/purpose buildings).

d) Technical progress in metering and billing technologies for thermal energy not reflected in the current provisions of the EED

In addition to certain provisions lacking clarity, significant market developments over recent years resulting in cost reductions for intelligent metering systems are not adequately reflected in the current provisions, some of which date back to as far as 2006 (Article 9(1)) of the EED was copied from Article 13 of Energy Services Directive[19] (ESD)). The requirements are therefore rather conservative, and out of date, particularly in a 2030 perspective, when it comes to the promotion of individual measurement devices. There is clear empirical evidence that accurate and timely information on consumption can help trigger behavioural changes leading to additional energy savings. Most heat cost allocators being installed in multi-apartment buildings nowadays are electronic and remotely readable devices not requiring manual readings and access to individual flats, thus allowing for cost-effective provision of enhanced – and notably more frequent - consumption information. Until and unless such devices replace conventional ones requiring access to individual flats, it will in most situations be difficult or too expensive to provide all consumers with such enhanced information in line with the vision for a New Deal for Energy consumers[20].

e) Market barriers: poor access to capital and lack of information

Poor access to finance hinders the exploitation of cost-efficient energy efficiency potentials. In particular, the energy poor have no access to the financing needed to reduce their energy consumption.

In addition, ineffective, uncoordinated and fragmented use of public finance - with too great a focus on grants and the use of publically supported financial instruments which are set up ad-hoc, are overly subsidised and do not reach sufficient economic scale to attract private finance can impair the development of well-functioning markets for energy efficiency investments[21].

Today, there are about 200 energy efficiency financing schemes in operation across different Member States, targeting the different markets and testifying to the broad range of different circumstances. In some cases, various schemes address the same sectors and the same beneficiaries in the same Member States, with different intensity of public support and competing solutions. In the area of energy services high intensity grants sometimes crowd out private investment (e.g. in public lighting or industry sectors), which is clearly sub-optimal.

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[19] Directive 2006/32/EC.

[20] COM(2015) 339 final.

[21] As regards the European Structural and Investment Funds, the strategic programming process and ex ante assessments for setting up of financial instruments ensures a coordinated and effective approach to address market gaps.

In 2015, the Energy Efficiency Financial Institutions Group (EEFIG) reported[22] to the Commission with an analysis of the obstacles that prevent up-scaled investment in economically viable energy efficiency projects. It identified four challenges:

1) **De-risking**: Addressing the financial community's perception, based on lack of experience with energy efficiency, of the high level of risk of investments in this sector and unclear business case (unclear benefits) at the demand side that reduces the investment appetite;

2) **Aggregation**: Enabling project promoters to bundle small, heterogeneous projects in larger packages which reduce transaction costs while enabling more effective (and profitable) investment structuring and governance;

3) **More effective use of public funding**: Reinforcing the use of public finance via financial instruments moving away from grants in favour of instruments that maximise the triggering of private capital allocation for energy efficiency;

4) **Regulatory framework**: Full implementation of existing energy efficiency legislation as well as "future concerted and consistent regulatory pressure to improve buildings efficiency". The report states that "The importance of leadership and signalling for energy efficiency investments should not be underestimated in the context of the EU's 2030 Climate and Energy package; the headline positioning of energy efficiency targets would impact how EU buildings' energy use will decrease and decarbonize from now until 2050 with intermediate milestones. If the EU wants to unlock the enormous potential for energy savings in its existing building stock then it clearly requires bold policy intervention going beyond the strong implementation of existing legislation."

The Commission is tackling these specific issues in its initiative on Smart Financing for Smart Buildings[23]. Energy saving obligations are an important complementary tool as they mobilise private money for energy efficiency investments (usually put in first by the utility and then paid back via energy bills).

1.4 Existing framework and outcome of the evaluations

1.4.1 Evaluation of progress towards the 2020 target (Articles 1 and 3)

In 2007, the EU committed itself to a 20% energy efficiency target in 2020, which means at most 1086 Mtoe of final energy consumption and 1483 Mtoe of primary energy consumption. Member States set their indicative national energy efficiency targets in 2013, which together add up to a reduction in primary energy consumption reduction of 17.6 % in 2020 and 20.6% expressed in final energy consumption.

Member States have made efforts to implement EU energy efficiency legislation, mainly the transposition of the EPBD by July 2012 and the EED by June 2014. In addition, energy

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22 https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency .

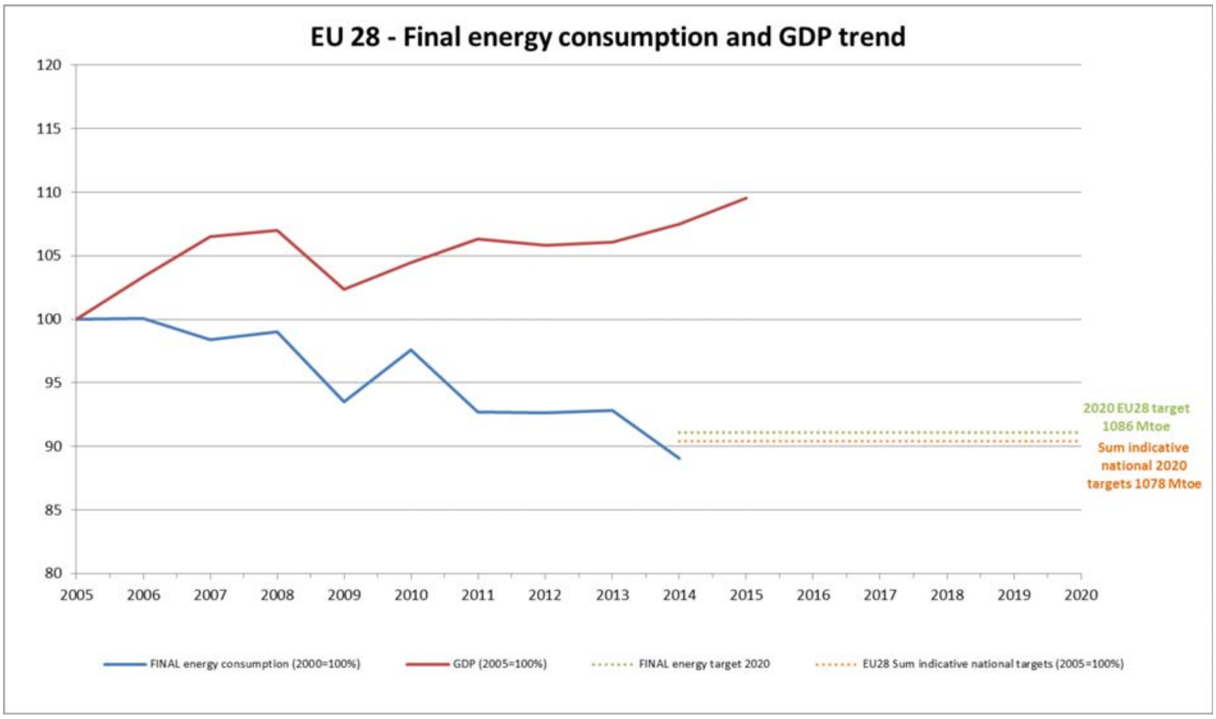
23 COM(2016)xxx.

labelling and eco-design requirements and CO_2 light duty vehicle standards have had a considerable impact on products' performance.

In 2014 primary energy consumption fell to 1507 Mtoe and final energy consumption to 1061 Mtoe. Compared to the 2007 baseline projections for 2020, this equals a reduction of 18.7% expressed in primary energy consumption and 21.8% in final energy consumption. This means that the European Union is close to achieving its primary energy efficiency target in 2020 and has already achieved its final energy consumption 2020 target, provided this level of consumption can be kept until 2020. While more progress is expected in implementation of energy efficiency policies, economic growth and lower fossil fuel prices might boost energy consumption in the next years. However, the overall expectation is that both targets will be met.

Final energy consumption decreased from 1191 Mtoe in 2005 to 1062 Mtoe in 2014 (-11%).

Figure 2: Final energy consumption EU28 (2005=100%)



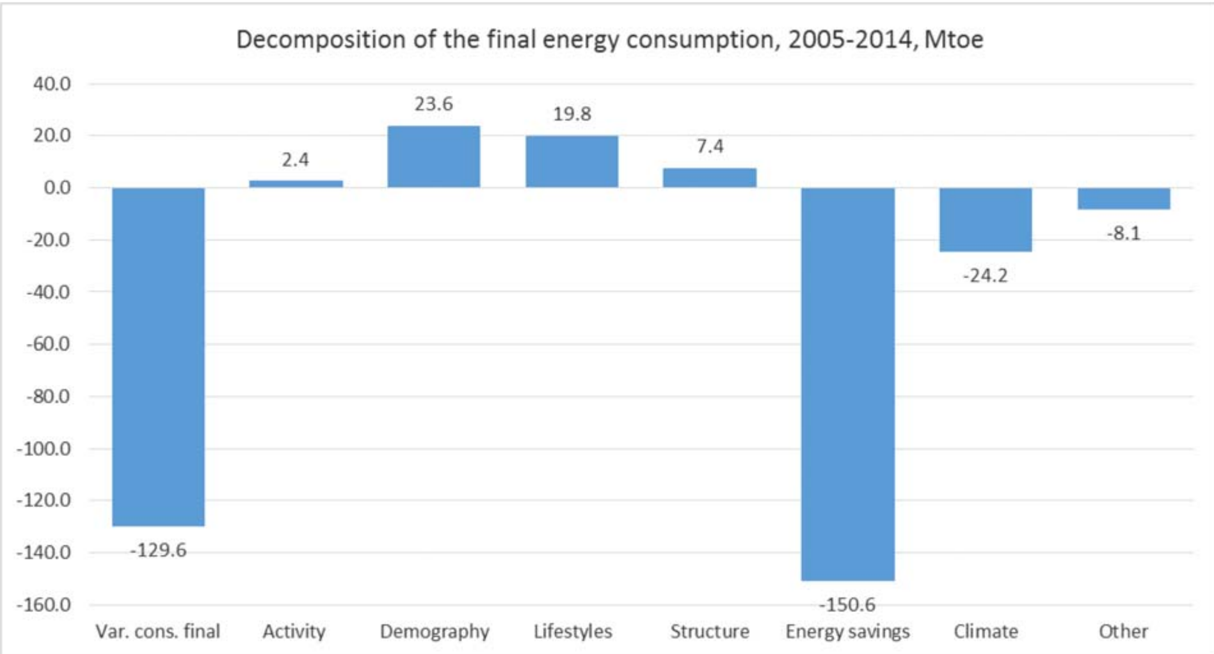
Source: Eurostat

Quantifying the saving impacts of energy efficiency measures based on a bottom-up engineering calculation is challenging for each energy efficiency measure as other external factors (e.g. weather) might overcompensate the savings effect of the measure. Furthermore, each type of measure has its own baseline and methodology for calculation of savings and thus adding up measures can only be an approximation. Another method is a top-down approach based on historical energy consumption statistics. Such a top-down calculation, called decomposition analysis, indicates how energy savings, but also other elements, such as increased activity, contribute to changes in energy consumption. Energy savings are mostly brought about by energy efficiency policies, but also by natural replacement of equipment and technological progress. The decomposition analysis does not allow singling out the impacts of each of the policies versus other drivers. However, it gives an indication of how much energy efficiency policies in total (and facilitated by normal replacement and technological progress) might have contributed to the overall downwards trend in energy consumption in the past years. In addition, at this point in time, official historical data is only available until 2014. Therefore the specific impacts of the EED, which came into force in 2014, cannot be shown yet. Nevertheless, the impacts of the other energy efficiency policies which were implemented so far can be estimated.

An analysis based on statistical data from 2012 showed that energy savings brought about a reduction of 53 Mtoe in energy consumption in the period 2008-2012 while the economic crisis (or more broadly activity level) contributed to this reduction with 33 Mtoe, structural changes with 5 Mtoe and modal shifts in transport with 3 Mtoe[24].

This analysis was confirmed by a decomposition analysis performed under the Odyssee-Mure project[25]. The analysis shows that a higher level of economic activity, demographic, structural and lifestyle changes would have led to an increase of final energy consumption in the period between 2005 and 2014. However, through the important contribution of energy savings it was possible to obtain a more-than-offsetting reduction in consumption by 151 Mtoe. The contribution of climate and other changes reduced final energy consumption together by 33 Mtoe. This shows that energy efficiency improvements were the most important factor leading to lower final energy consumption in 2014 compared to 2005.

Figure 3: Variation final energy consumption - European Union - Mtoe (2005-2014)



Source: Odyssee-Mure

[24] Behavioural and comfort changes led to a slight increase of energy consumption by 4 Mote but this increase was counterbalanced by the other decreasing factors. See chapter 4 of https://ec.europa.eu/energy/sites/ener/files/documents/2014_report_2020-2030_eu_policy_framework.pdf

[25] See http://www.indicators.odyssee-mure.eu/decomposition.html.

To close the remaining gap towards the 2020 target expressed in primary energy consumption, the Commission indicated in its Impact Assessment on Energy Efficiency in 2014 and its Energy Efficiency Progress Report 2015 that Member States need to accelerate their efforts in implementation of European legislation and their own policies in order to achieve their national energy efficiency targets for 2020 or to go beyond them[26].

The National Energy Efficiency Actions Plans (NEEAP) submitted to the Commission in 2014 and the Annual Reports show that Member States, in addition to a range of EU policy measures (e.g. eco-design, labelling, EU ETS, light duty vehicles standards), have introduced energy efficiency measures in the industrial, residential, services, transport and power generation sectors. They indicate that most Member States have increased their effort and either strengthened existing energy efficiency measures or introduced new ones.

To achieve the 2020 primary energy consumption target of 1483 Mtoe in 2020, primary energy consumption needed to be reduced by 370 Mtoe compared to 2007 baseline projections for 2020. Primary energy consumption was 1507 Mtoe in 2014. Therefore, an additional reduction by 24 Mtoe is needed by 2020. As highlighted in the Impact Assessment on Energy Efficiency in 2014 proper implementation in the three following policy areas are key for the achievement of the 2020 energy efficiency targets:

- Article 7 of the EED: The 2011 Impact Assessment on the EED estimated that 108-113 Mtoe of primary energy savings would be delivered by the implementation of **Article 7** in 2020[27]. The Commission reassessed the figure during the negotiations down to **84.5 Mtoe** in primary energy. A preliminary analysis of the Annual Reports 2016 shows that Member States achieved 12 Mtoe of energy savings in 2014[28].

- EPBD: The estimated energy saving impact of **60 – 80 Mtoe** energy savings in 2020 of the **revised EPBD**[29] will not be fully realised unless it is properly implemented. With the current state of implementation 48.9 Mtoe of savings were achieved in 2014[30]. Therefore, proper implementation could bring an additional 15 Mtoe savings[31].

- **Ecodesign, energy labelling, Energy Star and tyre labelling measures**: The different regulations are estimated to contribute with **162 Mtoe** primary energy savings in 2020[32]. In 2014, the assessment concluded that poor compliance holds back

[26] See SWD(2014) 255 and SWD(2015) 574.

[27] http://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_0779_impact_assessment.pdf (Annex VII).

[28] http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive/national-energy-efficiency-action-plans. Reported 12 Mtoe also include savings stemming from early actions introduced before 2014 (Article 7(2)d).

[29] Compared to the baseline PRIMES 2007. See SEC/2008/2864.

[30] SWD (2016) evaluation EPBD.

[31] See 'Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond' by Fraunhofer ISI, PWC and TU Wien (2014) (see https://ec.europa.eu/energy/sites/ener/files/documents/2014_report_2020-2030_eu_policy_framework.pdf).

[32] Compared to a business as usual scenario which represents the situation without measures as assessed during the first preparatory and impact assessment study for a product. Further information is provided under https://ec.europa.eu/energy/sites/ener/files/documents/Ecodesign%20Impacts%20Accounting%20%20-%20final%2020151217.pdf

the full saving potential of Ecodesign and Energy Labelling. With stronger enforcement an additional 4 Mtoe savings could be achieved[33].

These are the three most important policy areas on which Member States should focus in the next years. These policy areas contribute mainly to the 2020 target achievement, but they are also expected to bring the most significant savings in the course of the next decade as they target the sectors in which the highest cost-effective energy efficiency potential was identified in a study and modelling exercise performed in 2014[34]. As the table below shows, targeting barriers to energy efficiency with the help of moderate but targeted policies (LPI scenario) would lead to the highest cost-effective energy efficiency savings in the tertiary sector. If barriers to energy efficiency investments are almost completely removed with strong energy efficiency policies (HPI scenario), the highest cost-effective energy efficiency potentials can be realised in the residential and tertiary sector (final energy consumption in 2030 could be reduced by 25.9% in each sector compared to the baseline scenario). However, also the transport sector and industrial sector also have remaining cost-effective potentials which need to be exploited through the removal of energy efficiency barriers.

Table 1: Identification of saving potentials of sectors in 2030

Potentials in 2030 compared to the BASE_inclEA Scenario						
	Mtoe			% compared to Base_inclEA in 2030		
	LPI	HPI	NE	LPI	HPI	NE
All final demand sectors	**103**	**194**	**221**	**9.6%**	**18.2%**	**20.6%**
Residential sector	23	73	79	8.3%	25.9%	28.1%
Tertiary sector	25	47	50	13.9%	25.9%	27.7%
Transport sector	28	41	46	9.2%	13.4%	14.9%
Industry sector	26	33	46	9.5%	12.2%	16.8%

Source: Fraunhofer, PwC, TU Wien[35]

Consequently, all the measures listed above (Articles 7 and 9-11 of the EED, EPBD and ecodesign/labelling) will be analysed regarding their operation post-2020 and in view of the contribution to 2030 target. For other energy efficiency measures no revision is foreseen as the legal provisions that underpin them are fit for purpose. These measures will continue post-2020 (e.g. ESCOs, renovation of public buildings) and they form an important part of the policy mix to exploit the cost-effective energy efficiency potentials in the different sectors.

It has to be noted that the additional saving impact of the product legislation is expected to be less in the 2020s than currently, as most of the product groups which bring major additional savings are already covered by ecodesign legislation or other policy regimes or a natural limit

[33] See 'Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond' by Fraunhofer ISI, PWC and TU Wien (2014) (see https://ec.europa.eu/energy/sites/ener/files/documents/2014_report_2020-2030_eu_policy_framework.pdf)

[34] See https://ec.europa.eu/energy/sites/ener/files/documents/2014_report_2020-2030_eu_policy_framework.pdf

[35] Ibidem.

of efficiency is achieved – although significant potential remains through reviewing these regulations.

This impact assessment focuses mainly on analysing the potentials of the first policy area, namely EED/Article 7, to deliver the 2030 target. As a part of Energy Efficiency package, a separate impact assessment for the EPBD looks at potentials of buildings renovation.

1.4.2 Outcome of the evaluation on Article 7

Overview of the existing framework and progress in implementation

Article 7 on Energy Efficiency Obligation Schemes (EEOSs) is designed to attract private investment. It requires each Member State to deliver 1.5% new end-use energy savings per year of retail energy sales over the 2014-2020 obligation period, leaving the Member State to decide whether to achieve this through an EEOS or alternative policy measures or a combination. It is also in the remit of Member States to determine the sectors in which the measures should primarily take place.[36]

Energy saving obligations regulate the outcome but leave it to the market operators to determine the most cost effective path for achieving that outcome. It is not the government that decides how the obligated parties deliver their targets. If well-designed, such schemes can address multiple market failures, as they use the knowledge of well-placed actors in the energy sector who have information about the available energy efficiency services, technologies and the behaviour of their customers. They address the challenge that households in many cases do not have the necessary capital for upfront investments, nor the knowledge of what would be technically and economically feasible in each case. They can ensure that energy efficiency investments benefit from a scale effect and hence can lower the transaction costs for energy efficiency projects. Also they provide a general incentive to invest in energy efficiency in a market environment with inflexible prices and puts energy providers at the centre of the energy sector transition. In a well-designed scheme, the market delivers the desired outcome at least-cost. Energy saving obligations can further encourage the development of an ESCO sector, which is a key element in stimulating the adoption of energy efficiency improvements. At the time of adoption of the Directive in 2012, the Commission services estimated that Article 7 and the related Annex V would be responsible for more than half of the energy savings the Member States should achieve under the EED.

In implementing this provision, Member States' subsidiarity has been respected by leaving them flexibility in how they achieve the 1.5% end-use savings as long the cumulative savings amount is achieved by 2020. For example, Member States can choose a wide range of policy measures, energy using sectors and individual energy efficiency improvement actions (in total 477 measures were notified to achieve the 250 Mtoe of end-use savings by 2020, and 16 out

[36] A detailed intervention diagram of Article 7 can be found in Annex 6.

of those are obligation schemes implemented by utilities)[37]. Finally, Member States were free to not adopt an energy savings obligation scheme if in their particular regulatory context this was not deemed to be the most cost effective way, e.g. when due to a long history of national energy efficiency legislative efforts other measures already addressed the lack of incentives for energy efficiency investments.

Given the fact that the EED has triggered the uptake of energy efficiency obligation schemes (increasing in number from 5 to 16), and the fact that some Member States use specific trading platforms at national level, the Commission services organised a stakeholder meeting on 29 February 2016[38] to discuss the feasibility of cross border tradability of documented savings. The outcome of the meeting suggests that at this stage it is not feasible to establish an EU white certificate scheme and thus the option of tradability of savings across Member States was not considered in this impact assessment (see Annex 1).

Conclusions of the Evaluation

In terms of **effectiveness**, the evaluation of the implementation of Article 7 on energy efficiency obligation schemes and alternative measures reveals that Member States are on track to achieve the required savings by 2020 (based on their current notifications), provided that the measures are effectively implemented and that robust monitoring and control systems are established to check the credibility of reported energy savings. The evaluation showed that simplification of certain requirements of Article 7 and clarification of aspects such as what savings are eligible as well as concepts such as 'materiality' would improve implementation at national level and would allow an effective and efficient achievement of the required savings by Member States.

In terms of **efficiency**, the evidence of pre-existing schemes shows that the EEOS are highly cost-effective instruments. Certain alternative policy measures also tend to be cost-effective, for example voluntary agreements, taxation measures and financing schemes and incentives. Despite initial start-up costs, the administrative costs to run EEOSs are relatively low, although they can be expected to vary between Member States. There is more evidence available on how the monitoring and verification systems work for the EEOS than for the alternative measures, including only limited evidence on the administrative costs associated with the monitoring of the alternative measures under Article 7.

In terms of **relevance**, Article 7 remains relevant as it addresses a wide range of market and regulatory failures and can, in particular, be instrumental for making energy efficiency services and investments a business case. This becomes even more relevant in the context of the new 2030 ambitious climate and energy objectives.

In terms of **coherence**, Article 7 remains coherent with other measures of the Energy Efficiency Directive. The energy savings requirement of Article 7 provides an important contribution to the EU's collective energy efficiency target as set out in Article 3. It also

[37] More detailed information on major policy measures notified under Article 7, containing examples and best practice is provided in four case studies annexed to the dedicated study on evaluating progress in implementation of Article 7 (Ricardo AEA/ CE Delft (2015): Annex 4 of the Study on evaluating the implementation of Article of the EED).

[38] For more detail see Annex 1 on stakeholder consultation.

complements other EU energy efficiency policies in two ways. Firstly, only those energy savings that exceed the minimum requirements of other EU policies are eligible and can be counted towards the Article 7 target, so overlaps are minimised. Secondly, it drives forward the application of the energy efficiency requirements of other policies. For example, the Energy Performance of Buildings Directive (EPBD) sets minimum energy requirements for new or renovated buildings, but contains no requirements as to how many buildings must be renovated, or by when. By contrast, Article 7 requires Member States to show actual energy savings, and therefore encourages the building renovations to take place in practice. The same logic applies to eco design and energy labelling, when Member States have policies under Article 7 to encourage the purchase of highly efficient boilers or household appliances. Article 7 can therefore be seen as a 'pull' factor which increases the practical application of the other EU energy efficient policies, and indeed for national energy efficiency policies.

Finally, in terms of **added value**, Article 7 allows more effective and coordinated achievement of the EU 2020 energy efficiency objectives, while respecting the subsidiarity. Article 7 allows ensuring the stability to investors that in turn helps unlock the needed financing for implementing the energy efficiency measures.

1.4.3 Outcome of the evaluation on Articles 9-11 (on metering and billing)

Overview of the existing framework and progress in implementation

EED Article 9 contains provisions on individual metering generally, on smart metering of electricity and gas and on metering of thermal energy in multi-apartment/purpose buildings. Article 10 sets requirements for consumption based billing information in general (incl. as regards minimum frequency) and requirements on consumption information from smart meters for electricity and gas, as well as general information and billing requirements pertinent to costs, consumption and payment. Article 11 ensures that metering and billing are generally free of charges and sets out the conditions for the pass-through of cost of sub-metering/billing. In addition, Annex VII sets minimum requirements for billing and billing information based on actual consumption. These requirements set out both general requirements for all energy forms and specific requirements for where smart electricity and gas meters are installed, without requiring that such meters are installed. These complement the provisions in the internal market legislation on roll-out and functionalities of smart meters. The EED also covers thermal energy forms, which are not addressed in the internal energy market legislation.

Given that provisions on metering and billing are found in both the EED and in the Internal Energy Market (IEM) legislation, the Commission services developed "thematic" cross-cutting evaluations of these. The evaluation concluded that amendments to Articles 9-11 and related Annex VII would improve effectiveness, as detailed below.

The objective of Articles 9-11 is to strengthen the empowerment of final customers as regards access to up-to-date information on their actual, individual energy consumption at a frequency enabling them to regulate their energy use. The evaluation of existing metering and billing provisions notes that it is too early to draw too many firm conclusions as regards the effectiveness of Articles 9-11 of the EED given the relatively recent deadline for EED transposition (5 June 2014) Nevertheless it is already possible to identify, as regards the thermal sector, certain gaps, problems and potential improvements and clarifications. There was an evident intention at the time of the adoption of the EED to clarify the pre-existing requirements on metering and billing that were then contained in the 2006 Energy Services Directive, and in the IEM legislation. This intention was however only partially met and the current framework remains complex and open to interpretation with regard to the nature and scope of certain key obligations. This is particularly the case regarding the rights of consumers in multi-apartment/purpose buildings with central supply of heating, cooling and/or hot water to be informed about and billed according to their own consumption and the frequency with which this must happen.

Moreover, Articles 9(2) and 10(2) of the EED specifically concern requirements for smart electricity and gas meters, the roll-out of which is regulated in the IEM Directives and covered by a partially overlapping Commission Recommendation.

Conclusions of the Evaluation

In terms of **effectiveness**, the evidence available suggests that the provisions on metering and billing in the IEM Directives and EED, to the extent they can be assessed at this time, together are likely to have made some contribution towards the achievement of their dual objectives (enabling energy savings and effective consumer choice), although it is very difficult to quantify. However, the ambiguous wording of certain provisions has substantially reduced their impact, depending on how they were interpreted in individual Member States. This not least concerns the applicability of billing/information provisions for sub-metered consumers of thermal energy.

In terms of **efficiency**, there is reason to assume that the provisions considered have generally been efficient in terms of the proportionality between impacts and resources/means deployed.

With regard to **relevance**, most provisions remain highly relevant, although parts of both the IEM and the EED to some extent have been surpassed by developments and could benefit from being revisited / updated, including in the light of technical progress made in terms of the deployment of remotely readable devices for heat measurements.

In terms of **coherence**, the evaluation pointed to a number of issues where improvements would seem possible and desirable. Most importantly it would be simpler to ensure full consistency if billing and metering for gas and electricity was regulated in only one place and not also covered by EED legislation, hence those provisions should be moved to the Electricity and Gas Market Directives in the context of the future market design proposal.

As regards the **EU added value**, the evaluation concluded that, in a single market for energy, there is a strong case for suppliers being subject to similar if not identical obligations and rules, and for consumers to enjoy the same basic rights and be provided with comparable and recognisable information. Delivering a New Deal for energy consumers as part of an Energy Union with consumers at its heart means *inter alia* providing consumers with frequent and meaningful, accurate and understandable information on their energy consumption and related costs[39]. This contributes to realising the Energy Union and meeting EU goals on energy efficiency and greenhouse gas reductions.

1.5 Why does the problem need to be tackled now?

The assessment of 2030 energy efficiency target needs to be developed now for several reasons:

1. The level of the EU wide target for energy efficiency affects the amount and type of greenhouse gas reductions achieved in the non-ETS sectors[40]. This in turn contributes to the achievement of the national green house gas (GHG) reduction targets for the non-ETS sectors in the Effort Sharing Regulation for which Commission's proposal was published on 20 July 2016[41]. The aim of the Regulation is to achieve in 2030 the EU 30% GHG emission reductions compared to 2005 in the non-ETS sectors. However, energy efficiency policies will not only contribute to the emission reduction targets for 2030, they are also helping pave the way for a cost-efficient way for 80-95% emission reductions by 2050 (see Annex 3).

2. Current uncertainty about the energy efficiency ambition for 2030 can lead to delays and lower ambition of national contributions to EU objectives under the governance process of the Energy Union. The new governance system will ensure that a transparent and reliable planning, reporting and monitoring system is in place for all 2030 climate and energy targets, based on integrated national energy and climate plans and streamlined progress reports by Member States. Therefore, a timely and clear agreement on the energy efficiency target for 2030 is important to ensure a coherent planning of climate and energy policies on a national and European level.

3. The market design and renewable energy initiatives of the Commission will cover areas which are also linked to energy efficiency policies e.g. metering, consumer rights and demand response and deployment of renewables. To ensure that the energy efficiency is seen as an energy source in its own right and to accommodate energy efficiency and its value in increasingly flexible market, the contribution of energy efficiency in 2030 needs to be fixed. The overall energy efficiency framework should be made fit for purpose for the 2030 perspective to ensure that the different pillars of the Energy Union are coherent.

4. The Commission adopted in July 2016 its Strategy for Low-Emission Mobility[42]. The transport sector has the highest share of final energy demand. It can make an important contribution to energy efficiency notably via standards for vehicles and transport management policies. Furthermore, in the transport sector, potential synergies can be exploited in terms of realising important co-benefits in terms of decrease in pollution, congestion and thus improving quality of life, especially in cities. Therefore, different levels of the 2030 energy efficiency target require efforts in the transport sector which

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[39] COM(2015) 339 final.
[40] Some EE measures that concern electricity have also impact on the ETS sector.
[41] COM(2016)/482.
[42] COM(2016) 501 final.

are analysed in this impact assessment and, in more detail, in the Staff Working Document[43] accompanying the Communication *Strategy for Low-Emission Mobility*.

As regards the metering and billing provisions in Articles 9-11, the problems identified need to be addressed now in order to contribute to the delivery of a New Deal for Energy Consumers announced as part of the Energy Union. Delivering the New Deal means providing consumers with frequent access, including in near real-time, to partially standardised, meaningful, accurate and understandable information on consumption and related costs as well as the types of energy sources not just on electricity and gas but also on heating and cooling was set out in the Heating and Cooling strategy[44].

1.6 Nature and extent of the problem

The 2016 EU Reference scenario ('REF2016')[45], reflecting a scenario based on currently implemented policies and adhering to binding 2020 targets, demonstrates that the EU objectives of sustainability, energy security and competitiveness will not be reached. It indicates that the current national and European energy efficiency framework would lead to 23.9% of primary energy reduction compared to 2007 baseline projections in 2030. In the EU Reference scenario, primary energy consumption reaches 1436 Mtoe and final energy consumption reaches 1081 Mtoe in 2030[46].

This is because without a 2030 energy efficiency framework, large amounts of cost-effective investments in energy efficiency will not take place in the different sectors. This is in itself damaging for all EU citizens because the benefits for the environment, lower energy costs for households and companies, increased jobs and economy-wide economic activity and health protection possibilities are not exploited. Insufficient energy efficiency could also increase the risk of not achieving the agreed objective of at least 40% GHG reductions by 2030 and put the 2050 long term goal to decarbonise our economy in jeopardy or outside a cost efficient trajectory. In terms of **security of supply**, high energy demand increases the dependence of the EU on energy imports, in particular of gas. Gas imports amounted to 254 Mtoe[47] in 2014 and in the Reference scenario are projected to rise to 295 Mtoe in 2030. Various Member States rely on fossil fuel imports from single providers and their dependency on single import routes create many risks, including price volatility and sudden disruptions of supply.

The evaluation of Article 7 shows that the saving obligation will play a key role in the delivery of the 2020 target thanks to its "pulling" effect as it attracts private investment in energy efficiency, thus increasing the *rate* of energy efficient renovations or uptake of energy

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43 The same core policy scenarios (EUCO27 and EUCO30) from this Impact Assessment are used as a starting point in SWD(2016) 244 final. In addition, more ambitious scenarios are analysed, notably on more stringent light duty vehicles' CO2 standards – leading to higher energy savings in the transport sector.

44 COM(2016) 51 final, 16.2.2016.

45 See Annex 4 for more details.

46 A reference scenario follows the logic of including only policy measures which have been adopted until a certain cut-off date, without including new policies not yet officially adopted. In the Reference 2016 scenario, the cut-off date was December 2014 (the EED was therefore included, although with conservative assumptions as to its implementation).

47 In 2014, EU28 imported 257 bcm (233 Mtoe) of natural gas, 'Quarterly Gas Report on gas Market Observatory for Energy', Commission/DG Energy, Volume 8, 2015. (https://ec.europa.eu/energy/sites/ener/files/documents/quarterly_report_on_european_gas_markets_q3_2015.pdf).

efficient appliances and techniques. Therefore the expiry of Article 7 would not facilitate the realisation of sufficient savings in view of a 2030 target. It is likely that some Member States with a strong political drive for energy efficiency would continue using this instrument in the absence of EU framework, but the situation before the EED was adopted suggests that most would not.

With regard to metering and billing, the lack of clarity of certain key provisions has become evident in the course of the work with Member States to transpose and implement the provisions nationally, and dialogue with/feedback from stakeholders have confirmed that major divergences in interpretations exist, e.g. as regards the applicability of provisions for sub-metered heat consumers. The analysis presented later in this reports seeks to estimate the extent of the potential energy savings not exploited due to inadequate consumption information being given to sub-metered consumers of thermal energy.

2 Why should the EU act?

According to Article 194 of the Treaty on the Functioning of the European Union, Union policy on energy shall aim, in a spirit of solidarity between Member States, to promote energy efficiency and energy savings. The European Parliament and the Council, acting in accordance with the ordinary legislative procedure, shall establish the measures necessary to achieve the objectives.

In October 2014 the European Council requested the Commission to review the minimum 2030 energy efficiency target of at least 27% by 2020, having in mind an EU level of 30%. In December 2015, the European Parliament pointed to the need to assess the viability of a binding 40% EU energy efficiency target.

Agreeing on a common framework for energy efficiency for 2030 on the EU level as part of the overall energy and climate framework will help Member States to achieve a sustainable, secure and affordable energy system for European society as a whole and for European citizens. These challenges cannot be tackled at national level alone as climate change and security of supply are trans-boundary problems. All Member States face the same risk of increasing energy prices, which could lead to high energy bills for consumers and could weaken Europe's competiveness. The 2020 framework has been already proved to be an effective way of targeting these challenges[48].

Co-ordinated EU action helps Member States to better target national energy efficiency policies. EU-wide headline targets, coherent with other energy and climate objectives, namely the ETS, the Effort-Sharing Regulation and the EU Renewable energy target for 2030, facilitate the establishment of national policies and indicative targets. As in 2020, Articles 1 and 3 of the amended EED would again provide the appropriate legislative framework for all Member States to fix a coherent European 2030 energy efficiency level.

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[48] Back in 2010 Member States agreed on the EU 2020 headline targets for energy efficiency, greenhouse gases and renewable energy. It was decided that no binding energy efficiency targets were implemented but instead binding measures were put in place.

The overall level of target will influence the level of ambition of European energy efficiency policies, notably EU standards. The role of Member State action will, however, remain crucial to delivery of the target as it is mainly national measures that contribute and ensure meeting the overall agreed EU target.

