Deloitte.

Energy Efficiency in Europe

The levers to deliver the potential.

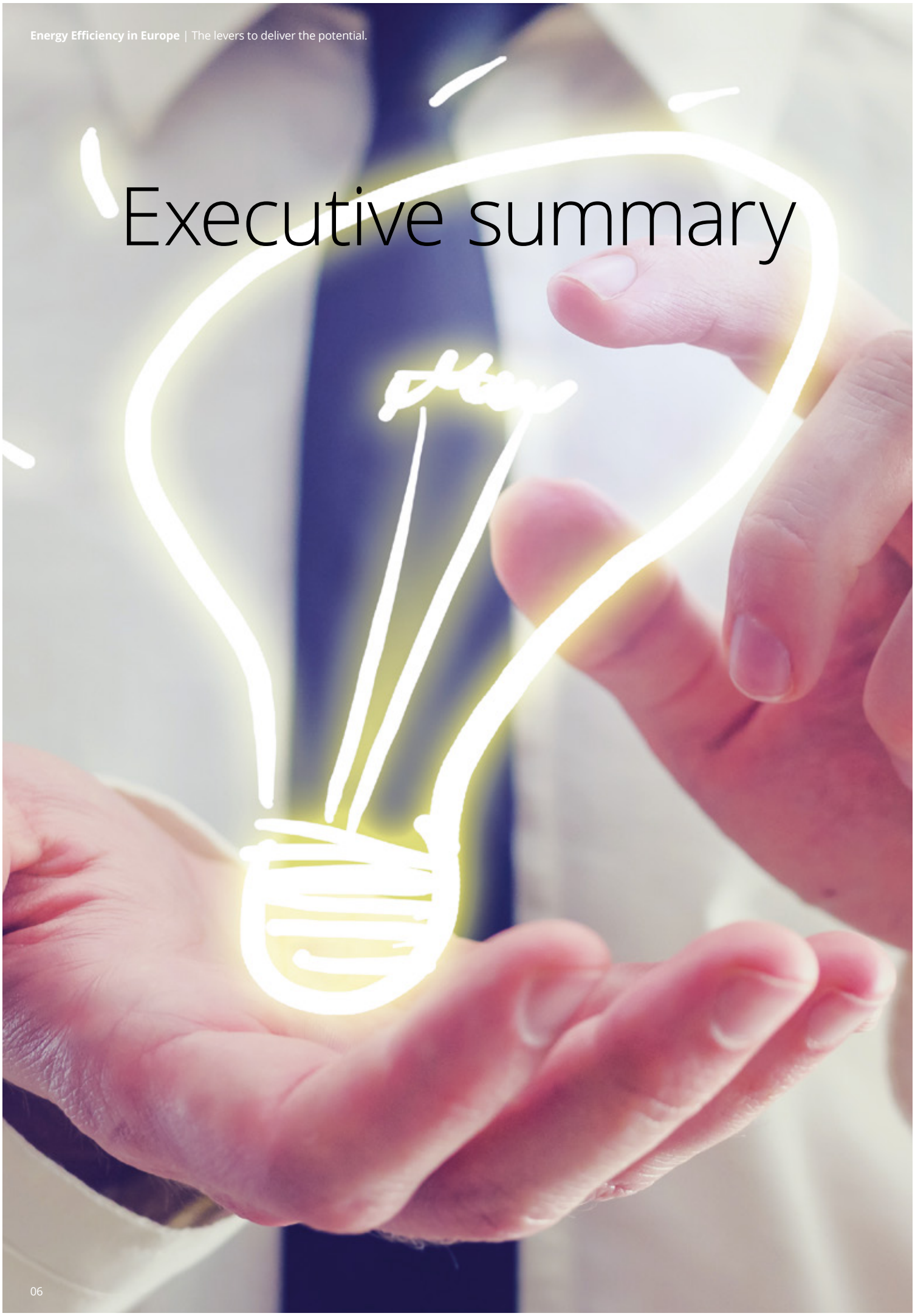
Content

Glossary

Abbreviation	Description
5E	Efficacité Energétique et Empreinte Environnementale des Entreprises
BAFA	German Federal Office for Economic Affairs and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle)
BAT	Building Automation System
BPIE	Buildings Performance Institute Europe
CBA	Cost Benefit Analysis
CDC	Caisse des dépôts et consignations
CEB	Council of Europe Development Bank
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CF	Cohesion Fund
CHP	Combined Heat and Power
CO_2	Carbon dioxide
COP21	21st session of the Conference Of the Parties
CPS	Carbon Price Support
CUMAC	Cumulé et actualisé (Cumulated and updated)
DSO	Distribution System Operators
EACI	Executive Agency for Competitiveness and Innovation
EAFRD	European Agricultural Fund for Rural Development
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EDD	European Eco-Design Directive
EDF	Électricité de France
EE	Energy Efficiency
EEA	European Environment Agency
EEC	Energy Efficiency Certificate
EED	Energy Efficiency Directive
EEEF	European Energy Efficiency Fund
EEFIG	Energy Efficiency Financial Institutions Group
EEG	Energy Efficiency Group
EIB	European Investment Bank
ELD	Energy Labelling Directive
ELENA	European Local Energy Assistance
EMFF	European Maritime and Fisheries Fund
EnMS	Energy Management System
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contract
EPC	Energy Performance Certificate
ERA	European Research Area
ERDF	European Regional Development Fund
ESCO	Energy Service Company

Abbreviation	Description
ESF	European Social Fund
ESIF	European Structural & Investment Fund
ETS	Emissions Trading System
ETSI	European Telecommunications Standards Institute
EU	European Union
EUA	European Emission Allowance
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIB	Green Investment Bank
GWP100	Global Warming Potential over 100 years
H2020	Horizon 2020 Programme
ICT	Information and Communications Technology
IEA	International Energy Agency
IEEN	Industrial Energy Efficiency Network
IFC	International Finance Corporation
ISO	International Organization for Standardization
JESSICA	Joint European Support for Sustainable Investment in City Areas
JRC	Joint Research Centre
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
MEPS	Minimum Energy Performance Standard
MLEI	Mobilising Local Energy Investment
MS	Member States
MURE	Mesures d'Utilisation Rationnelle de l'Energie (Measures for rational use of energy)
NEEAP	National Energy Efficiency Action Plan
nZEB	Nearly Zero-Energy Building
OECD	Organisation for Economic Co-operation and Development
PACE	Property-Assessed Clean Energy
PDA	Project Development Assistance
PEC	Primary Energy Consumption
PF4EE	Private Financing for Energy Efficiency
REN	Renewable Energy
SEFF	Sustainable Energy Financing Facility
SET plan	Strategic Energy Technology Plan
SME	Small and Medium-sized Enterprise
UK	United Kingdom
US	United States
WtW	Well-to-Wheels
YAECI	Yearly Appliance Energy Costs Indication
YEI	Youth Employment Initiative

Executive summary



In December 2015, the COP21 meeting and the Paris Agreement stressed more than ever how crucial it is for the future of mankind to hold the increase in the global average temperature to well below 2°C above pre-industrial levels (and even to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels). According to the International Energy Agency (IEA), energy efficiency is central to any two-degree energy scenario. **The IEA considers that, by 2035, investments in energy efficiency need to represent nearly half of all the global energy investments required to stay under the two degree limit**[1]. Accordingly, energy efficiency is one of the key elements of the EU's energy policy. This is reflected in existing legislation and in targets to be reached by 2020 and 2030.

While there is a broad consensus at the international level that there is considerable untapped economic and technical energy efficiency potential, the measures implemented with a view to an improvement in energy efficiency have not made it possible so far to stay on track to reach the targets set by the European Union. This is due in particular to various existing barriers, such as the diffuse nature of energy saving potential, the presence of many different market actors with partially conflicting interests, volatile energy prices and the very long payback period of energy efficiency investments, which make energy efficiency measures unattractive for investors.

The present study aims to identify the main levers for public authorities, private companies and households, which could help to better unleash the untapped technical and economic potential of energy efficiency in Europe.

Despite high potential and ambitions, progress falls below expectations

Energy is a key element of the European Union's economy. The EU consumes 11% of global energy (i.e. 1,606 Mtoe in 2014)[2]. 53% of this energy is imported at the cost of more than EUR 400 billion per year[5] (~3% of EU GDP in 2015), making the EU the biggest energy importer worldwide[5].

Numerous reports and studies have shown that **the untapped economic potential behind energy efficiency remains considerable**. The IEA, for examples, has been treating energy efficiency as the 'first fuel' since 2013[3] and reckons that **two thirds of the economically profitable investments to improve energy efficiency will remain untapped in the period to 2035**[4]. Most of these are in the building sector.

Hence, it is not surprising that energy efficiency is one of the cornerstones of EU Energy Policy[5], and closely linked to its three main pillars: security (security of supply, import independence, safe production), sustainability (reducing greenhouse gas (GHG) emissions) and competitiveness (affordable energy for end-users). In 2015, the new Energy Union Strategy confirmed the energy efficiency targets of an improvement in energy efficiency by 20% by 2020[6] and by 27% by 2030. In this context, the European Commission called for a fundamental rethink of energy efficiency and advocated treating it as an own energy source, representing the value of energy saved. However, despite the high ambitions and numerous actions taken, progress has not matched **expectations**: the implementation of the Energy Efficiency Directive (adopted in 2012)[7] is behind schedule and the 2020 target of a 20% saving is likely to be missed at the European level (primary energy savings are projected to reach only 17.6% by 2020[8]). This failure to meet the target is particularly striking, since **one third of the savings achieved so far can be attributed to the economic crisis**[9].

Clearly there is no silver bullet and the solution will lie in a complex set of many different measures.

1 *CarbonBrief (2014): IEA: The marginal cost of two degrees, http://www.carbonbrief.org/iea-the-marginal-cost-of-two-degrees*

2 *Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a*

3 *IEA (2013), Energy Efficiency Market Report 2013 – Market Trends and Medium-Term Prospects, page 3, available at: https://www.iea.org/publications/freepublications/publication/EEMR2013_free.pdf*

4 *IEA (2012), WEO 2012, available at: https://www.iea.org/publications/freepublications/publication/English.pdf. Note on the IEA methodology: This estimate is based on the IEA New Policies Scenario outlined in the World Energy Outlook 2012. Investments are classified as "economically viable" if the payback period for the up-front investment is equal to or less than the amount of time an investor might be reasonably willing to wait to recover the cost, using the value of undiscounted fuel savings as a metric. The payback periods used were in some cases longer than current averages, but they were always shorter than the technical lifetime of individual assets.*

5 *European Commission (2015) Energy Union Package [COM(2015) 80 final], available at: http://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF*

6 *The 2020 target is less than 1086 Mtoe of final energy consumption or less than 1483 Mtoe of primary energy consumption.*

7 *Directive 2012/27/EU of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0027*

8 *European Commission (2015), Report from the Commission to the European Parliament and the Council [COM(2015) 574 final], available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:574:FIN*

9 *European Commission (2015), Report from the Commission to the European Parliament and the Council [COM(2015) 574 final], page 3, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0574&rid=1*

We have grouped the key findings of this study **into six main lines of action that need to be tackled** to better unleash the untapped potential behind energy efficiency:

1. Set appropriate indicators and targets;
2. Promote product standards and labels;
3. Unleash the energy efficiency potential of buildings;
4. Mobilise retail consumers;
5. Send the right price signals;
6. Facilitate financing of energy efficiency measures.

1. Set appropriate indicators and targets

Using the right indicators and setting the right targets is key to monitoring progress and communicating on achievements. So far, under the Energy Efficiency Directive, Member States can choose whether to set their national target based on either primary energy consumption (PEC), final energy consumption (FEC), primary or final energy savings, or energy intensity.
However, there are several concerns with these targets: FEC covers only 66% of the EU-28's gross inland consumption[10], as it does not take into account energy losses from energy production, transport and distribution. Energy intensity (measured as units of energy per unit of GDP) is influenced by many non-energy related factors, such as standards of living, different weather conditions, the structure of the economy, etc.

At EU and national level, the main binding target for energy demand policies should be expressed in Primary Energy Consumption (PEC), since a target expressed in PEC covers both the reduction of energy consumption and the move to a more efficient and less carbon-emitting energy mix. Targets in PEC should be defined Member State by Member State, taking into account their economic growth, their specific energy mix and the structure of their economy.

In parallel, each Member State can use additional indicators, such as FEC or energy intensity, depending on its specific national situation, to monitor its progress and analyse the success of policy measures related to energy efficiency.

At the same time, it is important to ensure that targets are consistent with other objectives linked to energy and climate policies, such as those related to renewable energy and greenhouse gas emissions.

It is also important to prioritise those energy efficiency measures that have the most significant impacts on all aspects of European energy strategy: reducing GHG emissions, increasing security of supply and maintaining competitiveness. **Avoided GHG emissions should be promoted as an indicator** in order to assess the wider impacts of energy efficiency policies on overall energy and climate strategy and **to prioritise energy efficiency measures based on their overall impacts**. Avoided GHG emissions:

- encompass the broader picture (energy efficiency, renewables, mitigation of climate change);
- can be related to long-term global targets (e.g. the COP 21 target);
- are already widely in use (GWP100); and
- are well known to decision-makers and stakeholders.

Moreover, an adequate decomposition analysis method should be defined at EU level and used in all Member States to enable the **actual progress of energy efficiency to be tracked independently of structural and activity changes** (such as the impacts of an economic crisis).

10 Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

2. Promote product standards and labels

Energy standards and labels enable better communication and transparency for customers and investors, and enhance competition and innovation for companies. The Ecodesign and Energy Labelling Directives[11] implemented key measures to promote energy standards and labels for energy-using products in Europe, with much success (175 Mtoe of savings per year by 2020, or 11.6% of the EU-28's PEC in 2014). Further progress is still possible through several actions:

- **The list of product categories targeted by these directives could be further extended** (potential additional savings estimated at 6.2 Mtoe by 2020 for a selection of product groups (and at 8.9 Mtoe by 2030));[12]
- **Labels and ecodesign requirements need to be updated regularly**, taking into account technological progress and ensuring that the level of ambition is adequate;
- **The legislative process should be optimised and shortened**, particularly in relation to review studies designed to update requirements in line with technological developments;
- Last but not least, **stronger market surveillance is needed** to enforce ecodesign and labelling regulation.

Additionally, there is a need to ensure that consumers are informed about both the absolute and relative performance of their products and that the meaning of labels is fully understood. Hence, continuous efforts are needed to develop relevant, up-to date and easily understandable energy labels, **possibly integrating the full life cycle cost of energy-using products.**

3. Unleash the energy efficiency potential of the construction sector

Buildings account for 39% of the EU's total final energy consumption (2014), two thirds of which is in the residential sector. This is where the greatest potential for energy savings lies: 75% of the EU's building stock is still energy inefficient and **the rate of building renovation remains very low at around 0.4% to 1.2% per year[13], while a rate of around 3% per year would be needed[14]**.

European legislation on building sector energy efficiency is embedded in different Directives, mainly in the Energy Performance of Buildings Directive (EPBD)[15] and the Energy Efficiency Directive (EED). According to a recent study[16], 48% of the energy savings targeted under the EED's[17] energy obligation schemes (Article 7) are likely to be achieved in the building sector.

However, the implementation of the Directives is lagging behind: a recent study by BPIE showed that only five countries were fully compliant with European requirements: the Czech Republic, Finland, Romania, Spain and the UK[18]. **In practice, most Member States had not set a consistent path for the renovation of their national building stocks, but were following a rather short-sighted**

11 Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, available at: http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32009L0125, and Directive 2010/30/EU of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0030

12 Deloitte (2014), Preparatory Study to establish the Ecodesign Working Plan 2015-2017, draft report available at: http://www.ecodesign-wp3.eu/

13 European Commission (2016), An EU Strategy on Heating and Cooling (COM (2016) 15 final), available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0051&rid=1

14 BPIE (2014), Investing in the European buildings infrastructure – An opportunity for the EU's new investment package http://bpie.eu/wp-content/uploads/2015/11/Investing_in_Europe_s_buildings_infrastructure_BPIE_Discussion_Paper.pdf

15 Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32010L0031

16 Ricardo-AEA (2015), Study evaluating the national policy measures and methodologies to implement Article 7 of the Energy Efficiency Directive, available at: http://rekk.hu/downloads/projects/Final%20Report%20on%20Article%207%20EED.pdf, page vi

17 Article 7 refers to 'Energy efficiency obligation schemes' and requires, inter alia, that each MS 'shall set up an energy efficiency obligation scheme that shall ensure that distributors and/or retail energy sales companies should achieve a cumulative end-use energy savings target by 31 December 2020, at least equivalent to achieving new savings each year of 1.5% of the annual energy sales to final customers'.

18 It scores the strategies against the five component sections of Article 4 on a scale of 0-5 where 0=Missing, 1=Unsatisfactory, 2=Inadequate, 3=Adequate, 4=Good, 5=Excellent. A strategy is considered as being compliant with the minimum requirements of Article 4 if it achieves a rating of 70% and each of the individual sections scores at least 3.

strategy. Various measures have proven successful in encouraging the improvement of energy efficiency in buildings and these should be promoted more widely in the EU.

One example, already promoted in the EPBD, are Energy Performance Certificates (EPCs), an application of energy labels for buildings. EPCs have been shown to have a positive effect on energy efficiency improvements and to contribute to higher sale or rental prices (up to 6%)[19]. However, EPCs have not yet achieved their full potential, due to poor implementation, lack of enforcement and the variety of existing methods. Comparable buildings in different countries, or even regions within a country, can obtain different classifications. This weakens the reliability of the certificates. **Public authorities should therefore strive for better homogenisation of EPCs and promote them more extensively. The calculation and verification methodology for EPCs should be harmonised throughout the EU.**

At project level, a better anticipation of benefits resulting from energy efficiency measures is necessary to justify their implementation on solid grounds: ex ante assessment of energy savings should be based on real ex post evaluations of similar projects and be tailored to each specific measure. The analysis should also take into account potential co-benefits (impact on individual comfort, on the market value of buildings, etc.). These can be more significant than pure energy savings in certain cases. France's pilot energy renovation passport is one example of such specific analysis. This passport is an in-depth energy audit of a dwelling, with at least three detailed scenarios for the renovation work. It includes a detailed analysis, a cost estimation, and an assessment of expected savings and potential subsidies.

One key barrier to energy efficiency in the building sector is the landlord-tenant problem[20]. Solutions to this problem can be found in specific and innovative financing mechanisms that enable the tenant not to pay upfront for the investment in an energy efficiency measure, but to amortise the investment on a regular basis and in line with the energy savings generated. Examples are on-bill or on-tax financing schemes, such as Property-Assessed Clean Energy (PACE) programmes in the US. More than 47,000 residential PACE assessments worth almost $960 million have been implemented so far across California[21]. **Such mechanisms need to be promoted by public authorities and put in place by private companies.**

4. Mobilise retail consumers

Raising the awareness of the end-users, and gathering and communicating the relevant data, will play an important role in reaching the EU energy efficiency targets. End-users need to be mobilised to adapt their everyday habits and become more aware of their energy consumption, and of the potential savings they could generate. Several interrelated actions are required:

Measure precisely what end-users consume and quantify what they could realistically save. Rolling out smart meters, for electricity and/or gas, can work as an enabler for such measurement actions. In 2012, most Member States performed a cost-benefit analysis to decide whether they should introduce smart meters or not[22]. The average cost of a smart metering system is estimated at between EUR 200 and EUR 250 per customer, as opposed to average benefits per metering point (including the cost reduction permitted by average energy savings of around 3%[23] and other benefits,

19 Deloitte / a.k.a. Bio Intelligence Service (2013), Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, https://ec.europa.eu/energy/sites/ener/files/documents/20130619-energy_performance_certificates_in_buildings.pdf

20 The "landlord-tenant problem" is a typical case of split incentives, i.e. a situation where economic actors participating in an exchange do not share the same objectives. In the case of energy efficiency, split incentives occur between tenants and landlords. While tenants want to minimise their energy bill, landlords want to minimise their investment costs. Since the landlord will not get any return from investment in a more efficient energy system, and the tenant is not certain to cover the cost of an investment through cost savings on the energy bill, the energy efficiency potential often remains unrealised.

21 Berkelay LAB (2016), Residential Property Assessed Clean Energy in California, https://emp.lbl.gov/sites/all/files/lbnl-1003964.pdf

22 European Commission (2014), Cost-benefit analyses & state of play of smart metering deployment in the EU-27, [COM(2014) 356 final, SWD(2014) 188 final], http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0189&rid=1

23 European Commission (2014), Cost-benefit analyses & state of play of smart metering deployment in the EU-27, available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0189&from=EN

such as lower metering costs) of EUR 160 for gas and EUR 309 for electricity. As a consequence, 16 Member States[24] started a wide-scale roll-out programme (80% or more) for electricity, while seven countries[25] opted for a selective roll-out or a limited roll-out (i.e. less than 80%). Only a few countries (Austria, France, Ireland, Italy, Netherlands and UK)[26] have so far chosen to roll out gas smart metering.

Inform consumers through direct or indirect feedback. Potential gains have to be presented in a clear, transparent and easily understandable way. Achievable targets should be forecasted and progress monitored. Several companies are developing home automation systems (domotics) to provide end-users with relevant, transparent and incentivising feedback. Many new companies are emerging on this market (Nest, founded in 2010 and acquired by Google for EUR 3.2 billion in 2014), Evohome (United States), Tado (Germany), Hive, Heatmiser, Heat Genius and Connect (United Kingdom) or Istabai (Latvia), claim that they can help their clients cut their bills by up to 15%-50%. Gamification techniques, such as customer-feedback programmes comparing the energy performance of neighbours, can be used to make this feedback more attractive.

Convince end-users to become proactive. While more and more large companies are conducting energy audits and implementing Energy Management Systems (EnMS), specific measures are needed to encourage SMEs, and also households. A recent study found a tendency for countries to pay more attention to energy audits than specific instruments dedicated to EnMS[27]. An example of a mechanism to incentivise Energy Management Systems can be found in Germany, where energy intensive industries (> 1GWh) with a certified Energy Management System are exempt from the renewable energy surcharge (EEG surcharge).

These measures provide opportunities to develop new business models (smart metering, smart home appliances, consumer-friendly bills, etc.), which can be taken up either by incumbent operators (power utilities, energy providers) or by innovative, often IT-focused, new companies.

5. Send the right price signals

Higher carbon prices would contribute towards making energy efficiency measures economically more attractive. A structural reform of the EU emissions trading system (EU ETS) is being undertaken, but will most probably not be sufficient to solve all the current difficulties of the system (surplus of allowances, sensitivity to shocks, etc.). Further action is needed to set carbon price signals at a level that really induces actors to invest in energy efficiency, i.e.:

- **Make sure that the long-term reform of the ETS currently under discussion is ambitious enough and does not lead to any over-allocation of CO_2 allowances;** this implies, inter alia, that the calculation of future allocation of EU allowances should take into account all the energy and climate policy measures implemented at EU and national levels (especially those in favour of low-carbon energies and energy efficiency, since they have a significant impact on future GHG emissions);
- As long as the CO_2 price set by the EU ETS is not high enough, **complement the ETS by implementing carbon taxes**, similar to the UK's carbon floor price, which has increased the cost of carbon for UK power plants to £23/CO_2eq., as compared to EUR 5/tCO_2eq. through the EU ETS alone.

24 Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Poland, Romania, Spain, Sweden and the United Kingdom

25 Belgium, Czech Republic, Germany, Latvia, Lithuania, Portugal, Slovakia

26 http://ses.jrc.ec.europa.eu/smart-metering-deployment-european-union

27 European Commission (2016), A Study on Energy Efficiency in Enterprises: Energy Audits and Energy Management Systems, available at: https://ec.europa.eu/energy/sites/ener/files/documents/EED-Art8-Implementation-Study_Task12_Report_FINAL-approved.pdf

Revenues from carbon taxes could be used, for instance, to reduce other taxes or be channelled into energy-efficient investments.

- **Integrate diffuse emissions into these price-setting mechanisms as much as possible** (55% of overall GHG emissions are not covered by the EU ETS); this can be done either by integrating more sectors into the ETS (buildings, road transport, etc.) as is currently being done in California's ETS, or by implementing ambitious carbon taxes targeting diffuse emissions.

While the EU ETS and carbon taxes aim to reduce GHG emissions, other market-based mechanisms, such as **white certificates**, target energy savings directly. However, these schemes still have a long way to go before reaching full efficiency and credibility. **Quantification standards need to be implemented to avoid unrealistic energy saving calculations and a harmonisation of existing schemes is necessary to create a larger and more efficient market.**

6. Facilitate financing of energy efficiency measures

Facilitating access to energy efficiency financing needs to become a key priority at the EU and Member State level, and a set of key actions needs to be taken to get on track to meet the EU's long-term targets. Since **various barriers are limiting the attractiveness to traditional private investors of financing energy efficiency measures** (such as long payback periods, uncertain energy prices, lack of relevant and understandable information for investors, etc.), an efficient financing framework needs to be developed to ensure an optimal interplay between public and private actors.

The European Commission estimates that EUR 100 billion need to be invested annually to achieve Europe's 2020 energy efficiency targets[28]. Yet, the total annual investment by public banks is currently estimated at only EUR 15-20 billion[29]. Ramping up funds and facilitating the access to energy efficiency financing needs to become a key priority at the EU and at Member State level.

Public funds alone cannot finance all the necessary energy efficiency measures. The public sector needs to act as a catalyst, boosting private financing to close the investment gap.

- **Tailor-made solutions provided by closer public-private collaboration** need to be developed to drive broader investments in energy efficiency;
- **SMEs deserve particular attention.** SMEs represent 99% of all companies in the EU, but only 64% of all SMEs are taking action to save energy, compared to 82% of large companies[30]. Therefore, specific support needs to be offered to SMEs, among others, through intelligent project pooling structures and bundling mechanisms.

Innovative financing mechanisms need to be put in place and promoted in order to overcome existing market failures and to unlock the significant energy efficiency potential, in particular in the building sector. Such innovative mechanisms include energy performance contracting schemes (EPCs) offered by Energy Service Companies (ESCO), green bonds, etc. The latter constitute promising investment products for companies: green bond issuance increased 16-fold between 2012 and 2015 from USD 2.6 billion to USD 41.8 billion worldwide.

28 European Commission, Financing energy efficiency, available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency

29 DIW (2013), Financing of Energy Efficiency: Influences on European Public Banks' Actions and Ways Forward, page 1, available at: http://www.diw.de/documents/publikationen/73/diw_01.c.422405.de/hudson_financing.pdf

30 European Commission, Eurobarometer survey: SMEs are important for a smooth transition to a greener economy, http://europa.eu/rapid/press-release_MEMO-12-218_en.htm

Introduction

The COP21 meeting and the Paris Agreement, agreed upon in December 2015, highlighted more than ever how crucial it is for the future of mankind to hold the increase in the global average temperature to well below 2°C above pre-industrial levels (and even to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels). According to the International Energy Agency (IEA), energy efficiency is central to any energy scenario that matches this two degree limit. In fact, by 2035, investments in energy efficiency need to represent nearly half of all global energy investment in order to stay within this figure[31]. Accordingly, energy efficiency is a key element of EU's energy policy.

Many studies have stressed that the economic and technical potential behind energy efficiency is considerable, demonstrating that many readily available measures could yield significant savings, both in terms of energy consumption and in terms of costs.

Despite this emphasis on energy efficiency, both from international experts and policy-makers, there is a consensus that the measures targeting an increase in energy efficiency implemented so far have not enabled the EU to reach its targets. Different reasons for having fallen short of expectations have been put forward: energy savings potential is diffuse, with many different players involved; investment in energy efficiency is not particularly attractive from a purely financial perspective, because of long payback periods and uncertain returns on investments; the economic crisis and the dwindling energy prices are not favourable contexts for energy savings, etc.

This study aims to identify the main levers for public authorities, private companies and households, which could better unleash energy efficiency's technical and economic potential. Obviously, there is no silver bullet and the solution lies in a complex set of many different measures.

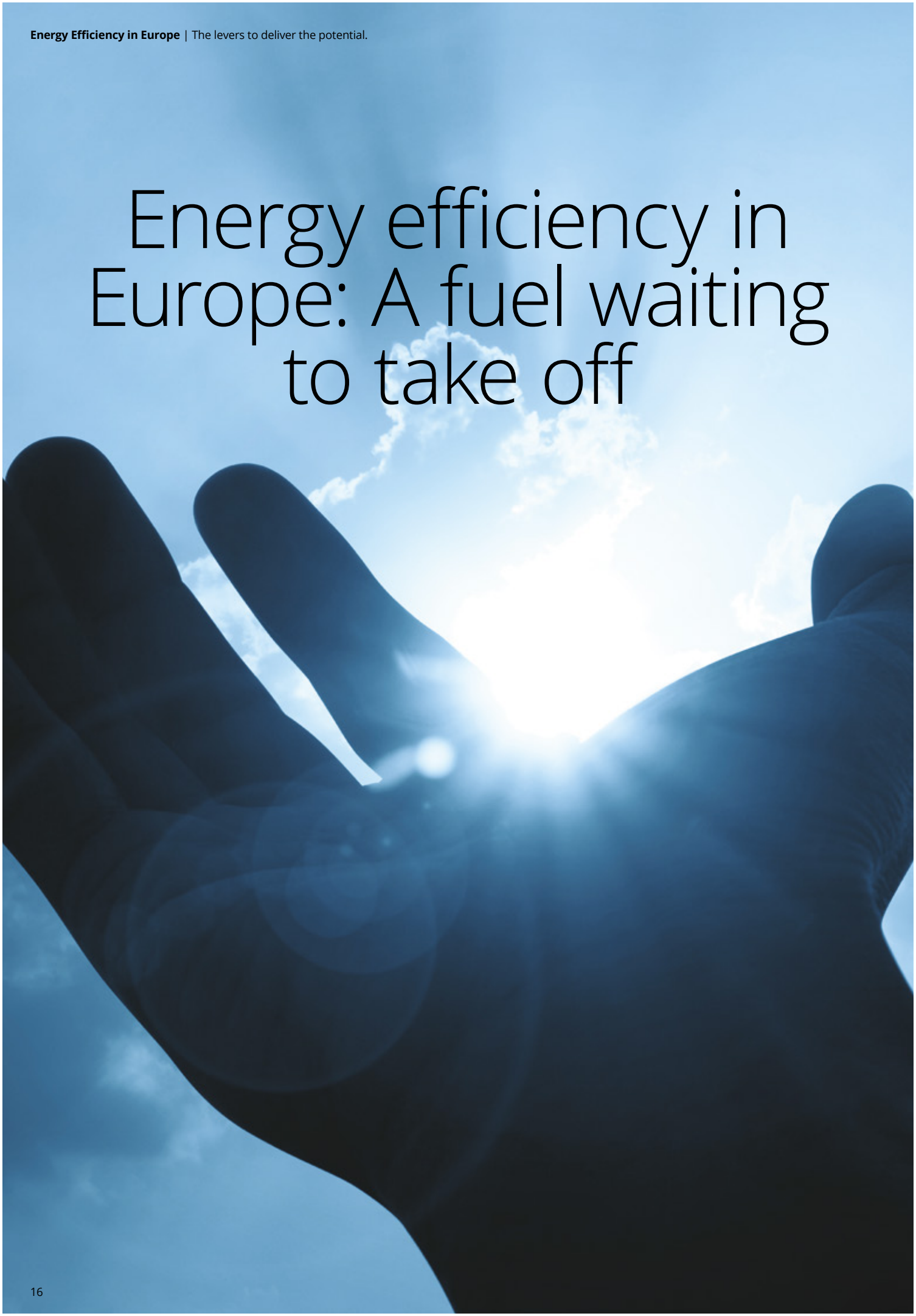
After an introductory section designed to present the context and key elements of European Union energy and energy efficiency policies, we group our key findings into six groups of proposals:

1. Set appropriate indicators and targets;
2. Promote product standards and labelling;
3. Unleash the energy efficiency potential of buildings;
4. Mobilise retail consumers;
5. Send the right price signals;
6. Facilitate financing of energy efficiency measures.

This study is based on Deloitte's in-house expertise, bibliographical analyses and consultation of several key European companies and industry associations. The views are Deloitte's own.

31 CarbonBrief (2014): IEA: The marginal cost of two degrees, http://www.carbonbrief.org/iea-the-marginal-cost-of-two-degrees

Energy efficiency in Europe: A fuel waiting to take off



1. A key element of the EU's energy strategy

Energy is at the heart of the European economy

The EU consumes 11% of global energy[32] and is the third largest energy consumer after China (23% of global energy consumption) and the United States (17%)[33]. Fossil fuels represent 72% of EU's energy consumption, nuclear 14% and renewables 13%.

Transport is the largest source of final energy demand (32%), followed by the residential sector (28%) and by industry (26%). 94% of transport energy consumption is based on oil products, of which 90% are imported.

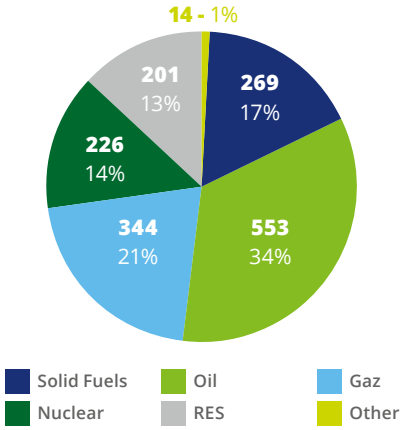


Figure 1: EU-28 Gross Inland Consumption[34] by energy source in 2014[35] (Mtoe, %)

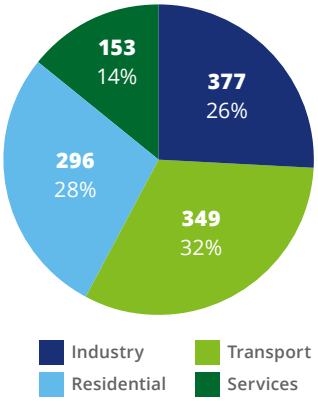


Figure 2: EU-28 Final Energy Consumption, by sector in 2014 (Mtoe, %)[36]

The EU meets 53% of its total primary energy needs from imports.

This costs more than EUR 400 billion per year (2013)[37], or around 3% of EU GDP. This makes the EU the world's biggest energy importer.

32 Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

33 Enerdata, Total energy consumption, https://yearbook.enerdata.net/energy-consumption-data.html

34 Gross inland energy consumption is equal to primary energy consumption plus the consumption of fossil fuels for non-energy purposes.