If cost-effective investments in energy efficiency are not undertaken, then other potentially more costly mitigation measures need to be taken to achieve the same GHG reduction effort. Therefore improving the business case for energy efficiencies can reduce the overall costs of GHG abatement as long as Member States have sufficient freedom to define the areas which they want to target and the policy approaches. The market and regulatory failures identified above are of relevance to all Member States alike as they are inherent to energy efficiency rather than linked to certain political and institutional set-ups. In particular all EU Member States will need to bring their energy systems on a decarbonisation path and create a framework in which there is a strong business case for energy efficiency.

One of the main articles of the EED is Article 7 which has delivered an effective contribution towards reaching the agreed indicative EU energy efficiency targets. With its binding nature, it requires Member States to address the fundamental obstacles preventing energy efficiency to take place – either through an obligation or through a set of alternative measures with similar effect. This is necessary as otherwise EU instruments only set minimum requirements, but do not fundamentally improve the attractiveness of investing in energy efficiency as such[49]. In line with the Better Regulation guidelines, Member States have significant flexibility[50] on how they implement Article 7, thus allowing all energy consumers in the EU to benefit from energy savings both directly (reduced energy consumption and lower energy bills) and indirectly (higher comfort level and better air quality, etc.). The extension of Article 7 is important in particular for the development of an energy efficiency market. It promotes investments and energy services available in the market thanks to the increased demand for energy efficiency improvements. This in turn creates new jobs, triggers innovation and the development of new technologies and techniques. In a single market for energy, there is a strong case for suppliers being subject to similar, if not identical, obligations and rules, and for consumers to enjoy the same basic rights and be provided with comparable and recognisable information. The EU needs to decide if and in which form Article 7, which would be a major contributor to the 2030 target, should continue to ensure that cost-effective energy saving measures are implemented post 2020. Updating the existing energy savings requirement of Article 7 is fully in accordance with the energy legal base introduced by the Lisbon Treaty, is in line with the conclusions of the evaluation of the EED and also fully respects the principle of subsidiarity by leaving it to the Member States to decide which policies and measures they would use to achieve the required savings in accordance with their national situation and specificities.

With respect to Articles 9-11 only the EU can act to ensure that its legal provisions are sufficiently clear and adequately reflect the possibilities offered by technological advances made. Guaranteeing certain minimum standards in terms of the frequency and content of

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[49] For example the EPBD lays down minimum energy performance requirements but does not set a rate at which buildings should be renovated.

[50] Through the energy efficiency obligation schemes or alternative measures which suit national circumstances; 477 measures notified were notified under Article 7 by Member States to reach the savings requirement by 2020.

billing and billing information empowers consumers and contributes to realising the Energy Union.

This proposal is entirely in line with Article 37 of the Charter for Fundamental Rights, under which a high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development. The proposals on metering and billing of energy for consumers will help ensure a high level of consumer protection, as required under Article 38 of the Charter. The requirement that meters or cost allocators be remotely readable respects the right to privacy of home and family life. The increased emphasis on solutions to energy poverty helps to combat social exclusion and poverty in accordance with Article 34.

Overall, the revised EED framework will help achieving the 2030 climate targets in a cost-effective way, while leaving flexibility to Member States on how to achieve the savings.

3 What should be achieved?

The **general objective** of this initiative is to ensure that energy efficiency contributes to the development of a competitive, sustainable and secure EU energy system in 2030 and beyond, as recognised by the Energy Union Strategy and in accordance with the 'energy efficiency first' principle.

The three **specific objectives** are as follows:

1. To respond to the political mandate given by the European Council and the European Parliament to determine the energy efficiency target in 2030, taking into account the multiple benefits and costs related to lower energy consumption, while respecting all other 2030 objectives. In addition, it has to be assessed whether the target should be binding or non-binding in nature.

2. To ensure that Article 7 contributes to the achievement of the energy efficiency target for 2030, as well as the overall GHG targets for 2030 and beyond by attracting private investments. In this respect, a business case for long-term energy efficiency private investments post 2020 needs to be ensured, while respecting the overall architecture of EU energy and climate change policies.

3. To empower consumers of thermal energy through better and sufficiently frequent feedback on their consumption including by taking advantage of progress in technology.

The three **operational objectives** are as follows:

1. In relation to the energy efficiency target, a legal revision of Article 1 and 3 is necessary to fix the EU 2030 energy efficiency target.

2. In relation to Article 7 it will require a legal revision of the policy framework so that it ensures that Member States achieve their required national energy savings by the end of 2030.

3. In relation to Articles 9-11 a legal revision is necessary to clarify the metering and billing requirements for consumers of heating, cooling and hot water and update them to reflect the capabilities of the technologies now available.

4 What are the various options to achieve the objective?

4.1 2030 energy efficiency target level – policy options for Articles 1 and 3

4.1.1 Level of energy efficiency target

As discussed above, the updated 2016 EU Reference scenario (REF2016) indicates that with no new policies beyond those adopted by the end of 2014, only 18.4% reduction of primary energy consumption will be achieved in 2020 (hence missing the 2020 indicative target). As the policy initiative supported by this impact assessment does not propose additional measures before 2020, the policy scenarios do not achieve the 2020 target either. In this respect, the policy scenarios are conservative. If the 2020 target is indeed achieved – and the Commission believes that it will be - less effort and investments will be needed after 2020 to achieve any given 2030 target[51].

REF2016 projects a 23.9% primary energy consumption reduction compared to the 2007 baseline projections for 2030[52]. It is assumed that national policies to achieve the required savings under Article 7 are mostly phased-out after 2020 because of the expiry of this article. Renewable energy would account for 24.3% of gross final energy consumption and GHG emissions would be reduced by 35.2% (37.7% in the ETS sectors and 23.7% in the ESD sectors) in 2030.

Different energy models have been used in order to respond to the political mandate given by the European Council and the European Parliament to determine the energy efficiency target in 2030, taking into account the multiple benefits and costs related to lower energy consumption, while respecting all other 2030 objectives.

Energy efficiency targets need to be assessed within the framework of the other targets that have been agreed by the European Council, *i.e.* an overall GHG emissions reduction (at least 40% compared to 1990), a GHG emissions reduction in ETS sector (43% compared to 2005, including the Market Stability Reserve and the proposed revision of the linear reduction factor), a GHG emissions reduction in sectors covered by the Effort Sharing Regulation (30% with respect to 2005) and renewable energy shares in final energy consumption (at least 27%). The different policy areas reinforce each other and are analysed as a package. In terms of ETS and non-ETS targets in 2030, these are met in the EUCO27 and EUCO30 scenarios, but necessarily overshoot in some of the more ambitious scenarios. In contrast to the REF2016, all policy scenarios are consistent with the EU's long term GHG reduction objective for 2050.

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[51] As set out in its Energy Efficiency Communication of 2014 and Energy Efficiency Progress Report of 2015, the Commission has strong grounds to consider that the 20% target for 2020 will be achieved with proper implementation of existing legislation, and is working intensively with Member States to achieve that.

[52] 2007 Baseline modelled with PRIMES projected for 2030 primary energy consumption reaching 1436 Mtoe and final energy consumption 1081 Mtoe.

The **first policy option** is to achieve a target of 27% reduction of primary energy consumption (compared to the 2007 baseline), the minimum energy efficiency ambition level agreed by the European Council in 2014. The scenario that reflects this policy option is considered as the **baseline scenario** in this impact assessment[53] and the policy scenarios are, most often, compared to this scenario.

Four further **policy options** explore 2030 **targets of a 30%, 33%, 35% and 40%** reduction of primary energy consumption (compared to 2007 baseline). The policy options with a level above 30% energy efficiency in 2030 also include higher RES shares of 28% which makes them closer to the 2030 renewable energy target called for by the European Parliament[54].

The baseline scenario and the four policy scenarios which reflect the different policy options are called respectively EUCO27, EUCO30, EUCO+33, EUCO+35 and EUCO+40[55].

Comparing the policy scenarios against REF2016 would show the costs (notably investment expenditure) necessary to achieve the GHG, Effort Sharing Regulations and RES target all together. Likewise, if compared to REF2016, benefits shown by a policy scenario are combined benefits of achievement of all targets. If, however, the policy scenarios are compared to EUCO27 (which is considered as the baseline), they only show incremental changes in impacts due to scaling up level of energy efficiency.

The mix of energy efficiency policies assumed for the scenarios follows the logic of the current European legislation. This policy mix involves policy instruments including carbon pricing to reduce emissions in the ETS and non-CO_2 emissions in the non-ETS sectors, standards, reduction of market barriers, incentives and obligations related to energy efficiency and RES policies in a coherent manner across Member States, taking into account the current policy framework (as developed in the REF2016). A top-down modelling approach was used to show the impacts of different energy efficiency levels on the energy system (e.g. energy mix) and macro-economic impacts (e.g. GDP, employment), social, environmental and health impacts. Energy efficiency policies are, however, depicted only in an aggregated and stylised manner which does not allow quantifying the achieved savings or costs of individual policy measures (e.g. Articles 7 or 9-11 of the EED).

The link between the policy scenarios and what they mean in practice can be explained in the following way: the energy efficiency targets are achieved by simulating a mix of European and national energy efficiency policies in all sectors: residential, tertiary, industrial, transport

53 Please see more information on the role and logic of baseline in the impact assessment accompanying the renewables initiative, Annex 4.

54 In December 2015 the European Parliament called "for three binding energy and climate targets for 2030, in particular the 40 % energy efficiency target; emphasises that the post-2020 EU energy efficiency target should be binding and implemented through individual national targets; urges the Commission to develop various 2030 energy efficiency scenarios, including at the level fixed by Parliament of 40 %" and "least 30 % for renewables" European Parliament P8_TA-PROV(2015)0444.

55 The PRIMES/GAINS modelling framework is used to analyse long term energy, transport and GHG emission trends in the EU. This modelling framework was used for the analysis underpinning the setting of the EU 2020 targets (including energy efficiency), the Low Carbon Economy and Energy 2050 Roadmaps, the 2030 policy framework for climate and energy and the Energy Efficiency Impact Assessment in 2014. The main difference to the energy efficiency modelling exercise performed in 2014 is that the energy efficiency policy scenarios in this Impact Assessment are based on the updated EU Reference scenario 2016. Therefore, the results are based on the latest energy projection. The discount rates used in the model have been reviewed. In addition, the policy scenarios differ slightly from the ones in 2014 in terms of policy mix.

and supply. The mix of energy efficiency policies assumed for the scenarios follows the logic of the current European legislation: the EED, the EPBD, regulations adopted under Eco-design, energy labelling and specific measures in transport (e.g. CO_2 standards for cars and vans). The stringency and intensity of the policy differs between the policy scenarios. Overall, the modelling aims to reflect a cost efficient achievement of GHG reductions in the context of different sets of GHG, energy efficiency and RES targets and existing policies[56].

The set-up of the five policy scenarios is different with respect to the intensities of the following policies:

- Standards (eco-design[57], building codes and CO_2 standards for vehicles) are intensified for all sectors in the different policy scenarios. Standards are an essential feature of a cost-effective approach. Both modelling experience and current practice show that the benefits in terms of economies of scale and overcoming market failures by using internal market rules are very important. For the most ambitious scenarios, the application of BAT (best available technology) in industry is assumed.
- Shadow Energy Efficiency Values (EEVs) were applied and scaled up representing yet to be identified policy measures aiming at achieving energy savings (notably reflecting implementation of Article 7, other national incentive and saving schemes). As EEVs apply to the entire residential, tertiary and industrial sector, they trigger the most cost-effective options in these sectors.
- The use of behavioural discount rates was adjusted with increasing energy efficiency levels in 2030. The Commission is working on improving financial instruments and other financing measures at the European level to facilitate access to capital for investment in thermal renovation of buildings. Together with further labelling policies for heating equipment and for other product groups, this can lead to a reduction of behavioural discount rates for households and the service sector.
- Some specific measures aimed at improving the efficiency of the transport system and managing transport demand are included as scenarios become more ambitious, in line with measures assumed in the scenarios presented in the Staff Working Document on Low Emission Mobility (e.g. full internalisation of local externalities on the inter-urban network, ambitious deployment of Collaborative Intelligent Transport Systems, promotion of efficiency improvements and multimodality, taxation).
- Policies were assumed which are facilitating the uptake of heat pumps for the scenarios more ambitious than EUCO27 to reflect option 3.b of the Article 7 analysis which would allow counting savings stemming from on-site renewable energies (e.g. heat pumps) within the 25% exemptions, more ambitious eco-design/labelling policies in this respect and the change of the primary energy factor.

A description of the approach and definition of the policy scenario is to be found in Annex 4.

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[56] While informative about the achieved additional emission reductions in case of coherent cost efficient actions across the EU in all policy areas to achieve all targets, these scenarios outcomes cannot be attributed to the effort sharing mechanism itself, which will sets targets differently from the cost effective outcome to allow for fairness between Member States.

[57] The modelling has shown that, with current assumptions about technology development, the potential of eco-design improvement is already exploited in the EUCO30 scenario.

As explained above, while some energy efficiency policies, notably standards for different product groups, are represented in greater detail, others are represented in an aggregated and stylised manner and the impacts of such policies are subject to higher uncertainty. Therefore the assessment regarding the level of the target would have to be complemented by specific assessments and associated analytical tools that would assess in more detail the effects of specific policy measures and instruments (but which lack a system-wide perspective). It is therefore likely that different policy mixes and specific policy instruments, different parameters of these policies (e.g. in case of CO_2 standards for cars and vans) and nature of instruments (e.g. regulation, voluntary agreement, financing, information campaign) from the ones assumed in this modelling exercise might be necessary, appropriate or desired.

4.1.2 Character and formulation of energy efficiency target

With regard to the character of the 2030 Energy efficiency target, the policy options start from the European Council Conclusions 2014 and the 2015 request from the European Parliament as described above.

Table 2: Policy options for Articles 1 and 3

Policy options	Articles 1 and 3
Option 1.1	Continuation of the current framework: Indicative EU target, indicative national pledges coupled with specific EU measures together with a governance system.
Option 1.2	Binding EU target, coupled with indicative national pledges and specific EU measures together with a governance system. This would replicate the intended approach for the renewable energy targets for 2030.
Option 1.3	Binding national targets.

With regard to the formulation of the 2030 Energy efficiency target, the options as shown in the table below are analysed.

Table 3: Policy options for Articles 1 and 3

Policy options	Articles 1 and 3
Option 2.1	Energy saving target
Option 2.2	Final and primary energy consumption target
Option 2.3	Either final or primary energy consumption target
Option 2.4	Final and primary energy intensity target

4.2 Attracting private investment – Policy options for Article 7

A set of policy options including non-legislative and legislative options are considered in order to address the drivers of the problems identified above.

Table 4: Overview of policy options for Article 7

Policy options	Article 7, Annex V (energy savings obligation)
Option 1 – No changes relating to regulatory framework	**Baseline scenario – no regulatory action at EU level; continue with guidance on regulatory framework and work on enforcement until 2020**
Option 2 – regulatory	**Extend Article 7 to 2030**
Option 3 – regulatory	**Extend Article 7 to 2030; simplify and update**
Option 4 – regulatory	**Extend Article 7 to 2030; increase the rate of savings**

4.2.1 Option 1: Baseline scenario – no regulatory action at EU level; continue with guidance on regulatory framework and work on enforcement until 2020

If pursued with this option, the regulatory framework which requires Member States to achieve annual savings of 1.5% from the annual energy sales under Article 7 of the Directive would expire after 2020. Under this option, the focus would be on continuing providing guidance to Member States on the application of the requirements of Article 7 and Annex V until 2020, such as what savings can be counted and on materiality or on the existing scope of eligibility (which were all assessed in the evaluation) in order to avoid delays in implementation and incorrect implementation.

At national level, energy efficiency obligation schemes would possibly continue in some Member States. Some alternative measures (in particular renovation of buildings) might also still be pursued although only as voluntary action and continue delivering some savings beyond 2020 and 2030 thanks to the long lifetimes of these measures. It is difficult to estimate to what extent such voluntary action would generate new savings, but it is likely that this would be minimal without EU intervention given the previous experience.

Exchange of best practice and experience through organising thematic workshops and seminars would be part of the work on enforcement. The focus would be on the annual monitoring of Member States' performance until the end of 2020, dialogue with Member States, and relevant infringement proceedings could also be taken in the context of the existing regulatory framework laid down to achieve the cumulative savings requirements by 31 December 2020 in line with Article 7(1).

While this option would reduce the risk of non-delivery of savings by 2020, it would however not address the issue of the short term perspective as Article 7 would cease to apply after 2020 and thus would not secure the needed investments to achieve savings and would not address the existing market and regulatory barriers in view of the 2030 target. This might in turn put a significant risk on the achievement of the EU 2030 energy efficiency target and also on the greenhouse gas emissions GHG target which depends strongly on energy efficiency measures (especially for non-ETS sectors) to be implemented in all Member States.

A number of respondents to the public consultation (including Member States) pointed out that guidance is needed on materiality and on which savings can be counted[58]. Many respondents stated that exchange of best practice through platforms and workshops is also needed.

The non-regulatory financial measures set out in the Smart Financing for Smart Buildings Initiative would enable a framework with greater private capital participation for in the sector. However, the necessary up-take of the opportunities offered by this framework would not be guaranteed and would be significantly lower without Article 7[59].

4.2.2 Option 2: Extend Article 7 to 2030

This option foresees the extension of Article 7 beyond 2020 while retaining the existing approach (1.5% of energy end-use savings from annual energy sales to be achieved via energy efficiency obligation schemes and/or alternative measures)[60].

Other options with a slower rate of savings are not investigated here because evidence shows that the current rate of savings is likely to be cost-effective in narrow terms, even without taking into account wider societal benefits[61].

In this option Article 7 will retain the same level of flexibility for Member States to fully or partially exclude energy sales in transport from the baseline (used by almost all Member States) or to use the four different exemptions up to 25% of the total saving requirement[62].

Besides flexibility in the calculation of savings requirement, Member States will retain their freedom how to achieve the energy savings in terms of selecting measures according to

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[58] Some also asked for more specific information on which savings may not be counted, for example under EcoDesign, the EPBD, and CO2 standards for vehicles, and also stated the need for clearer definition on lifetimes.

[59] Firstly, the injection of additional private finance as a result of the implementation of Article 7 would be missing (taking the form of finance coming from utilities driven by energy efficiency obligations; financing from firms driven by voluntary agreements; and financing from firms and individuals driven by tax incentives introduced to fulfil the requirements of Article 7). Secondly, Article 7 could not incentivise the aggregation of projects, notably through energy efficiency obligations and voluntary agreements. Thirdly, a strong regulatory framework would be missing as expressed by the Energy Efficiency Financial Institutions Group which said that "the importance of leadership and signalling for energy efficiency investments should not be underestimated in the context of the EU's 2030 Climate and Energy package; the headline positioning of energy efficiency targets would impact how EU buildings' energy use will decrease and decarbonize from now until 2050 with intermediate milestones. If the EU wants to unlock the enormous potential for energy savings in its existing building stock then it clearly requires bold policy intervention going beyond the strong implementation of existing legislation." (see https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report%20EEFIG%20v%209.1%2024022015%20clean%20FINAL%20sent.pdf).

[60] 68% respondents of the public consultation confirmed that Article 7 is an effective instrument to achieve final energy savings and 63% shared the view that Article 7 should be extended beyond 2020, as it is regarded as key contributor to the achievement of the 2030 target. The majority of NGOs and utilities and five out of ten Member States, which expressed an explicit view on effectiveness in the public consultation, considered Article 7 to be effective. The extension was supported by a majority of both participating NGOs and utilities. However, seven out of fifteen Member States, which expressed a view, did not support extending Article 7.

[61] In certain countries the cost of an average kWh delivered to final consumers has been estimated at about 14-23 times higher than the cost of saving one kWh of final energy - Rosenow, J., Bayer, E. (2016): Costs and benefits of the Energy Efficiency Obligation Schemes. Regulatory Assistance Project.

[62] This option requires no change of the existing flexibilities and exemptions under paragraph 2, as the evaluation showed significant use of the flexibilities and exemptions by Member States (see Annex 6) to continue recognising the different achievement levels and policy developments in Member States also in view of the next commitment period.

national situation and choosing the end-use sectors, including choosing how the savings are distributed over the whole commitment period as long the cumulative amount is achieved by the end of the period.

This flexibility will also be important to maintain coherence with the flexibilities foreseen for the achievement of the proposed more ambitious non-ETS GHG emissions targets in Member States under the Effort Sharing Regulation[63] in view of the 2021 to 2030 period.

Member States would be required to continue achieving new annual savings of 1,5% for ten year periods after 2030, unless review(s) by the Commission conclude that this is not necessary to achieve the Union's long term energy and climate targets for 2050.

4.2.3 Option 3: Extend Article 7 to 2030; simplify and update

As under the previous option, the extension of the period to 2030 would be in line with the general objective of aligning Article 7 with the overall 2030 framework for climate and energy. In addition to the elements analysed under option 2, this option aims at simplification and clarification of certain requirements posing most challenges in the current framework, in particular how to calculate savings.

Article 7 already allows Member States to impose requirements with a social aim, in particular related to energy poverty, on energy companies under their energy efficiency obligation schemes. The need to tackle energy poverty has been recognised politically at the EU level. Extending Article 7 to 2030 could encourage more Member States to include social aims in the measures they use to achieve their savings obligation in the next obligation period, in particular in relation to households affected by energy poverty[64]. If it were not considered appropriate to propose any regulatory action, consideration should be given to guidance, monitoring and reporting and exchange of good practice, etc.

Sub-option a) Simplification of what savings can be counted

The current Article 7 and Annex V lay down that only energy saving which are additional to those required under other EU legal requirements, can be counted for the purposes of Article 7. The evaluation shows that as it applies to savings calculated from national building codes[65], this requirement has been difficult to understand and to apply. It could be simplified by allowing Member States to count all savings stemming from energy efficiency renovations under national building codes, not only those above the cost-optimal level set in accordance with the Energy Performance of Buildings Directive, provided the materiality criterion[66] is fulfilled. This would facilitate the calculation of savings triggered by energy efficient

[63] The recent evaluation Study on the Effort Sharing Decision refers to the EEA Report (2014) pointing out that there are a number of positive synergies and that energy efficiency measures (i.e. EED and EPBD) help meeting the targets under the Effort-Sharing Decision.

[64] Four Member States have foreseen such measures (Austria, France, Ireland and the United Kingdom) under their EEOS.

[65] This is borne out by the responses of the Member States to the consultation, and in their replies to the structured dialogue with the Commission through the EU Pilot system – see Annex 3.

[66] In line with Annex V(2)(c), the activities of the obligated or participating parties must demonstrably contribute to the achievement of the energy savings claimed for the purposes of Article 7. I.e. that the actions of obligated and participating parties have actually contributed to the energy savings caused by the uptake of renovation of buildings.

renovation of buildings. This option would trigger more renovations of existing buildings, encourage long term energy saving measures and also ensure greater coherence with the EPBD.

Under this option the Commission would aim to develop a harmonised notification template (as suggested by the evaluation[67]) for Member States to submit the Article 7 notifications for measures in the 2020-2030 period, which would then be integrated in the national energy and climate plans under the governance initiative of the Energy Union.

Sub-option b) Allow counting on-building RES

This sub-option looks at whether Member States and obligated parties could be allowed to count to some extent on-building renewable energy measures[68] towards their Article 7 savings requirement[69].

4.2.4 Option 4: Extend Article 7 to 2030, increase the rate of savings

Similarly as under the previous options 2 and 3, the extension of the commitment period to 2030 would be in line with the general objective of aligning Article 7 with the overall 2030 framework for climate and energy. Two different levels of increased annual savings requirement for future obligation periods are examined while retaining the existing flexibilities and exemptions under Article 7(2).

Sub-option a) 1,75% savings per year;

Sub-option b) 2,0% savings per year.

These more ambitious levels should be looked only in conjunction with more ambitious scenarios for the energy efficiency target in 2030[70].

4.3 Empowering consumers - Policy options for Articles 9-11

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67 See SWD (2016) Evaluation Art7.

68 For example, installing heat pumps or solar thermal collectors etc.

69 A large majority of stakeholders (70%) shared the view that the scope of Article 7 should be clarified, and 67% (9 Member States) out of these favoured the extension of the scope to, for example, 'savings from energy management systems' (88), 'primary energy savings from the utilisation and recovery of waste heat' (68) and 'savings from switching from fossil fuel heating and cooling to renewable energy use' (55). On the other hand, 25% stated that the scope should be only end-use energy savings, as is currently the case and 8% provided other views. Most utilities favoured extension of the scope to measures e.g. that increase efficiency of district network infrastructure and generation (which is already possible under exemption (c) of paragraph 2 subject to certain requirements under Article 14 of the EED, including from providing storage capacities). On the other hand, most NGOs considered that that the scope should only be end-use energy savings, as it is at the moment.

70 Moreover, any decision to pursue energy savings during the next decade at a faster rate than during this one should be accompanied by a broader comparison of the merits of different measures to support this goal (see chapter 5).

This impact assessment considers options with respect to thermal energy forms only – that is, metering and billing of heating, cooling and hot water supplies. Electricity and gas aspects will be addressed in the context of the Market Design Initiative.

Given that the objectives are essentially to clarify and simplify the existing requirements in certain places (taking advantage of the fact that EED Articles 9-11 in the future would focus on thermal energy carriers only), whilst at the same time addressing some specific policy objectives already announced in the New Deal for Energy Consumers Communication and in the Heating and Cooling Strategy, only two options are considered: Non-regulatory (based on further guidance) and regulatory clarification and updating of provisions relating to thermal systems.

It should be stressed that Article 9(3) was introduced with the EED and the deadline for the application of its second subparagraph is only 31 December 2016. It is, therefore, premature to evaluate and change that particular subparagraph. However, the ongoing transposition work has already exposed challenges related to ambiguities in other provisions.

Table 5: Overview of options proposed in relation to Articles 9-11

Option	**Option 1**	**Option 2**
Short title **Component/sub-options**	**Non-regulatory guidance**	**Clarification / updating**
• Further **guidance** related to thermal energy in multi-unit buildings	✓	✓
• **Simplification and clarifications** of min. billing requirements, e.g. - Applicability to sub-metering - Simplified feasibility conditions for billing & billing info - Nature of comparisons	(✓)	✓
• **Heat meters/cost allocators must be remotely readable to enable enhanced consumption feedback** - if installed after 1 January 2020 - anywhere as of 2022 • Member States required to introduce **transparent rules on cost allocation**		✓
• **Further clarifications and simplifications** - Improving coherence & eliminating redundancy		✓

4.3.1 Option 1: Non-regulatory – Continue with the existing framework but give further guidance

Under this option, Articles 9 to 11 would not be changed with respect to thermal energy, and the focus would be on implementation and enforcement of the existing provisions based on the already issued Commission guidance note of November 2013 and on further guidance. Such further guidance is currently already under development with respect to heating, cooling and hot water in multi-apartment/purpose buildings[71]. This further guidance in particular focuses on the good practices for the application by Member States of the technical feasibility and cost-effectiveness criteria in Article 9(3), but could conceivably be expanded to include further guidance on any other issue related to the interpretation and implementation of Articles 9-11.

The key arguments in favour of this option are regulatory stability as the Directive is relatively recent.

4.3.2 Option 2: Clarification and updating of provisions relating to thermal systems

Under this option, in addition to the guidance already under development referred to under Option 1, Articles 9-11 of the EED and Annex VII would be changed to clarify, simplify and modernise with respect to thermal energy whilst they, in so far as electricity and gas are concerned, would be consolidated with the provisions in the Internal Energy Market legislation and any future changes proposed to these as part of the Market Design Initiative. More specifically, the following sub-options could be considered:

1.1. Require heat measurement devices (meters or heat cost allocators) to be remotely readable
- If they are newly installed as of 1 January 2020;

- Anywhere by 1 January 2027.

Both would aim at enabling transition to at least monthly feedback by 2022 for all buildings where meters or heat cost allocators are in place.

1.2. Require that Member States "shall" rather than "may" introduce transparent rules on cost allocation (cf. Article 9(3)).

1.3. Clarification and simplification

1.3.1. General clarification of applicability to sub-metered heat consumers (in particular clarify the extent to which obligations relating to "final customers" in Articles 9, 10 and 11 apply to consumers in multi-apartment/purpose buildings supplied with thermal energy from a central source).

[71] See draft from June 2016, "Specific guidelines for sub-metering of thermal energy in multi-unit buildings (implementation of Articles 9-11 of Directive 2012/27/EU on energy efficiency", https://ec.europa.eu/energy/en/studies?field_associated_topic_tid=45.

1.3.2. Clearer and simpler nature of obligations in Annex VII, section 1.1 (=replace "technical and cost-effectiveness" conditions for consumption and frequent billing with condition of whether or not meters/heat cost allocators are installed, and whether they are remotely readable).

1.3.3. Clarify the nature of minimum information elements (e.g. mandatory climate correction of heating and cooling comparisons and graphic comparisons).

1.3.4. Address certain overlaps between Annex VII 1.2.c and 1.3 (by deleting 1.3).

1.3.5. Clarify the respective role of the current Article 9(1) and 9(3) in respect of thermal energy forms, so that paragraph one of Article 9 is about metering (at entry of customer/building premises), and paragraph 2 is about sub-metering (in multi-unit buildings).

In the public consultation, 43% of all respondents expressed the view that the EED provisions on metering and billing are sufficient to guarantee all consumers easily accessible, sufficiently frequent, detailed and understandable information on their own consumption of energy, versus 32% who opposed this view and 25% who had no view. Most "free text" comments were provided by participants who did not think that the provisions are sufficient. Many argued that energy bills would be too complex to be properly understood by most customers. Furthermore, certain energy bills would be provided only once per year, which would not suffice to incentivise behavioural change. Yet others called attention to the possibility that suppliers are exploiting the conditionalities of the articles, so as to avoid having to provide individual metering. Finally, several participants also called for more live energy consumption data, which could be expressed in terms of Kilowatt hours and Euros.

At the stakeholder event organised in Brussels on 14 March 2016, support was expressed for both options 1 and 2.

5 Assessment of policy options

5.1 2030 energy efficiency target level

The sections below present a comparison of impacts of the different policy scenarios representing different level of ambition of the overall EU 2030 target with the baseline scenario. Each target is achieved applying a cost-effective approach within the values attributed to parameters used in the model, *i.e.* exploiting first the options with lowest costs in the targeted sectors across the countries as this is inherent feature of the PRIMES model. A multi-dimensional analysis of different levels of ambition is performed using also other models and assessments resulting in a comprehensive overview of benefits and costs of different ambition levels.

As described above, it needs to be kept in mind that a comparison of the policy scenarios against REF2016 would show the costs (notably investment expenditure) necessary to achieve the GHG, Effort Sharing Regulation and RES target all together. Likewise, if compared to REF2016, benefits shown by a policy scenario are combined benefits of achievement of all targets. If, however, policy scenarios are compared to EUCO27, they only show incremental changes in impacts due to scaling up level of energy efficiency. Therefore, EUCO27 is considered as the baseline scenario in this impact assessment.

The overall level of ambition would need to be delivered by policies at both European and national level. In order to represent the targets by scenarios, a series of assumptions was made about policies that would lead to achievement of targets (see Annex 4). The assumptions follow the logic of the current policy mix. These assumptions read together with impacts on energy consumption indicate in which sectors the highest efficiency gains lie (residential, tertiary) and indicate the broad level of ambition of the specific measures – be it standards or energy efficiency obligations. These assumptions, however, do not prejudge the policy set-up that will be put in place in order to achieve the targets in the next decade. The impacts of intensifying the current policy mix – as assumed in the policy mix of respective scenarios – are shown below.

5.1.1 Energy system impacts

5.1.1.1 **Primary energy and fuel mix**

Despite growth in EU GDP[72], **gross inland energy consumption and primary energy consumption**[73] are, by construction, reduced step-wise according to the increasingly ambitious options for the energy efficiency target for 2030. The absolute values for consumption and changes in consumption compared to the 2007 baseline, REF2016 projections and 2005 historical values can be found in Table 6. A target of 27% energy efficiency would equal primary energy consumption of 1369 Mtoe in 2030. When increasing the target to 30%, primary energy consumption is 1321 Mtoe in 2030. The policy scenarios demonstrate significant differences in terms of **the consumption of various primary energy sources**.

- As regards **solid fuels** (in particular coal), absolute gross inland consumption is significantly reduced in EUCO27 in comparison to REF2016. For EUCO30, EUCO+33 and EUCO+35 solid fuels consumption increases slightly compared to EUCO27 but still remains well below the solid fuel consumption in the REF2016. The highest intensity of energy efficiency measures leads to an overall reduction of solids consumption. In general lower ETS prices allow maintaining consumption of solids as the scenarios become more ambitious. Also, energy efficiency measures tend to target more specifically gas and oil consumption, as they represent the main fuel in, respectively, heating and transport energy consumption. In the most ambitious EUCO+40 scenario, GHG emission levels are reduced by more than 40% and consequently the required reduction in solid fuels consumption is stronger.
- For **oil**, the absolute reduction of consumption is closely linked with transport policies, notably CO_2 standards for light duty vehicles becoming more stringent. Additional reductions in oil consumption vary from 2% in EUCO30 to 9% in EUCO+40 compared to EUCO27.
- **Natural gas** is the fuel for which the reduction of consumption is most pronounced. The more ambitious the energy efficiency target, the higher are the reductions achieved as energy efficiency policies improve the thermal integrity of buildings

72 The GDP growth projections are established by DG ECFIN and are 1.2% p.a. over the period 2010-2020 and 1.5% p.a. over the period 2020-2050.

73 Gross Inland Consumption minus non-energy uses.

which reduces gas consumption. EUCO27 reduces gas consumption by 5% compared to REF2016. EUCO30 further reduced natural gas consumption by 10% compared to EUCO27. In EUCO+33, the reduction amounts to 19%. In the most ambitious scenario EUCO+40, gas consumption is reduced by 34% compared to EUCO27 baseline.

- Absolute consumption of **nuclear** decreases in 2030 in all scenarios.
- The consumption of **renewables** reflects the achievement of the target of 27% (or even overshooting it as in case of EUCO+ scenarios) of RES in gross final energy consumption[74]. As energy consumption decreases with increased energy efficiency, the shares of renewables in electricity, heating and cooling and transport "mathematically" increase. However, absolute consumption of renewables also declines (see table below) especially in heating and cooling as renovation of buildings reduces the need for all sources of heating and cooling, including renewable energy[75].
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Table 6: **Impacts on energy consumption**

Impacts on energy consumption (2030)	**Ref2016[76]**	**EUCO27**	**EUCO30**	**EUCO+33**	**EUCO+35**	**EUCO+40**
Gross Inland Energy Consumption (Mtoe)	1554	1486	1438	1377	1337	1245
Primary Energy Consumption (Mtoe)	**1436**	**1369**	**1321**	**1260**	**1220**	**1129**
Change in primary energy consumption in 2030 compared to 2007 Baseline (1887 Mtoe in 2030) (% change)	-23.9	-27.4	-30.0	-33.2	-35.3	-40.1
Change in primary energy consumption compared to REF2016 (Mtoe)		-67	-115	-176	-216	-307
Change in primary energy consumption compared to REF2016 Reference (% change)		-4,7	-8,0	-12,3	-15,0	-21,4
Change in primary energy consumption compared to historical 2005 energy consumption levels (1713 Mtoe in 2005) (% change)	-16	-20	-23	-26	-29	-34
Reduction requirement starting from the 2020 primary energy consumption target (1483 Mtoe) (Mtoe)	-47	-114	-162	-223	-263	-354
Reduction requirement starting from the 2020 primary energy consumption target (1483 Mtoe) (% change)	-3	-8	-11	-15	-18	-24
Energy Intensity (2005 = 100) (*primary energy to GDP)*	63	60	58	56	54	51
Gross Inland Consumption for REF and EUCO27 (Mtoe)	1554	1486	-3	-7	-10	-16

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74 This level was set by construction for all policy scenarios.