35 Calculations based on Eurostat data, Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

36 Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

37 European Commission (2015), Energy Union Package [COM(2015) 80 final], available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2015%3A80%3AFIN

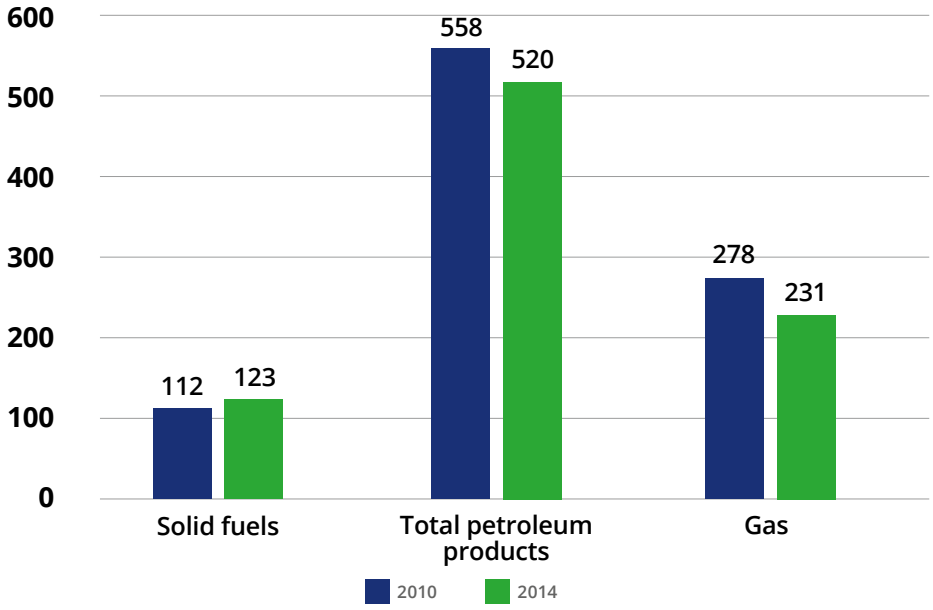


Figure 3: Net imports of solid fuels, petroleum products and gas in EU-28 (Mtoe).[38]

On average, EU household and industrial consumers currently pay more for their electricity than consumers in most major world economies. The exceptions are Japan (due to reactor shutdowns in the aftermath of the nuclear accidents in Fukushima), and Australian households.

In every EU Member State, the electricity price to industrial consumers is higher than in the US, India or Canada. This relative price difference as compared to other economies can have a strong impact on the competitiveness of European companies, in particular for energy-intensive industries.

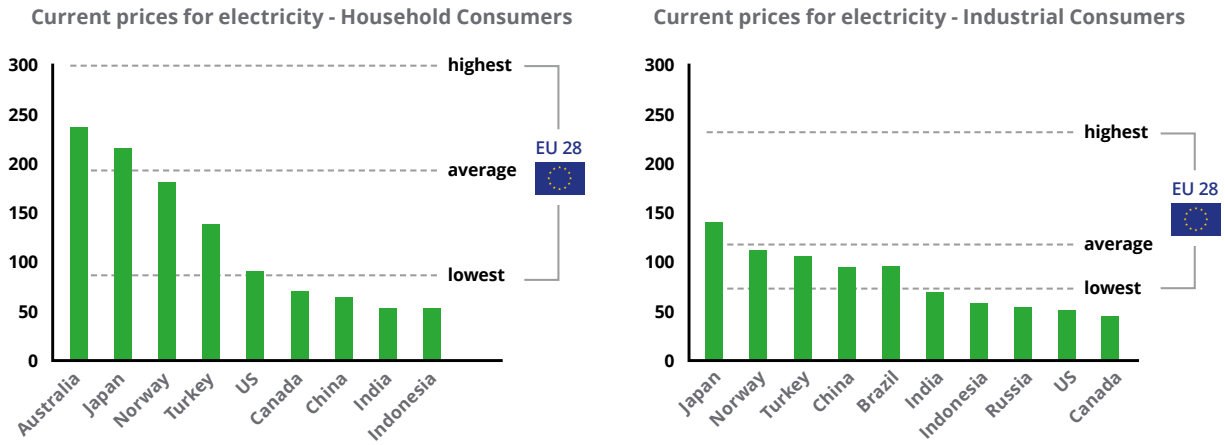


Figure 4: Current prices for electricity in EU-28 and other major economies for household and industrial consumers (EUR/MWh)[39]*, reference year 2012.*

Acknowledging that energy is at the heart of the European economy, **the EU has been defining ambitious energy strategies and targets for years**. These strategies aim at achieving energy sustainability (inter alia reducing greenhouse gas emissions), competitiveness and affordability, and security of supply. **Energy efficiency is a major component of these strategies and has a key role in reducing greenhouse gas emissions, increasing the EU's competitiveness and security of supply.**

38 Calculations based on Eurostat data, Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

39 European Commission (2014), Presentation « Energy Union and Climate Change Policy », https://ec.europa.eu/priorities/sites/beta-political/files/energy-union-1-year_en.pdf

Ambitious targets embedded in a complex regulatory environment

Irrespective of other considerations, such as carbon emission reduction requirements or import dependence, there is a clear case on efficiency grounds alone for the EU to use less energy. As part of an initial set of targets, **the EU set in 2007 an energy efficiency target of 20% by 2020**[40]. Four years later, the European Council acknowledged that the EU was off track to reach this target and as a result, the Energy Efficiency Directive (EED) was adopted in 2012 to help close the gap, amending and repealing older Directives[41].

The EED is grounded in three major cross-sectoral targets:

- **The Union's 2020 20% headline target.** The main objective of the Directive is "to ensure the achievement of the Union's 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date"[42]. It provides a legal basis for the target for 2020 of limiting primary energy consumption (PEC) to not more than 1,483 Mtoe or 1,086 Mtoe of final energy consumption (FEC)[43]. **This equates to a 20% saving compared to projections made in 2007, prior to the financial crisis.**
- **Indicative national efficiency targets.** The Directive requires Member States to set their own individual indicative national energy efficiency targets[44]. These are subject to an evaluation by the Commission, assessing whether they will be sufficient to reach the overall EU target[45].
- **Binding national targets for end-use savings.** The Directive[46] requires Member States to have an energy efficiency obligation scheme; this scheme should allow them to reach a general binding target from 1 January 2014 to 31 December 2020. This is new savings each year of 1.5% of annual energy sales to final customers[47].

In addition to the EED, several Directives and other regulatory texts or financial instruments were put in place to contribute to reaching the overall energy efficiency targets. Some of the regulatory texts, such as the EED[48] and the Energy Performance of Buildings Directive (EPBD)[49], will undergo a review in the second half of 2016. The complex regulatory environment is illustrated in the Figure 5 next page.

In 2014, the EU agreed on a new energy efficiency target of 27%, or greater, by 2030 (i.e. 27% energy savings compared with the business-as-usual scenario[50])[51]. The intention is to integrate the 2030 target in the EED as part of the review foreseen for the second half of 2016.

On 25 February 2015 the EC adopted a "Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy" (also known as the Energy Union Package or the Energy Union Framework Strategy), with an overarching goal of paving the way for the transition to a low-carbon, secure and competitive economy. That transition is to be grounded in the **three main pillars of EU energy policy: security** (security of supply, import independence, safe production), **sustainability** (reducing greenhouse gas (GHG) emissions) **and competitiveness** (keeping energy prices reasonable for end-users). Within this framework strategy, the Commission defined five dimensions[52], of which one is "Energy efficiency contributing to moderation of demand"[53].

In this context, the EC called for a fundamental rethink of energy efficiency **and advocated treating it as an own energy source**, representing the value of energy saved. This approach is new in the European energy strategy, but in line with the vision of the International Energy Agency (IEA) which - until a few years' ago - described energy efficiency as a "hidden fuel", but changed the notion to "first fuel" in its Energy Efficiency Market Report 2013[54].

In the aftermath of COP21, the EC did not change its strategy, stating that measures already taken or initiated were considered to be sufficient to deliver on the commitments[55].

40 Council of the European Union 7224/1/07, REV 1., available at: http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%207224%202007%20REV%201

41 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF

42 European Commission (2012), EED (2012/27/EU), Article 1.1

43 European Commission (2012), EED (2012/27/EU), Article 3.1(a)

44 European Commission (2012), EED (2012/27/EU), Article 3.1

45 European Commission (2012), EED (2012/27/EU), Article 24.7

46 European Commission (2012), EED (2012/27/EU), Article 7.1

47 Averaged over the most recent three-year period prior to 1 January 2013. For this calculation, the sales of energy used in transport may be partially or fully excluded.

48 The review will focus on Articles 1, 3, 6, 7, 9-11, 20 and 24, in view of the introduction of a new energy efficiency target for 2030: https://ec.europa.eu/energy/en/consultations/consultation-review-directive-201227eu-energy-efficiency

49 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&rid=1

50 This target will be reviewed by 2020, having in mind a target of 30% instead.

51 The European Commission had initially proposed 30% in its Energy Efficiency Communication; available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2014:0520:FIN.

52 The four others are: energy security, solidarity and trust; a fully integrated European energy market; decarbonising the economy; research, innovation and competitiveness.

53 European Commission (2015), Energy Union Package [COM(2015) 80 final], available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2015%3A80%3AFIN

54 IEA (2013), Energy Efficiency Market Report 2013 – Market Trends and Medium-Term Prospects, page 3, available at: https://www.iea.org/publications/freepublications/publication/EEMR2013_free.pdf

55 Speech by Miguel Arias Cañete on EU's climate and energy policies after COP21 - http://europa.eu/rapid/press-release_SPEECH-16-264_en.htm

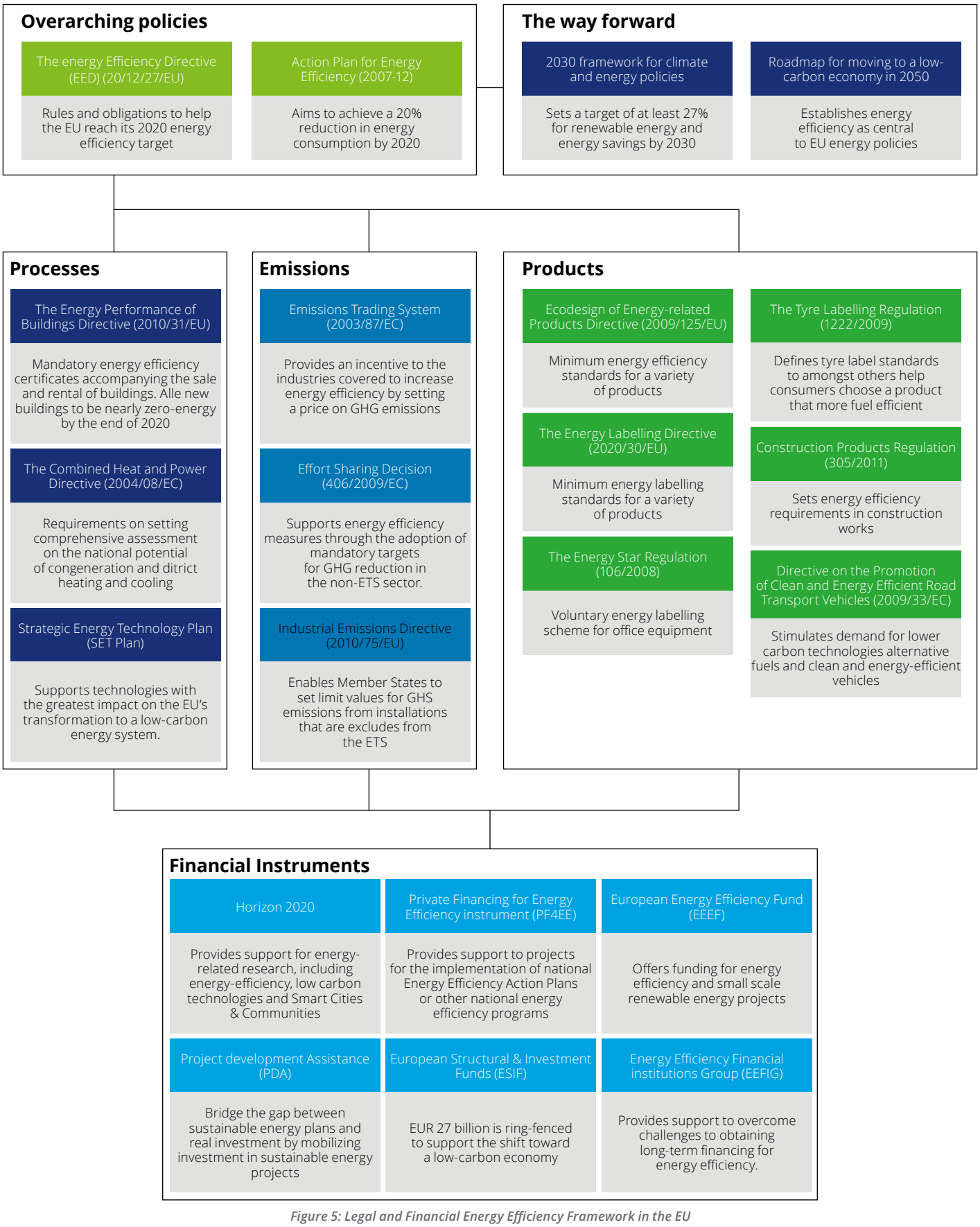


Figure 5: Legal and Financial Energy Efficiency Framework in the EU

2. Progress falls short of ambitions

2020 goals likely to be missed
In 2014, calculations published by the European Commission showed that, **based on the indicative energy efficiency targets fixed in Member States' National Energy Efficiency Action Plans (NEEAP)[56], the sum of those targets would lead to only 17.6% primary energy savings in 2020 when compared to projections[57], below the target of 20%**. So far, the EED has therefore not fully delivered what it was created for.

On 18 November 2015, the EC published the first State of the Energy Union[58], an assessment of the progress made since the inception of the Energy Union Framework Strategy in February 2015. A key conclusion was that "Member States should accelerate their efforts in order to achieve their national energy efficiency targets for 2020 or to go beyond them."[59] This assessment analysed the progress in the EU from several perspectives[60] and the diagnosis is particularly clear when it comes to energy efficiency:

- the 2020 target is likely to be missed if ambitions remain at the current level;
- Member States need to take additional measures and fully implement EU legislation;
- the greatest potential lies in the building sector;[61]
- financing energy efficiency measures remains an important barrier;
- information failures need to be overcome.

Transposition of EED behind schedule
EU Member States were required to transpose the EED's provisions into their national laws by 5 June 2014[62], but nearly all of them failed to do so on time. In the second half of 2014, the EC launched infringement procedures[63] against 27 EU Member States (all except Malta) for non-transposition of the Directive. Until 2015, the Commission had issued 22 reasoned opinions to Member States where transposition was still not completely achieved and had referred two Member States to Court (Hungary in March 2015[64] and Greece in June 2015). In October 2015, the EC requested eleven Member States (Belgium, Bulgaria, Cyprus, the Czech Republic, Spain, Finland,

56 Under the Energy Efficiency Directive (EED), each EU country must draw up a National Energy Efficiency Action Plan (NEEAP) every three years. This plan sets out estimated energy consumption, planned energy efficiency measures and the improvements each country expects to achieve. In addition, EU countries must report the progress achieved towards their national energy efficiency targets on an annual basis.

57 European Commission (2015), Report from the Commission to the European Parliament and the Council [COM(2015) 574 final], page 3, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0574&rid=1

58 European Commission (2015), State of Energy Union, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0572&from=EN

59 European Commission (2015), Report from the Commission to the European Parliament and the Council [COM(2015) 574 final], page 13, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0574&rid=1

60 Decarbonisation of the economy; energy efficiency; a fully-integrated internal energy market; energy security, solidarity and trust; research, innovation and competitiveness.

61 At that time, a dedicated EU-wide strategy for heating and cooling was missing; since then, in February 2016, the Commission proposed an EU heating and cooling strategy, available at: http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52016DC0051

62 European Commission (2012), EED (2012/27/EU), Article 28(1)

63 Infringement procedures take several steps to encourage countries to comply with a legislation before ultimately leading to the European Court of Justice and possible fines: a letter of formal notice, a reasoned opinion, and finally the referral to the European Court of Justice.

Hungary, Lithuania, Luxembourg, Poland and Portugal) to ensure full transposition of the EED.

Significant variations among Member States

Progress towards the EE targets varies strongly from one Member State to another. **A number of countries, including some of the largest economies in the EU, need to reduce their primary energy consumption at a higher rate in 2014-2020 than in the period 2005-2013 in order to reach their national indicative targets and to contribute to the achievement of the overall objective for 2020:** Belgium, Estonia, France, Germany, the Netherlands, Poland and Sweden.[65] The other Member States reduced their primary energy consumption between 2005 and 2013 at a higher rate than needed to meet their 2020 targets. But, as we have shown in a recent report[66], this achievement is partly due to the economic crisis. This has reduced the demand and consumption levels against which the targets are measured: it has made achievements look better than they otherwise would in countries such as Italy and Spain. Overall, the Commission estimated that **the economic crisis and its significant impact on growth have accounted for one third of the progress towards the 2020 target[67].**

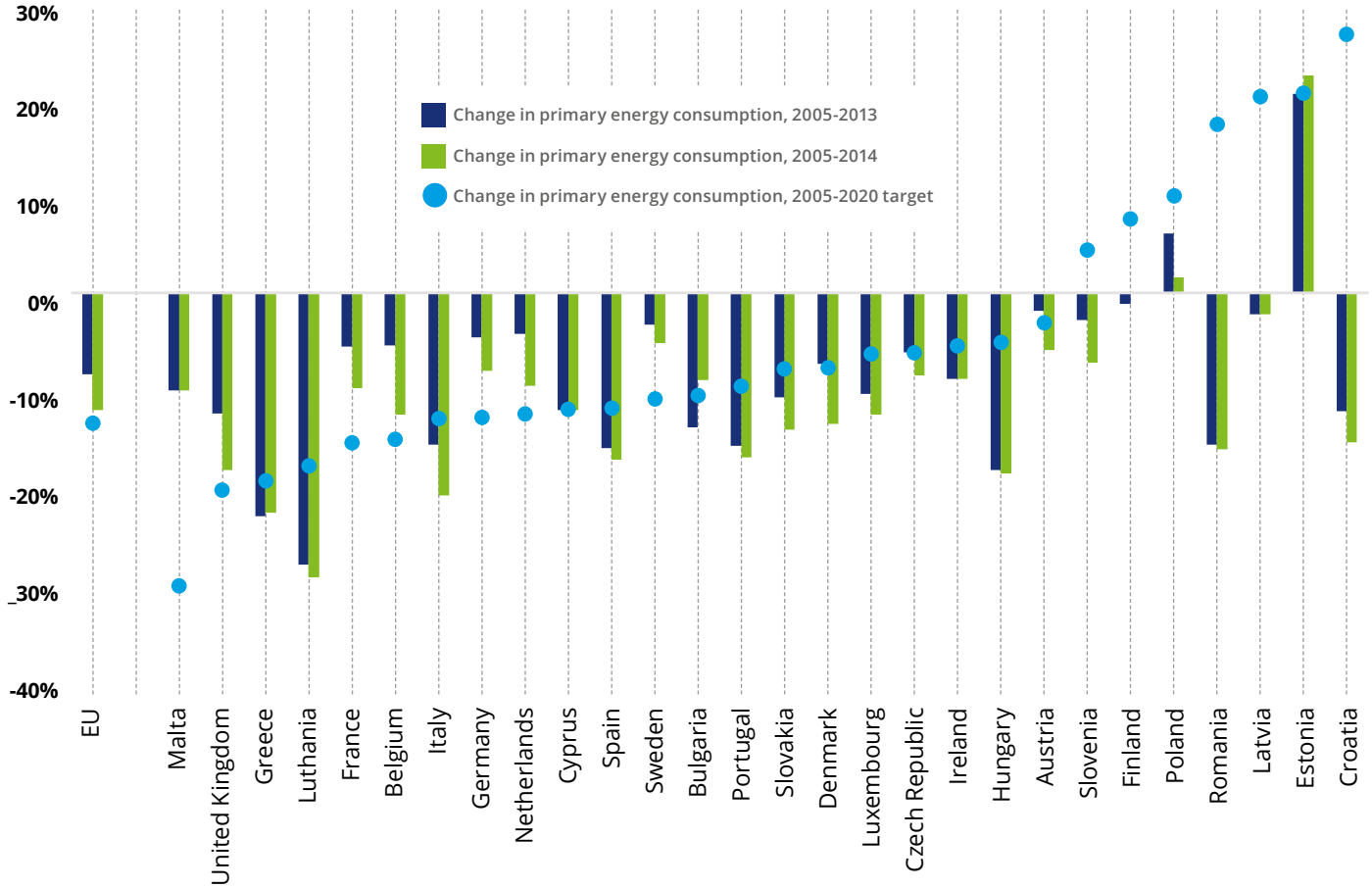


Figure 6: Primary energy consumption (2013-2014) and 2020 national targets, relative to 2005 levels (EEA)[68]

France, for instance, still needs to cut its primary energy consumption significantly to meet its 2020 target. The greatest potential lies in buildings, which represent more than 40% of final energy consumption and whose final energy consumption has been relatively stable since the mid-2000s, at a little less than 70 Mtoe. However, renovation of existing buildings, which is one of the main measures needed, has been much slower than expected. It is difficult to see how France can meet its commitment, other than by taking additional policy measures for buildings or driving new momentum in the CHP (combined heat and power) industry, which will still take time to reach its full potential[69].