75 It should be noted that increased share of RES contributes to the achievement of the energy efficiency target when it is expressed in primary energy, through increased statistical efficiency in power generation.

76 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

and % change from EUCO27						
- Solid fuels	185	164	4	1	2	-8
- Oil	513	470	-2	-4	-6	-9
- Natural gas	371	351	-10	-19	-24	-34
- Nuclear	187	187	-1	-2	-3	-11
- Renewables	297	314	-3	-7	-11	-15
Gross Inland Energy Consumption Shares (%) of:						
- Solid fuels	12	11	12	12	12	12
- Oil	33	32	32	33	33	34
- Natural gas	24	24	22	21	20	19
- Nuclear	12	13	13	13	14	13
- Renewables	19	21	21	21	21	21
Renewables Shares (%) in gross final consumption - Overall	24	27	27	28	28	28
- Share in heating & cooling	25	27	26	29	28	28
- Share in electricity	42	47	49	49	48	51
- Share in transport[77]	14	18	19	19	20	22
Overall RES consumption (Mtoe)	273	292	279	274	261	245
- RES consumption in heating & cooling	124	128	117	114	107	92
- RES consumption in electricity	128	143	142	140	135	133
- RES consumption in transport	39	46	48	48	49	53

Source: PRIMES

If the 2020 target is met, primary energy consumption will be 1483 Mtoe in 2020. This means that EU28 would have reduced energy consumption by **173 Mtoe over 10 years from 2010 to 2020**. To achieve a 27% energy efficiency target the EU would need to reduce its energy consumption by 114 Mtoe from 2020 to 2030. A 30% target would require the EU28 to save **162 Mtoe** in the next 10 year period between 2020 and 2030. The achievement of an almost similar energy consumption reduction could be facilitated by technological progress and experience gained in recent years. In addition, the realisation of remaining energy efficiency potentials in regions and sectors with currently low energy efficiency levels could contribute to achieve broadly the same amount of energy consumption reduction as in 2010-2020.

5.1.1.2 **Final energy consumption and sectoral split**

Energy efficiency policies affect final energy consumption in all four sectors: residential, tertiary, industrial and transport. As scenarios become more ambitious the reductions in energy demand become more significant across the four sectors. In the scenarios presented, energy efficiency improvements are most prominent in the residential and tertiary sectors. Energy efficiency improvements are lower in industrial and transport sectors, reflecting the current policy instruments and in the case of transport, the projected growth trend in activity.

As shown in Table 7 reductions in the **residential sector** range from 9% for EUCO30 to 37% for EUCO+40 compared to the baseline EUCO27. Similarly, reductions in the **tertiary sector** range from 9% to 35%. These reductions reflect decreasing demand for heating and cooling

[77] The share of renewables in transport is based on the definition as amended by the ILUC Directive.

due to buildings' thermal renovation, behavioural change[78], improved efficiency of heating and cooling appliances, including higher uptake of heat pumps and lower demand for electricity from other appliances.

For the **transport sector**, reductions range from 1% to 5%. The key drivers are the assumptions on CO_2 standards for light duty vehicles, which become more stringent as the scenarios become more ambitious. Other measures affect heavy duty vehicles and transport demand, but their impact is smaller.

In REF2016 there is already a reduction in energy demand in the industrial sector that reflects the increased energy efficiency embedded in newer production assets and the structural changes towards higher value added and less energy-intensive production. In the policy scenarios PRIMES modelling shows that reductions in industry range from 0.5% to 12% compared to the baseline EUCO27. They are mainly driven by the ETS and by the impact of ecodesign on performance of industrial motors. In the most ambitious scenarios horizontal energy efficiency measures and application of Best Available Technologies (BATs) have also a considerable impact[79].

Final energy consumption reduces as scenarios become more ambitious. In EUCO30 gross final energy consumption for heating and cooling demand is reduced by 7%, electricity demand by 3% and transport energy demand by 2% compared to the baseline EUCO27. The reductions increase in the EUCO+ scenarios. In order to see the effects of ecodesign, it is useful to focus on the residential sector performance in EUCO30 where heating and cooling useful energy per appliance use is reduced by 18 Mtoe, for water heating and cooking by 5 Mtoe, and for electrical appliances and lighting by 2 Mtoe compared to the REF2016 baseline EUCO27.

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[78] Modelled by scaling up Energy Efficiency Values (EEVs) as scenarios become more ambitious – please see Annex 4 for more information.

[79] The energy efficiency values (EEVs), scaled up as scenarios become more ambitious, were also applied to industrial sector (in all policy scenarios except baseline EUCO27). However, lower EEVs were applied than in residential and tertiary sectors in order to reflect the fact that industrial sector is already partly exposed to ETS and that many MS have so far chosen to exempt industrial sector from energy efficiency measures. EEVs make impact only at higher levels and thus mostly in EUCO+ scenarios.

Table 7: Other energy system impacts

Other energy system impacts (2030)	Ref2016[80]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Final Energy Demand (Mtoe)	1,081	1,031	987	929	893	825
Industry	270	269	268	259	251	237
Residential	288	267	243	213	199	169
Tertiary	179	166	152	135	127	108
Transport[81]	344	329	324	322	316	312
Reduction requirement starting from the 2020 final energy consumption target (1086 Mtoe) (Mtoe)	-5	-55	-99	-157	-193	-261
Reduction requirement starting from the 2020 final energy consumption target (1086 Mtoe) (% change)	-0,4	-5,0	-9,1	-14,4	-17,8	-24,0
Final Energy Demand in REF2016 and EUCO27 (Mtoe) and change from EUCO27 (% change)	1,081	1,031	-4.3	-9.9	-13.4	-20.0
Industry	270	269	-0.5	-3.8	-6.7	-12.0
Residential	288	267	-9.2	-20.4	-25.6	-36.9
Tertiary	179	166	-8.6	-18.5	-23.9	-35.0
Transport	344	329	-1.2	-2.0	-3.9	-5.1
Change in Final Energy Demand - compared to 2005 levels (1191.3 Mtoe in 2005) (% change)	-9,2	-13,4	-17,1	-22,0	-25,1	-30,7
Industry[82]	-17,6	-17,8	-18,2	-20,9	-23,3	-27,7
Residential[83]	-6,4	-13,1	-21,1	-30,8	-35,3	-45,2
Tertiary[84]	-2,3	-9,4	-17,1	-26,2	-31,0	-41,1
Transport[85]	-6,3	-10,7	-11,8	-12,5	-14,1	-15,2
Gross final energy consumption (Mtoe)	1,133	1,086	1,040	987	948	876
Heating and cooling	485	454	423	373	350	304
Electricity	302	302	292	286	278	260
Transport	274	256	252	250	242	239
Gross final energy consumption - REF2016 and EUCO27 (in Mtoe) and change from EUCO27 (% change)	1,133	1,086	-4	-9	-13	-19
Heating and cooling	485	454	-7	-18	-23	-33
Electricity	302	302	-3	-5	-8	-14
Transport	274	256	-2	-3	-5	-7
Residential sector: Useful energy per energy use (in Mtoe)						
- Heating and cooling	184	169	151	128	118	94
- Water heating and cooking	56	51	46	39	36	29
- Electric appliances and Lighting	48	48	46	46	45	45

Source: PRIMES

80 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency ((≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

81 Including pipeline transportation, ground activities in airports and harbours, etc.

82 Compared to 328 Mtoe in 2005 according to PRIMES.

83 Compared to 308 Mtoe in 2005 according to PRIMES.

84 Compared to 183 Mtoe in 2005 according to PRIMES.

85 Compared to 368 Mtoe in 2005 according to PRIMES.

Box 1: Bottom-up modelling of energy efficiency in the industrial sector[86]

In addition, a bottom up analysis using the ICF Industrial Energy Efficiency Model (IEEM) has been carried out to assess impacts in particular of a continuation and intensification of eco-design measures, the continuation of an energy efficiency obligation scheme post-2020 and better access to finance for energy efficiency actions for the industrial sector[1]. Analysis indicates that the individual saving impacts of eco-design policies are 1.8 Mtoe in the industrial sector in 2030 compared to the REF2016. Extending the energy efficiency obligation schemes would lead to 15 Mtoe saving in the industrial sector and improved access to finance to 11.8 Mtoe in 2030. The combined impact would be 28.6 Mtoe compared to the REF2016. There is limited overlap between policies on finance and energy efficiency obligation schemes, since policies are targeting different areas – either the supply side finance or the demand side of finance. The bottom-up model shows higher impacts of the three policy areas than the top-down energy model PRIMES.

Table 8 shows that all policy scenarios reduce demand for electricity in 2030 thanks to eco-design, continuation of energy efficiency obligations, other Member State energy efficiency policies and EBPD requirements. Nevertheless, the electrification of transport[87] starts to be visible in 2030 as shown by the stock of electric vehicles and consequently electricity demand in transport grows as scenarios become more ambitious. One modelling assumption was also the increase of electrification of heating in households (notably with policies facilitating the uptake of heat pumps)[88]. This will lead to an increased number of households with electric heating which drives up the demand for electricity in residential sector. The overall demand for electricity in households, however, declines in EUCO30 compared to EUCO27, and in EUCO+35 and EUCO+40 thanks to a larger impact of energy efficiency measures.

As a result of a higher share of RES in power generation, the carbon intensity of power generation decreases in baseline EUCO27 and all policy scenarios compared to the EU Reference scenario.

As the scenarios become more ambitious, thermal power generation capacity decreases (mostly gas - disadvantaged by the low ETS prices), whereas nuclear capacity remains stable. An increase of the energy efficiency target from 27% to 30% would reduce the net installed power generation capacity of thermal power plants by 10 Giga Watt and further reductions are achieved as scenarios become more ambitious. This shows that energy demand measures can

86 ICF Draft Interim Report July 2016 (Contract ENER/C3/2016-51. modelling concrete energy efficiency measures in energy intensive industries for the review of the Energy Efficiency Directive).

87 Electrification of transport is driven by CO_2 standards for LDVs. The standards are more stringent as the scenarios become more ambitious. In the EUCO+40 scenario, the CO_2 standards reflect the most ambitious edge of the European Parliament's proposal for 2025 CO2 standards for LDVs – such standards would lead to stronger electrification of the fleet and a visible increase in electricity demand from transport.

88 To reflect option 3.b of the Article 7 analysis which would allow counting savings stemming from on-site renewable energies (e.g. heat pumps) within the 25% exemptions, more ambitious eco-design/labelling policies in this respect or the change of the primary energy factor.

replace energy supply investments[89]. These reduced capacity investments lead to lower electricity prices.

Table 8 indicates also the penetration of electric heating in households and of electric light duty vehicles which is result of policies assumed. It also indicates the increase of efficiency of white and black appliances brought by the policies assumed.

Table 8: Electricity indicators

Electricity indicators (2030)	Ref2016[90]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Gross Electricity Generation (*TWh*)	3,528	3,526	3,413	3,341	3,246	3,035
- Solids Share	16.0	13.8	14.8	15.1	15.7	15.1
- Oil Share	0.5	0.5	0.36	0.37	0.39	0.36
- Natural Gas Share	17.9	15.1	12.3	11.6	11.1	9.2
- Nuclear share	22.0	22.0	22.5	22.8	23.1	22.8
- Renewable share	42.9	47.7	49.1	49.3	48.8	51.5
of which hydro share (%)	10.7	10.8	11.1	11.4	11.6	12.5
of which wind share (%)	17.2	19.6	20.3	20.2	19.8	20.6
of which Solar, tidal, etc. share (%)	6.6	8.7	9.0	9.1	9.0	9.7
of which Biomass & waste share (%)	8.0	8.4	8.5	8.4	8.2	8.5
Carbon intensity of power generation (t of CO2/toe of GIC)	0.20	0.18	0.18	0.18	0.19	0.18
Net Installed Power Capacity (in GWe)						
- Thermal power	379	369	359	354	352	347
- Nuclear	110	110	110	110	110	110
- Renewables	571	652	656	646	625	623
Electrification: number of HH with electric heating (in millions)	16	22	30	48	48	53
Electrification of transport: total stock of electrically chargeable (full electric, plug-in hybrids and fuel cells) cars and vans (in millions)	15,8	34,2	39,8	39,9	45,8	55,5
Final Energy per appliance type (ktoe)						
- Lighting	3,371	3,311	3,333	3,328	3,334	3,308
- White appliances	16,724	16,604	15,945	15,926	15,926	15,874
- Black appliances	28,068	27,623	26,256	26,255	26,238	26,195

Source: PRIMES

5.1.1.3 Energy imports

Although the import of fuels is not an energy security problem in every case, the magnitude and nature of, in particular, oil and gas imports, magnified by the projected reduced domestic production in the next decades, raise specific energy security issues. Energy efficiency policy can contribute to reducing energy imports in total – especially gas and oil imports. By reducing the overall scale of imports, energy efficiency helps lowering the magnitude of

[89] Also the IEA found that energy efficiency avoided over 1 trillion USD in investment needs in electricity generation in the past. International Energy Agency (2016): Energy Efficiency Market Report 2016 (see http://www.iea.org/publications/freepublications/publication/mediumtermenergyefficiency2016.pdf).

[90] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

potential disruptions of the economy because of supply severance or price shocks. Policies aiming at improving thermal integrity of buildings (stricter building codes, measures accelerating renovation rates and electrification of heating) reduce gas consumption since some 65% of gas in Europe is used for heating. CO_2 standards for LDVs, additional measures aiming at more efficient transport and demand management reduce oil consumption since road transport currently depends on oil products for 94% of its energy use.

Energy efficiency policy thus plays an important role in increasing the security of supply (together with diversification of suppliers and supply points, domestic renewable energy production, ensuring proper fuel stocks and building interconnectors), which is currently a political priority and one of the five dimensions of the Energy Union Strategy.

Net energy imports in 2030 decrease significantly for all scenarios. While the reduction of net energy imports in 2030 (in comparison to the year 2005) is 14% for EUCO27 baseline, the more ambitious scenarios achieve between 18 and 31% reductions. The trend is even more pronounced in 2050 (where for all scenarios imports more than halve in comparison to the year 2005). Looking at fuels separately:

- **Solids imports** are reduced compared to the REF2016 in 2030. In 2050 imports of solids would be only 1/10 of the 2005 level in all the scenarios.

- **Imports of oil** are significantly reduced but do not vary strongly among the scenarios. In EUCO27 they are reduced by 20% compared to 2005 levels and in more ambitious scenarios the reductions range from 21 to 27%. In 2050 imports of oil would be halved in comparison to 2005.

- **Imports of gas** are significantly reduced and fall further with the overall ambition of the energy efficiency target. In EUCO27, gas imports are lower than in the REF2016 but are still 10% higher compared to 2005 levels. However, in EUCO30 gas imports could be reduced by 3% compared to 2005 levels which would decrease Europe's dependency on gas imports considerably. In the more ambitious scenarios (EUCO+) reductions (from 2005 levels) range from 16 to 36%. In 2050 imports of gas would be halved in comparison to 2005.

The net monetary cost of fossil fuel imports decreases in 2030 as scenarios become more ambitious. Comparing EUCO30 to EUCO27 the average annual net cost of imports (in period 2021-2030) is 2% lower whereas for more ambitious scenarios the reductions in net cost of imports would range between 3% and 7%. As oil prices are higher than gas prices and are projected to increase faster, the differences are well pronounced in net cost of oil imports even though imports of oil do not vary strongly among the scenarios. In addition, strong energy efficiency policies can have impacts on international fuel prices as shown in the following section.

In the period 2021-2030 the target of 30% would bring a cumulative €70 billion saving in fossil fuels import bills in comparison to a 27% target. For more ambitious scenarios, the cumulative savings would range from €147 to 288 billion. The savings would be even greater in the period 2031-50.

Table 9: Impacts on energy security

Impacts on energy security (2030)	Ref2016[91]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Net Energy Imports Volume (2005=100)	93	86	82	77	75	69
- Solids	67	57	59	57	57	52
- Oil	88	80	79	77	75	73
- Gas	116	110	97	84	78	64
- Renewable Energy	796	848	804	803	785	762
Import Dependency[92] (% net imports to total gross inland energy consumption)	57	54	53	53	52	52
Gas imports (bcm)	327,5	309,2	272,7	236,7	220,2	181,5
Reduction compared to EUCO27 (bcm)			-36.4	-72.4	-88.9	-127.6
Reduction compared to EUCO27 (% change)			-11.8	-23.4	-28.8	-41.3
Value of Fossil Fuel Net Imports (billion €'10) *(average annual 2021-30)*	449	427	420	413	407	399
- Oil	326	309	307	303	300	296
- Gas	111	107	102	97	96	91
- Solids	12	11	12	12	12	12
Fossil Fuels Import Bill Savings compared to EUCO27 (billion € '10) (cumulative 2021-30)	4494	4274	-69.6	-147.3	-199.3	-287.5

Source: PRIMES

5.1.1.4 Electricity, ETS and international fuel prices

The result of the modelling of the different policy options is the projected electricity price which is one of main economic impacts directly affecting all energy consumers. The electricity price increases slightly from 158 €/MWh in REF2016 to 161 €/MWh in EUCO27 as additional investments in RES power generation and higher ETS prices have to be recuperated. Lower investments in power generation capacity, partly offset by the need to spread fixed costs over smaller amounts of electricity sold, contribute to slightly lower electricity prices in policy scenarios with higher energy efficiency levels than 27%.

[91] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

[92] Import dependency is defined in the table as the ratio between all fossil fuel imports and total energy consumption and, in contrast to absolute import quantities, in 2030 it shows little differences between scenarios with respect to the baseline scenario. This is mostly because energy consumption and energy imports decrease hand in hand. In general, the import dependency indicator should be interpreted with caution as the denominator of the ratio (total energy consumption) decreases with the overall level of energy efficiency target. It is more illustrative to use the absolute numbers of gas and oil imports to assess the impact of energy efficiency policies on security of supply.

The model runs show that for energy efficiency targets of 30% or higher, the primary impact is to lead to extra abatement of GHG emissions in sectors outside of the EU ETS (see Table 17).

The ETS carbon price in 2030 differs substantially across the various scenarios, reflecting the effect energy efficiency measures can have on emissions in the ETS sectors (via reduction of demand for electricity) and their interactions with other target levels. In REF2016, the ETS price is projected to reach 34 €/tCO2 in 2030. In EUCO27 scenario, which requires higher reductions due to a higher linear reduction factor, it increases to 42 €/tCO2.

Higher levels of energy efficiency levels than in EUCO27 result in a corresponding reduction in electricity consumption which leads to a lower demand for ETS allowances with a given ETS cap, which in turn can also contribute to reduced demand for allowances for hedging emissions from the power sector. Overall this can impact carbon prices downward.

For instance, in EUCO30 which increases by design energy efficiency levels by 3 percentage points while keeping the GHG and ETS target constant, the substitution of other emission reduction measures by energy efficiency clearly lowers the carbon price below REF2016 levels.

In the policy scenarios with higher energy efficiency levels, notably the step up to EUCO33+, while reductions are mainly driven by specific energy savings policies, the ETS continues to contribute to the achievement of the higher energy efficiency levels. The result is a more limited carbon price impact, but further reductions in emissions by 2030.

Stronger demand side policies that address specific market failures can significantly reduce the direct CO_2 costs of businesses subject to the EU ETS, but also reduce the positive incentive the ETS gives towards low carbon investments. On the other hand, the results also show that the ETS can incentivise energy efficiency if emissions reductions are adapted consequently.

A word of caution is necessary with regard to the absolute values of the resulting carbon prices. The modelling tries to reflect some features of the Market Stability Reserve in a stylised way, but can only approximate it with its five year steps and its foresight assumptions, and the exact interactions are uncertain. The new Market Stability Reserve gradually reduces allowances on the market to counteract the over-supply of allowances under specific circumstances. In very ambitious energy efficiency conditions, reduction of energy consumption in sectors whose emissions are covered by the ETS might cause a faster reduction in emissions compared to the decline in the overall number of allowances which are taken out of the ETS market until 2030 through the new Market Stability Reserve. However, if the decline in emissions is too strong due to ambitious energy efficiency policies, this might lead to imbalances between supply and demand in the ETS which might no longer be counteracted by the new Market Stability Reserve.

The concrete impacts of energy efficiency policies on the ETS price will depend on the sectors and fuels which energy efficiency policies affect. If the focus is mainly on the non-ETS sector, the impacts on the ETS price will be smaller than if energy efficiency policies focus on the ETS sectors.

Table 10: Electricity and carbon prices

Electricity, carbon prices and ETS emissions (2030)	Ref2016[93]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Average Price of Electricity (€/MWh)	158	161	157	158	157	159
ETS carbon price (€/t of CO2-eq)	34	42	27	27	20	14
ETS emissions (% below 2005)	-37.7	-43.1	-43.1	-44.3	-44.2	-48.3

Source: PRIMES

As in the energy efficiency Impact Assessment 2014, the impact of energy efficiency policies on international fuel prices was modelled, using the POLES model[94]. The results indicate that European energy efficiency policies would have some impact on international energy prices. This can be explained because of the significant reduction of the gas demand in the residential and tertiary sector. The results show that the international gas price in 2030 would be 1.1-.4.3% less than in the EUCO27, and the international oil price would be 0.3-1.4% less with energy consumption reductions of 30-40% in 2030 compared to EUCO27[95]. Coal prices are relatively unaffected.

Table 11: International fuel prices compared to EUCO27 (average 2020-2030)

International fuel prices compared to EUCO27 in % (average 2020-2030)	Ref2016	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
International oil prices	-	-	-0.3%	-0.6%	-1.0%	-1.4%
International gas prices	-	-	-1.1%	-2.3%	-3.0%	-4.3%
International coal prices	-	-	0.02%	0.01%	0.01%	-0.03%

Source: Poles, JRC

93 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

94 See Annex 4 (chapter 4.11) for further information.

95 The analysis has been produced using EU28 primary fuel demand from the scenarios analysed in this Impact Assessment (differentiated by fuel: oil, gas, coal) has been replicated in the POLES model. The modified demand affects the international fuel prices which decrease: a) the (world) oil price evolves with the (world) marginal production cost; b) the international gas price considered for the European market evolves with the new supply conditions and is partially indexed to the oil price (is thus affected not only by the decrease of gas demand but also by the decrease of oil demand) and c) the international coal price considered for the European market evolves with the average import cost to the European market. Feedbacks on non-EU countries are accounted for: they react to the lower international oil price in increasing their energy demand, which balances the decreasing EU energy demand and limits the impact on prices. These results should be further analysed, including their impact on feedback-effects on energy consumption and GDP in the EU. Elements like the missing flexibility of the gas infrastructure produces a higher price effect on the European gas markets, since the gas producers cannot easily redirect their fuel exports to other markets have not be taken into consideration.

5.1.1.5 **Competitiveness**

Lower energy consumption and decreasing energy prices due to higher levels of energy efficiency in 2030 will have a positive impact on energy related costs. The table below shows that the ratio of energy related costs (inclusive of auction payments ETS) to value added improves in EUCO30 compared to the baseline EUCO27. This indicates that energy efficiency investment efforts can, in fact, positively impact the competitiveness of energy-intensive industries. This is because any projected increase in the capital cost component is more than outweighed by the decrease in energy purchases (including auction payments). Only in the EUCO+40, the share increases slightly compared to the baseline EUCO27 which can be explained by slightly higher electricity price in EUCO+40 (see chapter above) and the high investments needs to achieve this very ambitious 2030 target.

Table 12: Energy related costs for energy intensive industries

Ratio of energy related costs inclusive auction payments ETS to value added in 2030	Ref2016[96]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Energy intensive industries (in %)	40.3%	40.8%	40.1%	40.0%	39.8%	40.6%

Source: PRIMES

As shown in the table below, energy intensity improves considerably for the industry sector and the service sector with increasing levels of energy efficiency in 2030.

Table 13 Impacts on energy consumption

Energy intensity (2030)	Ref2016	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Energy intensity						
Industry - value added related (toe/MEuro'13)	66	66	66	64	62	58
Domestic -household income related (toe/MEuro'13)	68	63	58	50	47	40
Services -value added related (toe/MEuro'13)	69	64	59	52	49	42

Source: PRIMES

5.1.2 Macro-economic and other economy-wide impacts[97]

Macroeconomic and sectoral economic impacts are assessed using two macroeconomic models: E3ME and GEM-E3. Similar to the Impact Assessment on energy efficiency in 2014, the choice in this impact assessment has been to use two macroeconomic models that

[96] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

[97] Results for GDP and total employment are provided for the two versions of each of the two macro-models in order to put forward a more comprehensive picture of potential macro-benefits and constraints arising from increased investments in energy efficiency. For the rest of the economy-wide related impacts, results are often presented only for the "no crowding out" version of E3ME and the "loan-based" version of GEM-E3 in order to keep the discussion within reasonable limits.

represent two different schools of economic thought, and that have been frequently used in the macroeconomic assessment of energy and climate policies[98].

Compared to previous impact assessments, the modelling has been further developed in order to provide a more rigorous assessment of the macroeconomic effects of varying "crowding out" assumptions and different financing mechanisms for energy efficiency investments[99]. Two versions of each macro-model have been run in order to provide a more nuanced picture of potential macro-benefits and constraints. In the case of E3ME, these versions are referred to as *"no crowding out"* and *"partial crowding out"*[100]. In the case of GEM-E3, the two versions are referred to as *"loan-based"* finance and *"self-financing"*. In the former, businesses and households can borrow in the markets, whereas in the latter no borrowing is possible and economic agents finance their investments in energy efficiency by spending less on other items[101]. In both cases, the more nuanced assumption is considered more realistic.

There are three main reasons why it is useful to include different macro-models that operate with different assumptions on crowding out and financing. First, these address model uncertainty and improve the robustness of modelling results that are reported. Second, to better understand likely ranges in macroeconomic effects and the barriers and bottlenecks that restrict potential macro-benefits from investing in energy efficiency, it is important to relax critical model assumptions, such as crowding out and the availability of lending. Third, self-finance and commercial loans have been found to be the first, and respectively, the second most common financing methods of energy efficiency investments in EU countries.[102] Including these in macro-models improves the understanding of the conditions necessary for realising potential growth and jobs benefits.

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98 More detail on the E3ME and GEM-E3 modelling structures is provided in Annex 4.

99 "Crowding out" effects refer typically to investments undertaken in particular sectors at the expense of other sectors (e.g. by drawing resources away from other businesses). Otherwise, with respect to households, both models assume there are crowding out effects, i.e. households spend more on energy efficiency and less on other items.

100 The "no crowding out" represents the standard approach in E3ME and its usual treatment of investment dynamics, whereby there is no maximum level imposed on production growth. Industries can grow by absorbing investments without negatively impacting other sectors (e.g. drawing on spare capacity or unutilised physical capital). The "partial crowding out" imposes a constraint on activity expansion by introducing a rule that would set a maximum amount that the sectors benefiting from energy efficiency policies would be allowed to increase by, without adversely affecting other economic activities. This rule is 5% over three years starting from 2021. For example, if in the year 2025, output is projected to increase in the construction sector by x% in EUCO27 relative to the Reference case, then in the next year (2026), the output of the respective sector is allowed to increase by a maximum of x% + (5/3)% without crowding out effects. In other words, the modelling of constrained expansion aims to implicitly mimic the effects of partial crowding out. The choice of 5% over three years starting in 2021 (translating in a 15% limit on additional / energy efficiency policy induced output growth by 2030) is arbitrary but suggests that first, firms keep enough spare capacity to cover 2-3 years of growth, and, second, that market players become aware of the increased investments in energy efficiency and try to adapt (the 3-year period allowing for the incorporation of changing expectations). Beyond that, physical and financial capital bottlenecks appear, constraining the potential for additional growth..

101 In the "loan-based" finance version, by assumption, an energy efficiency investment in 2020 would be financed via a loan which would cover 90% of total expenditure in 2020. This share is assumed to decrease after 2020, reaching 70% of total expenditure in 2035. Afterwards the percentage remains constant. The loan lasts for 10 years and repayment starts one period after it is issued. In the "self-financing" version, GEM-E3 excludes the possibility of firm and household indebtedness and assumes that all expenditures are self-financed by the sectors undertaking the energy efficiency investments, e.g. firms increase prices, households reduce other expenditures. More details on the scenario setup and model versions are provided in Annex 4.

102 See for instance the findings in OECD/IEA (2014) "World Energy Investment Outlook: Special Report".

5.1.2.1 **GDP impacts**

In both models investments in energy efficiency to reach the required energy efficiency targets for 2030 are the primary drivers for changes in GDP. The GDP impacts are likely to be positive as long as energy efficiency investments are more productive than alternative investment, there is spare capacity in the economy which is put to work, labour mobility is fluid across sectors, and financial capital is effectively mobilised towards energy efficiency investments across Europe.

The E3ME model projects positive GDP impacts as increased investment in energy efficiency makes productive use of idle resources in the economy. The net benefits remain positive at higher ambition levels but these are projected to diminish should capacity constraints limit the growth potential of economic activities benefiting from the demand of energy efficiency goods and services[103]. This shows that policies to trigger investment in energy efficiency have the potential to overcome market failures. When there is no crowding out investment is as such financed at no direct cost to the financing of investments in other sectors of the economy. In this case, GDP increases with the ambition of the target; from 0.39% in EUCO30 (which is around 70bn €) to 4.08% in EUCO+40 (relative to the baseline EUCO27). However, in the "partial crowding out" case, the E3ME model shows less (albeit still) positive GDP impacts, particularly for the more ambitious energy efficiency policy scenarios that vary from 0.39% in EUCO30 (which is around 70bn €) to 2.21% in EUCO+40 (relative to the baseline EUCO27).[104] All in all, the E3ME model simulations show that the realisation of macro-benefits from stepping up energy efficiency ambition levels will depend on the ability of economic sectors to effectively absorb the required energy efficiency investments, and expand their capacity and output accordingly without meeting significant constraints.

In the GEM-E3 model, GDP impacts can be either positive or negative depending on the extent to which economic agents have access to financial markets in order to finance their required energy efficiency investment expenditures. If third party finance for investments in energy efficiency is available so that businesses and households can access financial markets or banks ("loan-based" case), potential crowding out effects are mitigated and GDP increases in 2030. GDP increases by 0.26% in EUCO30 compared to EUCO27 (which is around 45bn €), although these increases become less positive with higher ambition levels for energy efficiency and drop to almost net zero GDP impacts in EUCO+40[105.] However, if households and businesses cannot borrow ("self-financing" case – a less realistic assumption given the

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[103] GDP gains in E3ME are mostly investment-driven. They are largely attributed to its non-equilibrium approach allowing for policy intervention to boost growth as resources are not assumed to be optimally and fully allocated under initial conditions. To get a better idea of EU GDP impacts in 2030 implied in the E3ME model versions, these can also be expressed in terms of changes in annual growth rates, i.e. they can vary in 2030 (relative to the projected annual growth rate for EUCO27) from an increase in the annual GDP growth rate by 0.11 percentage points in EUCO30 to an increase of 0.83 percentage points (the case of "no crowding out" for EUCO+ 40).

[104] The reasons why GPD impacts are the same for both "no crowding out" and "partial crowding out" in the EUCO30 case (relative to the baseline EUCO27) are attributed to the setup of the partial crowding out scenario, in the E3ME model. According to the model, output constraints imposed to reflect crowding out dampen potential production growth rates only with more ambitious energy efficiency policies, starting from EUCO+33.

[105] There are two main reasons for GDP benefits to diminish with the stringency of the energy efficiency policies, in GEM-E3. First, increasing financing requirements implied by the EUCO33, 35 and 40 scenarios increase the demand for money and hence increase lending interest rates, which in turn adversely impacts other sectors of the economy. Second, very high ambition in energy efficiency implies high marginal investment costs for incremental savings, hence diminishing expected returns on this investment.

data referred to above), this will, by construction, result in adverse impacts on other sectors of the economy and overall negative GDP impacts in 2030 (varying from -0.22% in EUCO30 to -2.12% in EUCO+ 40, when compared to the EUCO27 case). In this case, any potential positive impacts stemming from improved energy efficiency and multiplier effects of increased economic activity in sectors providing inputs to energy efficiency projects are outweighed by the negative impacts arising from higher cost of capital and relative loss in competitiveness associated with investments in other productive assets[106].

Table 14: GDP impacts in EU28 in 2030[107]

% change from EUCO27	Ref2016[108] (bn €2013)	EUCO27 (bn €2013)	EUCO30	EUCO+33	EUCO+35	EUCO+40
E3ME (no crowding out)	17,928	18,045	0,39	1.45	2.08	4.08
E3ME (partial crowding out)	17,928	18,045	0.39	1.30	1.58	2.21
GEM-E3 (loan-based)	16,955	16,962	0.26	0.21	0.16	0.06
GEM-E3 (self-financing)	16,955	16,907	-0.22	-0.79	-1.35	-2.12

Source: E3ME, Cambridge Econometrics and GEM-E3, National Technical University of Athens

When comparing to REF2016, the modelling shows that achieving a 40% greenhouse gas reduction, a renewable target of 27% together with an energy efficiency target of 30% in 2030 could lead to an increase of up to 1% in GDP by 2030.

In essence, an important policy implication of this analysis is that relative GDP impacts vary with time and will depend on assumptions if and when borrowing takes place and loans have to be paid back[109].

The modelling exercise has shown that it is key for policy makers to continue to facilitate the flow of funds from banks to private economic agents so that businesses and households can smooth out their consumption and savings patterns and help them invest in energy efficiency goods and services. It is also essential to identify labour and capital constraints that prevent sectors potentially benefiting from energy efficiency investment to expand their capacity

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106 The reason for this is that full crowding out effects occur in the self-financing GEM-E3 model version when no money is borrowed. Sectors that expand because of energy efficiency take the investments from other sectors, leading to an increase in interest rates (capital costs). This increase in interest rates (which is greater than the loan-based case) affects capital costs and the relative loss of competitiveness.

107 Projected GDP levels in 2030 for REF2016 are different between the two models mostly because each model builds its own macro- projections (based on energy inputs they receive from the PRIMES energy system model).

108 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

109 It is important to note that GDP impacts will also depend upon the time lag between when agents implement their energy efficiency investments and when agents need to pay for these. For instance, the GEM-E3 model which covers a projected time horizon up to 2050 shows that GDP impacts are more favourable in the 2030 horizon in the loan-based case compared to the case self-financing variant. Nonetheless, after 2030, GDP impacts tend to be more positive in self-financing case compared to the loan-based case as the economy is influenced by the repayment of debt accumulated for energy efficiency investments. In the long term, the model shows converging and positive impacts in 2050 in both financing versions. Please see Annex 4 for a discussion of GDP impacts across time and the relevance of loan financing availability and conditions using the GEM-E3 model.

accordingly. Improving access to finance could help mitigating any potential adverse effects on the economy that stem from crowding out at times of high levels of energy efficiency expenditures. Hence, crowding out of investments in other productive sectors of the economy could be avoided and the overall EU economy could be stimulated.

5.1.2.2 **Employment impacts**

In general, total employment is driven by employment-related multiplier effects[110] and interactions between sectors under the different policy-induced energy efficiency investment scenarios. These depend on the respective labour intensity of the sectors delivering inputs to energy efficiency projects (relatively high for sectors like market services, high-tech manufacturing, and construction sector) and that of the sectors negatively affected. The share of domestically produced inputs to total inputs also matters. Net employment effects also depend on the extent to which wages will adjust to changes in labour demand, and on the availability of skill formation and reorientation programs. Since energy efficiency investment requires more labour and brings more net benefits to the economy than other investment alternatives, energy efficiency is expected to reduce structural unemployment[111].

Table 15 summarises potential impacts on employment levels in the EU across the energy efficiency policy scenarios for the two macro-models. Employment impacts are likely to be on the positive side, as long as labour resources can be absorbed in the sectors projected to benefit from energy efficiency investments. In 2030, the positive employment effects of increasing the levels of ambition of energy efficiency polices (relative to the baseline EUCO27) range, in E3ME in the "no crowding out" case, between 0.17% (around 405,000 people) in EUCO30 and 2.08% (around 4.8 million people) in EUCO+40. In the "partial crowding out" case, E3ME shows lower net positive impacts on employment across particularly the more ambitious scenarios, an additional 404,000 people in EUCO30 and around 3.2 million people in EUCO+40 compared to EUCO27.

GEM-E3 shows positive or negative impacts on employment in 2030 depending on the extent to which economic agents are able to borrow the funds instead of paying for energy efficiency investments out-of-pocket and on the spot. In the "loan-based" finance case of GEM-E3, employment impacts are positive and range between 0.2% (around 434,000 people) in EUCO30 and 0.56% (approximately 1.2 million people) in EUCO+40 (relative to baseline EUCO27). In the "self-financing" case, which does not reflect the situation today or the expected situation in the future given the important enabling framework, employment impacts are projected to be negative, ranging from -0.18% in EUCO30 (around 382,000 people losing their jobs) to -1.36% (almost 2.9 million people) in EUCO+40 relative to the baseline EUCO27. This is largely attributed to the fall in GDP that is projected in the "self-financing" variant, meaning that full crowding out also negatively impacts employment, albeit to a lesser extent than output depending on the labour intensity of sectors.

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[110] Multiplier effects refer to the economy-wide ripple effects stemming from an initial change in aggregate demand. In other words, an increase in GDP is associated with an increase in income, and this extra income results in more spending, more demand, which in turn leads to higher GDP, more income and so on. The final impact on the GDP level is higher than the initial change in aggregate demand.

[111] COMBI-Project (2015) Literature review on macroeconomic effects of energy efficiency improvement actions, Deliverable 6.1 (see: http://combi-project.eu/). The project receives funding from the EU's Horizon 2020 programme (No 649724).

In E3ME, employment is determined primarily by the level/growth of economic output analysed above as well as relative labour costs/wage rates. Up to 2020 there is very little change in overall EU employment levels in the scenarios. However, once the energy-efficiency investment starts to grow quickly after 2025, employment is expected to increase substantially. In GEM-E3, employment is mostly affected by the projected changes in the activity of the more labour intensive sectors affected by energy efficiency policies. In GEM-E3, unused labour resources can be used in labour-intensive scenarios with only small effects on the equilibrium wage rates, whereas in E3ME impacts on wage rates are stronger, *i.e.* higher wage rates with increased labour demand partly counteracting the positive employment effects driven by GDP gains.

Table 15: Employment impacts in EU28 in 2030

% change from EUCO27	REF2016[112] (mln people)	EUCO27 (mln people)	EUCO30	EUCO+33	EUCO+35	EUCO+40
E3ME (no crowding out)	233.1	233.5	0.17	0.68	1.04	2.08
E3ME (partial crowding out)	233.1	233.5	0.17	0.63	0.85	1.40
GEM-E3 (loan-based)	216.4	216.6	0.20	0.28	0.36	0.56
GEM-E3 (self-financing)	216.4	216.0	-0.18	-0.51	-0.84	-1.36

Source: E3ME, Cambridge Econometrics and GEM-E3, National Technical University of Athens

When comparing to REF2016, the modelling shows that achieving a 40% greenhouse gas reduction, a renewable target of 27% together with an energy efficiency target of 30% in 2030 could create up to 900,000 new jobs.

Evidence shows that investing in energy efficiency compares favourably with investing in other energy sectors in terms of local job creation impacts.[113] Analysis by Pollin et al. (2009) evaluating different economic stimulus options, demonstrated that the employment creation from investing in energy efficiency is 2.5 to 4 times larger than that for oil and natural gas. A similar study by Wei at al. (2010) has shown that the energy efficiency industry is about twice as labour-intensive compared to the fossil fuel-based energy supply sector per unit of energy saved/produced. Cambridge Econometrics (2015) came to similar conclusions that energy efficiency investments create more employment than investments in energy generation[114]. A review of more than 20 studies concluded that for every £1 million spent on energy efficiency about 23 jobs are directly supported in the energy efficiency industry (Janssen and Staniaszek 2012). Applying this ratio to the total expenditure by energy companies in the UK, Italy,

112 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

113 Rosenow, J., Bayer, E. (2016): Costs and benefits of Energy Efficiency Obligation Schemes. Regulatory Assistance Project.

114 https://ec.europa.eu/energy/sites/ener/files/documents/CE_EE_Jobs_main%2018Nov2015.pdf.

France, Austria and Denmark and assuming a leverage factor of 2 suggests that up to 100,000 jobs are supported by EEOSs in those countries together[115].

5.1.2.3 **Other macroeconomic indicators**

Annex 4 provides the results of both models for sectoral output and employment; trade; competitiveness; real disposable income; consumer expenditure; public budgets; and other macro-indicators. For instance, **exports are projected to increase** in the macro-models for the cases where these project that overall GDP growth is stimulated by energy efficiency investments. The models also indicate an **increased competitiveness in sectors** (such as engineering) benefitting from lower energy costs and learning effects on energy efficient equipment. In addition, energy efficiency investment efforts are unlikely to adversely impact the competitiveness of energy-intensive industries, as any projected increase in the capital cost component is outweighed by the decrease in energy purchases (including auction payments) that could be experienced by these sectors (see chapter 5.1.1.5).

Furthermore, in terms of **impacts on third countries** and from a macro-economic perspective, overall extra-EU imports are projected to grow. This is due to increased EU aggregate demand that is stimulated through increasing energy efficiency investment efforts. As a consequence, third countries that act as main manufacturing trade partners exporting to the EU may stand to benefit. However, from an energy perspective, energy-exporting third countries could be adversely affected due to reduced EU energy demand and energy efficiency improvements in the EU.

5.1.3 Environmental effects and health impacts

5.1.3.1 **GHG emission reductions**

Both EUCO27 and EUCO30 achieve the same overall GHG reductions in 2030 (as compared to to 1990): 41% but more ambitious scenarios overshoot quite significantly the minimum 40% GHG reduction target. The EUCO+40 scenario achieves 47% reduction because of the combined effect of ambitious energy efficiency policies and a renewable energy share of 28%[116].

Both EUCO27 and EUCO30 achieve by design very similar reductions in 2030 respectively ETS and non-ETS emissions: 43 and 30% – in line with the targets agreed by the European Council. More ambitious scenarios reach in 2030 between 44 and 48% reductions in the ETS sector and between 34 and 39% in sectors covered by the Effort Sharing Decision, which is coherent with overall GHG emissions reductions.

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115 Rosenow, J., Bayer, E. (2016): Costs and benefits of Energy Efficiency Obligation Schemes. Regulatory Assistance Project.

116 In terms of impacts on GHG emissions, all scenarios achieve 2030 reductions of at least 40% in line with the European Council conclusions. The GHG and non-ETS/ESD emission results for the EUCO27 and EUCO30 scenarios are features/assumptions of the scenarios, while for the EUCO+ scenarios they are modelling results. Likewise, by design, all scenarios achieve the decarbonisation objective in 2050.

Table 16: Total GHG emissions

Emissions (2030)	Ref2016[117]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Total GHG emissions (% to 1990)	-35.2	-40.7	-40.8	-43.0	-43.9	-47.2
ETS (% to 2005)	-37.7	-43.1	-43.1	-44.3	-44.2	-48.3
ESD (% to 2005)	-23.7	-30.2	-30.3	-33.7	-35.5	-38.7

Source: PRIMES, GAINS

Some differences between the scenarios are visible in sectoral GHG emission reductions. Comparing the projected 2030 emissions to historical figures of 2005, the power generation, residential and tertiary sectors are projected to experience the biggest reduction across all policy scenarios.

For power generation, for the baseline EUCO27 and the policy scenarios reductions range from 48 to 56% with the effectiveness of the energy efficiency policies in reducing energy consumption taking over ETS prices as the driving force for emission reductions in the sector as energy efficiency ambition increases. In the residential sector, reductions range from 35 to 66% and in the tertiary sector very similarly from 43 to 63%. In both sectors reductions are driven by reduced demand from heating and cooling. In industry the reductions are less differentiated among the scenarios reflecting changes already taking place in the REF2016 scenario and the fact that current energy efficiency policy set-up is not targeting industry in a first place. For the installations covered by ETS, the key driving force in emission reduction is ETS although the ETS prices are lowered by the ambitious energy efficiency policies[118]. While the industry installations and supply side (power generation, CHP, district heating) show significant declines in emissions, other sectors covered by ETS demonstrate slower decline: aviation and non-energy related, i.e. process emissions.

As indicated, ETS emission reductions in EUCO+ scenarios are mainly driven by energy savings policies and achieved with very low ETS carbon prices (see Annex 4)[119].

Comparing other policy scenarios to the baseline, it can be observed that moving from a 27 to a 30% energy efficiency target in 2030, leads to additional emission reductions of 0.1% in industry, 8.5% in residential sector, 6.8% in tertiary and 1.6% in transport.

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117 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

118 In transport, the emission decrease is more differentiated across the scenarios because of the assumptions that are scaled up gradually across the scenarios. In addition, the bio-fuels penetration driven by overall RES target contributes to lowering GHG emissions. The decreases range from 18 to 23% relative to 2005. In a 2050 perspective, emission reductions increase significantly across all sectors as they are all compatible with the 2050 decarbonisation objective. The power sector is almost fully decarbonised reaching in all scenarios 94% reductions compared to 2005 and it remains the sector with the highest reductions. Residential, tertiary and industrial sectors achieve deep 84-88% reductions. The transport sector sees the lowest reductions of 67% relative to 2005 for the baseline and all policy scenarios but in line with White Paper for Transport ambition of 60% GHG reduction in 2050 with regard to 1990.

119 In the UK, the government has monetised the benefits stemming from avoided greenhouse gas emissions due to energy efficiency obligation schemes. Using guidance on the valuation of CO_2 savings from the Interdepartmental Analysts' Group the value of the avoided greenhouse gas emissions due to ECO have been estimated being worth up to €6.2 billion of non-EU ETS sector emissions and about €2 billion worth of traded EU ETS allowances. Together, the value of the greenhouse gas emission reduction is equivalent to 50% of the energy bill savings. Similar figures have been produced for the extension period of CERT with emission reduction benefits amounting to about 45% of the energy bill savings, see DECC (2010): Extending the Carbon Emissions Reduction Target to December 2012. Final Impact Assessment. DECC, London.

Table 17: Sectoral GHG emissions

Sectoral GHG emission impacts (2030)	Ref2016[120]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Power generation, CHP and district heating GHG emissions (% change compared to 2005)	-41.0	-48.0	-49.1	-50.5	-50.5	-55.8
Industry GHG emissions (energy) (% change compared to 2005)	-40.7	-43.6	-43.5	-45.9	-47.3	-51.6
Residential GHG emissions (% change compared to 2005)	-25.5	-34.8	-40.3	-53.2	-57.2	-66.1
Tertiary GHG emissions (% change compared to 2005)	-32.5	-42.5	-46.4	-54.1	-57.2	-63.3
Transport GHG emissions (% change compared to 2005)[121]	-12.3	-17.7	-19.0	-19.8	-21.7	-23.2
Power generation, CHP and district heating HG emissions (Mt of CO2 eq) for REF2016 and EUCO27 scenarios and % change from EUCO27 for other scenarios	978	861	-2.1	-4.7	-4.8	-15.0
Industry (energy) (Mt Co2 eq), (% change)	376	358	0.1	-4.0	-6.6	-14.3
Residential (Mt Co2 eq), (% change)	361	316	-8.5	-28.3	-34.3	-48.1
Tertiary (Mt Co2 eq), (% change)	183	156	-6.8	-20.1	-25.6	-36.1
Transport (Mt Co2 eq), (% change)	947	889	-1.6	-2.5	-4.9	-6.7

Source: PRIMES

5.1.3.2 Air pollution: health impacts and air pollution control cost

Latest research results confirm that energy efficiency measures will lead to improvements in air quality[122]. Although emission reductions from large combustion plants in the European Union have been significant in the past few decades, in some countries large emission reduction potentials are still untapped[123]. The residential sector in particular has potentials for untapped energy efficiency and, as a result, air pollution abatement and the EU is supporting research projects on how to exploit this potential[124]. The size of this potential depends on the fuel choice of households and the efficiency of the heating system.

According to the European Environmental Agency, energy efficiency improvements in the transport sector (such as efficiency improvements of vehicles and modal shift from motorised to non-motorised transport) can significantly reduce air pollution, particularly in urban areas. Transport is responsible for more than half of NO_x emissions, and contributes significantly

[120] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

[121] Including pipeline transportation, ground activities in airports and harbours, etc.

[122] European Environment Agency (2010). Impact of selected policy measures on Europe’s air quality. Luxembourg: Publications Office. Retrieved from http://dx.publications.europa.eu/10.2800/42618.

[123] COMBI-Project (2015). Literature review on avoided air pollution impacts of energy efficiency measures, Deliverable 3.1, http://combi-project.eu. The project receives funding from the EU's Horizon 2020 programme (No 649724).

[124] For examples LIFE projects linking energy efficiency with lower emissions of air pollutants (http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5240, http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5002 or http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3765).

(around 15 % or more) to the total emissions of the other pollutants. Road transport in particular makes a significant contribution to emissions of all the main air pollutants[125].

The table below shows that the different policy options all reduce emissions of $PM_{2.5}$, SO_2 and NO_X compared to the EUCO27[126]. The reductions become larger as the scenarios become more ambitious and reduce fossil fuel consumption and combustion more significantly. It has to be noted that energy efficiency policies mostly target gas and oil consumption, whereas coal consumption is mainly affected by ETS prices[127]. Therefore, the EUCO+40 scenario with very ambitious GHG reduction also significantly reduces coal consumption. The most pronounced differences between the scenarios are in gas consumption as described above.

Compared to EUCO27, EUCO30 reduces NOx emissions by 83 kton, SO_2 by 6 kton and $PM_{2.5}$ by 28 kton. The other options show higher reductions (see table below).

The reduction in air pollution has **positive impacts on human health**. The EUCO30 scenario reduces the number of life years lost due to lower $PM_{2.5}$ concentrations (a result of lower $PM_{2.5}$, SO_2 and NO_X emissions by some additional 2.5 million in 2030 compared to EUCO27). The number of life years gained increases to 8.7 million in EUCO+33, 11 million in EUCO+35 and close to 17 million in EUCO+40. Ozone mortality is also reduced more prominently. Positive impacts occur also in the **reduction of mortality due to lower ozone concentration** (cases per year), but these are small in comparison to the effect of particulate matter. The positive human health impacts are orders of magnitude larger in the options with higher energy efficiency.

The **reduction in mortality** can also be valued economically. The table shows that with a 30% energy efficiency target, health damage due to air pollution is reduced in 2030 by €2.9 to 6.6 billion compared to EUCO27. The range results from the use of a high and a low valuation of mortality (value of life year lost) also used for the Thematic Strategy on Air Pollution. These health benefits are much higher (up to €45 billion) for the more ambitious energy efficiency targets in line with higher reductions in emissions and their impacts.

Because of lower emissions, the **costs to control air pollution** are lower as well compared to EUCO27. For the EUCO30 scenario, the reduction in pollution control costs (e.g. for particle filters) is €1.7 billion. Cost savings are higher with higher energy efficiency targets. They range from €3.9 billion/year (EUCO+33) to €10.9 billion in the EUCO+40 option.

Summing up the monetized part of the health damage costs and the pollution control costs in 2030, the table below shows reductions in the costs between €4.5 and 8.3 billion for the EUCO30 scenario compared to EUCO27. This is mainly due to the reduction in mortality due to particulate matter concentrations. In the higher energy efficiency options the impacts are

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125 http://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-air-pollutants-8/transport-emissions-of-air-pollutants-2

126 For the analysis of reduced air pollution benefits the same methodology, based on the GAINS model, was used as in the Impact Assessment for the Roadmap to a Low Carbon Economy and IA accompanying policy framework for climate and energy in the period from 2020 to 2030.

127 It should be noted, however, that in some Member States coal is widely used for electricity, district heating/cooling and domestic heating. Especially the latter is not affected at all by ETS prices, but energy efficiency can have a big effect on domestic coal consumption and related emissions of air pollutants.

much higher and range from a € 15.2 to 28.4 billion/year (EUCO+33) to between €30.4 and 55.9 billion per year (EUCO+40).

Forest, catchment and ecosystem areas where acidification and eutrophication exceed critical loads are reduced. For example, the size of the area **with ecosystems exposed to acidification exceeding critical loads is reduced** by around 0.4 million km^2 in the EUCO30 compared to the baseline EUCO27. In the other options the area protected against acidification increases by 1.1 million km^2 (EUCO+33), 1.8 million km^2 (EUCO+35) and nearly 3.2 million km^2 (EUCO+40). Also the area of ecosystems that are no longer exceeding critical loads for eutrophication is increased by 4.3 million km^2 in EUCO30. For the other options the impacts are more significant. The area protected increases by 12 million km^2 in EUCO+33, 14.6 million km^2 in EUCO+35 and 22.8 million km^2 in EUCO+40.

Other effects linked to pollution are also reduced i.e. morbidity (health effects), damage to crops (e.g. because of lower ground level ozone emissions), but these benefits have not been quantified in this Impact Assessment. Furthermore, damage to materials, buildings and sensitive ecosystems (due to acidification, excess nitrogen deposition and ground level ozone) are also expected to be reduced but have not been assessed.

In conclusion, all policy options analysed come with significant environmental and health benefits, which are more prominent for the more ambitious energy efficiency targets[128].

Table 18: Impacts of reduced air pollution

Change in air pollution control costs and health damage in 2030 (compared EUCO27)	**EUCO30**	**EUCO+33**	**EUCO+35**	**EUCO+40**
SO2 (kton)	-6	-44	-63	-148
NOX (kton)	-83	-221	-309	-487
PM2.5 (kton)	-28	-89	-111	-163
Health impacts (million life years gained due to less PM2.5)	2.5	8.7	11.0	16.9
Premature deaths ozone avoided (cases per year)	114	337	438	662
Reduction in monetary damage health because of PM & ozone concentration (€ billion/year). Low estimate	2.9	10.1	12.8	19.5
Reduction in monetary damage health PM & ozone concentration (€ billion/year). High estimate	6.6	23.3	29.4	45.0
Air pollution control cost savings (€2010 billion/year)	1.7	5.1	7.2	10.9
SUM of reduction in pollution control costs & health damage costs (€ billion/year)	4.5-8.3	15.2-28.4	19.9.-36.6	30.4-55.9

Source: IIASA (2016) based on GAINS for emissions, health impacts and air pollution control costs (in € of 2010). Benefit valuation uses valuation of mortality (value of life year lost) used for the Thematic Strategy on Air Pollution of €57700 to 133000 per life year lost.

128 A 2007 review of the Vermont Weatherization program determined that health and safety improvements added an additional $1,044 in project cost, while returning benefits worth $2,372, including $1,421 due to fewer illnesses. Another comprehensive evaluation of the costs and benefits of the Warm Homes Scheme in Northern Ireland concluded that for every €1 spent on energy efficiency 42 cents was recouped by the health service. Recognising the significant health benefits of improved thermal efficiency the UK government trialled the prescription of high-efficiency boilers with the result that medical appointments for those households receiving a boiler dropped by 60% (www.gmjournal.co.uk/boilers_on_prescription_scheme_reduces_gp_appointments_by_60_25769832606.aspx).

5.1.4 Social impacts including affordability issues

One important aspect is the affordability for consumers of energy including both operational costs (purchases of electricity and fuels) and capital expenditure (measured by direct investment expenditures or alternatively coupled with the cost to borrow money for energy). As demonstrated in the analysis of system costs below all policy scenarios lead to considerable shifts from operational to capital expenditure. Operational expenditure is influenced by energy prices. Energy prices (except electricity) are projected to rise in the longer term and they do not vary among scenarios[129]. However, electricity prices are impacted by the energy efficiency policies.

The table below demonstrates that the share of energy-related costs (both including and excluding transport) in household expenditure grows only slightly in 2030 in step with increasing level of ambition of the target[130]. This means that the additional expenditure related to more energy efficient equipment is almost entirely compensated by the reduced expenditure on fuels and electricity. In the 2050 perspective, the share of energy-related costs would even decrease for households with higher energy efficiency levels in 2030. However, targeted financing schemes would certainly be needed in order to incentivise the necessary investment by consumers with lowest income without increasing the overall share of energy related cost in their household expenditure. In addition, it needs to be kept in mind that the share of energy costs in household expenditures (as shown in Table 19) does not take into account the positive impacts on households stemming from a higher employment and GDP impacts which would lower the share of energy costs as the real disposable income increases (see Table 20).

Table 19: Share of energy costs in household expenditure (2030 and 2050)[131]

Share of energy costs in household expenditure (2030)	Ref2016[132]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Share of energy related cost (excluding transport) in household expenditure in 2030 (in 2010: 6.2)	6.9	7.1	7.4	7.8	8.0	8.5
Share of energy related cost (excluding transport) in household expenditure in 2050 (in 2010: 6.2)	5.8	7.8	7.6	7.5	7.4	7.1

Source: PRIMES

[129] However, strong energy efficiency policies can have a positive impacts on international fuel prices as shown in the chapter 5.1.1.4.

[130] The modelling results presented here do neither offer a disaggregation of households among income groups nor analyse targeted financing schemes for consumers with low incomes that could serve to facilitate their access to capital to finance energy investments.

[131] These shares do not take into account an increase in real disposable income.

[132] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

When looking at the real disposable income, it can be seen in the table below that they increase with higher energy efficiency levels as society benefits from higher employment levels and GDP which has a positive impact on the real disposable income.

Table 20: Real disposable income[133]

Real disposable income (% change from EUCO27)	Ref2016[134] (EUR)	EUCO27 (EUR)	EUCO30	EUCO+33	EUCO+35	EUCO+40
E3ME (no crowding out)	11,371.4	11,446.7	0.16	1.00	1.42	2.88
GEM-E3 (loan-based)	11,334.2	11,368.6	0.25	0.30	0.23	0.18
GEM-E3 (self-financing)	11,334.2	11,319.6	-0.14	-1.00	-1.36	-1.84

Source: E3ME, Cambridge Econometrics and GEM-E3, National Technical University of Athens

Energy efficiency has positive social impacts measured by several metrics e.g. jobs which have been discussed above. This impact assessment also examines social impacts from the perspective of skills, energy poverty and equity, with analysis indicating positive crosscutting benefits. Energy poverty is closely linked to issues of affordability of energy in residential housing for low income groups; in this context it is important to underline the interlinkages between the general energy efficiency framework and the Energy Performance of Buildings Directive. These are designed to work together in the area of building renovation, the first one providing a framework for increasing the rate of renovation in the buildings sector, the second one to ensure that renovations – when carried out – meet higher minimum standards with regard to energy efficiency than previously. Together they drive increased investment in the sector[135].

Energy costs and their social impacts are of particular relevance in the residential sector for consumers with low incomes. On the one hand, these consumers may have the keenest interest in reducing their energy expenditures. On the other hand it is widely acknowledged that capital market failures mean that many households in this category do not have access to

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133 Real disposable income results are not reported for the E3ME case of "partial crowding out". This is because of the methodological approach of E3ME in representing potential crowding out effects, which are modelled via forcing higher savings to compensate for what would have been price changes if crowding out effects were to be modelled in a tradition general equilibrium model. In other words, because of the post-Keynesian approach to simulating the possible existence of crowding out effects that are typical to economic equilibrium approaches and not to non-equilibrium models, income effects cannot be adequately captured in the "partial crowding out" version of E3ME.

134 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency (≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

135 Research results show a positive correlation of the efficiency of a building as indicated in the certificates on the energy performance of buildings (EPCs) on the sales price of the property. This correlation affects even more the value of less energy-efficient properties, by decreasing their value by nearly 1/4. This indicates that more ambitious energy efficiency efforts in particular in the building sector could increase the value of a Member State's building stock in monetary terms. Energy efficiency investments are not stranded investments for home owners as the investments increases the value of the building. However, whereas the display of the EPC in the advertisements introduced by the EPBD plays a significant role for the sales price, the impact of energy efficiency measures on rental prices is less proven (See Jensen/Hansen/Kragh: Market response to the public display of energy performance rating at property sales (Energy Policy 93 (2016) 229–235).). This may be linked to the landlord-tenant problem and the question of whether higher rents can be compensated by the tenant by lower energy bills

the capital markets to obtain long term finance, and therefore will not be able to invest in energy efficiency. An issue of equal importance is the positive correlation between lower household income and an increasing likelihood that the household is in the rental market. In rental markets, where there is insufficient regulation or other shortfalls in the regulatory framework, the issue of capital rationing is compounded by the issue of split incentives, i.e. where the cost effective optimum is not realised due to lack of incentives for the owner to renovate. It is a challenge, but the clear positive relationship between reaching the cost effective level of investment in residential energy efficiency solutions and potential reduction in energy poverty must be further exploited.

Basic analysis has been carried out with the E3ME model to examine the distributional impacts across socio-economic groups (disaggregated by income quintiles) of implementing the energy efficiency policy scenarios. Modelling was carried out under an assumption of self-financing of energy efficiency investments by households[136]. The E3ME model supports the notion that in most countries real incomes[137] increase across all household groups, although the distributional impacts of energy efficiency measures are not uniform across all energy efficiency and lower heating bills[138].

Table 21: Distributional impacts for income by socio-economic group, % change in average real income EUCO30 and EUCO33 compared to EUCO27 in 2030[139]

(% change compared to EUCO27)		All households	Lowest Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
No Crowding out	EUCO30	0.10	0.16	0.18	0.15	0.12	0.03
	EUCO33	0.71	1.05	0.99	0.85	0.68	0.44
Partial Crowding out	EUCO30	0.10	0.15	0.17	0.15	0.12	0.03
	EUCO33	0.62	0.93	0.87	0.75	0.61	0.37

Source: E3ME, Cambridge Econometrics

Research on the multiple social effects of energy efficiency has recently gained momentum[140], but more is needed to sufficiently quantify the various social impacts of energy efficiency improvements. However, concluding from the available empirical data summarised by the COMBI project,[141] the strongest social welfare benefits can be expected in housing, transport and productivity related effects. Energy efficiency improvements in the housing sector have a positive impact in reducing energy poverty and associated negative aspects of

[136] Bank lending is not explicitly modelled in E3ME, although it is implicitly assumed that banks can create credit and lend to households without crowding out financial resources from other bank lending activities (i.e. no competition for loans is assumed) in the non-crowding out model run. No assumptions are made about the types of households that are most affected by the energy efficiency improvements.

[137] Income from wages, benefits and other after tax income.

[138] In many countries low-income households use a larger share of their incomes for space heating. Therefore, higher energy prices might have negative impacts. However, it is less relevant to the energy efficiency scenarios modelled here where energy prices do not change significantly between scenarios. However, it is noted that the prices of other goods may change in the scenarios due to indirect effects.

[139] EU average of the percentage changes per socio-economic group are shown, i.e. first the changes in real incomes per group are calculated; then these are averaged across Member States.

[140] IEA (2015). Capturing the Multiple Benefits of Energy Efficiency. Paris.

[141] COMBI-Project (2015) Literature review on social welfare impacts of energy efficiency improvement actions, Deliverable 5.1, http://combi-project.eu. The project receives funding from the EU's Horizon 2020 programme (No 649724).

well-being[142]. Energy efficiency improvements particularly in buildings thus have a positive welfare effect in the form of increasing comfort and an energy savings effect in the form of lower energy bills. For low-income households in particular, this can be a challenge. Accompanying measures, including via the use of financial instruments, are therefore necessary to make sure that households do benefit from such energy efficiency improvements. Improving the efficiency of buildings lived in by people who face fuel poverty is key in this respect as the multiple benefits. According to the IEA, positive health outcomes are strongest among vulnerable groups, including children, the elderly and those with pre-existing illnesses, as more efficient buildings improve the health and well-being for occupants[143]. A 2013 study for the European Investment Bank[144] found that the reduction of fuel bills through energy efficiency measures could mitigate energy poverty and many of the issues associated with inequality and social exclusion. Work on best practices undertaken with stakeholders in the Citizens' Energy Forum has also highlighted that energy efficiency improvements tend to be the best long-term solution to energy poverty[145].

Energy poverty alleviation is thus a function of investments in energy efficiency measures, and of the assumptions on the division of the surplus value. In the case of the building sector and energy poverty, the drivers for investment are renovation rates and energy performance standards for new buildings and for building renovations. Similar analysis has been carried out by E3ME of the impacts of increased investments in energy efficiency from increasing the ambition level in the EPBD impact assessment. While measures under Article 7 of the EED drive demand for increased energy efficiency in the housing sector, an increased ambition level is a necessary but not sufficient condition for ameliorating energy poverty. While modelling indicates that all scenarios reduce energy poverty, the results in this case are contingent on Member States implementing policies in parallel that favour the energy poor.

Welfare effects in the transport sector result particularly from modal shifts from motorised to non-motorised or collective forms of transport such as walking, cycling, public transport or a combination of these options. The most significant co-benefits of a modal shift towards active modes of transport arise from increased physical activity and may lead to lower levels of obesity, various physical and mental diseases and pre-mature mortality. Associated co-benefits would include reduced congestion and noise and air pollution to the general population. Secondary co-benefits may be located in employment and improvements in social cohesion[146].

Another potential area of benefits of energy efficiency investments is productivity benefits in commercial buildings. This is closely related to health and comfort benefits. Literature suggests a positive, significant and sizable influence of life expectancy (or some related health

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[142] For example, a better insulated building can lead to an increase in indoor average temperatures and decrease in damp. Empirical studies suggest that energy efficiency improvements in fuel poor households are usually divided into comfort improvements (i.e. rebound effect), but also into reducing energy costs through lower energy consumption. See COMBI-Project (2015). Literature review on social welfare impacts of energy efficiency improvement actions, Deliverable 5.1, http://combi-project.eu.

[143] IEA (2014): Capturing the Multiple Benefits of Energy Efficiency (see http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf).

[144] The Benefits of Energy Efficiency, http://www.eib.org/epec/ee/documents/factsheets-energy-efficiency-en.pdf

[145] A New Deal for Energy Consumers, COM(2015) 339 final

[146] COMBI-Project (2015). Literature review on social welfare impacts of energy efficiency improvement actions, Deliverable 5.1, http://combi-project.eu. The project receives funding from the EU's Horizon 2020 programme (No 649724).

indicator) on the subsequent pace of economic growth. Any energy efficiency improvement action which has a sizeable health impact may, therefore, also impact macro-economic growth[147].

5.1.5 Energy related investments

Table 22 below describes the average annual investment expenditures projected by PRIMES across scenarios. Energy related investment expenditures can be divided into:

- Investments on the supply side (power generation), namely in grids, power generation plants and industrial boilers; and
- Investments on the demand side, which include energy equipment (covering appliances in households and tertiary sector, vehicles, industrial equipment etc.) and direct energy efficiency investments (covering renovation of buildings improving their thermal integrity).

Only a part of the costs for appliances, which is deemed to represent the cost of energy efficiency improvement, is reported. Likewise, for building renovations the cost of improving the thermal integrity of the building envelope is isolated from the total renovation costs. Moreover, only the costs of thermal renovation triggered by the policies assumed (both in REF2016[148] and policy scenarios) are reported.

Investment expenditures are, alongside energy purchases, the key components of the total system costs figures. Importantly, energy system costs reflect the entire financial flows (among others cost of finance) related to scenarios whereas investment expenditure is net of financing or other costs.

It should be noted that projections of investment expenditure, while consistent across scenarios, are difficult to compare with the investment volumes that are currently being incurred to promote energy efficiency (and are delivering energy savings) as there are no complete data on investments by households or private businesses and methodologies (notably baselines) for estimation of volume of investment differ. Still, an attempt for such a comparison is presented in Annex 8.

Looking at EUCO scenario projections of future investment expenditure, it has to be borne in mind that that an increase in total investment expenditure between them and REF2016 is due not only to the energy efficiency targets but also the achievement of other 2030 targets (GHG emission reduction and renewable energies). However, comparing policy scenarios with EUCO27 indicates expenditure increases due to energy efficiency policies only[149].

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[147] Ibid.

[148] The REF2016 investments do not include renovations which are triggered by natural stock turnover. However, in REF2016, there is already thermal renovation triggered by existing energy efficiency policies (in 2015-2020 period only) which is reported.

[149] Looking at policy scenario projections of future investment expenditure, it has to be borne in mind that that an increase in total demand-side investment expenditure between policy scenarios and baseline is due not only to the energy efficiency target but also achievement of other 2030 targets. On the other hand, comparing policy scenarios among

Total investment expenditure increases in all scenarios - more significantly in more ambitious scenarios. Firstly, investments in REF2016 (needed for the currently adopted policies) can be compared to EUCO27 investments which are necessary to achieve all three minimum 2030 targets agreed by the European Council. The table below shows an increase of average annual investment needs of nearly €98 billion/year in the period 2021-2030 in order to reach the 27% energy efficiency target together with a 40% GHG and 27% RES target compared to the REF2016[150]. To achieve a 30% target would lead to an increase in average annual investment expenditure of €78 billion compared to a 27% target. For more ambitious scenarios an increase in average annual investments (compared to 27% target) would range from €196 to 529 billion. While the scale of the investment challenge is significant it leads to lower operational costs (energy expenditures) and is an opportunity for the European economy in terms of growth and job creation as demonstrated above.

Investment needs increase most significantly in the residential and tertiary sectors because the majority of energy efficiency policies assumed in the policy scenarios focus on these two sectors. In the residential and tertiary sectors, total average annual investments cover both increased investments in appliances and equipment as well as additional investments in the energy efficiency of the building envelope (thermal renovation). Investments are already high in the EUCO27 scenario, namely around €168 billion/year for residential (thermal renovation representing 1/4 of investments) and €40 billion/year for tertiary (thermal renovation representing 1/2 of investments). In both sectors investments would increase by €75 billion/year to achieve a 30% target and majority of this increase is due to thermal renovation of buildings. However, these sectors will benefit from reduced energy bills (see below the section on energy purchases). The average annual investments in industry and transport[151] increase slightly by €6 billion only between the two scenarios as industry is less targeted by the policy mix assumed and for transport, a strong change is assumed already for EUCO27 scenarios. On the other hand, investment in power generation and grids are constant between EUCO27 and EUCO30 and decrease for more ambitious scenarios as less energy needs to be generated, transported and distributed (as already demonstrated by a decline of net installed power generation capacity of thermal power plants (see Table 8). It has however to be noted that as energy efficiency in buildings increases, the need for additional renewables in heating and cooling is reduced. In order to reach the overall 27% RES target, additional investments in power generation thus have to be triggered in EUCO30 scenario compared to baseline.

In general, it needs to be kept in mind that there is also a high potential for policy learning by public bodies and technology cost reductions that can lower investment costs. Technological progress is essential for an early market penetration of energy efficiency technologies and

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themselves indicates expenditure increases due to energy efficiency policy only with exception of EUCO+40 scenario which also increases RES target above 30% in 2030.

[150] Looking at policy scenario projections of future investment expenditure, it has to be borne in mind that that an increase in total demand-side investment expenditure between policy scenarios and baseline is due not only to the energy efficiency target but also achievement of other 2030 targets. On the other hand, comparing policy scenarios among themselves indicates expenditure increases due to energy efficiency policy only with exception of EUCO+40 scenario which also increases RES target above 30% in 2030.

[151] For all scenarios (including REF2016) investments in transport are higher than for other sectors, this is because for transport total investments associated to the turnover of the rolling stock are reported, which are broader than (but include) those related to energy services.

contributes considerably to the achievement of higher energy efficiency targets in a cost-efficient manner[152].