The trend in Germany's primary energy consumption has been downwards over the last 20 years. To reach its 2020 (-20%) and 2050 (-50%) primary and final energy consumption targets[70], however, Germany must further improve its efficiency measures. The fourth energy transition monitoring report found that while reduction of electricity consumption and heating-related final energy consumption were on track, all other energy efficiency indicators (such as primary energy consumption, final energy productivity, final energy consumption in the transport sector) were deviating from the optimal path[71]. Future success will therefore strongly hinge on the effectiveness of its energy efficiency policies, especially in the buildings sector, which accounts for around 35% of final energy consumption.

More challenges ahead

Political targets regarding climate change mitigation are getting more ambitious in the years ahead: by 2050, the EU needs to cut GHG emissions by 80-95% below 1990 levels (and by 40% by 2030)[72]. In parallel, at global level, the Paris Agreement negotiated at the COP21 set a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels (with the aim of limiting the increase to 1.5°C).

Energy efficiency is considered to be one of the key means of reaching the GHG target along with renewable energies and the decarbonisation efforts of non-renewables. Therefore, the ambition behind the climate policies is likely to be translated into highly ambitious energy efficiency targets by 2050. This implies **that the pressure for further improvements for energy efficiency is likely to increase after 2020**. Currently, the 2030 target is set at 27%, but might be increased to 30% after a review in 2020[73].

One key challenge for the years to come will be to find a way to incentivise more energy efficiency investments at times of low energy prices and feeble economic growth without having a negative impact on households or on EU competitiveness on the global market.

64 In March 2015 the European Commission referred Hungary to the European Court of Justice. It wanted Budapest fined EUR 15,444 daily for not transposing the Directive by the June 2014 deadline. However, the reasoned opinion to Hungary, issued on 22/10/2015 replaced the Commission decision to refer Hungary to the Court of Justice, giving it two months to transpose the Directive into national law.

65 IEuropean Commission (2015), Assessment of the progress made by Member States towards the national energy efficiency targets for 2020 and towards the implementation of the Energy Efficiency Directive 2012/27/EU as required by Article 24 (3) of Energy Efficiency Directive 2012/27/EU, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0574

66 IDeloitte (2015), Energy Market Reform in Europe, available at: http://www2.deloitte.com/ru/en/pages/energy-and-resources/articles/energy-market-reform-europe.html

67 IEuropean Commission (2014), COM(2014) 520 final, page 4, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0574&rid=1

68 IEEA (2015), Trends and projections in Europe 2015 - Tracking progress towards Europe's climate and energy targets, EEA report, No 4/2015.

69 Deloitte (2015), Energy Market Reform in Europe, available at: http://www2.deloitte.com/ru/en/pages/energy-and-resources/articles/energy-market-reform-europe.html

70 As compared to 2008.

71 Ministry for Economic Affairs and Energy: Vierter Monitoring-Bericht zur Energiewende (2015), http://www.bmwi.de/BMWi/Redaktion/PDF/V/vierter-monitoring-bericht-energie-der-zukunft,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf

72 European Commission, 2030 Climate and energy framework, available at: http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm and Council of Ministers decision at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf

73 European Commission, 2030 Climate and energy framework, available at: http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm

3. Capturing more of energy efficiency's potential

A number of assessments highlight the disappointing progress towards Europe's energy efficiency goals, but **many studies and reports estimate at the same time that there is substantial potential for economically profitable investments in energy efficiency measures**. The International Energy Agency (IEA) estimated that two-thirds of the economically profitable investments to improve energy efficiency will remain untapped in the period to 2035[74].

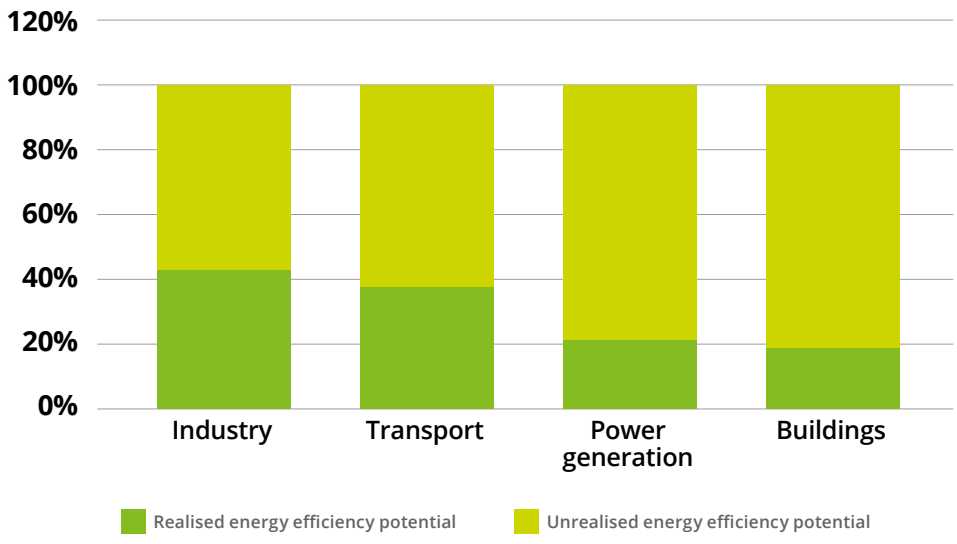


Figure 7: Long-term energy efficiency economic potential by sector[75]

74 IEA (2012), WEO 2012, available at: https://www.iea.org/publications/freepublications/publication/English.pdf. Note on the IEA methodology: This estimate is based on the IEA New Policies Scenario outlined in the World Energy Outlook 2012. Investments are classified as "economically viable" if the payback period for the up-front investment is equal to or less than the amount of time an investor might be reasonably willing to wait to recover the cost, using the value of undiscounted fuel savings as a metric. The payback periods used were in some cases longer than current averages, but they were always shorter than the technical lifetime of individual assets.

75 IEA (2012), World Energy Outlook 2012, https://www.iea.org/publications/freepublications/publication/English.pdf

The potential for energy savings is significant in all sectors, but **it has been widely acknowledged that the lion's share of the untapped economic potential is embedded in buildings. According to a recent study[76], 48% of the energy savings targeted under Article 7 of the EED[77] will be achieved in the building sector**.

Numerous recent studies have demonstrated that energy efficiency measures can be very profitable at different project and implementation levels and lead to high benefit/cost ratios[78]:

- As an example, it has been shown that investments in building automation systems (BAS), i.e. controlling a building's heating, ventilation, air conditioning, lighting, etc., can produce nine times the value in savings relative to the investment required[79]. When used properly, BAS optimise the functioning of buildings through effective control and lead to significant reductions in energy waste.

- Another recent study found that a programme to make British buildings more energy efficient would generate £8.7 billion of net benefits.[80]

The EU is unlikely to attain the 2020 energy efficiency targets, even though the economic crisis helped lower energy consumption in Europe. The current low price of raw materials, including energy sources, is reducing the pressure to save energy. Thus, if the EU wants to meet its 2030-2050 targets, it needs to take structural and long-term action. Conceptual theoretical frameworks describing barriers that lock in the economic potential behind energy efficiency have been developed throughout numerous studies[81 82 83 84]. However, it becomes more challenging to evaluate their relative importance from the point of view of the different sectors and market actors. **The main barriers that need to be overcome to unleash the potential for energy efficiency are:**

- **Financing:** Even if many energy efficiency measures are economically viable over the long term, they often come with long payback periods and high uncertainty rates (because of energy price instability, in particular). This issue is linked to different types of barriers, such as:
  - **Price signals that are not adequate** for promoting energy efficiency;
  - **Difficulties in getting access to available capital**;

- **Imperfect information** on energy efficiency, inter alia to help potential investors or end-users to invest in the most relevant energy efficiency measures;

- Specific incentive problems in the building sector, where the largest untapped potential lies, such as the **"landlord-tenant" problem** (while tenants want to minimise their energy bill, their landlords' interest lies in minimising the upfront investment costs);

- Suboptimal end-user behaviour, partly due to a **lack of awareness and knowledge** on the impacts of their energy consumption and on ways in which they could reduce it;

- **Inappropriate indicators and targets at European and national level** that hinder efforts to select the most cost-effective measures.

It is not the purpose of this study to provide an in-depth analysis of all the potential barriers for the different market participants and sectors, but to highlight six main lines of actions which can impact consumers' behaviours and capture the potential behind energy efficiency. These are summarised below and will be developed in more detail in the subsequent sections.

76 Ricardo-AEA (2015), Study evaluating the national policy measures and methodologies to implement Article 7 of the Energy Efficiency Directive, available at: http://rekk.hu/downloads/projects/Final%20Report%20on%20Article%207%20EED.pdf, page vi

77 Article 7 refers to 'Energy efficiency obligation schemes' and requires, inter alia, that each MS shall set up an energy efficiency obligation scheme that shall ensure that distributors and/or retail energy sales companies should achieve a cumulative end-use energy savings target by 31 December 2020, at least equivalent to achieving new savings each year of 1.5% of the annual energy sales to final customers.

78 Obviously enough, these examples provide only trends; the energy efficiency potential of any measure differs significantly by sector and application, and requires individual analysis.

79 Weide (2013), Building Automation: the scope for energy and CO_2 savings in the EU, available at: http://www.leonardo-energy.org/sites/leonardo-energy/files/documents-and-links/scope_for_energy_and_co2_savings_in_eu_through_ba_2nd_ed_2014-06-13.pdf

80 Frontier Economics (2015) Energy efficiency – An infrastructure priority, available at http://www.frontier-economics.com/documents/2015/09/energy-efficiency-infrastructure-priority.pdf

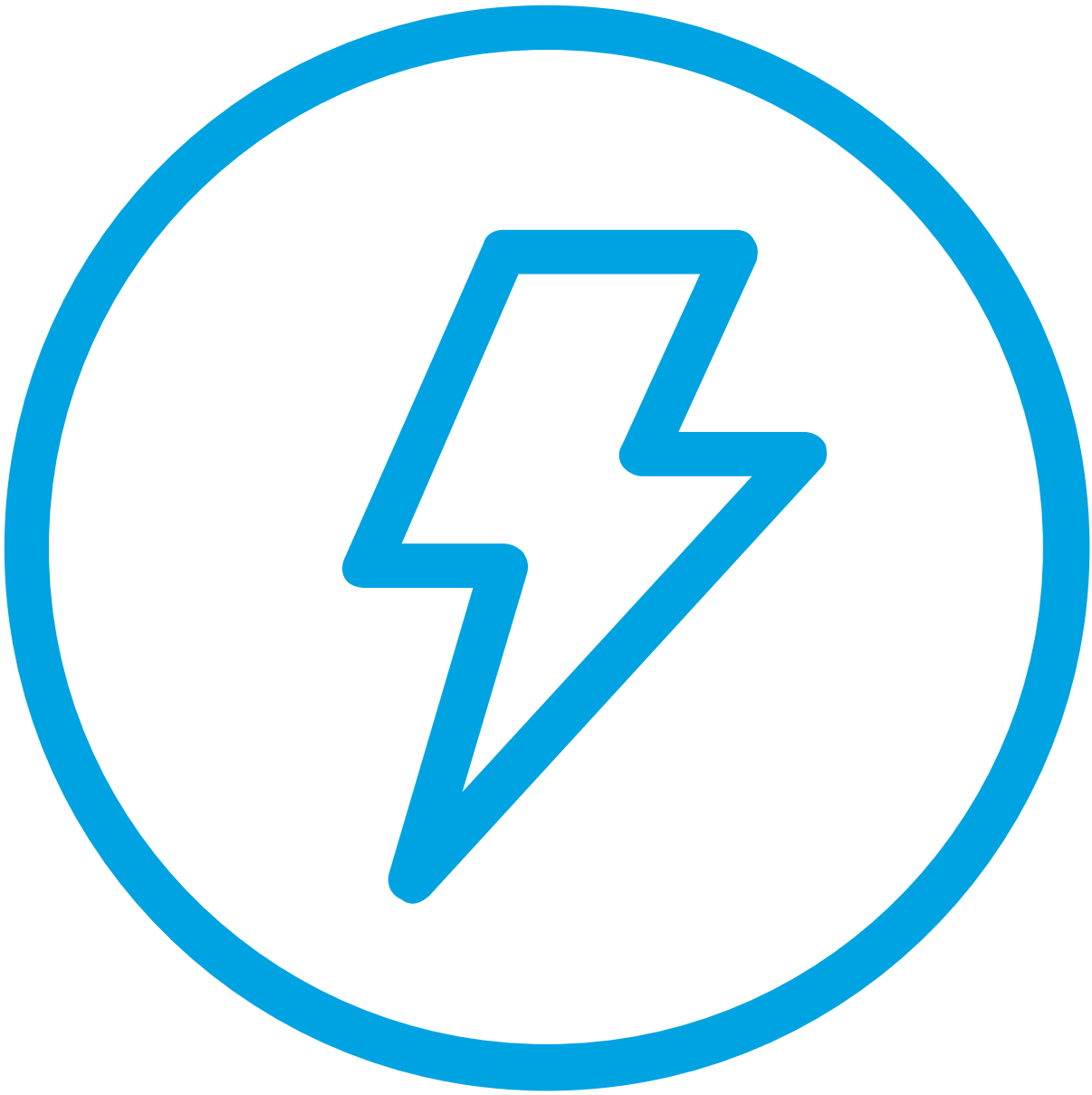
81 See e.g. Sorrell et al (2011), Cagno et al (2012), ACEEE (2013), etc.

82 United Nations Industrial Development Organization, "Barriers to industrial energy efficiency: A literature review" 2011

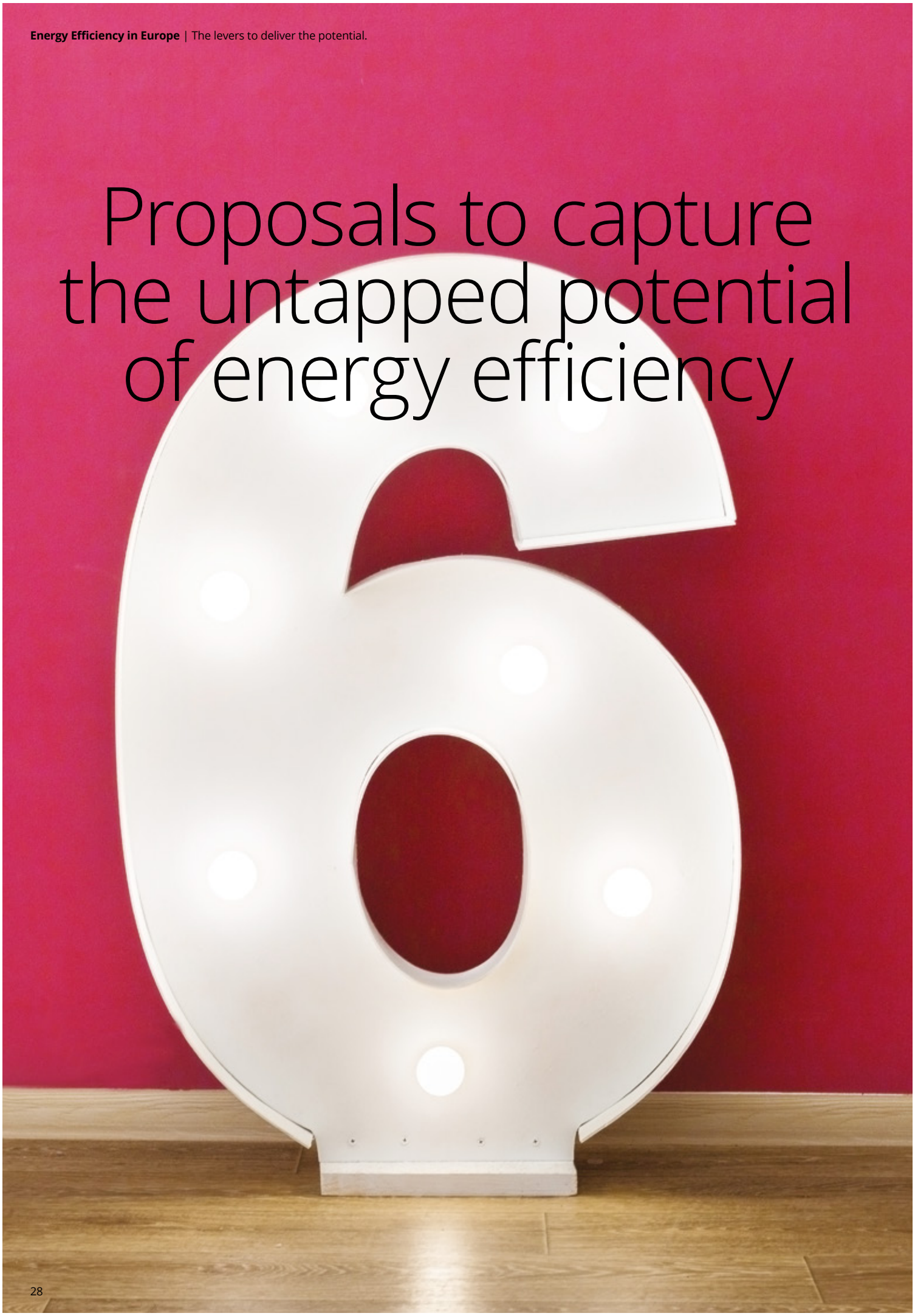
83 Firm-level Perspective of Energy Efficiency Barriers and Drivers in UK Industry – Indications from an Online Survey 2014 by Pranab Baruah, Nicholas Eyre, Jonathan Norman, Paul Griffin, Geoffrey Hammond

84 Barriers to energy efficiency: A comparison across the German commercial and services sector, Joachim Schleich 2009

Barriers	Lines of action
Inappropriate indicators and targets	***1. Set appropriate indicators and targets*** - Use simple targets to assess and communicate progress - Monitor progress with selected indicators and prioritise energy efficiency measures
Imperfect information on energy efficiency	***2. Promote product standards and labels*** - Overcome barriers to wider use of energy labels
Largest untapped potential in the building sector	***3. Unleash the energy efficiency potential of buildings*** - Energy standards for buildings: Energy Performance Certificates - Obtain the right assessment of potential energy efficiency project savings - New approaches to financing energy efficiency
End-users still having low energy efficiency behaviours	***4. Mobilise retail consumers*** - Measure consumption and quantify realistic savings - Inform consumers through direct and indirect feedback - Convince end-users to become pro-active
Price signals not adequate to promote energy efficiency	***5. Send the right price signals*** - Go beyond the Emission Trading Scheme's current reform plans - Introduce a carbon tax - White certificates as a specific market instrument for energy efficiency
Difficulties in financing the required energy efficiency investments	***6. Facilitate financing of energy efficiency measures*** - Ramp up public funding - Promote innovative financing mechanisms - Ease access to energy efficiency funding for small and medium enterprises



Proposals to capture the untapped potential of energy efficiency



1. Set appropriate indicators and targets

1.1. Use simple targets to assess and communicate progress

Set national targets in PEC (Primary Energy Consumption) at EU level

Various indicators can be used to analyse energy consumption and savings, but setting targets and quantifying Member States' progress should be based on a minimum set of relevant indicators. This will ensure comparability and proper monitoring at EU level and make it easy to communicate on progress in a clear, transparent and homogenous way. As of today, **Member States can set an indicative national energy efficiency target based on either primary energy consumption (PEC)[85], or final energy consumption (FEC)[86], primary or final energy savings, or energy intensity[87]**. Some countries concentrate on the decrease in their PEC (e.g. by increasing the efficiency of their generation sector or decreasing network losses) while other Member States focus on reductions in the final energy sector. France, for instance, focuses on final energy consumption, with a bottom-up approach per sector. Poland focuses on energy intensity, together with primary and final energy consumption.

Final energy consumption covers only 66% of the EU-28's gross inland consumption[88], as it does not take into account energy losses from energy production, transport and distribution. Therefore setting the main targets in terms of FEC overlooks potential energy efficiency gains in the energy sector. Proponents of FEC targets argue that this indicator acts on the demand side and that it is more closely related to action. However, as long as binding FEC targets are not defined on a sector level, there is no real momentum for specific demand side energy efficiency actions.

A country's energy intensity (i.e. the ratio of its gross inland energy consumption to its gross domestic product (GDP)) is often used to approximate its energy efficiency. Yet, this shortcut is problematic, since it can be driven by variations in different non-energy-related factors and thus lead to incorrect results. Such factors include exchange rates, the size of the country and the structure of the economy. For instance, a country with a high degree of industrial activity, such as Germany, may have a higher energy intensity than a country more dependent on services, such as the UK, without the latter automatically being more energy-efficient.

For these reasons, at a national level, the focus should be on binding targets expressed in Primary Energy Consumption (PEC), rather than in Final Energy Consumption (FEC) or energy intensity, since a target expressed in PEC covers both the reduction of energy consumption and the move to a more efficient and less carbon-emitting energy mix. Targets in PEC should be defined Member State by Member State, taking into account their economic growth, their specific energy mix and the structure of their economy.
Each Member State can use additional indicators, such as FEC or energy intensity, depending on its specific national situation, to monitor its progress and analyse the success of policy measures related to energy efficiency. Inter alia, monitoring and analysing the FEC provide important insights into individual developments at national level, allow a better understanding of the sectorial origins behind energy savings and can help create a momentum for specific demand-side energy efficiency actions.
At the same time, it is important to ensure that these targets are consistent with other objectives related to energy and climate policies, such as those related to renewable energy and greenhouse gas emissions.

Use decomposition analysis to assess real energy savings

Energy efficiency measures are far from being the only factors explaining trends in Member States' energy consumption: economic activity (e.g. the impacts of the economic crisis), demography and lifestyles, climate and other factors play significant roles as well. It is important to separate pure energy efficiency impacts from these other factors.

85 According to Eurostat, "Primary Energy Consumption" is "Gross Inland Consumption excluding all non-energy use of energy carriers (e.g. natural gas used not for combustion but for producing chemicals). This quantity is relevant for measuring the true energy consumption and for comparing it to the Europe 2020 targets."

86 According to Eurostat, "Final energy consumption is the total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself."

87 European Commission (2012), EED (2012/27/EU), Article 3.1, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&rid=1

88 Eurostat © European Union, 1995-2004, http://ec.europa.eu/eurostat/web/products-datasets/-/nrg_100a

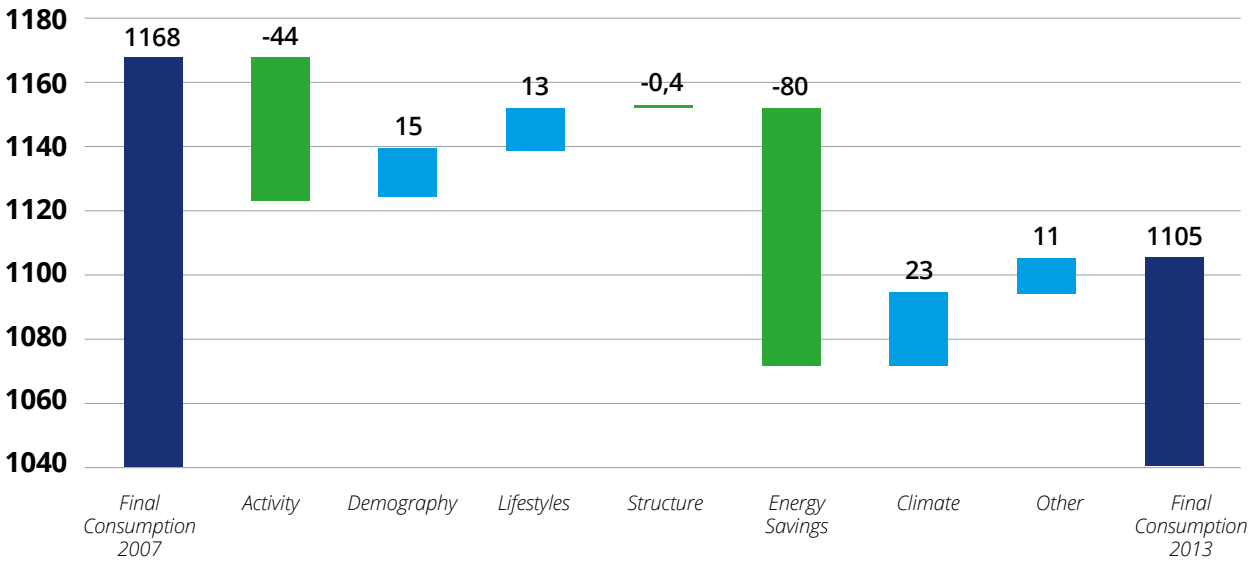


Figure 8: Variation of final energy consumption in the EU, between 2007 and 2013, in Mtoe[91]

A decomposition analysis method should be defined at EU level and used in all the Member States to make it possible to track the actual progress of energy efficiency, independently of economic activity and structural changes (e.g. a shift from industry to services).

Different methodologies exist to decompose energy consumption into its factors and could be used for this purpose[89]. The graph below shows an example of such a decomposition analysis into the main drivers of final energy consumption in the EU between 2007 and 2013. It was carried out by the ODYSSEE project[90]. This graph provides information on FEC rather than on PEC, since it is not straightforward to establish a clear relationship between PEC and the analysed parameters (economic activity, demography, lifestyles, energy savings, climate, etc.)

1.2. Monitor progress with key indicators and prioritise energy efficiency measures

Impacts vary widely depending on the type of energy efficiency measures

Energy efficiency measures do not necessarily have the same impacts on the different pillars of EU energy policy.

Reducing energy demand has very different impacts depending on the primary source of energy: For instance, reducing the consumption of energy from hydropower does not reduce GHG emissions, does not improve energy security and does not necessarily increase competitiveness. Similarly, the impact on energy efficiency from the consumption reduction of power from coal or gas is not the same. Coal-fired power plants use energy less efficiently than most gas-fired plants (the efficiency of up-to-date coal-fired power plants can be as high as 46%, but is as high as 60% for gas-fired plants). Coal-fired plants also emit around twice as much CO_2 for the same production of electricity.

With major budget constraints in most European Member States, it is therefore important to prioritise those energy efficiency measures that have the most significant impacts on all aspects of the European energy strategy: reducing GHG emissions, increasing security of supply and maintaining competitiveness.

Examples of interlinkages at the microeconomic level between energy efficiency, GHG emissions and renewables are presented below in two examples in Box 1 (for private transport) and Box 2 (for heating).

89 E.g. ODYSSEE decomposition analysis, Paasche, Laspeyres, LMDI, LMDII, etc.

90 The objective of the ODYSSEE-MURE project is to monitor energy consumption and efficiency trends, and to evaluate energy efficiency policy measures by sector for the EU countries and Norway. The detailed methodology behind this analysis can be found on the project website: http://www.indicators.odyssee-mure.eu/php/odyssee-decomposition/documents/interpretation-of-the-energy-consumption-variation-glossary.pdf

91 Calculation based on ODYSSEE-MURE data, http://www.indicators.odyssee-mure.eu/decomposition.html

Box 1: Energy and climate impacts of private transport

This box presents a comparison of different technology options, i.e. a combination of powertrains and energy carriers (liquid fossil fuels, biofuels or electricity – the latter being based on the average European electricity mix)[92]. The different impacts are quantified over the whole life cycle of the energy carrier (e.g. for fossil fuels: from the wellhead to combustion in the car).

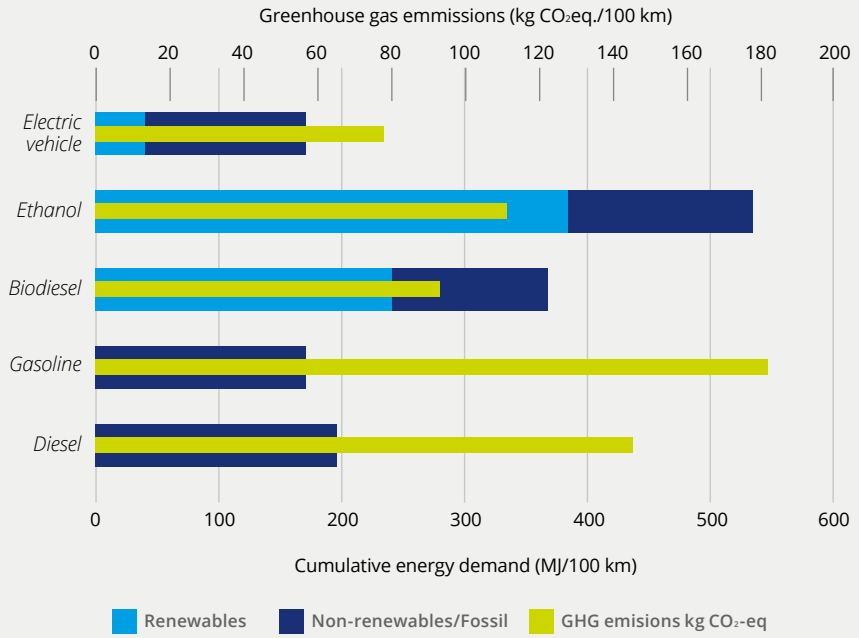


Figure 9: Cumulative energy demand and global warming potential for selected private vehicle technologies[93]

A vehicle with a diesel powertrain shows a relatively good energy performance – only 15% more life cycle energy consumption as compared to an electric vehicle – but a relatively poor performance with regards to GHG emissions compared to electric or biofuel-powered vehicles. The best GHG emissions performance is achieved for electric vehicles – even if they are charged with the average European electricity mix, more than 75% of which consists of fossil fuels. Biofuels offer an intermediary performance for GHG emissions, but have the highest cumulative energy demand.

The same reasoning is valid for other sectors. In the following box we present the same type of calculation for heating systems.

92 This analysis is mostly based on the JRC-EUCAR-CONCAWE Well-to-Wheels (WTW) database (available here: http://iet.jrc.ec.europa.eu/about-jec/downloads) that provides information on cumulative energy demand and GHG emissions for different transportation technologies

93 Calculations based on JRC-EUCAR-CONCAWE Well to wheel analysis (version 4a). The following pathways were chosen: Diesel - Conventional diesel DICI; Gasoline – average between Conventional gasoline PISI and Conventional gasoline DISI; Ethanol – average among 9 different ethanol from wheat production pathways; Biodiesel – Rape (REE), meal to animal nutrition, glycerine to fuel 2010; Electric car - EU mix light vehicle. (http://iet.jrc.ec.europa.eu/about-jec/downloads)

Box 2: Energy and climate impacts of heating

The impacts of electric heating depend very much on the electricity mix from which electricity is produced. In France, with a high proportion of nuclear and hydropower in the electricity mix, electric heating emits very few GHG, less than half those of gas; in Poland, with an electricity mix dominated by coal-powered thermal plants, electric heating emits a considerable amount of GHG per unit of heat produced (expressed in MJ), ten times more than in France and 4.7 times more than natural gas-powered heating.

But in both cases, the energy efficiency of electric heating is very low compared to decentralised fossil fuel-powered heating. To provide the same quantity of heat to the end-user requires twice as much primary energy with electric heating than with decentralised fossil fuel-powered heating (i.e. burning natural gas, coal or fuel oil).

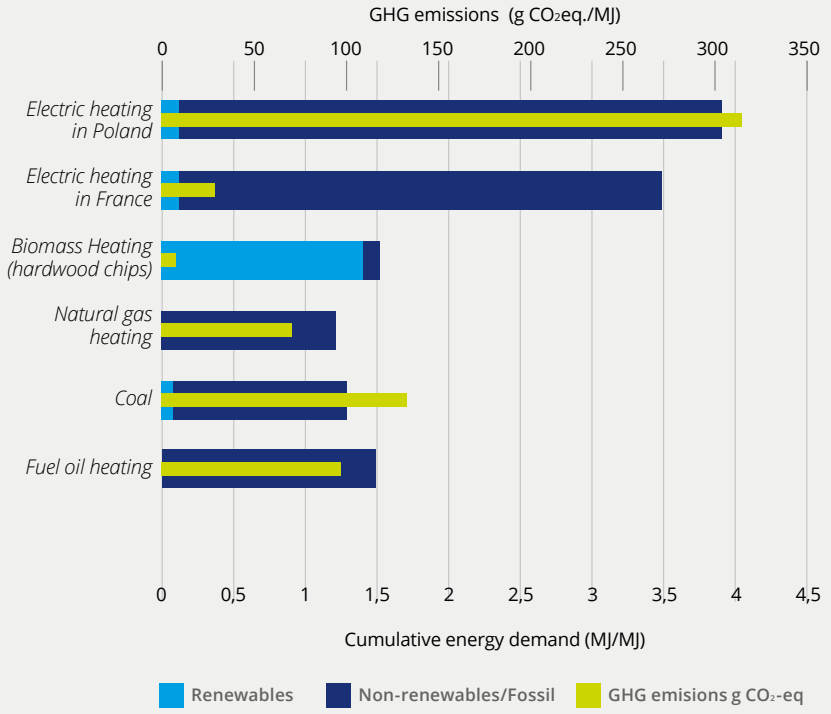


Figure 10: Cumulative energy demand and global warming potential for selected heating systems [94]

94 *Calculations based on ecoinvent v3.2 database. The following pathways were chosen: Hardwood chips - Heat production, hardwood chips from forest, at furnace 1000kW; Natural gas - heat production, natural gas, at boiler condensing modulating >100kW; Coal - heat production, at hard coal industrial furnace 1- 10MW; Heavy fuel oil - heat production, heavy fuel oil, at industrial furnace 1MW. Note that electric heating is not included since the conversion of heat into electricity has a 100% yield and the only energy losses occur upstream (electricity production and distribution). (http://www.ecoinvent.org/)*

Prioritise energy efficiency measures by piloting towards an overarching target: avoided CO_2 emissions

Energy efficiency is not an end in itself. The three pillars of the EU energy policy (energy security, sustainability and competitiveness) should remain the ultimate objectives. Energy efficiency policies should therefore be seen as contributors to these overarching targets.