Table 22: Investment expenditures

Investment expenditures: total and sectorial decomposition in billion €'10 (average annual 2021-30)	Ref2016[153]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Total energy related investment expenditures	938	1,036	1,115	1,232	1,324	1,565
Change from EUCO27 in bn €			78	196	288	529
Households	127	168	214	286	337	455
Change from EUCO27 in bn €			47	118	169	288
Tertiary	23	40	68	119	157	257
Change from EUCO27 in bn €			28	79	117	217
Industry	15	17	19	24	29	51
Change from EUCO27 in bn €			1	6	12	34
Transport[154]	705	731	736	729	733	740
Change from EUCO27 in bn €			5	-2	3	9
Grid	34	39	36	34	31	26
Change from EUCO27 in bn €			-3	-5	-8	-13
Generation and industrial boilers	33	42	42	40	37	36
Change from EUCO27 in bn €			0	-2	-5	-6

Source: PRIMES

Energy efficiency investments necessary to implement European and national policies will increase the initial capital costs for energy consumers. However, over time, energy efficiency investments will pay back as they will reduce operating costs (energy bills for energy consumers to pay for fuels and electricity) compared to the situation without the intervention. In other words, an increase in capital costs due to up-front investments for energy efficiency improvement measures will be to a large extent compensated by lower operational costs[155]. This is demonstrated by a general shift in the structure of costs for energy consumers, i.e. diminishing energy purchases (consumer paying less for fuels and electricity) and increasing investment expenditures (consumers paying for additional energy efficiency investments)[156].

Average **energy purchases** in 2021-2030 are reduced from €1,448 billion in REF2016 to €1,415 billion in EUCO27. A further reduction of energy purchasing costs by €28 billion is

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152 See 'Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond' by Fraunhofer ISI, PWC and TU Wien (2014) (see https://ec.europa.eu/energy/sites/ener/files/documents/2014_report_2020-2030_eu_policy_framework.pdf).

153 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency ((≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

154 This includes investments in transport equipment for mobility purposes (e.g. rolling stock but not infrastructure) and energy efficiency. They exclude investments in recharging infrastructure. However, the electricity prices in PRIMES are calculated in order to recuperate all costs including those related to recharging infrastructure for electric vehicles.

155 For individual energy customers a long payback period of energy efficiency investments is an important factor which prevents many energy customers from investing in energy efficiency.

156 See also Annex 4 with a more detailed table on system costs.

possible in EUCO30 (compared to EUCO27). For more ambitious scenarios, a decrease in average annual energy purchases range from €52 to 86 billion compared to EUCO27. Across all scenarios, the reductions are mainly achieved in the residential and tertiary sector. In addition, a small reduction of international fuel prices due to strong European energy efficiency policies (see chapter 5.1.1.4) could have some impact on the energy purchase costs for consumers.

Table 23: Energy purchasing costs

Energy purchasing costs (2030)	**Ref2016[157]**	**EUCO27**	**EUCO30**	**EUCO+33**	**EUCO+35**	**EUCO+40**
Energy Purchases in billion €'13 *(average annual 2021-30)*	1,448	1,415	1,388	1,363	1,360	1,329
Industry	272	271	269	267	264	261
Residential	417	410	397	386	380	365
Tertiary	249	243	235	226	222	213
Transport	510	491	486	484	494	489

Source: PRIMES

5.1.6 Energy system costs

In the REF2016, the average annual total energy system costs[158] for the decade 2021-2030 are projected to be €1,928 billion. This equals a ratio of total energy system cost to GDP of 12.28%. When looking at a longer time horizon (2021-2050), average annual total energy system costs are projected to be €2,130 billion with a ratio of total energy system cost to GDP of 11.70% (a growing GDP is assumed until 2050).

In the period 2021-2030, a target of 30% would lead to an average annual increase in system costs of €9 billion compared to a 27% target. This constitutes an increase of 0.44% in total energy system costs or, expressed as share of GDP, an average annual increase in system costs of 0.05 percentage points compared to EUCO27. Taking a longer term perspective (2021-2050), the average annual system costs for the 30% scenario would be € 9 billion lower than in the EUCO27 scenario, as the benefits of investments made between 2021 and 2030 continue to pay off post-2030.

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157 Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency ((≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

158 Energy system costs for the entire energy system include capital costs (for energy installations such as power plants and energy infrastructure, energy using equipment, appliances and vehicles), energy purchase costs (fuels + electricity + steam) and direct efficiency investment costs, the latter being also expenditures of capital nature. Capital costs are expressed in annuity payments, calculated on the basis of sector specific discount rates (see Annex 4 for further explanations on discount rates). Direct efficiency investment costs include additional costs for house insulation, double/triple glazing, control systems, energy management and for efficiency enhancing changes in production processes not accounted for under energy capital and fuel/electricity purchase costs. They do not include any disutility costs associated with changed behaviour, nor the cost related to auctioning of allowances which lead to corresponding revenues which can be used. Energy system costs are calculated ex post after the model is solved. The calculated cost is influenced by the discount rate used; capital expenditures and energy efficiency investment costs have been discounted with a financial discount rate of 10% (see further information in Annex 4).

Looking at more ambitious (than EUCO30) scenarios, they require an increase in average annual costs for the period 2021-2030, ranging from €34 to 133 billion or 0.20 to 0.80 percentage points of GDP higher compared to EUCO27.

Table 24: Energy system costs 2021-2030[159]

Energy system costs (2030)	Ref2016[160]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Total System Costs in billion €'13 (average annual 2021-30)	1,928	1,943	1,952	1,977	2,014	2,077
Change in system costs compared to EUCO27 (in bn €'13)			9	34	71	133
Total System Costs as % of GDP (average annual 2021-30)	12.28	12.37	12.42	12.57	12.80	13.18
Total System Costs as % of GDP increase (average annual 2021-30) compared to EUCO27 in % points			0.05	0.20	0.43	0.80

Source: PRIMES

Table 25: Energy system costs 2021-2050[161]

Energy system costs (2050)	Ref2016[162]	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Total System Costs in billion €'13 (average annual 2021-2050)	2,130	2,264	2,255	2,290	2,324	2,384
Change in system costs compared to EUCO27 (in bn €'13)			-9	26	60	121
Total System Costs as % of GDP (average annual 2021-2050)	11.70	12.35	12.31	12.51	12.70	13.04
Total System Costs as % of GDP increase (average annual 2021-50) compared to EUCO27in % points			-0.04	0.16	0.35	0.70

Source: PRIMES

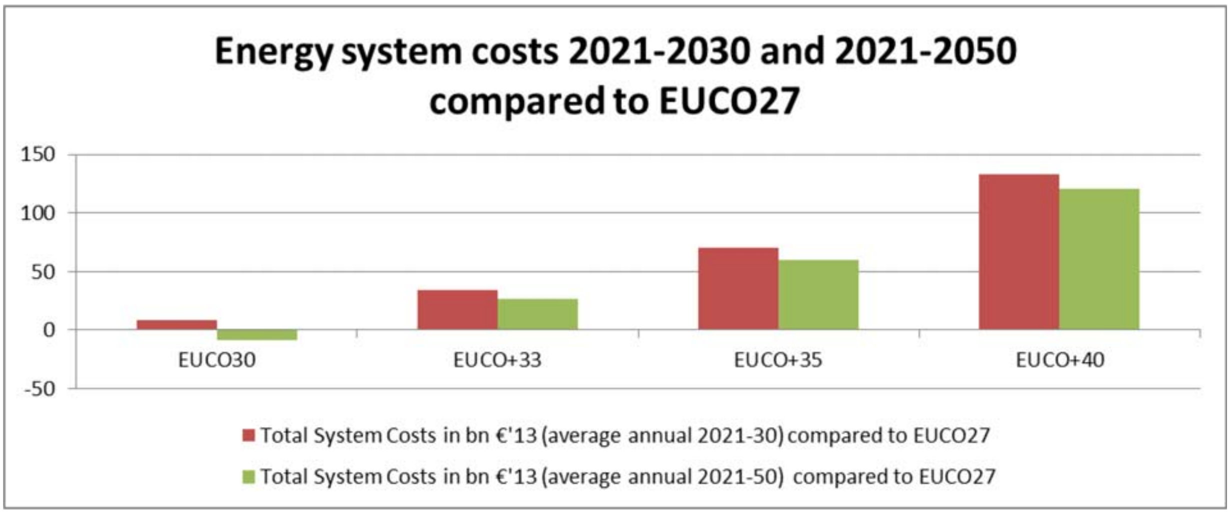
[159] The small difference between the total system costs and the summation of capital costs, energy purchase costs and direct efficiency investment costs (as shown in Annex 4) is due to the inclusion of the supply side auction payments under energy purchases, embedded in the energy prices (but not included under the reported total system costs which exclude auction payments).

[160] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency ((≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

[161] The small difference between the total system costs and the summation of capital costs, energy purchase costs and direct efficiency investment costs (as shown in Annex 4) is due to the inclusion of the supply side auction payments under energy purchases, embedded in the energy prices (but not included under the reported total system costs which exclude auction payments).

[162] Whereas the EUCO scenarios achieve the 2030 targets for RES (≥27%), GHG (≥ 40%) and energy efficiency ((≥27%), the REF2016 does not achieve these targets. Therefore, a comparison of the results of EUCO scenarios with REF2016 should not be undertaken to identify the impacts of a higher energy efficiency level above 27% in 2030 only because this comparison would include also the impacts of a higher RES and GHG targets and the associated cost.

Figure 4: Energy system costs (2021-2030 and 2021-2050)



Source: PRIMES

In the PRIMES model, private discount rates have been used to reflect the decision-making process of economic actors. The behavioural discount rate for investments in buildings renovation of households was slightly lowered with the intensification of energy efficiency policies in more ambitious policy scenarios. A 10% discount rate was used – after the model was solved – to annualise the capital and energy efficiency investment costs reflecting opportunity costs of raising funds by the actor on a private basis. The 10% discount rate was kept unchanged among the scenarios. This rate is similar to the WACC used for supply side investments.

Energy efficiency measures are mainly financed by private capital in the form of savings from households, equity from companies, commercial debt originating from small consumer loans by retail banks and large-scale green bonds issued on the capital markets. This mobilisation of private financing is reinforced by a number of public schemes (around 200) across Europe, which primarily take the form of grants, low interest rate credit lines[163], tax rebates or guarantees[164]. To facilitate future investment expenditure from the private sector, it would be helpful to ease access to financing and bring down its costs by addressing a number of market failures, by 1) using public funding more effectively and by supporting the development of attractive financing solutions built upon the emergence of new business models (**more effective use of public funding**); 2) securing sustainable large-scale pipeline of bankable energy efficiency projects (Aggregation and assistance); 3) de-risking of energy efficiency investments which are currently still seen as risky and costly (De-risking). In that context, these three pillars of the **"Smart Finance for Smart Buildings"** Initiative come with a coherent response to the need to strengthen energy efficiency financing streams in Europe.

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163 For example, Energy Efficiency Fund operated by VIPA in Lithuania.

164 At the EU level, the most important financing streams for energy efficiency are the European Structural and Investment Funds (ESIF). Energy Efficiency has also been a beneficiary of the European Fund for Strategic Investments (EFSI). In addition, there are two specific EU financial instruments for energy efficiency, the European Energy Efficiency Fund which provides market-based financing to public projects and PF4EE (Private Finance for Energy Efficiency) which combines lending from the EIB to private banks together with guarantees and technical assistance.

5.2 Assessment of the character of the target

The different policy options regarding the target formulation are analysed qualitatively in relation to the following criteria: Effectiveness, efficiency, relevance, coherence, subsidiarity and proportionality. -1 is given for a high chance of not meeting the criterion, 0 for neutral and 1 for a high chance of meeting the criteria.

This analysis is done having in mind the initiative on governance of the Energy Union, which is developed in parallel as decided by the European Council in 2014. It will provide a mechanism for Member States to present their energy efficiency targets for 2030 and projections towards these targets as contributions to the EU wide energy efficiency 2030 target. This will help to track the progress towards the EU 2030 energy efficiency target.

Effectiveness[165]

In general, the **binding nature** of a target is assumed to impact on the **delivery of the target** only. Measures need to be put in place **which ensure that the agreed target is achieved** by the EU as a whole or by individual Member States. In contrast, **indicative targets** are seen to focus on **binding measures and actions** that trigger energy efficiency investments and which enable the EU28 and Member States to achieve their indicative target.

Option 1.1 (indicative EU and national targets) would be a continuation of the current approach, ensuring a continuity of a framework to which relevant stakeholders including Member States have become accustomed. However, this option does not ensure effectiveness as Member States can set their ambition level according to their national circumstances which does not necessarily lead in the sum to the overall EU target as it is the case for the 2020 targets. In addition, the indicative nature of the current target has sometimes made it difficult to mobilise the necessary policy effort. Experience with the 2020 indicative national targets under Article 3 of the EED has shown that there is only limited scope to increase Member States' efforts to ensure that all 28 indicative national targets add up to the overall EU target[166]. Effectiveness could be achieved if a review of the progress towards the 2030 target would be foreseen in legislation which would allow legislation to be adopted in time to deliver the needed additional savings by 2030[167]. Without an early review clause or even a concrete 'what if' clause in the EED if the 2030 target is at risk, the effectiveness score would be -1. However, if legislation would create a presumption for the Commission to take action in case the EU is at risk to achieve the 2030 energy efficiency target, the score can be increased to zero as this would increase the effectiveness of this option.

By contrast, **option 1.3** with binding Member States targets would be the most effective way of achieving the agreed 2030 EU energy efficiency target level as it could be assured that the sum of national targets of Member States, if defined by the Commission or the individual contributions agreed between Member States, would be in line with the overall European

165 Effectiveness considers how successful the option is in achieving or progressing towards the set objectives.

166 Article 3(3) EED required the Commission to review in 2014 if the European Union achieves its 2020 target. The Commission concluded that new primary legislation would be unlikely to enter into force soon enough to deliver the required savings to close the gap towards the 2020 target. Therefore, the Commission stressed the need to properly implement existing energy efficiency legislation (COM(2014) 255 final).

167 On the other side, it is difficult to conclude many years ahead of 2030 if the EU is at risk to meet the energy efficiency target as many different factors might influence the energy consumption in the years until 2030.

energy efficiency target (effectiveness score 1)[168]. In case of binding national Member States targets, the whole EED needs to be reassessed as Member States might need to have more flexibilities. In this context, also a complete removal of Article 7 which sets requirement for Member States to save a fixed amount of final energy from energy sales every year needs to be considered in this case. Therefore, option 1.3 would require a complete reassessment of the Directive to ensure consistency of national binding targets with binding measures.

Option 1.2, a binding EU target (as will be implemented for the renewable energy framework 2030), will be effective for energy efficiency only in combination with an early review clause or a 'what-if-clause' and in combination with a strong governance system. National plans which will be introduced under the Energy Union governance would include an explicit aim of contributing to the overall EU target for energy efficiency. If a review by the Commission would show an insufficient level of ambition, an iterative process would need to take place with the aim of reinforcing the content of the plan(s) and respective Member State effort. Without such an early review clause and a strong governance framework no instruments would be available to ensure the full delivery of Member States toward the agreed 2030 EU energy efficiency target. Therefore, the score is set also at zero for option 1.2.

Efficiency

Efficiency considers the relationship between the resources used by an intervention and the changes generated by the intervention. At a national level, no proof could be found that a binding efficiency target takes more resources than an indicative target as the target finding procedure is assumed to be the same. However, experience with the 2020 targets on renewable energies and greenhouse gas emission shows that binding national targets generate more changes and efforts due to a stronger signal to relevant actors, such as investors and consumers, about the policy direction (national targets are achieved in almost all Member States)[169]. Price drops for some renewable technologies show that a binding renewable energy target in 2020 helped to reduce the costs. This binding policy framework was needed for renewable technologies to be able to compete with other technologies. A binding renewable target in 2020 gave investors the security that it is worth investing in renewables.

Most energy efficiency technologies are cost-efficient. However, many energy efficiency investments have a long payback period which hinders end-consumers to invest in energy efficient solutions. Households prefer a short payback period and commercial consumers usually within 1-4 years. The energy efficiency framework helped in the past years to bring down the costs of energy efficient solutions e.g. for windows. To further reduce the cost, e.g. for building insulation or efficient appliances, a secure policy framework with a binding national energy efficiency target for 2030 could help to incentivise more investments in this sector. As the generated changes are considered higher for binding national targets, option 1.1 is scored with zero, option 1.2 with zero and option 1.3 with 1.

Relevance

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[168] However, it needs to be kept in mind that a target in itself does not deliver any energy savings. Energy savings are delivered only through energy efficiency measures which reduce energy consumption reductions through technological improvements or a change of behaviour.

[169] See e.g. EEA Report No 4/2015: Trends and projections in Europe 2015.

Relevance looks at the relationship between the needs and problems in the society and the objectives of the intervention. The objective of an indicative or binding national energy efficiency target is the same, namely to reduce energy consumption. Also the relationship between the needs and problems of society which are tackled through an energy efficiency target remain the same, irrespective of the binding nature of the target. Therefore, all options are scored with 1.

Coherence

As described in the Energy Efficiency Impact Assessment 2014, an indicative energy efficiency 2030 target would accommodate the differences in the national/domestic markets and their energy efficiency potentials. Member States know their energy efficiency potential best to identify cost-efficient remaining potentials and market barriers. Member States would be also more flexible to adjust their indicative targets in case of considerable changes e.g. in the economy. It would also limit the risk of imposing too much rigidity on the overall energy and climate framework which includes also the GHG (ETS and ESD) and renewable targets. For example, a strong increase of the share of renewables could make it necessary to adjust the energy efficiency target expressed in primary energy consumption to update it due to the latest market projections. But also the national binding targets under the Effort Sharing Decision Member States might need flexibilities to achieve the cost-effective mix between the different policies.

However, too great a range of flexibility could risk coherence at EU level if changes towards the indicative energy efficiency are undertaken by Member States which would result in total in a lesser reduction of energy consumption for 2030 than the one agreed. Therefore, option 1.2 (binding EU target) with an early review clause or a 'what-if-clause' in legislation combined with the governance system would guarantee that the EU28 target would be met even with leaving enough flexibility to Member States in setting and adjusting their indicative national targets. The governance process also has the merit of increasing the economic efficiency of its implementation. In terms of economic efficiency the need to consult neighbouring Member States as part of the establishment of national plans would mean that decisions about managing energy demand and deciding on supply options would be better coordinated among Member States across the internal energy market. The same applies to option 1.1 (indicative targets) if combined with an early review clause. Therefore, both options are scored with 1.

Option 1.3 (binding national targets) is scored with zero. The reasons for this were already given in the Impact Assessment (2014)255 final: Experience with the Renewable Energy Directive shows that binding targets can be a strong driver for national action: a target at Member State level can ensure political accountability and commitment to deliver results while providing flexibility to choose and apply the most suitable tools to achieve the target[170]. On the other hand important synergies in policy making on EU level (e.g. common methodologies for establishing cost-optimal levels for building renovations) would be lost. Regarding coherence this approach would run counter to recent proposals on governance and might lead to increases in administrative cost linked to fragmented EU action and potential

[170] The shared efforts between Member States would have to be devised, taking into account for example such factors as the energy efficiency potential, early action, the structure of the economy

harm to businesses operating across the internal market would limit the economic efficiency of this approach.

Subsidiarity and proportionality

The principals of subsidiarity and proportionality ensure that decisions are taken as much as possible at national, regional or local level, except in the areas that fall within its exclusive competence of the EU. Proportionality requires that any EU action should not go beyond what is necessary to achieve the objectives. Option 1.1 and 1.2 are scored with 1 because targets will be set by Member States. However, the score of option 1.3 would depend largely on the decision that will set the target. In case the targets are defined at EU level, the score of the subsidiarity and proportionality criteria would be -1. In case the national binding targets would be set at national level, the score would be 1 as well. For that reason, a score of zero is applied.

Table 26: Comparison of policy options for the character of the 2030 target

	1.1 Indicative EU and national targets with review/what-if-clause and governance system	1.2 Binding EU target with review clause/what-if-and governance system	1.3 Binding MS targets
Effectiveness	0	0	1
Efficiency	0	0	1
Relevance	1	1	1
Coherence	1	1	0
Subsidiarity and proportionality	1	1	0
SUM	**3**	**3**	**3**

Combining the different criteria assessments, no option could be identified as a preferred option. However, as described above, if option 1.1 or 1.2 is chosen, an early review clause or a 'what if' clause needs to be stipulated in the EED. If option 1.2 is chosen, the governance system will be of major importance.

5.3 Assessment of the formulation of the target

The European Council conclusions in 2014 used the same formulation while referring to the energy efficiency 2030 as the one used for the 2020 target. The 2014 Commission's Communication, however, proposed that in the framework of the governance, "[…] the Commission will explore the use of additional indicators, to express and monitor progress towards the energy efficiency target, such as energy intensity, which better take account of underlying changes in and projections for GDP and population growth". In the public consultation (see Annex 1) stakeholders also commented on the formulation of the energy efficiency target. 23% of the respondents, the biggest group after those in favour of maintain the current formulation (for the 2020 framework) asked for an energy intensity target.

The formulation of the target will be analysed below based on effectiveness, efficiency, relevance, coherence, as well as the transparency and ease of monitoring.

Policy option 2.1 (final energy savings) is discarded for the following reason: a saving target was included in the former Energy Services Directive 2006/32/EC[171] which was repealed by the EED. Such a target does not necessarily translate into an energy consumption reduction (e.g. when the economic activity level increases at the same time, due to a very cold winter or rebound effects). Therefore with a final energy saving alone there is no guarantee that energy consumption is reduced to ensure decarbonisation in 2050. Second the monitoring of achieved savings is more difficult. The achievement of the target cannot easily be monitored through official statistics. Therefore a political decision was taken in 2012 to move away from a saving target towards an energy consumption reduction objective. Also the coherence with other 2030 EU climate and energy goals might not be achieved. This is confirmed by the public consultation in which only 8% of the respondents asked for a change towards a final energy saving target for 2030.

The remaining options are 2.2 primary and final energy consumption, 2.3 either primary or final energy consumption and 2.4 primary or final energy intensity: ***Final energy consumption targets*** address energy efficiency in industry, residential, transport, services and other final sectors. Whereas ***primary energy consumption targets*** address energy efficiency in all those sectors and, in addition, also in the generation sector and energy networks. ***Energy intensity*** is defined as primary or final energy consumption divided by the gross domestic product[172].

Effectiveness

As described in SWD(2014) 255 final or primary energy consumption targets are the most straightforward options. However a reduction of energy consumption can be caused by energy efficiency measures but also because of a change in temperature (which causes a lower energy demand), a change in the economic structure, a change in the generation mix or other factors. In particular, future economic developments of the economy need to be anticipated correctly when setting long-term energy consumption targets. If growth turns out to be higher than anticipated, achieving the target will require additional energy efficiency measures, potentially making them no longer cost-effective. If on the other hand growth is lower than anticipated, the target can be met without the energy efficiency improvements that were originally envisaged and therefore some of the cost-effective potential will not be realised. From this angle, option 2.2 and 2.3 can, by construction, be defined with the aim of reaching a certain energy consumption level in 2030, **but without actually targeting the underlying causes to the changes**.

An important difference between final and primary energy consumption targets is that most of the energy efficiency measures target energy consumption reduction in end-users sectors. A final energy target would make it easier to break down the level of efforts by sub-sector (residential, industry, transport) and therefore it would become easier to monitor progress in the different sectors. However, energy efficiency measures also target the supply side which would not be covered by a final energy efficiency target only. Some Member States have put in place several measures to increase the efficiency of their power plants which would not be

[171] The energy efficiency target of the Energy Service Directive 2006/32/EC was based on proving 9% end use energy savings in 9 years against the average of a five year base period.
[172] To monitor trends, GDP is in constant prices to avoid the impact of inflation.

counted then. Therefore, it was decided on a political level in 2012 that the EED should contain both targets, a final and primary energy consumption target for EU28.

According to Article 2 of the EED '*energy efficiency*' means the ratio of output of performance, service, goods or energy, to input of energy and '*energy efficiency improvement*' means an increase in energy efficiency as a result of technological, behavioural and/or economic changes. This means that also economic changes, e.g. a switch from energy intensive industries towards a more service oriented economy, count towards the energy efficiency target in case the target is defined for the whole economy and not per each sector. Economic cycles should not, however, be counted. Decrease of energy consumption due to an economic crisis is taken into account under option 2.2 and 2.3 even if this is not related to a technical energy efficiency improvement and this represents a weakness of these metrics.

When setting absolute energy consumption targets using the PRIMES or any other partial equilibrium energy model **economic developments, changes in economic structure, changes in the energy mix etc. until 2030 and beyond are taken into account**. This **ensures that e.g. economic growth is not supressed when setting the energy efficiency headline targets**. However, if the one of the factors is projected wrongly this would lead to an overly stringent or overly lax 2030 energy efficiency target if it is formulated as an absolute energy consumption target. Therefore, these options are given a score of zero.

The risk of setting an energy efficiency target not in line with the real economic developments would be lower under option 2.4 (energy intensity indicator). Energy intensity indicators account for economic cycles. The main reason for observing closely this indicator is that historically, economic growth led to higher energy consumption. In the future, higher consumption of energy due to economic growth is to be expected. What the energy efficiency policies aim at is not to cap the absolute amount of energy consumed in a manner that could turn out to be prohibitive in times of high economic growth or a very lax target in times of economic slowdown. Instead, energy should be used in a more efficient way (i.e. using less energy per unit of economic output). This indicator identifies to what extent there is decoupling between energy consumption and economic growth. While economic growth assumptions are likely to be different from the real-life trend, the following situations can be envisaged: If 1) in 2030 the economic growth is smaller than assumed in current PRIMES runs, the energy intensity ratios will have a smaller denominator. In order to meet the target the energy consumption will have to be smaller as well (reflecting that some part of energy consumption reduction will happen automatically due to reduction in activity) but if 2) conversely, economic growth is bigger than assumed in PRIMES, the energy intensity ratios will have a higher denominator. In order to meet the target the energy consumption can be bigger as well (reflecting that some increase in energy consumption will happen due to an increase in activity). However, when setting an intensity target there is also the risk that the numerator is projected wrongly (as for options 2.2 and 2.3). Nevertheless, as energy intensity accounts better for changes in economy, this option is scored with 1.

Efficiency

Efficiency considers the relationship between the resources used by an intervention and the changes generated by the intervention. No evidence could be found that the different options require different resources. However, regarding the changes generated, option 2.2 (primary **and** final energy consumption target) will be more efficient as the concept of having a target expressed in primary and final energy consumption incentivises **changes in all sectors**. The same applies to option 2.4, if expressed in final **and** primary energy intensity. Whereas option

2.3 will generate changes if expressed in final energy consumption in in industry, residential, transport, services and other final sectors only but not in the generation sector and energy networks. Member States could achieve their target without generating any savings in the final energy consumption sectors (e.g. in buildings) if the target is expressed in primary energy consumption only. Member States could e.g. focus on a shift towards more renewable energies only, instead of aiming for energy efficient housing. Therefore options 2.2 and 2.4 will be scored with 1, and option 2.3 with -1.

Relevance

Relevance looks at the relationship between the needs and problems in society and the objectives of the intervention. High energy bills and energy poverty are a major problem in many Member States, With 11% of European citizen unable to keep their houses warm in the winter. Companies also suffer from high energy bills due to competitive disadvantages, in particular energy intensive industries (large and small) but also in the service sector. Therefore, energy efficiency policies should in particular target end consumer sectors to improve their situation. Option 2.2 which include a final energy consumption target is therefore scored with 1, whereas option 2.3 is scored with 0 which would only include one of the two targets only and would not cover all relevant sectors (in case of a final energy efficiency consumption target the generation sector and energy networks would not be covered where also huge energy efficiency potentials exist).

The relevance of a final and primary energy intensity target is not obvious for all sectors as energy consumption is not always closely linked to the development of the economy in some sectors. The **correlation between energy consumption and economic growth is low in the residential, services, passenger transport and generation sector**. However, **energy consumption is highly correlated with economic developments in industry and freight transport**. An analysis of these correlations is included in Annex IV of SWD(2014)255. However, even if both indicators are considered, option 2.4 is scored with zero only, as the correlation with economic growth is not given for all sectors covered by both indicators.

Coherence

All options are in line with the other climate and energy 2030 targets, namely the RES and GHG targets. Policies targeting those two areas will also contribute towards energy efficiency (see Annex 4). In terms of coherence with other targets, all options are scored with 1.

Transparency and monitoring

The administrative costs for all policy options can be estimated to be low or even close to zero as these targets can be monitored through official statistics (primary energy consumption, final energy consumption, energy intensity) which are readily available at national level and from Eurostat.

The contribution of each Member State is difficult to measure if the targets are expressed at EU level as a primary or final energy intensity target. For stakeholders and citizens it is more difficult to understand what a Member State needs to contribute to the EU level and if a Member State is on track to achieve its own target. Therefore, options 2.2 and 2.3 are scored with one, whereas option 2.4 is scored with zero.

Table 27: Comparison of policy options for the nature of the 2030 target

	2.2. Primary **and** final	2.3 **Either** primary **or**	2.4. Primary and final

	energy consumption	final energy consumption	energy intensity
Effectiveness	0	0	1
Efficiency	1	-1	1
Relevance	1	0	0
Coherence	1	1	1
Transparency and monitoring	1	1	0
SUM	**4**	**1**	**3**

Source: DG ENER assessment

In the public consultation 31% of respondents expressed the view that the new EU energy efficiency target for 2030 should be expressed in both primary and final energy consumption in 2030, followed by energy intensity (23%), and primary energy consumption in 2030 only (10%). 'Other' included a wide range of different proposals.

In the past, the 2020 energy efficiency targets were set based on energy consumption projections using the energy model PRIMES. For these energy consumption projections for 2020, different assumptions had to be made regarding economic growth and other factors. These EU Reference scenario projections are updated on a regular basis taking into account the latest policy developments and other economic trends[173]. However, the 2020 targets still refer to the projections made in 2007 which assumed a high economic growth and an increase of energy consumption in the long term. However, the latest reference projections in 2013 and 2016 show that the energy consumption projection will drop considerably by 2020 and 2030 due to energy efficiency measures, economic changes and other factors (see

173 See Annex 4 for the description of the latest update in 2016 on the EU reference scenario.

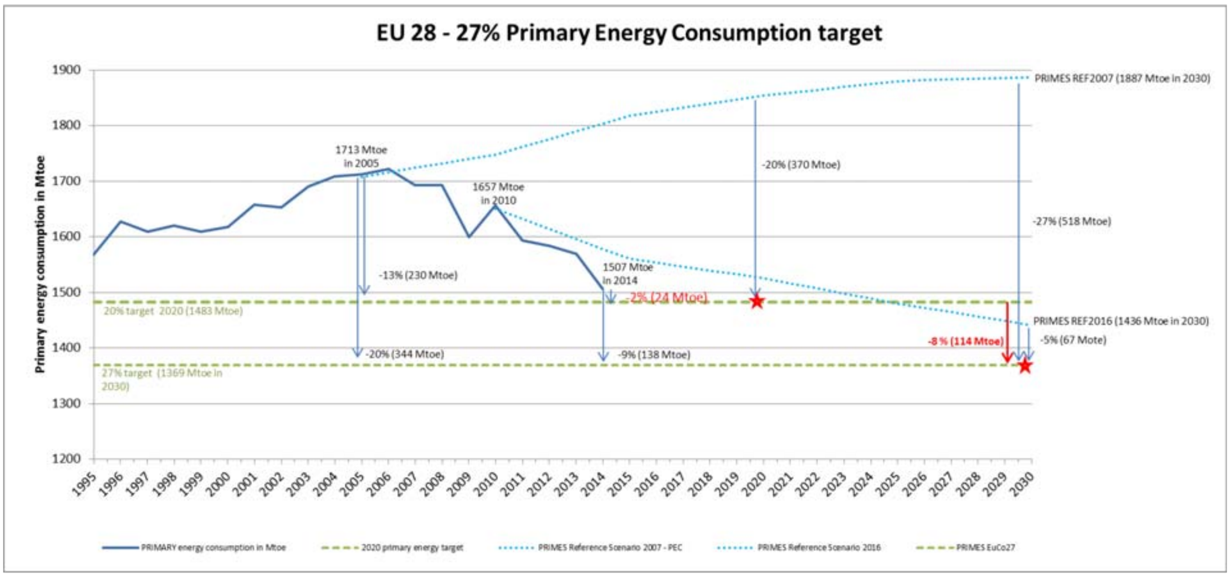
Figure 5).

The EU Reference projections 2007 projected a primary energy consumption in 2030 to be 1887 Mtoe of primary energy consumption and 1416 Mtoe of final energy consumption[174]. However, the new REF2016 projects a primary energy consumption of 1451 Mtoe and a final energy consumption of 1082 Mtoe in 2030 only. The figure below visualises the differences between the EU reference projections performed in 2007 and 2016. The latest projections take into account the implementation of the EED but also the impacts of the economic crises from 2009/2010, changes in economic structure, changes in fuel prices etc.[175].

[174] In PRIMES 2007 the primary energy consumption in 2020 was projected to be 1854 Mtoe of primary energy consumption and 1357 Mtoe of final energy consumption.

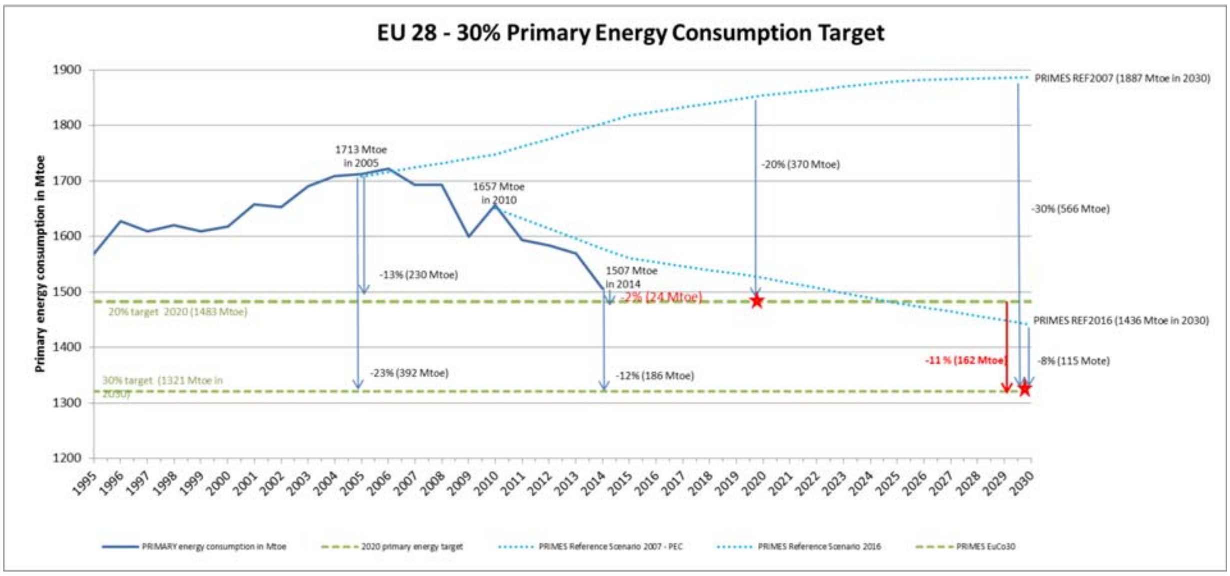
[175] Please, see further details in Annex 4.

Figure 5: 27% Primary energy consumption target



Source: PRIMES and Eurostat

Figure 6: 30% Primary energy consumption target



Source: PRIMES and Eurostat

For stakeholders and European citizens, it is difficult to understand how the energy efficiency targets are set. A definition of energy efficiency targets against an outdated projection made in 2007 can cause confusion and makes it difficult to assess the progress towards these targets.

The other energy and climate targets for 2020 and 2030 are based on historic levels of GHG emissions or can be easily related to historical years, as in the case of RES. Possible targets assessed with EU Reference projections should be translated into energy efficiency improvements or energy reduction targets compared to 2005 levels. Therefore, the Commission proposes to translate the defined energy reduction target into a reduction target compared to **2005 as the reference year for energy efficiency** for consistency reasons with the other climate and energy targets. This should be done for the 2030 energy efficiency target expressed in both final and primary energy consumption as this would increase the transparency of the target setting and facilitates the assessment of the targets.