In a post-COP21 context, it is important to focus on the energy efficiency policies that will contribute most to climate policy, in line with the long-term goal of keeping the increase in the global average temperature to well below 2°C above pre-industrial levels. In this respect, **avoided GHG emissions are the most appropriate indicator to play this global role**, since:

- they encompass the broader picture: they are an indication of energy efficiency, renewables (since properly managed renewable energies emit few GHG[95]) and climate change mitigation;
- they can be related to long-term global targets (e.g. the COP21 target);
- they are already widely used (GWP100[96]), well known and commonly used by decision-makers and stakeholders.

Avoided GHG emissions can therefore be considered as the simplest proxy to take into account several aspects of energy efficiency measures and to be able to prioritise them when needed. At this stage, this indicator is not mature enough (missing standards) to act as a binding target in the very near future. Therefore, efforts should be done to further develop the methodology and to agree on a standardised approach, paving the way for the indicator to become reliable enough.

Setting the right indicators and targets is vital in monitoring progress and communicating on achievements. At present, under the Energy Efficiency Directive, Member States can choose whether to set their national energy efficiency target based on either primary energy consumption (PEC), final energy consumption (FEC), primary or final energy savings, or energy intensity.

- **At EU and national level, the main target for energy efficiency policies should be expressed as Primary Energy Consumption (PEC).**

Further indicators should be used not to set targets, but to analyse and monitor progress:

- With major budget constraints, it is important to prioritise the energy efficiency measures that have the most significant impacts on all aspects of the European energy strategy: reducing GHG emissions, increasing security of supply and maintaining competitiveness.
- **Avoided GHG emissions should be promoted as an indicator**, in order to assess the wider impacts of energy efficiency policies on the overall energy and climate strategy and **to prioritise energy efficiency measures according to their overall impacts**.

95 With a few exceptions, especially certain categories of biofuels, when you consider their life cycle emissions and take into account emissions from indirect land use change (iLUC).

96 GWP100 (Global Warming Potential over 100 years) is currently the most used metric to calculate greenhouse gas emissions. Global warming potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. GWP100 is calculated over a specific time interval: 100 years. GWP is expressed as a factor of CO_2 (carbon dioxide) (whose GWP is standardized to 1), in tons of equivalent CO_2 (tCO_2eq).

2. Promote product standards and labels

2.1. High potential of eco-design and energy labelling

The EU Ecodesign and Energy Labelling Directives

Energy standards and labels, when carefully designed and widely recognised, can help actors and end-users, including non-experts, select the technically most efficient energy efficiency equipment. Financing entities, for instance, often do not have the necessary information or adequate expertise to streamline the evaluation and financing process. Standards and labels provide them with a clear indication of which projects are worth financing. Standards and labels also represent essential guidelines for the industry sector, driving innovation and growth, spreading new technologies and best practices. They help develop and foster global markets and harmonise international policies, enabling better transparency for customers and enhancing competition.

In the EU, energy standards and energy labels for energy-related products are promoted by the Ecodesign Directive (EDD)[97] and by the Energy Labelling Directive (ELD)[98] respectively:

- **The EDD provides EU-wide rules for improving the environmental performance of energy-related products, setting out mandatory minimum energy performance standards (MEPS), which remove the worst performing products from the market (supply side).** This is a product-oriented policy tool seeking to integrate environmental aspects in the design phase of products with the aim of improving their environmental performance throughout the product's entire life cycle (ecodesign). It is generally accepted that the majority of environmental and cost impacts of a product are determined during the design phase, often long before these impacts actually manifest themselves. For example, the choice of carbon fibre over steel for a component in the design phase results in a lighter product (less energy needed to transport it), but makes it less suitable for recycling (greater impact on end-of-life). The figure below illustrates the ecodesign principle.

- **The Energy Labelling Directive (ELD) complements these requirements with mandatory energy labelling for selected energy-related products** (e.g. for air conditioners, televisions, etc.[99]), driving demand towards more efficient products (demand side).

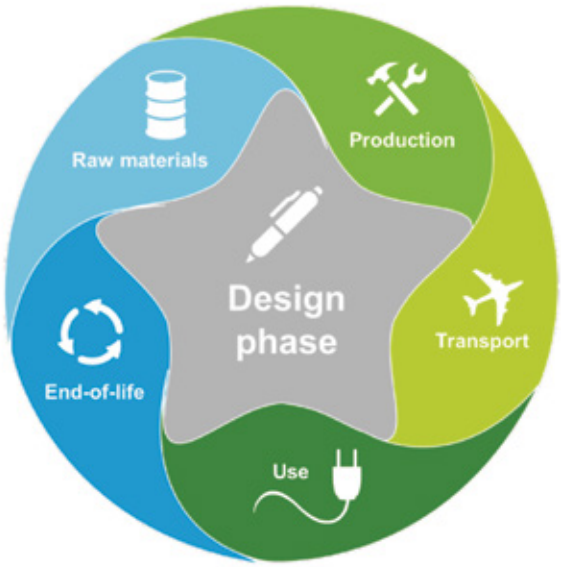


Figure 11: Ecodesign principle

97 European Commission (2009), Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&rid=1

98 European Commission (2010), Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0030&rid=1

99 For a complete list please refer to the Energy Labelling Framework Directive and the delegated regulations: https://ec.europa.eu/energy/sites/ener/files/documents/list_of_enegy_labelling_measures.pdf

These two Directives are estimated to already have an overall positive impact on driving energy savings (175 Mtoe per year by 2020[100], or 11.6% of EU28's PEC in 2014). This is equivalent to 19% savings compared to business-as-usual energy use for those products. By setting increasingly stringent standards and thus reducing the energy consumption of the main appliances, these policy measures will deliver almost half of the 20% energy efficiency target by 2020.

However, there are still some significant opportunities for additional energy savings: the Commission regularly calls for the establishment of a Working Plan to include additional products in the list of product groups which are considered as priorities for the adoption of implementing measures[101] under these two Directives. In 2015, Deloitte[102] carried out the preparatory study to establish the third Ecodesign Working Plan (2015-2017)[103]. This study proposed to include a selection of new priority product groups in the list. Our analysis showed that there is **still approximately more than 6.2 Mtoe (264 PJ) that can be saved through ecodesign measures by 2020 (and 8.9 Mtoe by 2030) for a selection of product groups**.

Possible ways forward for the Ecodesign and Energy labelling directives

Despite their positive impacts, these two Directives still have a variety of challenges to resolve as has been shown in a recent impact assessment[104]. These include:

- The trend for appliances to get larger: it has been shown, for example, that the average viewable surface area of a television went from a 19" diagonal in 1990 to 32" in 2010; it is projected to rise to an average 51" in 2030[105].

- Long rulemaking processes, leading to outdated technical and preparatory work. The legal process from the preparatory study to the publication of the product regulation takes on average more than four years; this corresponds to or exceeds the life-cycle of several product groups (especially in ICT). Among other factors, it can lead to a too low level of ambition for a number of product regulations, as compared to what is technically and economically feasible[106].

- Non-compliance due to 'weak enforcement': a recent study estimated that around 10% of potential energy savings from Ecodesign and Energy Labelling are lost as a consequence of poor enforcement.[107]

Policy makers should regularly update ecodesign requirements, taking into account the technological process and ensuring that the level of ambition is adequate. The legislative process should be optimised and shortened, in particular when it comes to review studies, needed to update requirements in line with technological development. Furthermore, stronger market surveillance is needed to enforce ecodesign and labelling regulation.

2.2. Overcoming the barriers to wider use of energy labels

Simpler and more intuitive labels

There is a need to ensure that consumers are informed about both the absolute and relative performance of their product and that they understand the meaning of the labels. Currently, a huge variety of different energy label scales exist (from A to G, A+++ to D, etc.), making it almost impossible for customers to find their way. Furthermore, energy labels have lost their informative value, as energy efficiency has significantly improved since labels were introduced in 1995. Most of the products on the market today are to be found in the top energy efficiency classes, making the label less informative. For this reason, on 15 July 2015, the Commission proposed a return to a single A to G label scale[108].

100 European Commission, Energy efficient products, http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products; http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2015%3A345%3AFIN, page 2

101 European Commission (2009), Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, Article 16(1), available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&rid=1

102 Together with the Oeko-Institut and ERA Technology.

103 The final reports of the Ecodesign Working Plan study are currently in the process of being approved for publication and final draft documents are available on the project website: http://www.ecodesign-wp3.eu/

104 European Commission (2015), Impact assessment [SWD(2015) 139 final], available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015SC0139&rid=1

105 VHK (2014), EcoDesign Impact Accounting, Part 1, https://ec.europa.eu/energy/sites/ener/files/documents/2014_06_ecodesign_impact_accounting_part1.pdf

106 European Commission (2015), Impact assessment [SWD(2015) 139 final], Annex 10, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015SC0139&rid=1

107 Ecofys (2013), Evaluation of the Energy Labelling Directive and specific aspects of the Ecodesign Directive: Background report I: Literature review, http://www.energylabelevaluation.eu/tmce/Final_technical_report-Evaluation_ELD_ED_June_2014.pdf

108 European Commission, Energy efficient products, http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

While returning to a single scale can be seen as a first step in the right direction, continuous efforts still need to be made to develop relevant, up-to date and easy-to understand energy labels.

The YAECI[109] project is a good example of how consumers can be helped to better understand energy labelling, by integrating data on overall costs, in addition to energy alone. **With the participation of Deloitte[110], this project provides customers with information on the yearly energy cost of energy-labelled products at the time of their purchase.** The following figure shows an example of such a label for a washing machine, indicating annual operational energy and water consumption and expenses.

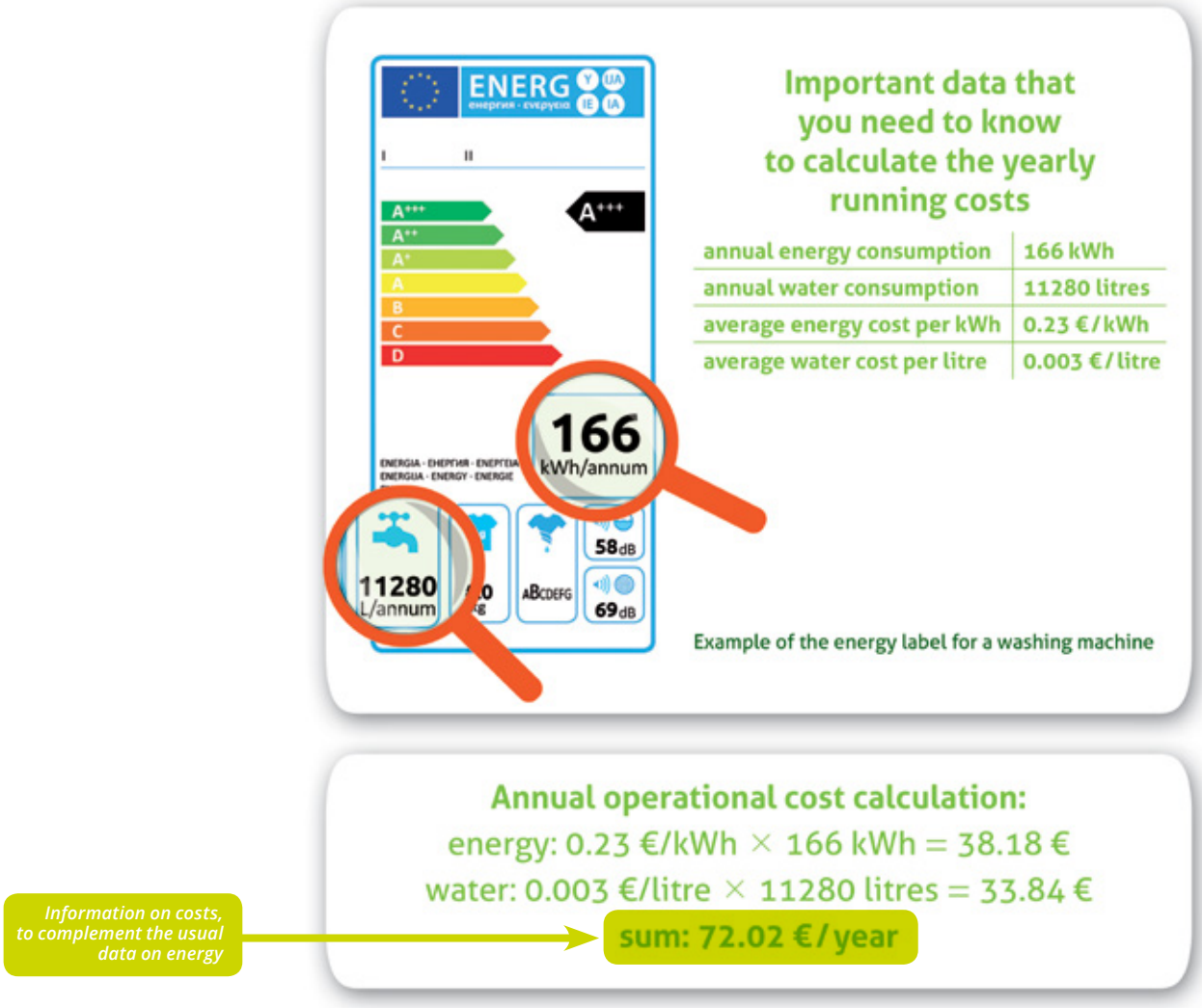


Figure 12: Appliance energy cost indication for washing machines from the YAECI project[111]

109 Yearly Appliance Energy Costs Indication. Information on the project is available here: https://ec.europa.eu/energy/intelligent/projects/en/projects/yaeci

110 Under the name BIO Intelligence Service.

111 SEVEn7, Appliance Energy Cost Indication http://www.appliance-energy-costs.eu/download-library/appliance-energy-cost-indication

Additional regulatory steps

Measures should be taken to make public procurement of energy efficient products, services and buildings mandatory for public bodies at regional and local levels. Energy labels can be useful in implementing public procurement programmes, rebates or tax incentives, since category labels make it relatively easy for inspectors to verify compliance.

Energy performance standards and labels enable better communication and transparency for customers and investors, provide guidance for green public procurement, and enhance competition and drive innovation for companies.

The Ecodesign and Energy Labelling Directives implemented key measures to promote energy standards and labels for energy-related products in Europe, with much success (175 Mtoe per year by 2020). Further progress is still possible by:

- **Extending further the list of product categories targeted by these directives** (estimated potential additional savings of 6.2 Mtoe by 2020 (and 8.9 Mtoe by 2030) for a selection of product groups);
- **Regularly updating labels and ecodesign requirements, taking technological progress into account and ensuring that the level of ambition is adequate;**
- **Optimising and shortening the legislative process, in particular in relation to review studies designed to update requirements in line with technological developments;**
- **Last but not least, strengthening market surveillance to enforce ecodesign and labelling regulation.**

Additionally, there is a need to ensure that consumers are informed about both the absolute and relative performance of their products and that the meaning of labels is fully understood.

- **Hence, continuous efforts are needed to develop relevant, up-to-date and easily understandable energy labels**, possibly **integrating the full life cycle cost of energy-related products**.

3. Unleash the energy efficiency potential of buildings

3.1. Buildings are Europe's worst energy-guzzlers

Buildings accounted for 39% of the EU's total final energy consumption in 2014, of which two thirds in the residential sector. Buildings generated around one quarter of GHG emissions not covered by the EU Emission Trading Scheme (ETS) [112]. Space heating makes up 67% of total household consumption, way ahead of water heating, appliances, lighting, and cooking and cooling. High energy consumption for space heating is partly due to the fact that **75% of the EU's building stock is still energy inefficient** (compared to current regulations on energy performance of buildings) and the rate of building renovation remains very low at around 0.4% to 1.2% per year[113].

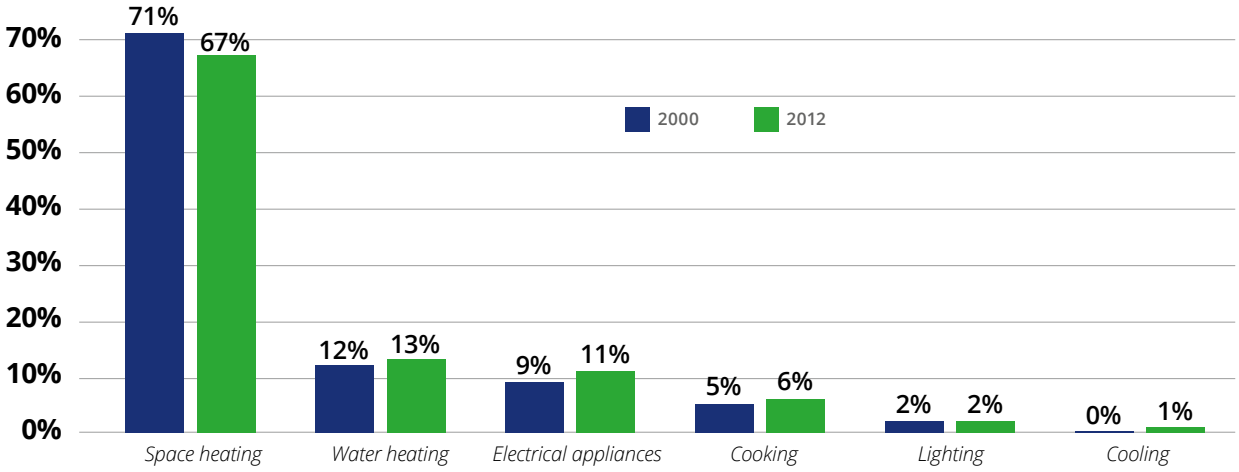


Figure 13: Household energy consumption in the EU [114]

Measures have been introduced in recent years – on building renovation, thermal insulation, thermal regulations for new buildings, more energy-efficient appliances, etc. – but the energy savings generated as a result have done only little more than compensate for an overall increase in demand due to changes in lifestyle. Final energy consumption in households fell by 3% between 2005 and 2013 (whereas the EU's total primary energy consumption decreased by 8% over the same period), but would have been 14% higher without any measures. Energy savings were only able to compensate for the increase in the number of dwellings (demographic effect) and the fact that households are tending to use more appliances in the home and live in larger homes.

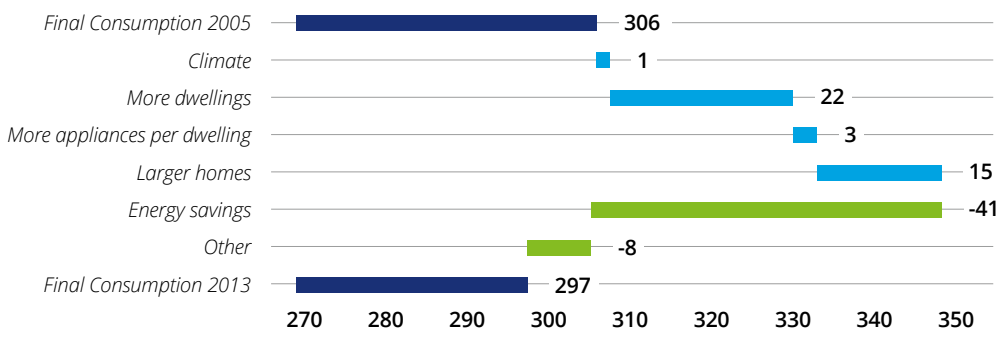


Figure 14: Variation of households' consumption in the EU between 2005 and 2013 (in Mtoe) [115]

112 The EU Emissions Trading System (EU ETS) is a pan-European greenhouse gas emission allowances trading scheme. It covers GHG emissions in 31 countries (28 EU countries and the three EEA-EFTA states (Iceland, Liechtenstein and Norway), from large emitters: more than 11,000 power stations and industrial plants, as well as airlines.

113 European Commission (2016), An EU Strategy for Heating and Cooling [SWD (2016) 24], available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM%3A2016%3A51%3AFIN

114 Data provided by Enerdata/ODYSSEE MURE project, http://www.odyssee-mure.eu/publications/efficiency-by-sector/household/household-eu.pdf

115 Calculation based on ODYSSEE MURE data, Energy Performance Certificates, http://www.odyssee-mure.eu/news/workshops/london/19-Energy-Performance-Certificates.pdf

3.2. Mixed success from regulatory action to date

The ambitions

European legislation covering the energy efficiency of the building sector is embedded primarily in two different Directives, the Energy Efficiency Directive (EED)[116] and the Energy Performance of Buildings Directive (EPBD)[117].

The EED set a 3% annual renovation target for central government buildings, but did not provide renovation targets for the rest of the building stock. It required Member States to establish long-term strategies for mobilising investment in the renovation of national buildings stocks in 2014. These building renovation roadmaps are published and submitted to the Commission as part of the National Energy Efficiency Action Plans (NEEAPs)[118]. Article 4 specifies five requirements that renovation strategies need to cover: 1) An overview of the national building stock; 2) Identification of cost-effective approaches to renovation; 3) Policies and measures to stimulate cost-effective deep renovation of buildings; 4) A forward-looking perspective to guide investment decisions; and 5) Evidence-based estimates of expected energy savings and wider benefits.

The EPBD is the key legislative instrument to unlock the savings potential in the EU building sector. It is being reviewed in 2016. It requires Member States to implement a number of measures, including the introduction of Energy Performance Certificates (EPC) and inspections of heating, ventilation and air conditioning systems. Furthermore, all new public buildings need to be nearly zero-energy by 2018; this applies to other new buildings by the end of 2020.

Mixed results

In November 2015, the Buildings Performance Institute Europe (BPIE) provided a first assessment of Member States' renovation strategies.

One of the main conclusions of the study was that only five countries were complying fully with the requirements: Czech Republic, Finland, Romania, Spain and the UK[119]. In practice, most Member States had not set a consistent path for the renovation of their national building stocks, but were following a rather short-sighted strategy.

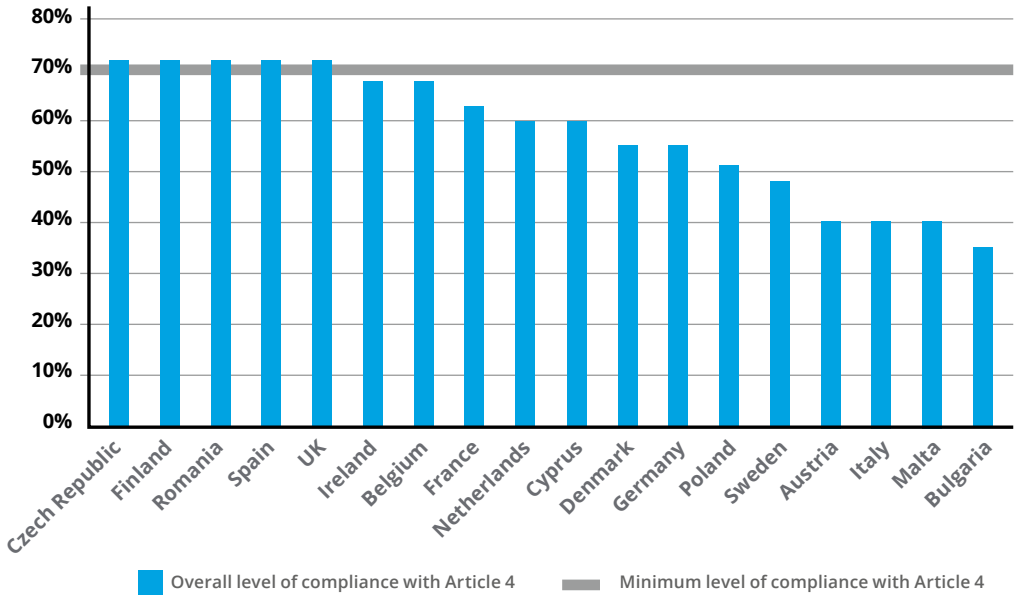


Figure 15: Compliance with the five requirements of the Article 4 of the EED [120]

116 The review will focus on Articles 1, 3, 6, 7, 9-11, 20 and 24, in view of the 2030 energy efficiency target. https://ec.europa.eu/energy/en/consultations/consultation-review-directive-201227eu-energy-efficiency

117 European Commission (2010), Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&rid=1

118 The Policies Partners (2013), Renovation Roadmaps for Buildings, http://www.eurima.org/uploads/ModuleXtender/Publications/96/Renovation_Roadmaps_for_Buildings_PP_FINAL_Report_20_02_2013.pdf

119 It scores the strategies against the five component sections of Article 4 on a scale of 0-5 where 0 = Missing, 1= Unsatisfactory, 2=Inadequate, 3=Adequate, 4= Good, 5= Excellent. A strategy is considered as being compliant with the minimum requirements of Article 4 if it achieves a rating of 70% and each of the individual sections scores at least 3.

120 BPIE (2015) - Do building renovation strategies live up to the name?, available at: http://bpie.eu/wp-content/uploads/2015/11/Do-building-renovation-strategies-live-up-to-the-name.pdf. It can be noted that only 18 strategies were studied by the BPIE since the others were not available in English when the study was drafted.

The countries with the best performance in this study were those with the most rapid turnover of the dwellings stock, a high rate of updating of thermal regulations, and programmes for incentivising the retrofitting of existing dwellings to balance out the increased number and average size of dwellings. Significant energy savings can be realised either through simple measures (insulating the roof and walls, and installing double or triple glazing) or major renovation works (building envelope, more efficient boilers, and automated and controlled systems).

Barriers to achieving more

Until now, the potential in the building sector has been greatly underexploited for several reasons:

- The buildings market is large and highly disaggregated. Decisions on energy efficiency are taken by multiple players with diverging interests ("landowner-tenant problem"[121]) and energy efficiency projects are often small, and spread among many different actors.
- The financial structures of energy efficiency funds are often too complex and bureaucratic, in particular for households or SMEs; they cannot afford to invest enough time or money to get significant returns.
- The high volatility of energy prices and the very long return on investment make energy efficiency measures very unattractive for investors. Furthermore, the current context of low energy costs does not incentivise investing in technologies with high ramp-up costs, since the reduction in overall operational costs is unlikely to repay the initial investment.

3.3. Energy standards for buildings: Energy Performance Certificates (EPC)

Energy Performance Certificates (EPCs) are a specific application of energy labels to the case of buildings. They indicate the energy performance of a building or building unit and potential energy savings.[122] EPC usually provide information about the building's energy use as well as typical energy costs, and offer in a second part recommendations about how to reduce energy use. Their main objective is to provide information to building owners, tenants or property actors when a building or building unit is rented or sold and in this way to drive demand for energy efficiency in the building sector.

EPCs have existed in European legislation since the first Energy Performance of Buildings Directive, or EPBD (2002/91/EC)[123]. The recast EPBD (2010/31/EU) implemented several additional requirements to improve the overall scheme. These included quality controls, a penalty system or the promotion of the EPC in the retail market.

The following figure (next page) shows an example of an Energy Performance Certificate in the UK.

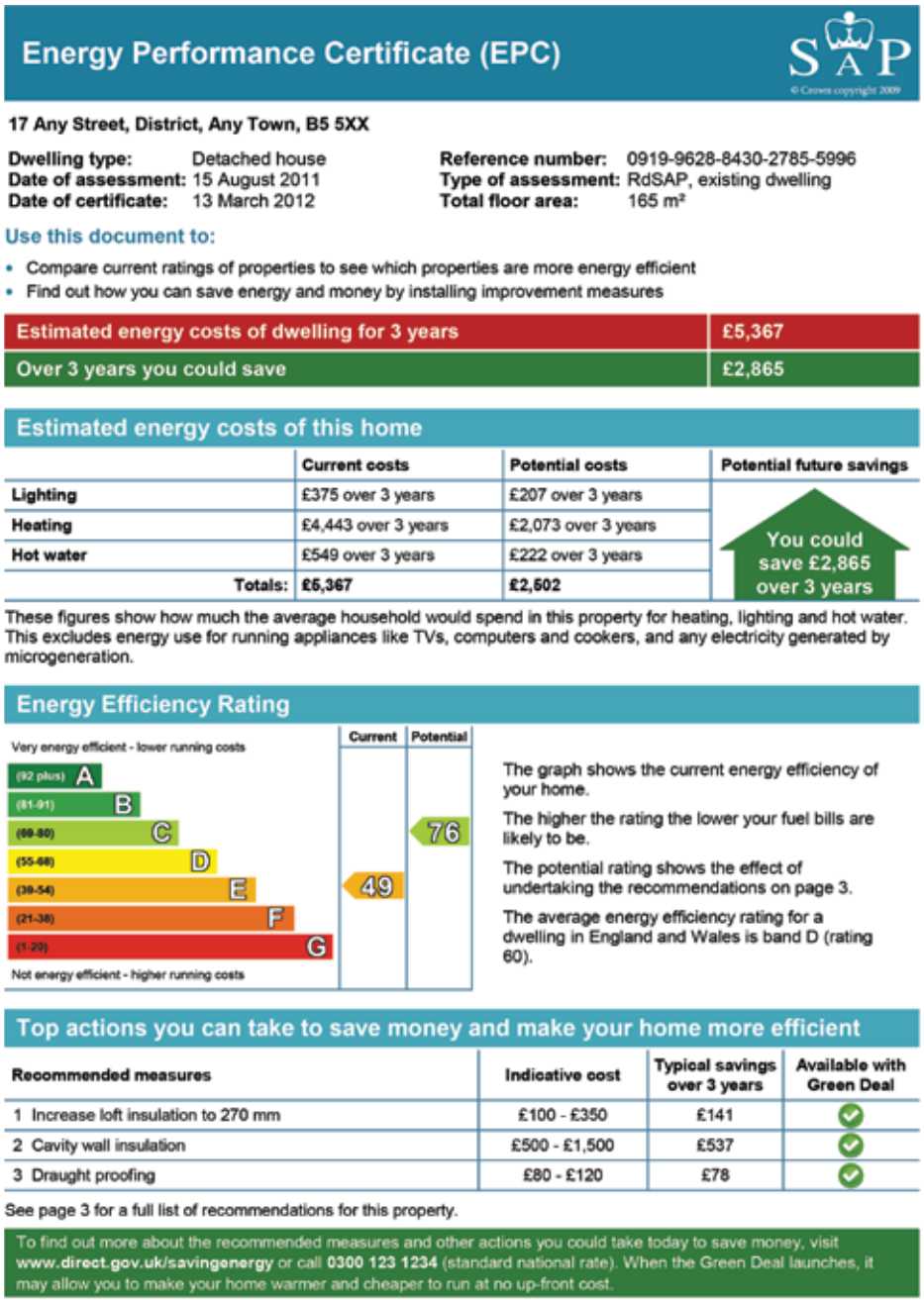
121 The "landowner-tenant problem" is a typical case of split incentives, i.e. a situation where economic actors participating in an exchange do not share the same objectives. In the case of energy efficiency, split incentives occur between tenants and landlords. While tenants want to minimise their energy bill, landlords want to minimise their investment costs. Since the landlord will not get any return from investment in a more efficient energy system, and the tenant is not certain to cover the cost of an investment through cost savings on the energy bill, the energy efficiency potential often remains unrealised.

122 The EPBD requires that EPCs be calculated to a specific methodology, described in Annex I of the Directive.

123 Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002L0091

Information on potential costs savings

Information on recommended energy efficiency measures



Energy Performance Certificate (EPC)

SAP

17 Any Street, District, Any Town, B5 5XX

Dwelling type: Detached house
Date of assessment: 15 August 2011
Date of certificate: 13 March 2012
Reference number: 0919-9628-8430-2785-5996
Type of assessment: RdSAP, existing dwelling
Total floor area: 165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	£5,367
Over 3 years you could save	£2,865

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	£5,367	£2,502	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.

Figure 16: First page of an EPC in the UK [124]

124 *Gov.UK, Energy Performance Certificate (EPC), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49997/1790388.pdf*

According to a study conducted by Deloitte in 2013 on the impact of energy performance certificates in five EU countries[112], **EPCs have a positive effect on energy efficiency and led in general to higher sale prices or rents**.[125]

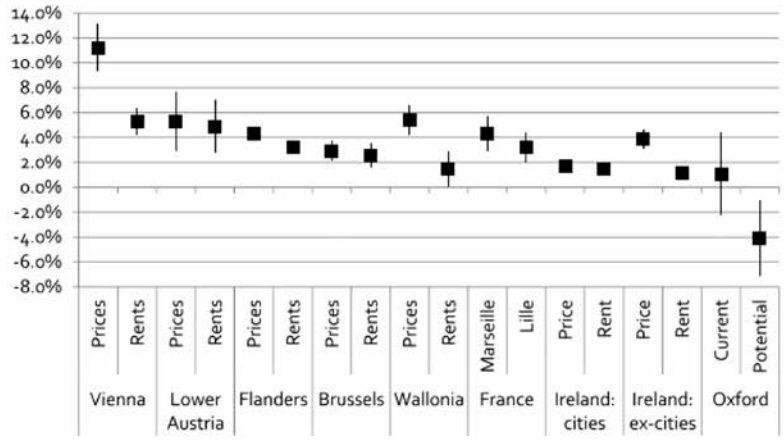


Figure 17: Effect of one-letter or equivalent improvement in EPC rating across European property markets (95% confidence interval)

However, there is no common calculation method for the EPC across European Member States, which has led to a situation where comparable buildings in different countries, or even regions within a country, can be classified differently. The EPBD (Directive 2010/31/EU on the energy performance of buildings) leaves Member States the freedom to design EPCs at national level.
While Annex I of the EPBD provides a common general framework for the calculation of the energy performance of buildings, data collection and reporting (national or regional databases), the calculation methods differ significantly from one Member State to another, as does the level of qualifications required of experts.[126] However, there is neither a technical, nor an economic justification for using different calculation methods[127].
The following figure provides examples from different countries showing the variety of ratings: final and primary energy demand (in kWh/m²/a) in Germany, greenhouse gas emissions and achievable energy performance for different categories of energy consumption (in kWh/m²/a) in Italy, seven scores from A to G in Finland, 15 scores from A1 to F in Ireland, etc.

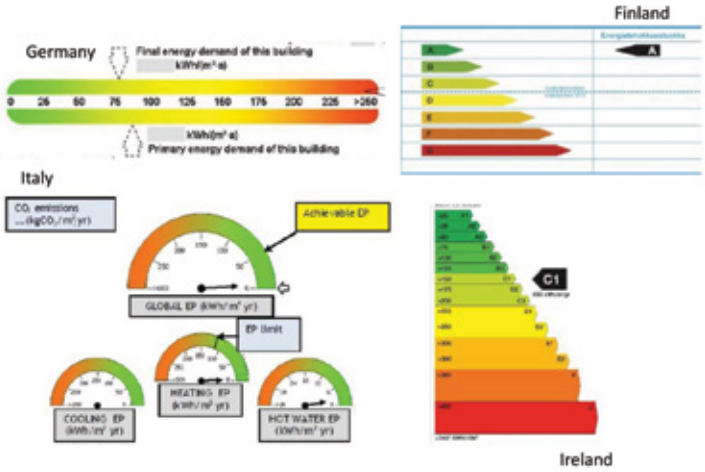


Figure 18: EPCs in four different countries [128]

125 Bio Intelligence Service (2013), Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, (Bio Intelligence Service is now part of Deloitte); https://ec.europa.eu/energy/sites/ener/files/documents/20130619-energy_performance_certificates_in_buildings.pdf

126 As an example, the German DIN V 18599 series, the Dutch NEN 7120 and the Italian UNI-TS 11300 series represent national divergences from the CEN-EPBD standards.