Table 28: Alternative formulation of the targets – PEC in 2030 compared to 2005 levels

	REF2016	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Change in primary energy consumption compared to 2005 levels (1713 Mtoe in 2005) (% change)	-16	-20	-23	-26	-29	-34

Source: PRIMES and Eurostat

5.4 Impacts of policy options for Article 7

This chapter assesses specific impacts of the policy options of Article 7. It is based on a bottom-up engineering approach for estimating levels of energy savings in view of the 2030 framework[176].

5.4.1 Impacts of option 1: No action at EU level – continue with guidance on regulatory framework and work of enforcement until 2020

Reduction of energy consumption

The analysis shows that the impact of Article 7 will not cease after 2020 due to long lifetimes of some of the measures notified by Member States, e.g. renovation of building envelope or certain elements of the building, installation of technical building systems (see more detail in Annex 6).

As the Commission does not have information on post-2020 saving levels of Member States in the absence of EU regulatory intervention, it is assumed that no new savings will be generated even though it is likely that some Member States will continue putting in place measures also without Article 7[177].

In the EU Reference scenario it is assumed that Article 7 obligations end in 2020 and therefore does not trigger any new savings post 2020. Given that savings stemming from energy efficiency measures under Article 7 implemented before 2020 cannot be precisely quantified, the bottom-up engineering calculation was used[178]. The annual energy savings are estimated to reach 61 Mtoe in 2020 due the policy implemented during the 2014-2020 period. From 2020 onwards, the annual energy savings from Article 7 will decline, as this policy will no longer be a stimulus for triggering 'new' savings each year. It is estimated that some 49

[176] There is a range of economic, social and environmental impacts thanks to the measures implemented under Article 7. These Article impacts constitute a fraction of the overall energy consumption reduction impacts which were analysed in the chapter 5.1 for the different energy efficiency target level. The respective impacts of Article 7 measures are difficult to quantify for due to the recent implementation of energy efficiency obligation schemes under Article 7 in Member States. Nevertheless, impacts of Article 7 were quantified where possible.

[177] Most probably those Member States with a long history of EEOSs, which have become already a part of their national economic model – will continue with energy saving measures beyond 2020.

[178] As recognised by Ricardo AEA/ CE Delft in its study on evaluating the implementation of Article 7, this figure is based on engineering bottom-up modelling on basis of the notified savings and does not take into account the reality check.

Mtoe savings will continue to be delivered in 2030 as a result of the long term measures introduced in the 2014-2020 period[179].

Administrative burden

With the expiry of the savings obligation under Article 7, there would be no reporting requirements for this policy post 2020. This would reduce the administrative burden to some extent. The reporting of progress in view of the achievement of the 2030 energy efficiency target would continue under the new governance instrument only. To this end, even though the administrative burden would be taken away just for one provision of the EED, it would not liberate the Member States from the overall reporting on tracking progress towards the achievement of the 2030 energy efficiency target.

However, the benefit from a reduced administrative burden would be low compared to the missed opportunities associated with the link of Article 7 with other energy efficiency policies. Article 7 is a cross-cutting policy which has links with other legislation including the EPBD and Ecodesign. It works as a pull-mechanism (e.g. for the EPBD) and triggers investments for renovation of buildings stemming from the obligation to achieve new savings each year.

5.4.2 Impacts of option 2: Extend Article 7 to 2030

In this chapter the impacts of the extension of Article 7 are compared with the impacts of policy option 1 – baseline scenario.

Reduction of energy consumption

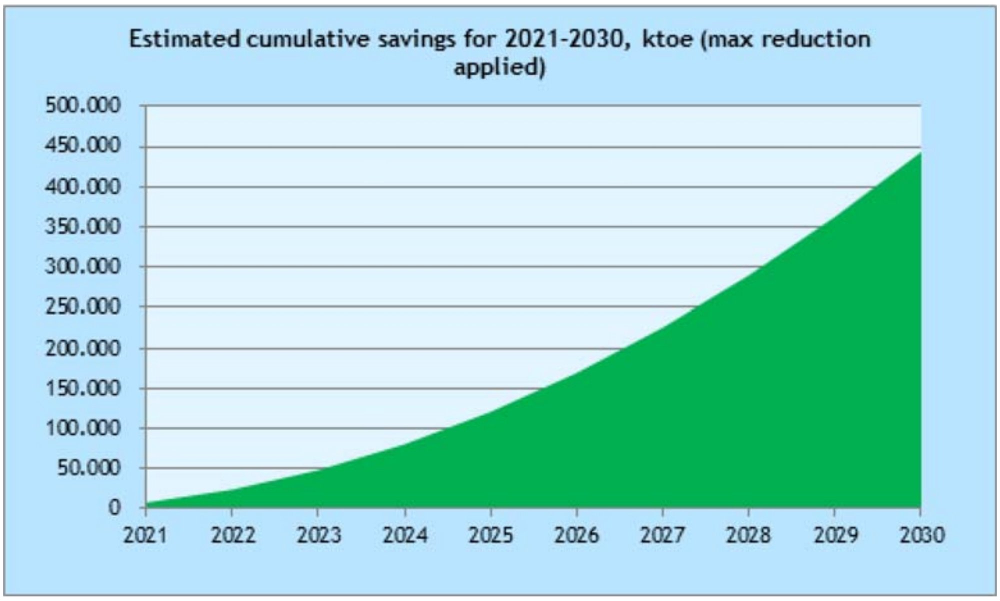
The extension of Article 7 to 2030 will allow securing, on a purely engineering calculation, a maximum of 81 Mtoe[180] of new savings in 2030 (see

[179] In addition, there is a need to factor in potential overlaps between the different policies and also the rebound effect which is not reflected in these estimations.

[180] Description of the calculation of the amount of savings is provided in Annex 6.

Figure 7) on the basis of the same 1.5 % savings rate per year. In cumulative terms these savings are estimated to amount to 443 Mtoe by 2030 (for the whole period 2021 – 2030). This figure needs, however, to be adjusted to take into account overlaps with other policy measures also contributing to the energy efficiency target, and rebound effects (see Annex 6). This is a conservative estimate based on PRIMES reference scenario 2016 on how final energy consumption would evolve over the next years. In reality Member States might have higher reduction levels in final energy consumption which would thus result in lower amount of energy savings required by 2030.

Figure 7: Estimated amount of energy savings (ktoe), engineering calculation, with 1.5% rate[181]



Source: Ricardo AEA/CE Delft (2016)

As mentioned above under option 1, some of the energy saving measures (e.g. roof insulation) put in place by the Member States in the 2014-2020 period have long lifetimes and will continue to deliver energy savings after 2020. As pointed out under policy option 1, the effect of these long term savings will diminish with time and it is difficult to quantify it precisely for 2021-2030[182]. The effect of these savings has been estimated to amount to 49 Mtoe in 2030. Any contribution from measures that have already been put in place will be a useful, additional contribution towards the achievement of the 2030 target into addition of the new energy savings generated during the period 2021-2020. It should be noted that savings obtained after 2020 may not count towards the Member State's current savings requirement for 2014-2020.

Analysis of the current period shows that Article 7 has triggered the implementation of energy efficiency obligation schemes (EEOS) in many Member States. In the past, this has proven to be an effective tool for energy savings. Sixteen countries have notified EEOSs[183], an increase from five EEOSs which existed before the introduction of Article 7. The extension of the period would confirm the new schemes, consolidate the learning effects of the implementing public authorities and obligated parties and ensure that they would continue to deliver. The notified cumulative savings under EEOSs amount to 86 Mtoe by 2020. This represents 34% of the total savings to be achieved under Article 7 by 2020. The evaluation also suggests that 19 % or 49 Mtoe of the savings are triggered by the financing schemes or incentives. This

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181 Calculation is based on the projected final energy consumption averaged over 2015-2020 (2016 PRIMES reference scenario).

182 As recognised by Ricardo AEA/ CE Delft in its study on evaluating the implementation of Article 7 this figure is based on engineering bottom-up modelling described in Annex 6, and does not take into account the reality check.

183 This figure is subject to changes as one Member State will replace the EEOS by alternative measures, while some Member States are considering introducing an EEO scheme in addition to the alternative measures; and in four Member States the scheme is not operational yet.

shows the important role of Article 7 as a "financing instrument", which *inter alia* contributes to the increase of the renovation rates.

The effect on energy demand depends also on the application of the flexibilities (excluding sales in transport) and exemptions under Article 7(2) which have a direct impact on the national savings contributions and were used by Member States to the large extent in the current obligation period 2014-2020 (analysed in Annex 6).

Economic impacts

Energy efficiency policy in general provides macroeconomic benefits in the form of GDP growth and indirect and induced jobs. In addition, consumers can reduce their energy bills, and invest the savings in goods and services which creates additional jobs as described in chapter 5.1.1.5[184]. It is estimated that the extension of Article 7 to 2030 would contribute with extra savings to the macro-economic benefits. Article 7 is one of the policies that are needed to achieve energy efficiency levels above the EU Reference Scenarios.

Costs and benefits

Because Article 7 is new, there is limited data on the costs and benefits of most of the measures which Member States have selected to implement Article 7[185]. Better data are available on energy efficiency obligation systems because some Member States had introduced monitoring schemes already before Article 7 was enacted under the EED[186]. Member States always have the choice to use either energy efficiency obligations or – where they find them more cost-effective - alternative measures. Therefore, an assessment of the cost-effectiveness of energy efficiency obligation schemes is a good basis for assessing the cost-effectiveness of Article 7 as a whole.

Studies show that obligated companies pay from 0.4 eurocents in France to 1.1 eurocents respectively per kWh of energy saved through energy efficiency obligations in selected Member States[187]. For other Member States these are similar – 0.5 eurocents/kWh in Denmark, 0.7 eurocents/kWh in Italy and 0.5 eurocents/kWh in Austria. So is the weighted cost of supplying energy to the sectors covered by the obligations – 13 eurocents/kWh in Denmark, 9 eurocents/kWh in Italy and 8 eurocents/kWh in Austria (see Table 29). Overall, the European energy efficiency obligations seem to represent a good level of cost-effectiveness as compared to the cost of supplying energy as shown in the table below.

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184 These 'ripple effects' of capital expenditure can be estimated using multipliers along the whole supply chain. An illustration of this effect can be found in a recent paper assessing investment in building fabric insulation. See Rosenow, J., Platt, R., Demurtas, A. (2014): Fiscal impacts of energy efficiency programmes - the example of solid wall insulation investment in the UK. Energy Policy 74, pp. 610-620.

185 Start of the obligation period was on 1 January 2014.

186 Assessed Member States are: Austria, Denmark, France, Italy and the United Kingdom.

187 Including administrative costs, which are estimated at 0.2%-1.4% of the costs for the obliged companies.

Table 29: Comparison of costs of EEOSs across selected countries (unit cost of saved energy)

	Time period	Weighted average EEOS cost of lifetime energy savings (Eurocent / kWh)[188]	Weighted average retail prices of comparable energy supply for relevant sectors (Eurocent / kWh)
UK	2008-2012	1.1	10
Denmark	2015	0.5	13
France	2011-2013	0.4	9
Italy	2014	0.7	9
Austria	2015	0.5	8
Vermont, U.S.	2012-2014	3.2*	11.57
California, U.S.[189]	2009-2011**	2.1	12.24

Source: Regulatory Assistance Project

** Includes both electricity and natural gas and fuel oil savings; may not fully account for longer-lifetimes of non-electricity savings measures.*

*** Data for a different set of years; the cost to the energy companies not available for the 2010-2012 period.*

Looking at the costs and benefits of Article 7 from a narrow 'private cost' perspective, as well as from a societal cost perspective, it could be concluded that the programme leverages additional investment attaining the societal costs by consumers on average 2-3 times the cost to the obligated parties. For example, the societal costs in the United States reach to 2.4 billion Euro per year for the programme that costs utilities 1 billion€ per year. In Europe, the leverage effect is a bit lower and range from 1.4 to 2 times of the investment cost to the obligated parties. Recent studies show that the proportion of the investment costs paid by the obligated companies is in France is 72% and in the UK 69%. In other Member States the share is even lower[190]. The complete data including both energy company costs and contributions from the beneficiaries are available only for the British and French EEOS and are shown in Table 30[191].

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188 The figures for the U.S. are generally higher because costs in the US are generally higher than those in the EU due to: shorter measure life assumptions, more 'aggressive' or 'deeper' savings, also targeting energy poverty which is more costly; costs are levelised whereas in the EU not all countries discount energy savings, the higher depth of savings than in most of the EU examples.

189 https://emp.lbl.gov/sites/all/files/cse-report-summary-overview-presentation_0.pdf

190 Rosenow, J., Bayer, E. (2016): Costs and benefits of the Energy Efficiency Obligation Schemes. Regulatory Assistance Project (data are for 2008-12 (UK), 2015 (Denmark), 2011-13 (France), 2014 (Italy) and 2015 (Austria)). The share of the private cost contributed by the consumers depend on the design and objectives of the programme. In the UK, the average annual cost for the period of 2005 to 2008 was 1.97 Bn €; but for 2008-2012 this figure was 1.51 Bn € for the household sector, as the programme also covered the cost accrued to energy poor households and vulnerable consumers. In Denmark the share paid by the obligated parties was much lower and reached 30% in industry sector.

191 Rohde C. Rosenow J. Eyre N. (2014) Energy Saving Obligations. Cutting the Goardian Knot of leverage (2).pdf.

Table 30: British and French energy efficiency obligation schemes [192]

	Energy efficiency investments: annual cost to energy companies (€ billion)	Energy efficiency investments:, overall annual cost for society including to consumers (€ billion)	Energy savings per year (ktoe)
UK	1.05	1.51	237
France	0.39	0.54	377

Source: Regulatory Assistance Project

As regards alternative measures put in place by Member States it could be concluded that public funding attracts additional private investment for energy efficiency through the different financing and fiscal instruments and which in turn allows achieving certain level of leverage in the implementation of energy efficiency projects. The level of leverage of private investment though differs from country to country. For example, in Germany one of the KfW programmes designed for energy efficiency renovations attracted 19.4 billion€ (i.e. 78 %) in private investment of the total annual investment of 25 billion €, while in Lithuania the share of private investment for the Renovation programme of the multi-apartment buildings was considerably lower and reached around 37 % in private investment (55 million € in private funding per year in addition to 145 million € of public investment). The total annual investment for the tax incentive in Ireland "Accelerated Capital Allowance" reached 10.6 million Euro where 9.5 million € of private investment per year was attracted in addition to 1.1 million € of public investment through the tax incentive[193].

Costs have decreased over time in the established schemes, thanks to the expertise gained by the obligated parties and improved quality of installation of the measures[194] and thanks to innovative financing models such as white certificate trading. Evidence shows that costs to the energy companies vary significantly depending on the country ranging from 185 million € per year in Denmark to more than 1 billion €o per year in the UK[195], depending on the size of the scheme and the target to be achieved, and also on the specific actions financed through the EEOS. The obligated parties usually pass on to their customers the costs of achieving the savings obligation through increased energy bills; however, this may vary (e.g. in fully liberalised markets obligated parties can pass on the costs at their own discretion and may spread the cost unevenly across customers). On the other hand, customers benefit from the energy efficiency improvement measures undertaken by the obligated parties in the form of reduced energy consumption and reduced energy bill.

Article 7 could also have a distributional effect. Consumers with higher incomes are most likely to take up opportunities offered by the EEOSs because they can afford to contribute to the investment. On the other hand, the availability of the financing contribution and the willingness of utilities (i.e. obligated parties) to take over the burden to organise the

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192 Energy savings indicated are relevant for the household sector in the UK covering 2008-2012; in France, energy savings are depicted for all sectors covering 2011-2013.

193 The level of private investment and number of projects is calculated as average of investment/projects in ACA equipment by companies between 2009 -2012.

194 eceee (2012) Briefing for DG Energy, EU Experience of Energy Efficiency Obligations/White Certificates & their Importance in Meeting Climate Change Challenges.

195 Rosenow, J., Bayer, E. (2016): Costs and benefits of Energy Efficiency Obligation Schemes. Regulatory Assistance Project.

installation of the energy efficiency measures could trigger investment decisions among lower income groups.

If Member States are concerned about the distribution effect they can address it through the design of the scheme to ensure that the measures reach energy poor households as priority. This is already done by some Member States (e.g. Ireland and the UK). The reduced energy demand as a result of the energy saving actions under the EEOS will contribute to lower energy prices (see chapter 5.1.1.4) and to some extent offsetting the costs of the EEOS. In particular, lower energy prices would be beneficial for all consumers. Social aspects are analysed from a broader energy efficiency perspective in chapter 5.1.4.

Since all Member States already have Article 7 measures in place[196], no additional budgetary consequences for the public authorities of Member States might be expected if the same intensity of 1.5% per year is retained for the new period 2021-2030. For example, the final evaluation of the obligation period 2008-2012 for the Carbon Emissions Reduction Target (CERT)[197] in the UK provides data on the cost of the EEOSs to the obligated energy suppliers. It shows that the average costs per year to the energy companies were significantly (33%) lower than originally estimated in the impact assessment. This is in line with historical precedence as through innovative delivery and economies of scale, energy savings are consistently delivered by energy suppliers cheaper than anticipated.

There is limited evidence for alternative measures due to the recent implementation, and therefore it is difficult concluding about the cost consequences specifically related to Article 7 implementation. According to the evaluation it could be expected that the costs to public authorities carrying out the alternative measures will depend on the type of measure and the savings level to be achieved, only the source of financing will differ and how the costs are recovered[198].

As indicated above, it is also likely that a positive impact will continue to take place for the **energy poor** as this is already being addressed by some Member States under Article 7 (Austria, France, Ireland and the United Kingdom). Ireland has set a binding sub-target for suppliers that 5% of savings should be achieved in energy poor households. The UK also decided to achieve a certain amount of savings in low income areas and vulnerable households[199]. In this regard, UK provisional figures provided in the recently submitted EED Annual Report show that by the end of January 2016 there were 1.7 million measures installed under its ECO[200].

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196 At the time of drafting this report, some Member States have notified changes as regards the measures they intend to use for achieving savings under Article 7.

197 Ipsos MORI, CAG Consultants, University College London and Energy Saving Trust (2014).

198 SWD(2016) Evaluation EED article 7

199 Of these, around 978 000 measures were installed in 767 000 low income and vulnerable households, or households in specified low income areas. Measures installed included: cavity wall insulation (37 %), loft insulation (26 %), and boiler upgrades (21 %).

200 Energy Company Obligation, introduced in January 2013. Under ECO, energy suppliers are obligated to achieve carbon saving targets in the domestic sector and energy bills reductions in low income and vulnerable households. See https://ec.europa.eu/energy/sites/ener/files/documents/UK%202016%20Energy%20Efficiency%20Annual%20Report_en.pdf.

Administrative burden and compliance costs

It is not expected that the extension of the obligation period under Article 7 as such would result in additional administrative burden and compliance costs for Member States as no new obligations or additional reporting would be required from the Member States.

Indeed it is very likely that thanks to the new integrated governance system in view of the 2030 framework[201] administrative burden associated with reporting and monitoring obligations could be reduced. Expertise gained in administering the obligation schemes and alternative measures could also contribute to this. The evaluation report shows that administrative and compliance costs related to monitoring and verification of energy savings, are relatively low for energy efficiency obligation schemes. They currently range from 0.2-1.4% of the programme cost (see table below) but this depends on the specific scheme in question. The extension of Article 7 would imply a continuation of the recurrent compliance costs, i.e. the monitoring and verification of the savings created as well as the reporting of those to the Commission.

Although certain reporting requirements under Article 7 and Article 24(1) may be assumed to pose additional administrative burden to Member States, the stakeholders' replies to the public consultation of the EED revealed that monitoring is an effective and efficient way to track progress of achieved savings on an annual basis. The flexibility given by this policy in terms of measures pursued and calculation methodology applied should be balanced with robust monitoring and verification mechanisms which require reporting by Member States (including participating parties at national/regional level depending on the programme).

Administrative and compliance costs have a negligible effect on consumer energy bills compared to the cost consumers need to pay for the supplied energy including charges and levies associated with supply. The EEOS create almost no extra costs for governments as they are financed through energy prices or grid charges, or - if certificate trading is part of the scheme - by a charge per certificate issued.

[201] The governance framework in view of the 2030 framework intends to streamline and simplify the existing planning and reporting energy and climate obligations.

Table 31: Annual company cost and compliance cost of EEOSs[202]

	Time period	Energy company costs (million Euro/ year)	Energy company costs (Euro/ capita/ year)*	Administrative costs (% of overall program costs)
UK	2008-2012	1,052	16	0.2%
Denmark	2015	185	33	0.3%
France	2011-2013	390	6	0.4%
Italy	2014	700	12	1.4%
Austria	2015	95	11	not available
Vermont	2012-2014	39	62	<0.3%**
California	2010-2012	742[203]	19	not available

Source: Regulatory Assistance Project

** shown on per capita basis solely for the purpose of allowing for comparison; this does not indicate the amount of money paid by individuals.*

*** This is an estimate, based on the monitoring and evaluation expense of the Vermont Department of Public Service as a percentage of total operating expenses for state-wide energy efficiency programmes.*

Other impacts

The extension of Article 7 to 2030 would send a positive signal to investors and the energy market in general which in turn would have a positive impact on the uptake of innovative technologies, techniques and services, as it will stimulate demand for energy efficiency improvement measures. Greater demand for energy efficiency improvement measures is likely to positively stimulate the **energy services market** and also the manufacturing of energy efficient products. Competition in the markets is therefore likely to somewhat increase in the long term. This could reduce prices for products and services offered and encourage enterprises to innovate and develop more energy efficient products.

At least half of the Member States use some sort of IT tool for monitoring and verification of reported savings which allows them to effectively address the risk of double counting and which increases the efficiency in processing the data and reduces the cost due to the growing demand for these technologies. It is expected that further uptake of **digitalisation** related to the implementation of the energy efficiency measures could take place post 2020.

The extension of Article 7 would continue to have a positive impact on the further development of **innovative business models** – notably energy performance contracting especially due to the greater uptake of EEOS whereby energy suppliers very often make use of energy services companies (ESCOs) as third parties[204]. Some Member States, for example France and Italy, have put in place White Certificate Schemes enabling bidding for the best market price for white certificates issued following the installation of energy efficiency improvement actions. Evidence from these schemes suggests that trading systems have helped

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202 The obligated parties in most of the cases pass on to their customers the costs of achieving the savings obligation.

203 Total program expenditure over 3 years ($2.5 billion) / 3, converted into Euros. Source: CPUC 2015 report on IOU programs, http://switchboard.nrdc.org/blogs/lettenson/2015-03_10-12%20EM%26V%20Report_CPUC.pdf.

204 RAP (2012): Best practices in designing the EEOSs.

aggregating investments for small projects, creating new business models, especially energy performance contracting and ESCOs which are often SMEs. In Italy, for example, 967 ESCOs have been actively involved in the White Certificate scheme to install energy efficiency measures as of 2015[205]. ESCO activities range from heating/cooling solutions to energy services for buildings and industry. The energy services market in Europe is undergoing changes that are stimulating growth, with a corresponding increase in the revenues of ESCOs; these changes, are achieving sales for products and services in the billions of euros range. This is happening for example in France where the growth in the energy services market is also expected at annual rates of 3% to 4%[206].

This in turn has a positive spill over effect on the growth of **small and medium enterprises (SMEs)** due to the higher demand for these services which is likely to grow even further. Studies show that SMEs are key actors for upscaling energy efficiency[207]. Especially in households 70% of these measures are carried out by SMEs[208].

5.4.3 Impacts of option 3: Extend Article 7 to 2030; simplify and update

All impacts related to the extension of Article 7 that are assessed under option 2 remain valid for option 3. This chapter will analyse the impacts of a simplification of what savings can be counted and the consideration of renewable energy produced by buildings for own use.

Reduction of energy consumption

The simplification proposed under **sub-option 3.a** on what can be counted under Article 7 will not change the impact in terms of end use energy savings to be achieved in 2030. However, it will facilitate the achievement of the expected savings (81 Mtoe in 2030 as referred to in chapter 5.4.2) as the requirement of what can be counted under the EPBD will be fully relaxed by allowing taking full credit of savings from the energy efficient renovation of buildings.

Analysis on impact on energy consumption is carried out for the **sub-option 3.b** that considers allowing on-building renewables under the Article 7 savings requirement for the new period 2021-2030.

According to the assessment of the notified cumulative savings by Member States under Article 7 to be achieved by 2020, at least 3% (8.5 Mtoe) of the expected savings could be associated with renewable energy in buildings as the primary action. This number might be slightly higher (5%) for measures targeting multiple actions, for example under the EEOSs in France, Italy and the UK. In addition, it could be assumed that some 25% of the cumulative energy savings notified (62.5Mtoe) are to be generated from actions that are partially linked to the renewable energy installation in buildings (for example, installation of heat pumps or solar

205 http://www.gse.it/it/CertificatiBianchi/Pages/default.aspx.
206 IEA Energy efficiency market report, 2015.
207 JRC European ESCO Market report 2013.
208 International Union of property Owners (UIPI).

thermal collectors as part of measures targeting the renovation of the heating system of the building)[209].

Studies show that around 63 Mtoe of thermal energy and around 9 Mtoe of electricity would be generated by buildings in 2020 (2 Mtoe of electricity will be self-consumed by the buildings, the rest being fed into the grid)[210].

Renewables will help reduce the energy dependence on imported fossil fuels and mitigate the carbon emissions, which is in line with the Energy Union strategy and the 2050 Energy Roadmap. Recent data[211] demonstrate that around 380 Mt CO_2 emissions have been avoided in 2014 as a result of the use of renewable energy[212], which is comparable with the annual emissions of Poland.

Recent estimates suggest that renewables used for producing energy at building level will increase in parallel with other renewable generation, driven by substantial cost-reduction and an enabling framework, which already today allows these technologies to compete with fossil fuel technologies[213]. Estimates[214] of overall cost of support per kWh generated in the EU-28 (see Table 32) shows that certain renewable technologies have benefitted from variable range of support, sometimes higher (for solar PV), and sometimes lower (heat pumps) than the cost of energy efficiency measures which ranges between 0.4 – 1.1 Eurocent/ kWh saved energy for some EU Member States having an EEOS (see above). Therefore, it is likely that some renewable technologies would be able to compete with energy efficiency measures targeting energy efficiency in buildings, if allowed under Article 7.

Table 32: Overall cost per kWh generated per RES technology[215]

Total cost of deploying RES (€ct/kWh)	2008	2009	2010	2011	2012	2008-2012
Solar	46	46	41	32	22	**31**
Heat pumps	0.081	0.052	0.047	0.014	0.000	**0.03**

Source: Commission services' estimate

Cost reduction is observed for efficient technical building systems (such as solar technologies or geothermal heat pumps) which are getting cheaper and more effective every day (see Figure 8 and Figure 9).

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209 Only limited information is available to the Commission on the specific actions to calculate the exact amount.

210 Interim results of the Study on on Renewable Energy Progress, based on PRIMES EUCO27 and EUCO30 scenarios, 2016, Öko Institut.

211 EEA Report (2016): http://www.eea.europa.eu/publications/renewable-energy-in-europe-2016.

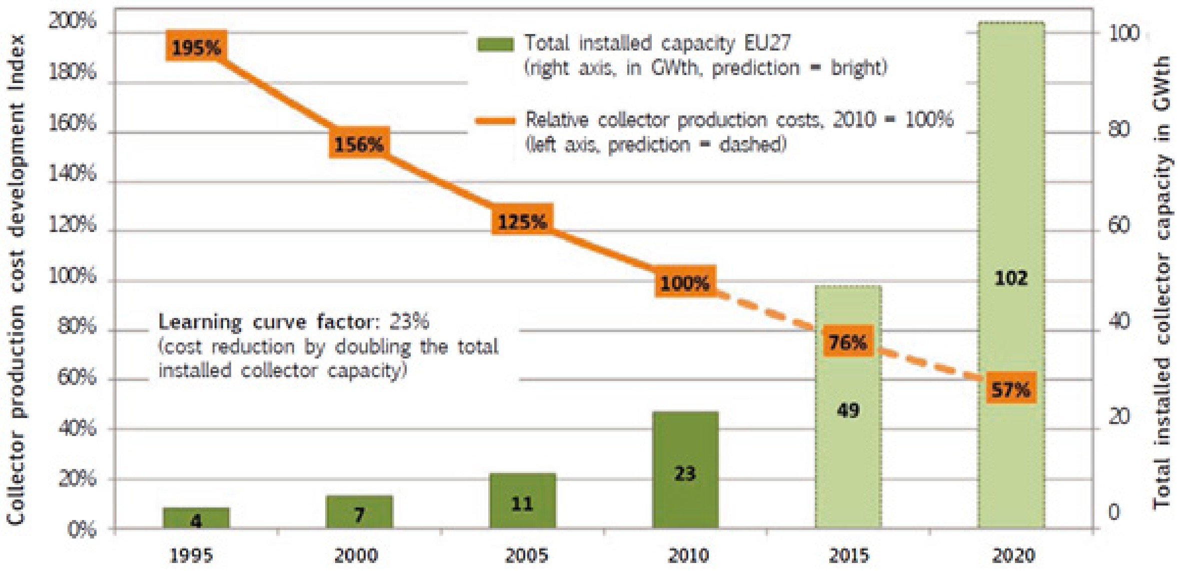
212 Fossil fuels use has also been reduced by an estimated 114 Mtoe (megaton oil-equivalent) the same year, comparable to the fossil fuel consumption of France.

213 Interim results of the Study, on Renewable Energy Progress, based on PRIMES EUCO27 and EUCO30 scenarios, 2016. Öko Institut.

214 Based on the total energy generated divided by the overall support (investment and operational) every year. It is not discounted and doesn't take into account the lifetime of the installation. Based on interim results of the Study on Subsidies and costs of energy, European Commission (2014) and Öko-Institut, aggregated from Eurostat SHARES 2014.

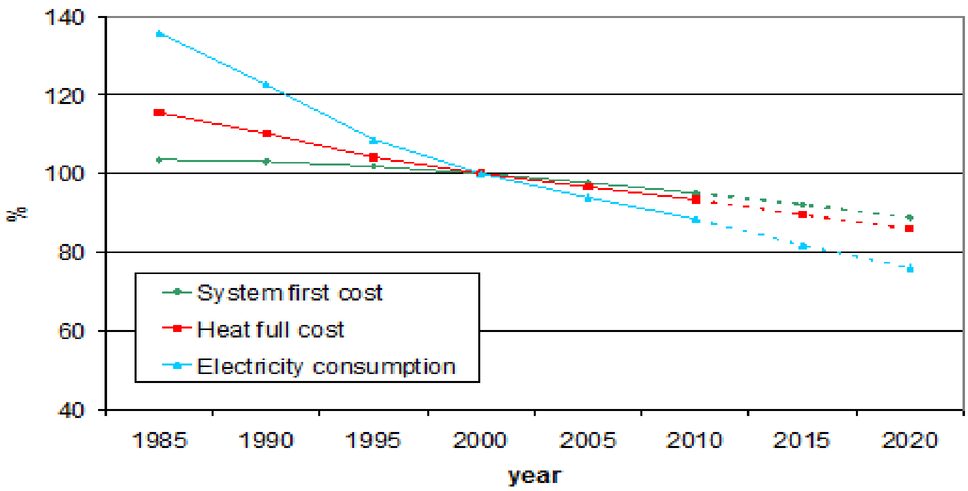
215 Costs are not discounted and do not take into account the lifetime of the installation.

Figure 8: Costs for high-efficient flat plate solar collector panel (of about 2.2 to 2.5 m² gross collector area) manufactured in Europe[216]



Source: Solrico & Trenkner consulting

Figure 9: Development of geothermal heat pump system first cost, heat full cost, and electricity consumption of geothermal heat pump systems in the residential sector in Central Europe (Germany, Austria, Switzerland, Luxembourg)



Source: European Technology Platform on Renewable Heating and Cooling, "Strategic Research and Innovation Agenda for Renewable Heating & Cooling")

In the U.S. eight States have experience with the integrated approach of energy efficiency and renewable obligations, called 'renewables portfolio standards' (RPS)[217]. They allow energy

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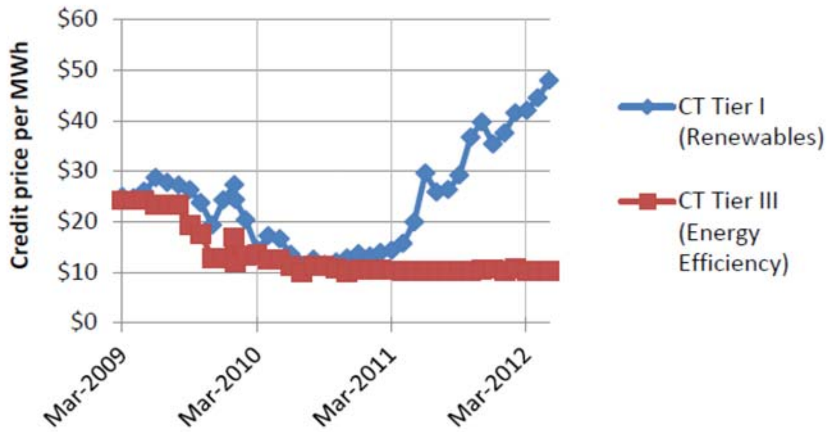
[216] Based on a learning factor of 23%, derived from these historical data, cost reduction projections are calculated up to 2020 based on market expectations of the National Renewable Energy Action Plans (NREAPs).

[217] U.S. NREL (2012): Technical Report: http://www.nrel.gov/docs/fy13osti/55979.pdf.

efficiency as one of the non-renewable resources that count towards compliance. Including energy efficiency in an RPS target lowers the effective amount of renewable energy that must be procured if energy efficiency is not capped. Capping the level of energy efficiency at a certain percentage ensures that both renewable energy and energy efficiency are utilised and provides a level of certainty to market participants. In the two States which directly compare costs of meeting the combined targets with renewables versus energy efficiency, the cost of energy efficiency is well below the cost of renewables. For example, the Michigan PUC assessed that the weighted average energy optimization cost of conserved energy was $15.82/MWh, compared to a life cycle cost of $91.19/MWh for renewable energy.

In Connecticut, Tier III credits (energy efficiency credits) have historically seen credit prices at least slightly lower than Tier I (renewable energy certificates) as shown in the figure below. Prices tracked closely in 2009 and 2010 but in 2011 this trend changed. By mid-2012, Tier I renewable energy certificates increased up to nearly $50/MWh, while energy efficiency credits remained in the $10/MWh range[218].

Figure 10: Efficiency and renewable credit trading prices in Connecticut[219]



Source: Spectron 2012; indicative pricing only

Hawaii no longer has a combined standard and the majority of states with ambitious energy efficiency policies drive them through EEOSs, rather than the combined EE/RES mechanisms. In fact, even Connecticut, which has a combined RES/EE policy, delivers most energy efficiency through EEOS, rather than this combined policy.

The Danish energy efficiency obligation scheme already contains this element by allowing energy distributors to count certain end-use renewable technologies such as heat pumps and solar thermal solutions (except for biomass). This approach is combined with the increased national energy savings target of 3% (while for the purposes of Article 7 Denmark counts only energy efficiency under its annual 1.5% savings requirement)[220]. Denmark also permits

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[218] It is probable that the increase in Tier I pricing was due to a shortage of eligible supply of renewables.
[219] NREL (2012): Technical Report: http://www.nrel.gov/docs/fy13osti/55979.pdf.
[220] Gives a prioritisation factor of 1.5 to energy companies if they promote measures with long term effect (e.g. insulation of walls, roof etc.).

energy generated from the local renewable energy plants which reduce the need for non-renewable energy input to a specific consumer (or a closed circle of consumers, i.e. block heat) to be counted as savings[221]. The overall objective of the Danish scheme is to ensure the cost-effectiveness of the measures so the obligated parties (energy companies) should aim at minimizing the cost per kWh saved. Therefore, energy companies will implement only those measures which make economic sense and benefit the consumer. For example, the Danish scheme allows energy companies to count towards their savings requirement the difference between the actual oil or gas consumption and the electricity consumption by the heat pump. Therefore, energy taken from the air or the ground is not counted. The evidence shows that heat pumps are a relatively cost effective solution both for the consumer and society and reduces the need for supplied fossil fuel.

Given the analysis above, it could be concluded that from the technical point of view it would be an effective way of promoting on-building renewables[222] by counting them to some extent under Article 7 in the new period post-2020 as a way of reducing the delivered energy consumed by the buildings. This would allow increased coherence with the EPBD to some extent (which takes into account the overall energy performance of buildings) and potentially with the reviewed RES Directive. Such integrated approach would help Member States to achieve both objectives in a facilitated way.

Even though this approach would trigger a positive effect in principle, such a combination would not be appropriate without a firm link to an equivalent and proportioned increase of level of ambition of Article 7, to ensure that the end-use energy savings can be achieved to contribute to the energy efficiency target. Therefore, it would best fit as part of the options allowed under Article 7(2) by adding it to the already existing exemptions capped to maximum application of 25%. This would allow Member States to exploit these possibilities by keeping the same level of flexibility under Article 7(2).

Administrative burden and compliance costs

The simplification proposed in sub-option 3.a would have a positive impact as it would reduce administrative burden for Member States and undertakings (i.e. obligated parties). With the proposed simplification of the rules on what savings can be counted under Article 7, Member States would be able to use the calculation methodologies already used under the EPBD. Similarly, sub-option 3.b on on-building RES would not result in additional administrative burden as the calculation approach under the EPBD could be used.

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221 In buildings that are connected to district heating systems, effects of local solar heating systems may not be included, unless these are included as a part of the district heating plant's supply strategy. See Annex 1(8) of the Agreement with the energy companies, of 13.11.2012.

222 Although the definition of 'nearly zero –energy building' in the Energy Performance of Buildings Directive refers to energy from renewable sources produced on-site or nearby, it was decided to restricted this new possibility to renewable energy generated on or in buildings to respect the overall objective of Article 7 of achieving end-use energy savings as a result of reduced energy consumption by buildings.

5.4.4 Impacts of option 4: Extend Article 7 to 2030; increase the rate of savings

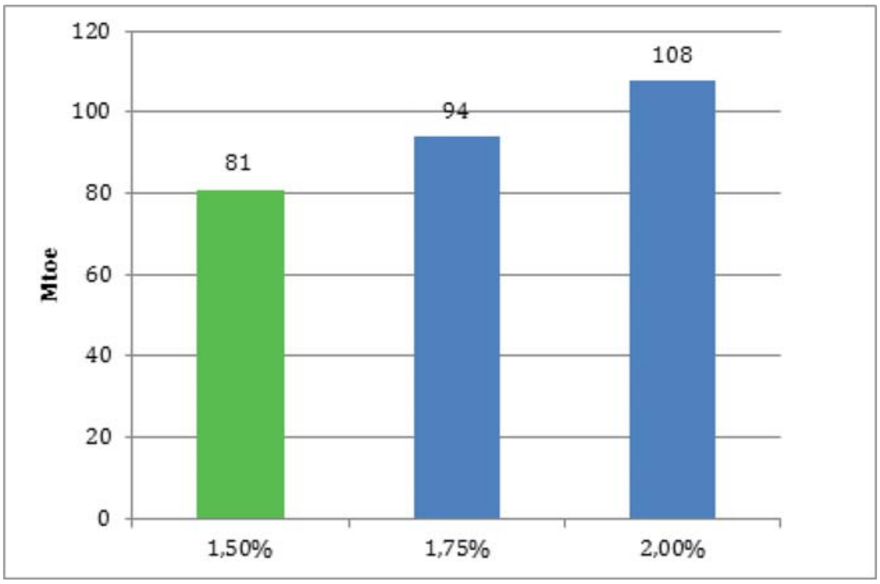
Higher levels of energy savings of 1.75% and 2.0% are closely linked with more ambitious policy scenarios analysed for the 2030 energy efficiency target and should be looked at in this context and not as a self-standing element.

It could be assumed that the increase in the level of savings would result in comparable economic benefits and environmental benefits described under the previous options 2 and 3. In terms of costs, there is limited evidence of the costs associated with the higher levels of ambition for Article 7 including the degree to which low cost savings would take place before the high cost energy savings.

Reduction of energy consumption

As indicated under option 2, the extension of Article 7 to 2030 will allow securing a maximum of 81 Mtoe of savings in 2030 (in cumulative terms 443 Mtoe over the whole obligation period)[223]. With higher rates than 1.5% an impact on the energy demand would increase accordingly. Figure 11 depicts possible scenarios for three levels of rates (1,5%; 1,75% and 2,0%) based on the bottom-up engineering estimation of the potential amount of savings that could be reached in year 2030.

Figure 11: Estimated energy savings in year 2030, maximum reduction applied (Mtoe)[224]



Source: Commission services' estimate

223 Description of the calculation of the amount of savings is provided in Annex 6 (on analytical approach).
224 Calculation based on the final energy consumption averaged over 2015-2020 (PRIMES ref. scenario).

Administrative burden and compliance costs

It is unlikely that the higher rates of savings requirement would automatically result in a linear increase of administrative burden and compliance costs. This is due to the fact that Member States have already put in place the regulatory framework for implementing Article 7 to achieve savings due by the end of this period (2014–2020) including the calculation methodologies (for example, catalogue of standardised measures which is widely used for carrying out measures under the EEOSs) and systems for monitoring and verification of claimed savings by the obligated or participating parties.

5.5 Empowering consumers - impacts of policy options for Article 9-11

The options considered in relation to Articles 9-11 differ mainly with respect to the following aspects:

- Support to new (= remotely readable) technologies;
- Legal clarity;
- Regulatory stability / ability to enforce existing rules in coming years.

In Table 33 the options are assessed qualitatively with regard to these aspects. Subsequently, impacts in terms of energy savings, costs and administrative burdens are assessed before the options are compared in chapter 6.5.

Table 33: Assessment of options with respect to main differences (from "---" to "+++")

Option	Support to new technologies	Legal clarity	Regulatory stability	Comments
1 non regulatory	+	--	+++	COM guidance could recommend take-up of remotely readable devices for delivering feedback and provide further interpretive advice, but with no guarantee of this being taken-up in practice. It would give no legal clarity, so whilst it would allow focusing on implementation in the foreseeable future, the existing challenges identified in that respect would not go away
2 Clarification and updating	+++	+++	++	Only with legislative changes all the issues identified in the existing legislation can be fully addressed, and remotely read devices can be promoted with a guaranteed effect. If changes to the legislation are limited to obvious clarifications and a few distinct "new policy" points (cf. points 1.1. and 1.2 in the option description), regulatory stability should still remain.

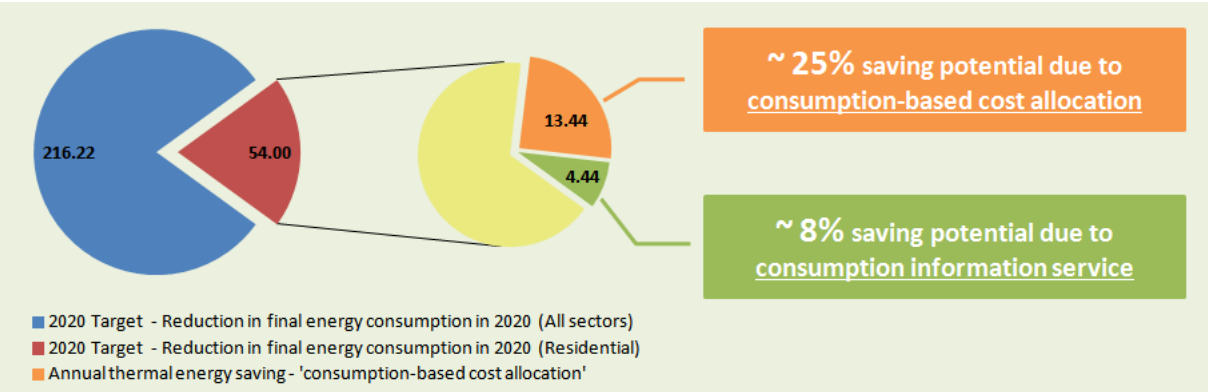
5.5.1 Reduction of energy consumption

The energy savings to be expected from the different options are difficult to assess. An attempt has made to quantify first the full technical potential and thereafter the share of this which each option might be able to realise.

The analysis focuses on heating and hot tap water; collective cooling systems are still rare, at least in the residential sector. There is a good base of evidence for savings accruing from sub-metering in space heating. In the absence of dedicated studies of savings in hot tap water made when cost-allocation and consumption information measures are introduced, it is assumed that the proportional behavioural effects on hot tap water usage are similar in magnitude to those for space heating. The methodological approach is detailed in Annex 6.

The results indicate that the total remaining potential energy savings in EU-28 that might be achieved through individualised metering and billing (i.e. consumption based cost allocation) in multi-apartment buildings compare to around 25% of the residential sector's expected contribution to the overall reduction of final energy consumption under the EU 2020 energy efficiency target. Additionally, savings from introducing consumption information service could reach an amount corresponding to around 8% of the 2020 reduction target for the residential sector in EU-28[225].

Figure 12: Savings potential expressed as contribution to the 2020 energy efficiency target



Source: Empirica estimations based on Guidelines for good practice[226]

As stated earlier, the actual impact to be expected from each option is difficult to assess. The impact mainly stems from three effects:

1. **Improved implementation of current heat cost allocation requirements**: this effect is in principle minor as none of the options involve changing the current conditionalities for individual metering. However, option 2 which ensure more transparency for final consumers about how costs in multi-unit buildings are allocated (cf. point 1.2 in option description) will likely have a positive effect on implementation due to less opposition from tenants or co-owners not understanding or considering the allocation as unfair.

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[225] Known limitations in the data used/needed to perform the above analysis include: 1) Due to lack of data, no correction has been applied for buildings in which occupants have no control over temperature or ventilation; 2) Conversion from savings in building's energy demand to savings in the resulting final energy consumption assumes 85% heating system efficiency (compare Enerdata (2011) Quantitative evaluation of explanatory factors of the lower energy efficiency performance of France for space heating compared to European benchmarks);; 3) Variation across Member States in the proportion of building elements (e.g. walls, windows) in a 'typical' multi-family building was not taken into account.

[226] empirica (2016) Guidelines on good practice in cost-effective cost allocation and billing of individual consumption of heating, cooling and domestic hot water in multi-apartment and multi-purpose buildings, Available at https://ec.europa.eu/energy/sites/ener/files/documents/MBIC_Guidelines20160530D.pdf.

2. **Improved implementation of current provisions on sub-annual (2-4 times per year) billing/consumption information services**: This is a key part of the effect since a key issue addressed by the options is the applicability of Articles 10 and Annex VII to sub-metered flats.

3. **Further enhancing feedback**: options which help promote remotely readable meters or heat cost allocators (HCAs) can be expected to trigger additional savings by enabling more complete and more frequent (at least monthly) consumption feedback than what is currently required by the EED. Near-real time feedback on smart phone apps, websites etc. could also be enabled and more widely applied by this scenario.

The total potential of the first two effects has been estimated as explained above. Even in the baseline scenario and non-regulatory option 1, a considerable share of this is expected to be realised as a result of implementation of the existing EED provisions.

In contrast, the effect of further enhanced feedback is enabled by and dependent on more consistent roll out of remotely readable sub- devices and their use to provide more frequent and useful feedback than is currently required by the EED. This could for example be monthly consumption information provided by email or paper, but also information closer to real time (weekly or even daily values) made available via a secure web site or a smartphone application. The effect of such enhanced feedback depends on a lot of factors and is difficult to estimate at EU level. A recent meta-analysis of existing studies in this field shows a range of observed savings of up to 14% in heat related studies, with an average of 4%[227]. The analysis also shows significant variations depending on the medium used to convey the information, with bills having a relatively smaller average effect (4%) than for example in-home displays (7%), cards (7%) or PC/Web access (10%). It concludes i.a. that "…*feedback can reduce the households' energy consumption up to realistic 5 to 10%*" and that it works best when it is delivered regularly and with high frequency and, as regards billing, is made through enhanced billing versus standard billing. For the purposes of this analysis, it is conservatively assumed that enhanced feedback enabled by increased deployment and use of remotely readable devices would trigger additional savings of the same scale as the estimated potential for the more basic consumption information service reflected in the current EED minimum requirement, i.e., an additional total of 4,4 Mtoe. Specifically, an average saving of 3% from current EED feedback requirements is assumed together with a potential for an additional 3% from enhanced, more frequent feedback enabled by remotely readable devices.

The assumed contribution in terms of the percentage of delivery of the full potential and the resulting total approximate savings are set out in table below. Even for option 2 the full potential estimated above of the existing requirements is not assumed to be 100% realised since Member States will retain the possibility to make exceptions for reasons of technical feasibility and cost-effectiveness. Nevertheless, the estimated effect of option 2 is substantially higher than of option 1 which is not estimated to result in significant savings

227 "Energy Feedback Systems: Evaluation of Meta-studies on energy savings through feedback", Joint Research Centre, 2015 (http://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/energy-feedback-systems-evaluation-meta-studies-energy-savings-through-feedback).

compared to business as usual. As for option 2, the improvement is in the order of 50% over business as usual[228].

Table 34: Assumed contributions of individual measures to the savings effect of each policy option

	Heat cost allocation implementation of EED requirements		**Informative billing implementation of EED requirements**		**Enhanced feedback**		**Total potential/ effect**
Total potential	100%/13,4 Mtoe		100% / 4,4 Mtoe		100%/4,4 Mtoe		100%/22,3Mtoe
	Assumed contribution (% of total) of each option / resulting saving						
Baseline/business as usual	85%	11,4	20%	0,9	25%	0,9	13
Option 1	90%	12,1	25%	1,1	25%	1,1	14
Option 2	95%	12,8	90%	4,0	100%	4,0	21

5.5.2 Costs

A consideration of potential cost implications of the different options requires a discussion of the detailed clarifications or other elements that are envisaged/possible under the policy options considered.

Remotely readable requirement (Option 2)

Option 2 would add a new requirement for newly installed sub-metering devices (be it meters or HCAs) to be remotely readable as of 2020, and all non-readable devices to be turned into or replaced by remotely readable devices by 2022. The advantage is that data can be read without access to the individual flats, either by so-called "walk-by" technology or via a dedicated data network infrastructure installed in the building. Remotely readable devices are marginally more expensive than the simplest devices available on the market implying some increased costs, part of which is for the data network infrastructure if such is installed[229]. On the other hand they generate costs savings and additional consumer benefits by eliminating the need for meter readers to access every single building unit in sub-metered buildings. For frequent information services, such cost savings are critical.

It is emphasised that neither option 1 nor option 2 would change the existing cost-effectiveness criteria for the deployment of individual meters or HCAs. The unchanged cost-effectiveness criterion would therefore ensure that any cost increases would not be disproportionate to the increased benefits.

Moreover, the transition towards remotely readable devices is already occurring in the market. The vast majority of HCAs installed in recent years are remotely readable and this requirement would support or accelerate this trend and ensure it continues. Figure 13 is based on data obtained from providers of heat cost allocation services. It shows the trends in recent years and industry estimates of the expected developments in the next few years.

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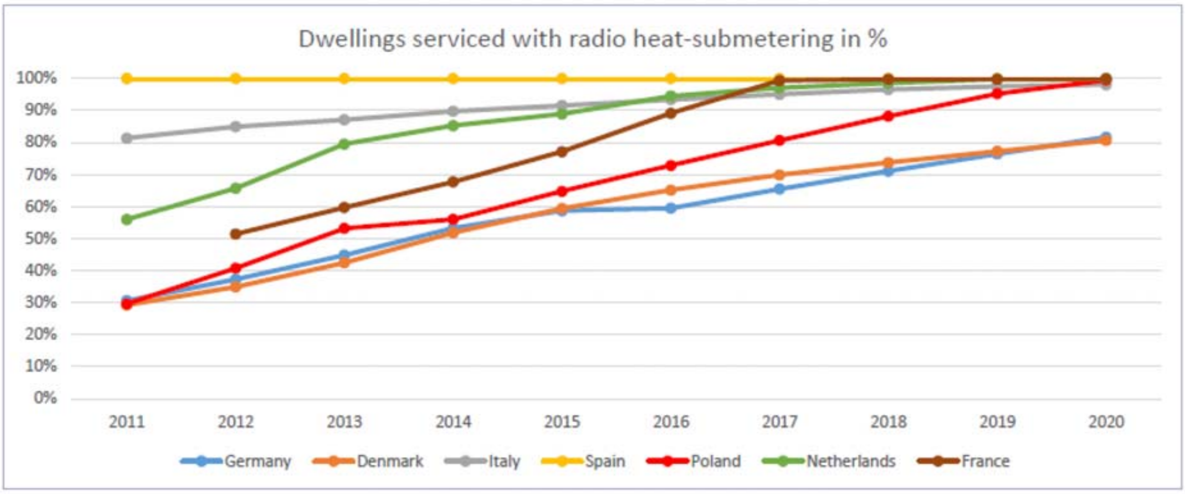
228 It is emphasised that the estimates must be considered to indicate orders of magnitude rather than precise figures, given the difficulty of predicting behavioural changes of this kind in widely varying circumstances and with limited statistical data available.

229 Whilst there is little cost data available in the public domain and pricing policies vary between service providers, information from the industry suggests that typical additional monthly costs per dwelling for a heat cost allocator installation and related web service capable of providing access to monthly consumption information is in the order of 1-2 euros, although this may be higher in certain markets or buildings.

Figure 13: Share of sub-metered dwellings serviced with remote readings (not requiring access to flats) in selected European countries.



Source. EVVE (The European Association for Energy Cost Allocation), May 2016.

Focusing the future market on remotely readable devices could very well increase competition in this market segment and put downwards pressure on prices, which in turn would further reduce the already fairly marginal price difference. The overall effect of this requirement is principally expected to be a consolidation of the ongoing trend and a signal to manufacturers and service providers about focusing investments exclusively on "future proof" digital technologies.

Competition in the provision of these services would be facilitated by ICT focused technologies. Final consumers would benefit from deployment of modern devices not having to face recurring manual readings for which they have to be at home. Giving some time for fully phasing in the remote reading functionality would prevent buildings recently having installed non-remotely readable HCAs (to the extent such cases even exist) from incurring significant sunk costs. Indeed, both meters and heat cost allocators are in any case typically replaced on a regular basis (typically at most 10 years) due to technical or legal requirements. Recently installed meters without this functionality might be retrofitted with optical sensors or add-on modules at modest additional costs.

Simplified criteria for application of consumption based billing and frequent information (Option 2)

As regards the current conditionalities for the mandatory application of consumption based billing and frequent billing information (Article 10(1)), option 2 would replace these with two simpler and more operational but largely equivalent conditions:

- **Technically feasible** ≈ "where meters or heat cost allocators are installed"
- **Economically justified** ≈ "where remotely readable individual meters or heat cost allocators are installed"

Regarding **"technically feasible",** the availability of individual measurement devices is clearly a good indicator and reasonable and simpler substitute for "technical feasibility" when it comes to consumption based billing on an annual basis. However, for producing sub-annual billing information the availability of sub-annual (e.g. quarterly) cost data might also be a constraint. To this end option 2 envisages allowing the sub-annual information to be consumption information only, which it is feasible to produce as long as individual measurement devices are available.

Regarding the "**economically justified**" condition, the key determinants are the availability of sub-annual cost-data and corresponding individual measurements/readings, respectively. The cost of providing/communicating sub-annual information is very marginal, especially if it is done electronically[230]. As regards the cost data, the same remarks as above apply. As regards sub-annual availability of individual measurements or readings, this is not problematic where remotely readable devices are installed. Where this is not the case, sub-annual consumption information will require manual meter reader access to each flat in the buildings concerned. The cost of this may in some cases be justified by the additional benefits, in others not. Conservatively, it is here assumed that sub-annual manual meter readings in most cases will cost more than the value of the additional savings triggered.

In conclusion, the simplification/reformulation of the conditions for the mandatory application of consumption based billing and "frequent" billing or consumption information is not expected to entail any cost increases. It will however make it much simpler for consumers and landlords/building owners to determine at a building level where these services must be offered.

Improved comparisons in billing/consumption information (Option 2)

Comparisons with previous consumption periods as well as with "average normalised or benchmarked final customer consumers in the same user category" are already requirements under Annex VII of the EED. However, there is currently some ambiguity about the extent to which they are mandatory for sub-metered consumers, and the use of such comparisons is not generalised.

Comparisons with consumption periods in preceding years are relatively straightforward. Presenting them in the format of a graph should not pose any significant challenges or additional costs. As regards climate-correction, this also ought already to be incorporated in any year-to-year comparison relating to heat since such comparisons are otherwise of little value in terms of understanding the evolution in consumption. Nevertheless, under option 2 climate correction would be expressly required to ensure that this is done and that the information provided to consumers is meaningful. This kind of calculation is rather straightforward as long as data for heating (or cooling) degree days are available. It should not impose any significant additional costs apart from perhaps an initial software adjustment for sub-metering service or district heating/cooling providers that do not already make such adjustments.

[230] Whilst handling of complaints or enquiries may trigger some additional costs, these are unlikely to be significant if the sub-annual information concerns consumption alone (as opposed to billing/cost information).

5.5.3 Administrative burden

Given that all options are formulated with the objective of simplification and clarification in mind, they should generally help reduce administrative burdens at all levels, in particular for Member States.

For building owners/managers, the transition to monthly billing or consumption information as of 2022 for buildings where remotely readable equipment is installed could conceivably increase the administrative burden in relation to provision of such information. However, a number of factors mitigate, counter-act or justify this risk/effect:

1. The adjusted requirements envisaged under option 2 would provide that heating and cooling information need not be provided monthly outside the heating/cooling seasons.
2. If managers opt for consumption information only, this is unlikely to trigger significant additional burdens in terms of complaints handling, etc.
3. Once sub-metering has been introduced for a building and the necessary infrastructure in terms of equipment and software is in place, the additional effort to make available frequent *consumption* information is very marginal, especially if done electronically.
4. It is compensated by a more significant savings effect due to a better informed consumer.
5. In the absence of monthly consumption information, sub-annual billing relies on estimates which can result in significant corrections once a year following the actual meter/HCA readings, sometimes entailing big unexpected payment requests of consumers. This is known to cause confusion and frustration and be a common source of complaints. Such problems are likely to be substantially reduced if consumers can follow their actual use month by month. This will reduce the administrative burden related to complaints and back-payments.

Indeed the advantages in terms of potential reductions in administrative costs deserve to be explored in a bit more detail. In the electricity and gas sector, the single biggest source of complaints from household customers are concerns related to "Invoicing / billing and debt collection"[231] which in reality often is about annual statements and back-billing of "debt" caused by too low estimated inter-annual bills.

For heating new data available to the Commission confirm a similar pattern. From an analysis of real customer data from a sample of 27.000 sub-metered buildings in an EU Member State, made available to the Commission by a provider of cost-allocation services, it transpires that 90% of all complaints received from sub-metered consumers were from households whose annual settlement bill required an extra, unforeseen payment. The data in other words shows a strong correlation between the net-position of a household's heating bill, the point of annual settlement, and the propensity to complain. The data also shows that 50% of the consumers in the buildings analysed face annual billing corrections (extra-payments or reimbursements) which are bigger than 32% of the total annual heating bill. This analysis suggests that more frequent/monthly billing or consumption information based on actual consumption rather than

[231] ACER/CEER Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2014, November 2015, section 3.2.2.

estimates likely could reduce the number of complaints and the associated administrative costs very significantly.

As regards the mandatory obligation for Member States to introduce transparent rules on cost allocation rules envisaged under option 2, this would be expected to facilitate the work of building managers/owners and sub-metering service providers. With transparent, public rules and principles it should be easier for these actors to explain and justify cost allocation to sub-metered consumers. An initial effort would be associated for Member States with introducing these rules, but many of them have done so already with reference to the current EED provisions or even before that[232].

5.6 Interaction between energy efficiency policies

As described in the problem definition, this impact assessment is intended to serve as the basis for the Commission to identify the EU target for energy efficiency in 2030. In this respect, it is also necessary to analyse the contribution of existing and planned EU measures in the field of energy efficiency could make to these targets. Therefore, before concluding on the preferred options, the links between the EED with the energy efficiency EU measures which are part of Energy Efficiency Package 2016 are analysed:

- The set of revisions to the EPBD that is identified as the preferred option in the EPBD impact assessment that forms part of this package;

- The revision of the EED, in particular the extension of Article 7 but also the clarification/updating of metering and billing provisions (Articles 9-11);

- The Commission's proposal to amend the framework legislation for energy labelling of products, the ecodesign and labelling measures that form part of the first and second ecodesign working plans and have not yet been finalised; and an estimation of the ecodesign and labelling measures that may form part of a third ecodesign working plan.

It should be noted that these measures are all considered to be "cost-effective" even in the narrow, private-cost sense of the term. Savings under the EPBD are constrained by the Directive's "cost-optimal" methodology for setting building standards. Member States have the full flexibility to decide which measures they implement under an energy efficiency obligation scheme or alternative measures to deliver the required final energy savings under Article 7 of the EED, and the evidence quoted above shows that obligation schemes are cost-effective. It is therefore assumed that Member States choose cost-effective measures only. Ecodesign measures are required by the Directive to be set at the level of Least Lifecycle Cost.

As described above, the impact of a single policy measure on the 2030 target level cannot be quantified by the partial equilibrium energy system model that has been used. A **simplified calculation** can be, however, performed to estimate the individual contribution of each of the

[232] Such rules have been identified in at least 12 MS, and others are considering introducing them (source: empirica).

proposed changes in this Energy Efficiency Package 2016 to the overall 2030 energy efficiency target bearing in mind that each of these estimations uses different baseline.

In order to do so, use is made of the results of the engineering analysis of the maximum impact of each set of measures considered in isolation (Article 7 EED, Articles 9-11 EED, EPBD and Ecodesign/Labelling). Second, overlaps between the four initiatives are considered where possible. Third, an estimation of the rebound effect of these sets of measures is undertaken and fourth, these savings will be compared against the results of the policy scenarios modelled with the partial equilibrium energy system model (PRIMES).

1. The maximum impact of extending Article 7 beyond 2020 would result in 81 Mtoe energy savings in year 2030. Given the cross-cutting nature of Article 7, some savings might overlap with some other provisions of the EED to some extent. The Commission services have estimated that this overlap amounts to around 24% of the total energy savings stemming from the measures notified under Article 7 for the period 2014-2020233. If applying the same pattern of overlap for the next period 2021-2030, it would reduce the estimated impact of 'pure' Article 7 savings.

   The EPBD and Article 7 are also complementary and reinforce each other. As described above, EPBD sets e.g. minimum requirements for new buildings, building undergoing a major renovation or building elements whereas Article 7 mainly accelerates the renovation rate of buildings or building elements. The 'cost optimal level' of the EPBD is intensified every 5 years by 5%. Therefore, it is assumed that the 10% (2x 5% in 2020-2030) of the required savings can be attributed to the strengthening of the 'cost optimal levels'.

   There are also overlaps between Article 7 and ecodesign measures as some of the measures which were notified for the saving obligation period 2014-2020 also incentivise the uptake rate of more efficient products. However, no data are available to quantify this impact.

   Combining the overlaps with other EED articles and the 'cost optimal level' of the EPBD would reduce the estimated impact of 'pure' Article 7 savings to 53 Mtoe in 2030.

2. The maximum impact of the **changes to Articles 9-11** considered in respect of thermal energy has been estimated to be in the order of **8 Mtoe** compared to business as usual. Overlaps with the other polices are likely to be minimal since this estimate only covers the residential sector and essentially relies on an extrapolation of empirical observations of typical actual savings brought about by *behavioural changes* in the use of centrally provided heat.

[233] The Commission services have undertaken a rough estimate of the overlaps of the policy measures notified by Member States under Article 7 for the period 2014-2020 with other obligations stemming from the EED. Measures which fully or partially overlap with Articles 5, 6, 8, 14, 15 and 17 of the EED. The total amount of savings subject to such overlap amount to 59.457 ktoe which is 24% of the total energy savings from policy measures notified under Article 7 (251.813 ktoe). The exact amount of savings attributed to the 'partial' overlap could not be quantified due to lack of information as regards individual actions envisaged under the policy measures notified. The maximum overlap thus was assumed even though it would not depict the situation accurately. .

3. The engineering analysis in the respective Impact Assessment shows that the maximum impact of **the preferred option of the revisions to the EPBD** would lead to final energy savings of **28 Mtoe** in 2030.

4. The anticipated annual maximum impact of the energy labelling and Ecodesign measures is final savings of **30 Mtoe** in 2030. Ecodesign and labelling pull improved technical building systems into the market and influence the 'depth' of the renovation. They deliver synergies with the EPBD. Overlaps between the two should not be double counted[234]. It is assumed that Ecodesign and energy labelling advance the frontier of renovations that are considered as "cost optimal" for the purposes of the EPBD (every 5 years by 5%). Therefore, it is assumed that the overlaps are 10% (2x 5% in 2020-2030). Taking this factor into account reduces the **combined estimated impact of these two policies** from 60 Mtoe to **52 Mtoe**.

The three sets of measures are therefore estimated to have a combined maximum impact, once overlaps are eliminated, of around **113 Mtoe** in 2030.

By reducing energy bills, energy efficiency measures give consumers more money to spend on energy-consuming goods and services. By reducing the price of energy services, consumers might increase their demand for energy-intensive goods and services at the expense of less energy-intensive ones. These effects offset the maximum estimated energy savings. Together they constitute the rebound effect. Barker et al. (2009) estimated that this effect would reduce the impact of a range of policies introduced over the period 2013-2030 by 31% by 2020 and 52% by 2030. The policies under consideration here would largely take effect in the period 2020-2030. An intermediate value – 43% – is therefore used, reducing the estimated savings to 65 Mtoe in 2030. However, Cambridge Econometrics (2015) estimated, following a literature review, that the rebound effect would be lower – 21%. That would imply reducing the estimated savings to 90 Mtoe in 2030.

It is thus estimated that, with the overlapping impacts of the different policies and rebound effects taken into account, the final saving impact of **the different sets of measures, taken together, will be in the range of 65-90 Mtoe in 2030.**

Taking possible higher saving rates under Article 7 into account would bring higher final energy savings in 2030 as shown in the table below.

234 Overlaps between ecodesign and Article 7 (e.g. boiler replacements) have not been taken into account due to lack of data.

Table 35: Impacts of assessed policies

Energy efficiency policy mix	Article 7		
	1.5% = 81 Mtoe	1.75% = 94 Mtoe	2% = 108 Mtoe
Article 7 savings after a 34% deduction of savings stemming from other EED articles (24%) and overlaps with the strengthening of the cost-optimal level of the EPBD (10%) in Mtoe	53	62	71
Final energy savings in 2030 for preferred option of EPBD review and Ecodesign/Labelling	52	52	52
Final energy savings for preferred option of Art. 9-11 EED review	8	8	8
Savings from all policies taking a conservative rebound effect of 43% into account	**65**	**70**	**75**

Energy efficiency policy mix	Article 7		
	1.5% = 81 Mtoe	1.75% = 94 Mtoe	2% = 108 Mtoe
Article 7 savings after a 34% deduction of savings stemming from other EED articles (24%) and overlaps with the strengthening of the cost-optimal level of the EPBD (10%) in Mtoe	53	62	71
Final energy savings in 2030 for preferred option of EPBD review and Ecodesign/Labelling	52	52	52
Final energy savings for preferred option of Art. 9-11 EED review	8	8	8
Savings from all policies taking a conservative rebound effect of 21% into account	**90**	**97**	**104**

Source: Commission calculations

REF2016, among other things, includes existing measures in transport, the EPBD in its current form and eco-design and labelling implementing measures[235]. It also includes the EED in its current form, under which the provisions of Article 7 cease to apply in 2020, while the rest of the EED would continue to be in force. In this setting there are projected primary energy savings of 23.9% in 2030, while final energy consumption would be 1081 Mtoe in 2030[236].

To achieve more ambitious targets for energy efficiency in 2030, energy consumption would have to be further decreased. The table below shows by how much final energy consumption would need to be lower than REF2016:

[235] Ecodesign and labelling implementing measures which were adopted up to 2014.

[236] Statistical cross-effects with certain types of renewable energy can make the interpretation of detailed savings figures expressed in primary energy confusing. The analysis is therefore made in terms of final energy.

Table 36: Final energy consumption in Mtoe in 2030

Final energy consumption in Mtoe in 2030	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Final energy demand	1031	987	929	893	825
Reduction compared to reference scenario	50	94	152	189	256

Source: PRIMES

The modelling results provide an outline of how these additional savings could be achieved. The EU Reference scenario assumes a continuation and implementation of the energy efficiency framework beyond 2020 e.g. the renovation of public buildings under Article 5 or the further development of the ESCO market according to Article 18. However, as described above, Article 7 will not be obligatory post-2020.

To achieve a level of at least 27% of energy efficiency, the policy scenarios assume for the transport sector, policies and measures under consideration at European level. For the other final demand sectors, eco-design/labelling, building standards were intensified in the model to reflect the proposals of the parallel initiatives and general incentives for a thermal improvement of buildings were gradually intensifies - as described above and in Annex 4 – to reflect current policies and the proposed policy changes to achieve different energy efficiency levels in 2030.

The table above shows the required energy consumption reductions from all sectors under the different policy scenarios. It need to be kept in mind that these are **savings which are needed in addition to the energy efficiency framework which is already in place and which delivers savings**. These additional savings in 2030 compared to the business-as-usual baseline will need to be compared with the anticipated impacts of the proposed, new energy efficiency policies.

In a simplified manner, combining the bottom-up engineering results for the different packages with the modelling results shows the contribution of each measure towards the different target levels.

Figure 14: Energy efficiency policy mix 2030 - Conservative rebound effect

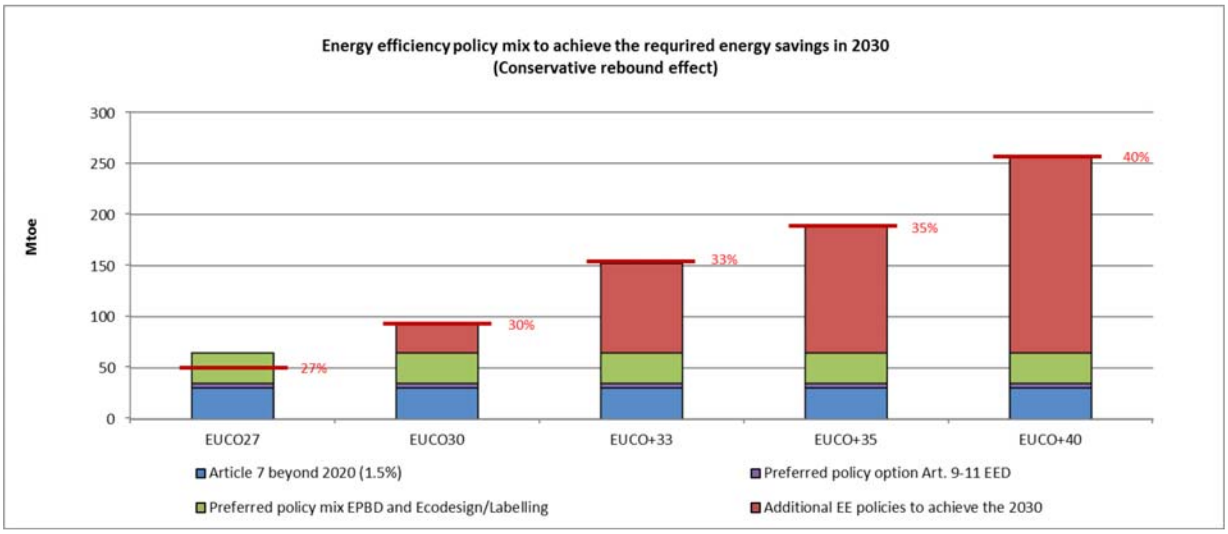
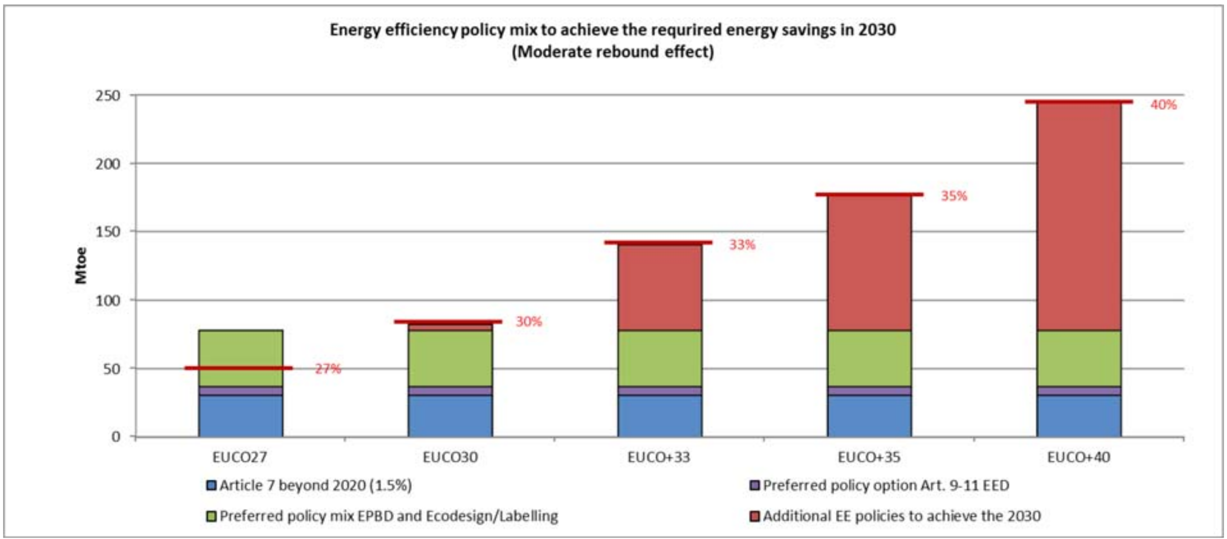


Figure 15: Energy efficiency policy mix 2030 - Moderate rebound effect



Comparing the different energy efficiency 2030 targets which are based on the modelling exercise with the engineering results, it can be seen that the extension of Article 7 to 2030 would contribute considerably to achieve an EU target above 27% in 2030. The changes to the EPBD would contribute together with the changes on metering and billing, various eco-design and energy labelling initiatives also to a large extend (see graphs above).

To achieve a 30% target the following would therefore be needed at EU level:

1. Extension of Article 7 post 2020;
2. Change of EPBD as indicated in the Impact Assessment to deliver additional energy savings in the buildings sector by 2030.
3. Ambitious implementation of the Ecodesign Working Plan and the review of the Labelling Directive to deliver additional energy savings by 2030.
4. Timely adoption of the proposed changes to the ETS and Effort Sharing Regulation to ensure a reduction of GHG emissions of at least 40% in 2030.

5. Enforcement of renewables policies necessary to achieve a renewable target of at least 27% in 2030.
6. Further strengthening of CO2 standards for cars and vans, measures on management of transport demand.
7. Continued improvement of financial instruments and other financing measures at European and national level lowering the cost of capital for investment in thermal renovation of buildings are needed to increase the rate of renovation and depth of renovation as well as the uptake of efficient products. Facilitating smart financial framework for energy efficiency investments is part of the accompanying Communication. It is considered that the impact of this framework will be to enable and enhance the required investments and hence act as a complement to the policy framework.

To achieve a 30% target the following would also be needed at Member States, regional and local level:

1. Assessment of cost-efficient energy efficiency measures in order to set national 2030 energy efficiency targets. These targets may take into account national circumstances affecting primary and final energy consumption but should contribute sufficiently to the EU 2030 energy efficiency target.
2. Continued effort to implement the other EED requirements and measures to achieve the required savings in 2030;
3. Continuation of national measures which increase the rate and depth of renovation and the uptake of energy efficient products;
4. Continuation of national measures which increase the uptake of energy efficiency measures in the industrial, service and agricultural sector which is also an enabler for economic modernisation and competitiveness;
5. Further tackling of market barriers to energy efficiency investments;
6. Further empowering of energy consumers.

6 Comparison of the policy options

6.1 Preferred option for the level and formulation of the 2030 target

In terms of economic impacts on energy sector, energy system costs increase as scenarios become more ambitious. In the period 2021-30, a target of 30% would lead to an increase in average annual system costs of € 9 billion compared to a 27% target (or, expressed as share of GDP, an increase in average annual system costs of 0.05 percentage points compared to 27% target). However, taking a longer term perspective (2021-50), the average annual system costs for 30% scenario would be € 9 billion lower than in the 27% scenario, as the benefits of early investments continue to pay off post-2030.

In addition to overall system costs a general shift in the structure of costs for energy consumers has to be considered, i.e. diminishing energy purchases (consumer paying less for fuels and electricity) and increasing investment expenditures (consumers paying for additional energy efficiency investments). Total energy efficiency investment expenditure increases in all scenarios – more significantly in more ambitious scenarios and again mostly in the residential and tertiary sectors. In the period 2021-30, a target of 30% would lead to an average annual increase in investment expenditure of €78 billion compared to 27% target. At the same time energy purchases visibly decline. In the period 2021-30 a target of 30% would lead to an average annual decrease in energy purchases of €28 billion compared to 27% target. In addition, the reduction in energy purchases continues after 2030.

The following impacts associated with energy efficiency improvements have been identified:

- Energy efficiency has a strong beneficial impact on security of supply and the level of gas imports in particular. For example, increasing the level of ambition from 27% to 30% would reduce gas imports by 12%, i.e. 36 bcm. The additional savings in oil imports would be marginal only. Decreases in net energy imports translate into savings in the fossil fuel imports bill and over the period 2021-30 the target of 30% energy efficiency would bring about a cumulative reduction in the fossil fuels imports of €70 billion in comparison to the 27% energy efficiency target.

- Investments in power generation and grids are constant or decrease as the scenarios become more ambitious and this reflects less need for additional generation capacity. Lower electricity demand and lower investments in power generation capacity contribute to lower electricity prices. Electricity price reductions range from 1% to 2% in the year 2030 (compared to 27% target).

- All policy scenarios reduce the demand for electricity in 2030 as eco-design and energy savings obligation and national energy efficiency incentive scheme are assumed to continue. In the longer term, it is assumed that the combination of climate, energy efficiency, renewable and transport policies also trigger electrification which could counterbalance the decreasing trend of electricity demand.

- Energy efficiency targets and policies interact with the EU Emissions Trading System which is the main European instrument to ensure the achievement of the -43% target. The ETS carbon price in 2030 differs substantially across the various scenarios, reflecting the important effect of energy efficiency measures on emission reductions in the ETS sectors (via reduction of demand for electricity, partly offset by energy efficiency measures supporting electrification in heating and transport). As their ambition grows, energy efficiency policies reduce both costs and incentives from the ETS itself for GHG abatement. The ETS Market Stability Reserve (MSR) adopted in 2015 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, for example in relation to improved energy efficiency. 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. For very ambitious levels of 2030 energy efficiency targets, this might pose risks to the overall coherence in delivering the climate objective. Therefore, it might need to be considered as part of the first review of the Market Stability Reserve parameters foreseen by 2021 whether this justifies a change to the parameters (e.g. the MSR feeding rate) in case of ambitious energy efficiency targets to preserve the overall policy coherence in delivering the climate objective in a cost effective manner, as agreed by European leaders.

- All policy options analysed come with very significant air quality, environmental and health benefits, which are more prominent for the more ambitious energy efficiency targets. Summing up the monetized impacts of the reduced health damage and pollution control costs in 2030, a 30% target leads to a reduction in combined costs between €4.5 and 8.3 billion compared to a 27% target (depending on low or high valuation). This is mainly due to the reduction in mortality due to particulate matter.

- More ambitious energy efficiency measures in particular in buildings help to improve the living standards of EU citizens. In particular, targeted energy efficiency measures in buildings can help households with lower incomes to reduce their energy bills and improve their living conditions. This can be reinforced if targeted measures are put in place to help them making the necessary investments.

- In terms of the macro-economic impacts, stepping up the level of energy efficiency efforts is expected to have moderate positive impacts on economic growth. GDP impacts are likely to be on the positive side and relate to the positive impacts of boosting domestic investments, most importantly in the construction sector and in the engineering and transport equipment. These macro-benefits would accrue across Europe, as long as the scale of the required energy efficiency investments does not act as a constraint on the overall economy. Mitigating measures to ensure that physical capital bottlenecks and private lending deployment constraints are effectively addressed can reinforce this effect. Two methodologically different macro-economic models are used in this Impact Assessment. They show that there can be potentially net positive impacts on GDP from investing in energy efficiency. As the stringency of the energy efficiency target increases the marginal net benefits diminish[237]. It is important to note that any potential GDP and macro-economic benefits will vary post-2030 depending on financing arrangements, the repayment conditions of the private debt for energy efficiency investments accumulated before 2030, and long-term energy efficiency gains.

- A higher level of energy efficiency creates employment opportunities. Employment impacts are likely to be positive, as long as labour resources can be absorbed in the sectors expected to benefit from energy efficiency investments. However, employment opportunities from more ambitious energy efficiency efforts could be created particularly if banks facilitate lending to economic actors to finance their energy efficiency investments and if labour inputs required for energy saving activities are not sourced from other growing sectors of the economy. In addition, the magnitude and sectorial distribution of employment impacts depend on the labour intensity of sectors and on the responsiveness of wages to labour demand. Overall, employment tends to increase in sectors that provide inputs to energy efficiency projects and/or have significant forward and backward linkages with other sectors of the economy (e.g. construction sector, engineering, certain basic manufacturing sectors). Sectoral employment is projected to decrease in energy supply-related activities in line with the projected fall in output in these sectors. Accompanying measures targeting skill

[237] The drivers of these results are mostly threefold. First, they depend on whether the magnitude of energy efficiency investments will "crowd out" investment resources from other productive sectors of the economy (higher "crowding out" negatively impact the macro-economy). Second, GDP impacts will depend on whether existing unemployed and underutilised labour and capital resources can be effectively deployed in economic sectors providing energy efficiency investment goods and services (higher deployment of unutilised resources positively impact the macro-economy). Third, potential macro-benefits can be better realised if access to the required private finance is facilitated and economic agents are able to cover upfront costs and smoothen their investment, saving and consumption patterns.

matching and labour mobility will be critical to effectively reaping potential employment benefits.

In general, the analysis at the economy-wide level showed that energy efficiency policies should be designed in such a way that possible crowding-out of investments in other economic sectors is limited, the private financing of energy efficiency investments is encouraged, and unnecessary market distortions and negative macroeconomic effects are avoided. To tackle some of these issues, the review of the EED is accompanied by a 'Smart Finance for Smart Buildings' initiative.

Accompanying policies should address inhibiting factors that prevent spare capacity and capital to flow into energy efficiency investments and unemployed people to fill the vacancies created by energy efficiency. Labour skills shortages and barriers to labour and financial and physical capital mobility need to be addressed. Stimulus to higher investments, leading to a "virtuous cycle" with higher growth and more savings needs to be given to the market.

Most important is the confidence of the banking system and investors who react to credible and lasting signals and incentives, such as stepping up an ambitious political commitment for a 2030 energy efficiency target, and helping prove the case for the business opportunity of investment in energy efficiency goods and services.

The provision of macroeconomic benefits of a more stringent energy efficiency target would also depend on the success of EU's Capital Market Union (insuring greater capital mobility and unlocking funding for Europe's growth) and on the effectiveness of EU's aim within Europe **for private capital to finance** profitable investments **without a need for direct public funding interventions**, as well on EU's Industrial Policy (aiming to increase the share of manufacturing in the economy) that could support key economic sectors in the effective provision of energy efficiency equipment, goods and services.

Table 37: Summary table

2030 results unless indicated otherwise (PRIMES results/features unless indicated otherwise)	**REF2016**	**EUCO27**	**EUCO30**	**EUCO+33**	**EUCO+35**	**EUCO+40**
Main features scenarios						
Primary Energy Consumption (Mtoe)	1,436	1,369	1,321	1,260	1,220	1,129
Change in primary energy consumption in 2030 compared to PRIMES 2007 Baseline levels (% change)	-24	-27	-30	-33	-35	-40
Change in primary energy consumption compared to historical 2005 energy consumption levels (% change)	-16	-20	-23	-26	-29	-34
Final Energy Consumption (Mtoe)	1,081	1,031	987	929	893	825
GHG emmissions with regard to 1990 (% change)	-35	-41	-41	-43	-44	-47
GHG emissions in ETS sectors with regard to 2005 (% change)	-38	-43	-43	-44	-44	-48
GHG emissions in non-ETS sectors with regard to 2005 (%)	-24	-30	-30	-34	-36	-39
RES share in final energy consumption (% change)	24	27	27	28	28	28

Security of supply						
Gas Net Energy Imports Volume (2005=100)	116	110	97	84	78	64
Fossil Fuels Import Bill (for REF2016 and EUCO27) and savings compared to EUCO27 (for other scenarios) (cumulative 2021-30) (billion € '13)	4494	4274	-69.6	-147.3	-199.3	-287.5
Environmental impacts and health						
Carbon intensity of power generation (t of CO2/toe of GIC)	0.20	0.18	0.18	0.18	0.19	0.18
Residential and tertiary GHG emissions compared to 2005 (% change)	-28	-38	-43	-54	-57	-65
Sum of reduction in pollution control costs & health damage costs (billion € '10 /year) compared to EUCO27 [GAINS model]			4.5-8.3	15.2-28.4	19.9.-36.6	30.4-55.9
Competitiveness						
Ratio of energy related costs (inclusive ETS auction payments) to value added in 2030 for energy intensive industries (%)	40.3%	40.8%	40.1%	40.0%	39.8%	40.6%
GDP impacts (billion € '13 for REF2016 and EUCO27 and % change relative to EUCO27 for other scenarios) [E3ME model, no crowding out]	17,928	18,045	0,39	1.45	2.08	4.08
GDP impacts [E3ME model, partial crowding out]	17,928	18,045	0.39	1.30	1.58	2.21
GDP impacts [GEM-E3 model, loan-based]	16,955	16,962	0.26	0.21	0.16	0.06
GDP impacts [GEM-E3 model, self-financing]	16,955	16,907	-0.22	-0.79	-1.35	-2.12
Employment						
Employment impacts (million workplaces for REF2016 and EUCO27 and % change relative to EUCO27 for other scenarios) [E3ME model, no crowding out]	233.1	233.5	0.17	0.68	1.04	2.08
Employment impacts [E3ME model, partial crowding out]	233.1	233.5	0.17	0.63	0.85	1.40
Employment impacts [GEM-E3 model, loan-based]	216.4	216.6	0.20	0.28	0.36	0.56
Employment impacts [GEM-E3 model, self-financing]	216.4	216	-0.18	-0.51	-0.84	-1.36
Electricity, ETS and international fuel price prices						
Net Installed Power Capacity - Thermal power (GWe)	379	369	359	354	352	347
Average Price of Electricity (€ '13/MWh)	158	161	157	158	157	159
ETS carbon price (€ '13/t of CO2-eq)	34	42	27	27	20	14
International oil prices compared to EUCO27 (average annual 2020-2030) (% change) [POLES model]			-0.3%	-0.6%	-1.0%	-1.4%
International gas prices compared to			-1.1%	-2.3%	-3.0%	-4.3%

EUCO27 (average annual 2020-2030) (% change) [POLES model]						
International coal prices compared to EUCO27 (average annual 2020-2030) (% change) [POLES model]			0.02%	0.01%	0.01%	-0.03%
Investments and system cost impacts						
Total energy related investment expenditures (bn €'13) (average annual 2021-30)	938	1036	1115	1232	1324	1565
Energy Purchases (bn €'13) (average annual 2021-30)	1448	1415	1388	1363	1360	1329
Total System Costs (bn €'13) (average annual 2021-30)	1928	1943	1952	1977	2014	2077
Total System Costs (bn €'13) (average annual 2021-50)	2130	2264	2255	2290	2324	2384

Source: PRIMES, GAINS, E3ME, GEM-E3, Eurostat

6.2 Comparison of the policy options for the character of the 2030 target

No preferred option could be identified in the assessment of whether the energy efficiency target for 2030 should be indicative as in 2020, binding on EU level as the RES target for 2030 or binding on national level. As for the 2020 energy efficiency target, this is a political decision. However, as shown in the assessment of the options, all would require a timely review of the progress towards the 2030 target and an effective governance system.

6.3 Comparison of the policy options for the formulation of the 2030 target

With regard to the formulation of the target, the analysis showed that a continuation approach chosen for the 2020 energy efficiency target is the preferred option. Therefore, the 2030 target should be expressed on EU level as maximum primary and final energy consumption in 2030.

The defined energy reduction targets should be translated into reduction targets compared to **2005 as the reference year for energy efficiency** for consistency reasons with the other climate and energy targets. This should be done for both the energy efficiency target 2030 expressed in final and primary energy consumption as this would increase the transparency of the target setting and facilitates the assessment of the targets.

6.4 Comparison of the policy options for Article 7

The proposed policy options for Article 7 are compared with the baseline scenario on the basis of the better regulation criteria: 1) **Effectiveness**: The extent to which proposed options would achieve the objectives; 2) **Efficiency**: Analysis of benefits versus the costs; and 3) **Coherence**: Coherence of each option with the overarching objectives of EU policies.

As regards **effectiveness** - option 1 would fail to achieve the objective of this initiative of attracting private financing and thus securing the economically viable energy savings in view of the 2030 energy efficiency target. By contrast, options 2 and 3 foreseeing the extension of Article 7 to 2030 would attain the objective of attracting private financing for energy efficiency by continuing this key instrument accounting for more than half of energy savings from the EED and thus contributing to the achievement of the energy efficiency target for 2030. Even though option 4 would allow securing the fixed level of the savings, it would go beyond the objectives and thus is deemed not effective in this context. Furthermore, option 3 would be more effective as it aims at simplification of the key requirement of what savings can be attributed to the measures put in place, which was interpreted inconsistently by Member States, in particular for calculating savings from the national building codes. Clarification of this requirement would also contribute to the achievement of the savings by 2020 and secure the needed contribution towards the 2030 target.

In addition, option 3 would be more effective in terms of ensuring greater 'pulling effect' on other EU energy efficiency policies in particular the implementation of the Energy Performance of Buildings Directive (given that the simplified requirement of eligibility would encourage increasing the rate of renovation).

Allowing the counting of on-building renewables under Article 7 would be effective in helping Member States to achieve both energy efficiency and renewable objectives and would also increase coherence between these instruments, it would risk undermining the end-use energy efficiency objective unless the level of ambition is sufficiently high or the contribution of renewables is capped.

In terms of **efficiency**, the evaluation shows that measures taken under the EEOSs are a cost effective way of achieving the existing ambition level of 1.5% per year. Therefore keeping the same level of ambition (1.5% per year) as proposed in policy options 2 and 3 would imply a similar pattern of costs and benefits for the next obligation period if Member States continue with the same instruments as in the current period. Simplification and clarification of the key requirements proposed in option 3, notably that of what savings can be counted (i.e. “additionality”), will facilitate the calculation of savings triggered by renovation of buildings, and it would also reduce the administrative burden for Member States. This option would also be more efficient for utilities as integrated approach would reduce the costs of achieving RES and EE objectives by implementing certain measures at buildings level.

By contrast, there is limited evidence on the efficiency of option 4 - on whether higher rates proposed by this option would not result in increased compliance costs and administrative burden for Member States and obligated parties.

Option 1 would not be coherent with other EU energy and climate policies as it does not foresee the regulatory action to extend the Article 7 after 2020. On the other hand, options 2-4 are **coherent** with the overarching EU policies; however, **option 3** would ensure greater synergies with other policies, notably the EPBD and to some extent the RES Directive.

Table 38: Overview of comparison of the policy options for Article 7

Policy option	effectiveness	efficiency	coherence
Option 1	Limited effectiveness due to limited contribution to the 2030 target as Article 7 expires post 2020 and limited attraction of private capital without regulatory action at EU level	No changes in costs and benefits to obligated parties (in Member States retaining the EEOS or alternative measures)	Not coherent as Article 7 expires after 2020
Option 2	The required level of savings for 2030 would be achieved in view of the overall EE target for 2030	Efficient as mechanisms and structures have already been established by the Member States	Coherent with the EU 2030 energy target and the energy and climate framework for 2030
		No additional costs since 1.5% savings rate retained	Integrated reporting and monitoring under the new governance
Option 3	Effective as the extension would attract the private investment to help securing the required level of savings in view of the overall EE target for 2030	Efficient as mechanisms and structures have already been established by the Member States	Coherent with the EU 2030 energy target and the energy and climate framework for 2030
3.a	Achievement of savings will be facilitated by the simplification of what savings can be attributed to the EPBD	No additional compliance costs and administrative burden since 1.5% savings rate retained	Integrated reporting and monitoring under the new governance
	Increased effectiveness of the EPBD (more renovations) as Member States would be allowed to take full credit	Will facilitate calculation of savings related to building renovation due to the simplification of what savings could be attributed to the EPBD	
3.b	Effective of achieving EE and RES objectives, but would undermine the EE element if the savings rate 1.5 % is retained	Efficient for utilities as integrated approach would reduce the costs of achieving RES and EE objectives by implementing certain measures at buildings level	Coherent in helping achieve both EE and RES objectives
Option 4	Effective as the more ambitious policy would help securing the needed level of savings (and attracting more private capital) in view of the overall EE target for 2030	Limited evidence on whether higher rates would result in increased compliance costs and administrative burden	Coherent with more ambitious EU 2030 energy efficiency target

The principle of **subsidiarity** is respected in all options, given that Member States will retain the same flexibility in terms of selecting their policy mix and the approach to achieve the required savings by 2030, including how the savings are phased over the whole commitment period. The 477 different energy saving measures notified to the Commission so far show that Member States have taken full advantage of this flexibility.

In terms of the **proportionality** principle, the following aspects were assessed:

- Overall, option 1 would not be appropriate in terms of what is necessary to achieve the Union's objectives (energy reduction requirement by 2030) in this policy context, if the current approach of the formulation of the EU energy efficiency target for 2030 is retained which is selected as preferred option (different options on the nature of the target are discussed in chapter 5.2 on the formulation of the target).
- Options 2-3 would be in line with what is necessary to achieve the Union's objectives if the same rate of 1.5% per year is retained also for the new commitment period (2021-2030). By contrast, as indicated above, option 4 would go beyond what is necessary to achieve the Union's objectives. The scope of the elements proposed in options 2 and 3 is limited only to those aspects that require the action by the Union (setting the savings requirement and putting in place the framework to ensure that these savings are achieved in a credible way).
- Options 2 and 3 would allow reaping significant benefits that outweigh the costs to the end-consumers. These are direct benefits (i.e. reduced energy bills thanks to the reduced energy demand) and indirect benefits (higher disposable income and comfort level along with the positive impacts on health etc. and environment, higher asset value of a renovated building, increased productivity for industry, reduced burden on public budget for public administrations, a greener image, etc.) as a result of the energy efficiency improvement measures taken by obligated or participating, entrusted parties. This is especially the case concerning energy poor households[238] as these options allow them to further benefit from the renovation of their buildings that reduces energy bills and thus reduces the energy consumption and also the health risks of consumers affected by energy poverty. Given that both options will retain the same level of flexibility as in the existing approach, the level of costs related to measures will depend on each measure, and its design, as indicated under the section on impacts. By choosing to achieve the 1.5% savings through the EEOS associated costs are placed on end-consumers (who can benefit from economic savings associated with measures that can outweigh their costs) and on economic operators (energy suppliers and distributors who can attract new customers and benefit from increased customer loyalty following the implementation of measures), without placing burden on the public finances. Such evidence is not available though for option 4 which proposes higher savings rates than 1.5% per year.
- The instrument is simple as it proposes amending the existing Directive 2012/27/EU on energy efficiency to ensure the achievement of the required savings under Article 7

238 It is up to the Member States to identify which end-use sectors and consumers should be targeted under Article 7, but it is well proven in some Member States that energy efficiency measures can help effectively address energy poverty.

and contribute to the energy efficiency target for 2030, and would ensure the effective enforcement of the updated Article 7.

The preferred option is **option 3** thanks to the simplification and clarification elements proposed under sub-option 3.a, which would facilitate the achievement of savings by 2030 if the current pattern is to continue in the next commitment period (in fact, the majority of savings are generated in the buildings sector). This option also would ensure overall clarity in terms of requirements applicable to the energy efficiency obligation schemes and alternative measures.

As regards allowing on–building renewable measures to count towards the Article 7 energy savings requirement, this approach is recommended in principle but would not be appropriate without a firm link to an equivalent and proportioned increase of level of ambition for energy efficiency.

6.5 Comparison of the policy options for Article 9-11

Based on the analysis in Chapter 5.5 the proposed policy options for Article 9-11 are compared using the better regulation criteria.

Table 39: Overview of comparison of the policy options for Articles 9-11

Policy option	Effectiveness	Efficiency	coherence
Option 1 **Non-regulatory.**	Unlikely to significantly contribute to the key objectives (clarification & adjustment to technology /market progress)	Will not impose any new costs but is also unlikely to ensure that the existing framework delivers what was expected, even if administrative efforts by authorities, COM and market players would still be needed.	Unlikely to improve coherence with IEM legislation and proposal in the context of the Market Design Initiative
Option 2 **Clarification/ updating (regulatory)**	Allows clarification of identified issues, as well as promotion of more effective services exploiting remotely readable devices.	Would deliver objective efficiently. Does not entail significantly more (if any at all) net-costs when account is taken of additional savings triggered and reduction in admin. burden related to back-payments and complaints handling, and in any case these would be better directed at clearer ends/purposes (because obligations would be clearer and simpler)	Coherence would be achievable

Overall, the **preferred option is option 2** as it is deemed most likely to deliver on the dual objectives of ensuring clarity and alignment with technological/market realities and does not have major disadvantages compared to option 1. Regulatory stability can be safeguarded by not changing the key provisions relating to deployment of metering and heat cost allocation in the first parts of current EED Article 9(3), and rely on further guidance with respect to the application of cost-effectiveness and technical feasibility conditions in that article.

7 Monitoring and evaluation

7.1 Monitoring the progress towards the 2030 target

To ensure that the agreed EU energy efficiency 2030 target is achieved in 2030 requires a constant monitoring of progress towards this agreed target. This assessment needs to be based on robust indicators which are easy to understand and which measure progress with regard to energy efficiency in a meaningful way.

For many years, Member States have adopted several energy efficiency policies and programmes as demonstrated in the National Energy Efficiency Action Plans (NEEAPs) which were already required under the previous Energy Services Directive 2006/32/EC. The NEEAPs have gradually improved the strategic planning of energy efficiency policies in most of the Member States, including the evaluation of existing policies and informs the European Commission and other Stakeholders of the developments and planned energy efficiency activities in a country.

In its Energy Efficiency Progress report 2015[239], the Commission suggested fifteen indicators to measure the progress of Member States towards their 2020 targets:

1. Long-term indicator: Comparison of primary energy consumption trends 2005-2013 with the rate of decrease that would be needed in 2005-2020 to reach the indicative national target;
2. Long-term indicator: Comparison of final energy consumption trends 2005-2013 with the rate of decrease that would be needed in 2005-2020 to reach the indicative national target;
3. Short-term indicator: 2012 compared to 2013 primary energy consumption;
4. Short-term indicator: 2012 compared to 2013 final energy consumption;
5. Energy intensity indicator for the whole economy 2005-2013;
6. Energy intensity indicator for industry 2005-2013;
7. Final energy consumption per capita 2005-2013;
8. Final energy consumption per m^2 2005-2013;
9. Energy intensity of the service sector 2005-2013;
10. Total final energy consumption of the transport sector 2005-2013;
11. Share of collective passenger transport means 2005-2013;
12. Share of railway and inland waterway freight transport 2005-2013;
13. Heat generated from CHP plants 2005-2013;
14. Transformation output of district heating plants 2005-2013;
15. Transformation output/input ratio for thermal generation 2005-2013.

Those indicators should be used to monitor progress per Member State as the historical data for all indicators (except indicator 8) are available from Eurostat. This enables stakeholders to track progress based on official data.

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239 COM(2015) 574 final. In addition, the Commission highlighted some of these indicators in its State of the Energy Union report COM(2015) 572 final.

In particular final and primary energy consumption, energy intensity for the economy, industry and the service sector should be one of the main metrics to be monitored in governance process. However, appropriate indicators covering each sector should be monitored in any case.

To better distinguish between energy efficiency improvements and other factors such as a change in the energy mix, in the economic structure, in the economic development, of climate conditions or other factors the Commission will make use of a decomposition analysis. The Commission has supported for many years the Odyssee-Mure project which already gives insight on the impacts of energy efficiency measures. In parallel, the Commission is working on the development of its own decomposition analysis.

The EED includes already provisions that enable the Commission to assess the progress of Member States. Article 24 of the EED requires Member States to publish a National Energy Efficiency Action plan every three years which includes all major developments and planned initiatives with regard to energy efficiency[240]. In addition, Member States need to send an Annual Report to the Commission providing information on the reasons for a constant or increasing energy consumption in the previous year, an update of the mayor legislative and non-legislative measures implemented in the previous year, the renovated and not renovated floor area of public buildings (over 250m^2) according to Article 5(1) and the achieved energy savings according to Article 7.

In October 2014 – when agreeing on the 2030 Framework for climate and energy – the European Council called for a reliable and transparent governance system meant to guarantee that the EU meets its common climate and energy policy goals. On 19 March 2015, the European Council concluded that the governance system will build on existing building blocks such as national climate programmes, national plans for renewable energy and energy efficiency. As described in chapter 5.3, a strong governance system is needed to ensure that a target expressed as indicative targets or an EU binding target is met. Therefore, the above mentioned reporting requirements will be assessed in more detail in the dedicated governance impact assessment.

The planned governance system will allow the Commission to assess the collective efforts presented in Member States' national plans in view of delivering on the agreed EU 2030 energy efficiency target. If the sum of the national energy efficiency targets of all Member States is not sufficient to achieve the EU energy efficiency 2030 target, additional measures at EU level will be needed to complement national efforts to ensure the target delivery by 2030. This will ensure insufficient collective efforts by Member States will not risk meeting the EU 2030 target on energy efficiency. In addition, to ensure the coherence of energy and climate policies and to avoid potential overlap between climate and energy objectives, changes to energy consumption and their impacts on other energy and climate objectives should be reported and monitored. This will allow the interaction between climate and energy policies to be identified and provide evidence to inform how to address potential issues related to the coherence between such policies. As described in chapter 5.3, a timely review of the progress

[240] More details on the required information can be found in Annex XIV of the EED and in the Guidance for National Energy Efficiency Action Plans SWD(2013) 180 final.

towards the 2030 target is also needed and a corresponding clause should be included in the EED.

7.2 Monitoring and evaluation of Articles 7 and 9-11 of the EED

The 2011 Impact Assessment supporting the EED[241] addressed four aspects of monitoring arrangements:

1. Overall progress on energy savings and expected progress;
2. Progress with individual measures;
3. Review of overall energy efficiency progress in 2013;
4. Legal transposition and implementation of the new Directive/Regulation.

The follow up of these four points was and continues to be Articles 3, 7 and 24 of the Directive contain detailed requirements on reporting and monitoring. The requirement on Member States to notify an Annual Report[242] (and a detailed National Energy Efficiency Action Plan every three years) on progress achieved towards their national energy efficiency targets allowed the Commission to comply with its obligation to assess progress towards the EU's 2020 target, in its 2014 Energy Efficiency Communication[243] in which it concluded that the EU would achieve energy savings of around 18-19% in 2020 rather than the 20% target. The Member States were required to notify to the Commission already by 5 December 2013 their detailed plans on how they would achieve the savings required under Article 7. Updated notifications were received in 2014 from a number of Member States[244].

The transposition and implementation of the Directive was followed up by the Commission after the transposition deadline of 5 June 2014, at which point only 4 Member States had declared full transposition. Infringement procedures for non-communication are still on-going against 18 Member States, but as the last pieces of transposing legislation are adopted, the cases are being closed. The Commission has also engaged in structured dialogue with the Member States through the EU Pilot tool with respect to their implementation of Article 7, as well holding meetings on the implementation of Article 7 at technical level with all Member States that so requested.

At a more detailed level, Article 7 of the Directive requires Member States to monitor and verify the energy savings they claim and this was explored in the structured dialogue mentioned above and followed up with a specific workshop on sharing of best practice in monitoring and verification.

Under the current proposal, no change is made to the current reporting obligations but as indicated above the new governance initiative will ensure that a transparent and reliable planning, reporting and monitoring system will be put in place, based on integrated national energy and climate plans and streamlined progress reports by Member States regularly

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241 SEC(2011) 779 final.

242 http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive/national-energy-efficiency-action-plans.

243 COM(2014) 520 final: https://ec.europa.eu/energy/sites/ener/files/documents/2014_eec_communication_adopted_0.pdf.

244 http://ec.europa.eu/energy/en/topics/energy-efficiency-directive/obligation-schemes-and-alternative-measures.

assessing the implementation of national plans along the five dimensions of the Energy Union. This will ease the administrative burden on Member States but still allow the Commission to monitor Member States' progress towards their energy efficiency targets and that of the EU. Indicators of success in line with the preferred option once the proposal is adopted would be:

- Correct transposition and implementation of the changes to the Directive;
- Increased progress towards the national and EU energy efficiency targets;
- Improved ability of consumers to know about their thermal energy consumption;
- Reduction of administrative burden on Member States and improved reporting on the savings claimed under Article 7 by the Member States.

Member States are required to report annual energy efficiency statistics, allowing the Commission to evaluate their progress towards their national energy efficiency targets, as well as collectively towards the EU target.

The achievement of the operational objectives will be monitored in a number of ways. The amending Directive will contain a transposition deadline and the Commission will check whether the Member States have notified their legal transposition measures as required. The Commission will also examine the conformity of the national measures with the new requirements under the EED. If a Member State has not transposed the changes to the EED, or not done so fully, or has done so incorrectly, the Commission will initiate a dialogue with the Member State in question, which can result in infringement procedures.

Under the new Energy Union governance system Member States will have to submit to the Commission Integrated National Energy and Climate Plans which will allow the Commission to track their progress towards greater energy efficiency.

Monitoring of progress under the new governance system will be key to track progress on how Member States achieve their national energy savings requirements due by the end of 2030. The Commission's role is therefore incremental to continue assisting Member States in their implementation by providing guidance to Member States on the regulatory framework and fostering exchange of best practice via workshops and other fora.

The information received from the Member States will allow the Commission to assess what energy savings Member States claim under Article 7 of the EED. The changes proposed give more prominence to monitoring and checking of savings by the Member States, both in terms of materiality (was the policy measure actually responsible for the energy savings), eligibility (are the savings additional to what would have happened anyway?) and calculation (how has double counting been avoided, on what has the "lifetime" of the measure been based etc.).

In terms of improving the ability of consumers to know about their thermal energy consumption, a first key indicator would one which indicates how many people in multi-apartment buildings actually have meters or cost allocators in accordance with the existing requirements of Article 9(3). The shares of buildings/building units equipped with individual and collective metering respectively is one of the indicators selected for the future *EU Building Stock Observatory*, so as and when data becomes available for this indicator. This will provide useful information on the matters analysed here. Moreover, industry associations of providers of heat cost allocation services may be requested to help provide data on the amount of buildings serviced and the kind of service provided, including possibly the frequency with which consumption is provided to consumers, the share of remotely read dwellings as well as samples of the billing information provided.