127 Ecofys (2015), Public Consultation on the Evaluation of the EPBD, http://bpie.eu/wp-content/uploads/2015/12/Task2_final-report_Public-Consultation-on-the-Evaluation-of-the-EPBD.pdf

128 ODYSSEE MURE project, Energy Performance Certificates, http://www.odyssee-mure.eu/news/workshops/london/19-Energy-Performance-Certificates.pdf

New energy performance building standards, which will be published as EN or EN-ISO standards at the earliest by the end of 2016 or beginning of 2017, should be used by all Member States to guarantee a homogenous approach. In 2010, the EC issued a Standardization Mandate (M/480) to several standardisation bodies (CEN[129], CENELEC and ETSI) "for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU)[130]. Since then, CEN and the International Organization for Standardization (ISO) have been developing procedures and standards for buildings, systems and products for low energy buildings that could meet the nearly zero-energy buildings (nZEB) targets specified in the EPBD.

A recent study on energy performance certificates across the EU found that while most Member States have incorporated penalties for non-compliance with the EPBD in transposing it into national law, there is a considerable lack of enforcement of the penalty system. This directly affects the quality, and therefore the credibility and success of the EPC schemes[131]. Indeed, for existing buildings not all Member States require the physical presence of an accredited certifier on site to collect all the necessary technical information and issue the EPC. Instead, EPCs are sometimes issued based on information provided by the building owner. These are in general less accurate and reliable.

To overcome these shortcomings, the following measures could be implemented:

- Standard formats for data input, calculations and reporting should be aligned across the EU, and be transparent and publicly available. In particular, as soon as the new EN or EN-ISO energy performance building standards are published, they should be used by all Member States to guarantee a homogenous approach.
- EPCs should always be based on onsite visits and evaluation processes, carried out by competent certifiers who have successfully completed mandatory tests and training.
- Member States need to make sure that compliance is monitored and that non-compliance is penalised; otherwise the scheme will lack credibility and reliability.
- Once such a common approach is established, a centrally managed database could be envisaged for energy performance of buildings to help monitor the improvements over time and to design appropriate policies. The EC should provide guidance and assistance to the Member States on introducing such policies.
- With such common standards, it could make sense also to introduce binding targets on energy performance for different building types. However, these should be agreed upon at national level, since the starting points differ from one Member State to another.
- As soon as the EPC scheme is reliable enough, it could also make sense to link financial incentives to the scheme. One possibility could be to provide cheaper loans for investments that improve the energy performance of buildings whose better performance has been certified by the EPC.

3.4. Obtain the right assessment of potential EE project savings

Assessing the benefits of energy efficiency measures correctly ex ante is necessary to justify their implementation on solid grounds.

The assessment should be specific: Encourage assessments of potential EE gains

To be implemented on a large scale, **building renovation needs to be based on measures tailored to each building, taking into account its intrinsic characteristics and the way it is used, and with a clear assessment of costs and benefits**. Such specific assessments for each building can be a powerful

129 European Committee for Standardisation, European Committee for Electrotechnical Standardisation and European Telecommunications Standards Institute.

130 European Commission, Standardisation Mandates, http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=465

131 BPIE (2014), Energy Performance Certificates across the EU, http://bpie.eu/uploads/lib/document/attachment/81/BPIE_Energy_Performance_Certificates_EU_mapping_-_2014.pdf

awareness-raising instrument and could encourage many households and companies to renovate their buildings: firstly by quantifying the real energy efficiency potential in buildings; secondly by easing the implementation of the most efficient energy efficiency measures. For instance, as part of the implementation of its energy transition law adopted in 2015, France launched a pilot of the so-called "energy renovation passport" (passeport rénovation énergétique) on 10 November 2015. This passport is an in-depth energy audit of a dwelling, with at least three detailed scenarios for renovation work, based on the lifestyle of its inhabitants. It includes a detailed analysis, a cost estimation and an assessment of expected savings and potential subsidies. Participation in this scheme is voluntary.

Integrate all impacts in the assessment: Put forward co-benefits

Energy efficiency in buildings can yield significant co-benefits, which come in addition to pure energy savings: building owners and occupants may benefit from improved durability, reduced maintenance, greater comfort, lower costs, higher property values, increased habitable space, increased productivity, or improved health and safety. Benefits for governments often include reduced societal health costs, improved air quality, an improved tax base, higher GDP and enhanced energy security. Utilities benefit from cost and operational benefits from increased customer satisfaction, reduced emissions and reduced system capacity constraints[132]. **These co-benefits from energy efficiency measures can be a greater incentive than the economic benefits from the savings on energy bills alone. They should be thoroughly assessed and put forward to provide a comprehensive assessment of all the benefits of energy efficiency.**

Base the assessment on ex post evaluations: assess past measures

Ex-post analyses, assessing the real impacts of measures implemented in the past, are crucial to assess which measures are really cost-effective. Real-life energy efficiency gains are often lower than estimated in a theoretical ex-ante evaluation, since these underestimate many real-life barriers (e.g. sub-optimal end-user behaviour) which reduce the practical gains. As an example, a recent analysis from Georgetown University (Levinson, 2015) found that, contrary to expectations, "there is no evidence that homes constructed since California instituted its building energy codes use less electricity today than homes built before the codes came into effect"[133], thus questioning the effectiveness of building energy codes in California.

3.5. New approaches to financing energy efficiency in buildings

On-bill Repayments

On-bill financing programmes are a way for utilities to incentivise customers to invest in energy efficiency measures, such as efficient lighting, efficient air conditioning or better insulation. It is essentially a loan provided by utilities to customers to finance energy efficiency improvements in their buildings. The loan is then repaid on a monthly basis through the utility bill. One major difference as compared to Energy Performance Contracting (EPC)[134] is that homeowners (or businesses) are liable to repay the charge, even if the promised saving on their energy bills does not materialise[135].

One example for such a system is The Green Deal in the UK[136]. The Green Deal Finance Company was a novel funding mechanism in the UK residential energy efficiency market, which was launched in 2013. It enabled households to finance energy efficiency improvements through loans that were linked to their electricity bill. The loan could be passed to the next owner or tenant if the originator of the loan moved house before the end of the loan's term. Over a period of two and a half years, only 15,000 people participated in the Green Deal, far fewer than the government expected in the beginning.

132 IEA (2015), Capturing the Multiple Benefits of Energy Efficiency, http://www.iea.org/topics/energyefficiency/energyefficiencyiea/multiplebenefitsofenergyefficiency/

133 A. Levinson (2015), How Much Energy Do Building Energy Codes Really Save? Evidence From California Houses, http://faculty.georgetown.edu/aml6/pdfs&zips/BuildingCodes.pdf

134 See section 6.2 on "Promote innovative financing mechanisms".

135 Whereas with Energy Performance Contracting, the risk of getting savings lower than expected is not supported by homeowners, but by the Energy Service Company (ESCO): the ESCO uses the stream of income from the reduction in energy consumption to repay the up-front costs of the project. For more details on EPC and ESCO, see section 6.2.

136 Utilities help households to improve household goods such as boilers and are reimbursed via the energy bill.

The Green Deal was heavily criticised by different groups for its lacks of incentives and overall design. Although the UK government put the so called 'golden rule' in place – i.e. the expected energy savings were always to exceed the cost of repayment the high interest rates, hidden charges and penalty payments deterred people from participating. As a consequence the government abandoned the programme in July 2015 without any replacement strategy.

Well-designed on-bill repayment programmes have a high energy saving potential, since they can help resolve the problem of split incentives between owners and tenants, bypassing the high upfront costs for both. However, the example of the Green Deal in the UK shows that such a mechanism needs to be designed very carefully: policy makers need to make sure that no adverse effects arise when putting such a system in place and that enough stimulus is created to drive demand for the uptake.

On-tax financing systems

On-tax financing systems are among the emerging financial instruments for energy efficiency measures. As in the case of on-bill repayments, the objective is to smooth the upfront investment costs: it allows local or state governments to fund the upfront cost of energy improvements to commercial and residential properties. These are then paid for by the property owners by increasing property taxes by a set rate over around 20 years.

A prominent example of on-tax systems are the Property-Assessed Clean Energy (PACE) programmes in the US. Property owners can choose to participate in a PACE programme and repay their improvement costs over a certain period of time, ranging normally from 10 to 20 years. Repayments are based on property assessments, which are paid as an addition to the owners' property tax bills. Non-compliance with payment has the same consequences as the failure to pay any other portion of a property tax bill. The following figure illustrates the PACE programmes' financing mechanism.

The Property-assessed clean energy (PACE) system has been successfully implemented in the US. As an example, more than 47,000 residential PACE assessments worth almost $960 million have been implemented so far across California[138]. **In view of its considerable potential, a similar system could also be adopted on a large scale in Europe. Various schemes such as on-bill repayments or taxes exist, allowing smoother investment costs.**

They make it possible for the tenant to repay energy efficiency measures on a regular basis and to avoid high deterring upfront costs. These schemes have a high energy saving potential, since they can help resolve the problem of split incentives between owners and tenants, bypassing the high front up costs for both of them. **Best practice in designing such schemes efficiently should be widely shared and similar experiences should be strongly encouraged by the public authorities.**

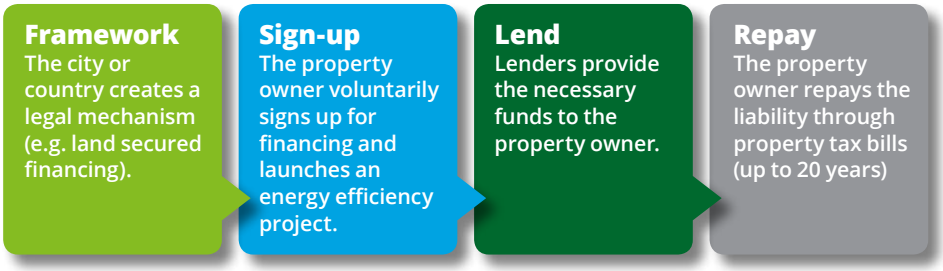


Figure 19: Illustration of the PACE process [137]

137 Data provided by Energy.gov, Property-Assessed Clean Energy Programs, http://energy.gov/eere/slsc/property-assessed-clean-energy-programs

138 Berkelay LAB (2016), Residential Property Assessed Clean Energy in California, https://emp.lbl.gov/sites/all/files/lbnl-1003964.pdf

Buildings use 39% of the EU's total final energy (2014), two thirds of which in the residential sector and the rest in services. Of the EU's building stock 75% is still energy inefficient and that is where the largest energy saving potential lies. Only five countries have complied fully with the requirements on energy efficiency in buildings (Article 4) contained in the Energy Efficiency Directive.

Energy Performance Certificates (EPCs) are a specific application of energy labels to the case of buildings. They have in general a positive effect on energy efficiency and result in higher sale or rental prices[139] but they have not reached their full potential yet due to poor implementation and lack of enforcement. Furthermore, because of the variety of methods used, comparable buildings in different countries, or even regions within a country, can obtain different classifications.

- **Public authorities should look for better homogenisation of EPC's and promote them more extensively. The calculation methodology for EPC should be harmonised throughout the EU.**

At project level, a better anticipation of the benefits of energy efficiency measures is necessary to justify their implementation on solid grounds. The ex-ante assessment of energy savings should be:

- based on real ex post evaluations of similar projects;
- tailored to each specific building;
- be comprehensive, and include potential co-benefits (impact on individual comfort, on the market value of buildings, etc.), which are sometimes more significant than pure energy savings.

One key barrier in the building sector is the landlord-tenant problem (while tenants want to minimise their energy bill, the owner is interested in minimising investment costs). Specific and innovative financing mechanisms have been developed to enable the tenant not to pay for the investment in energy efficiency measures upfront but on a regular basis, in line with the savings that the energy efficiency measures generate: e.g. on-bill or on-tax financing schemes.

- **Such mechanisms need to be promoted by public authorities and put in place by private companies in order to overcome existing market failures as the landlord-tenant problem.**

139 *Deloitte / a.k.a. Bio Intelligence Service (2013), Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, https://ec.europa.eu/energy/sites/ener/files/documents/20130619-energy_performance_certificates_in_buildings.pdf*

4. Mobilise retail consumers

Energy end-users should be aware of the challenges at stake, know what they can do and be convinced of the usefulness of changing their day-to-day habits.

4.1. Measure consumption and quantify realistic savings

The role of smart meters in gathering relevant information

Rolling out smart meters (for electricity and gas) can be a way to generate more detailed data and help households take more informed decisions related to their energy consumption, based on precise and real-time cost information.

Under EU energy market legislation (Third Energy Package[140]), Member States are required to ensure the implementation of smart metering (depending on the results of a long-term cost-benefit analysis (CBA), if one has been conducted). If the CBA is positive, there is a roll-out target of 80% market penetration by 2020 for electricity. In 2012, most Member States performed a CBA on whether they should introduce smart meters or not[141] and the EC conducted a comparative analysis of these CBAs. It concluded that cost estimates vary significantly from one Member States to another (EUR 77 to EUR 766 per customer). The average cost of a smart metering system is estimated at between EUR 200 and EUR 250 per customer, opposed to average benefits per metering point of EUR 160 for gas and EUR 309 for electricity. These benefits include a cost reduction from average energy savings of around 3%[138] and other benefits, such as reductions in metering costs. The negative CBA results for gas are linked to the challenging business case for gas smart metering, since gas networks can store large amounts of energy and are much less dynamically responsive than electricity systems. For this reason only a few countries (Austria, France, Italy, Ireland, Italy, the Netherlands and the United Kingdom)[142] have opted for smart metering in the gas sector so far.

The following graph summarises the costs and benefits for each country and shows whether the country decided to roll out smart meters for electricity or not.

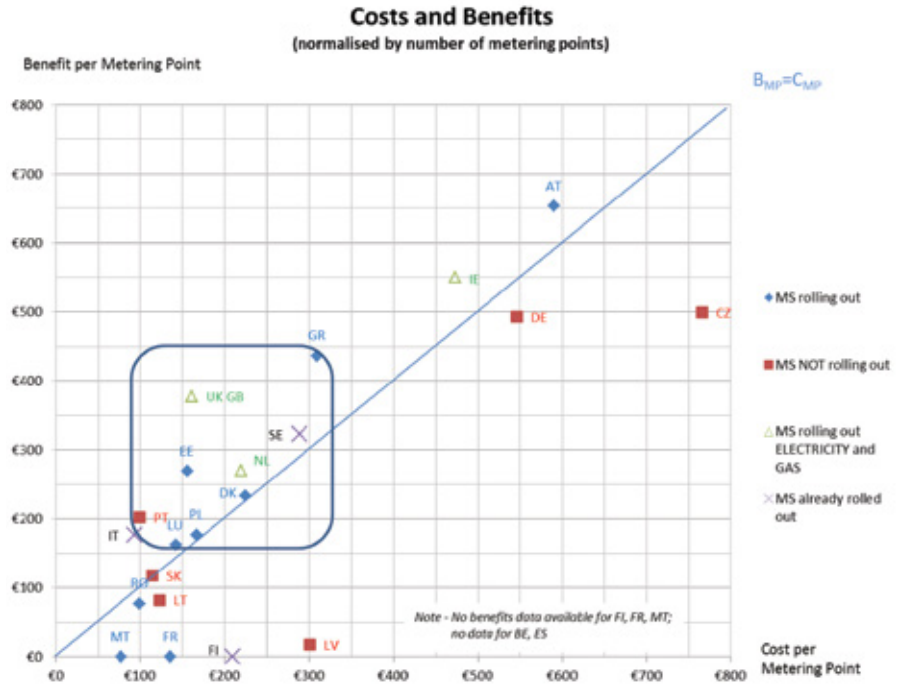


Figure 20: Costs and Benefits of Smart Meters for electricity per Metering Point in different MS[143]

140 The Third Energy Package consists of two Directives and three Regulations and entered into force on 9 September 2009; https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation

141 European Commission (2014), Cost-benefit analyses & state of play of smart metering deployment in the EU-27, [COM(2014) 356 final, SWD(2014) 188 final], http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0189&from=EN

142 http://ses.jrc.ec.europa.eu/smart-metering-deployment-european-union

143 European Commission (2014), Cost-benefit analyses & state of play of smart metering deployment in the EU-27, available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0189&rid=1

The German CBA concluded that a full-scale roll-out would result in a negative outcome, but that smart meters could be economically justified for specific customers (e.g. with a consumption higher than 6,000 kW/a). Based on the German CBA, Deloitte performed an analysis to offer strategic advice to distribution grid and metering station operators in Germany[144]. Two main scenarios were studied: the first describes the current legal framework scenario and refers to the partial roll-out scenario in the CBA, with 27% of intelligent measuring systems by 2030. The second, the "rollout plus" scenario, foresees the sequential phase-out of conventional meters by installing 100% intelligent meters by 2032, keeping the implementation of intelligent measurement systems (including inter alia internal displays in households) at 30%. One of the main conclusions of the report is that, **in Germany, a global installation for internal displays in households is not recommended from the perspective of a meter operator due to high specific expenses. Furthermore, different geographical particularities need to be taken into account to find optimal individual solutions.**

As a consequence of these CBAs, **16 MS[145] started a wide-scale roll-out programme (80% or more) for electricity**. Seven countries[146] decided on a selective or limited roll-out (i.e. less than 80%). As of today, MS have committed to roll out around 200 million smart meters for electricity and 45 million for gas by 2020. This is accompanied by a total potential investment of EUR 45 billion. The EC estimates that by 2020, around 72% of EU consumers will have a smart meter for electricity and 40% for gas[143].

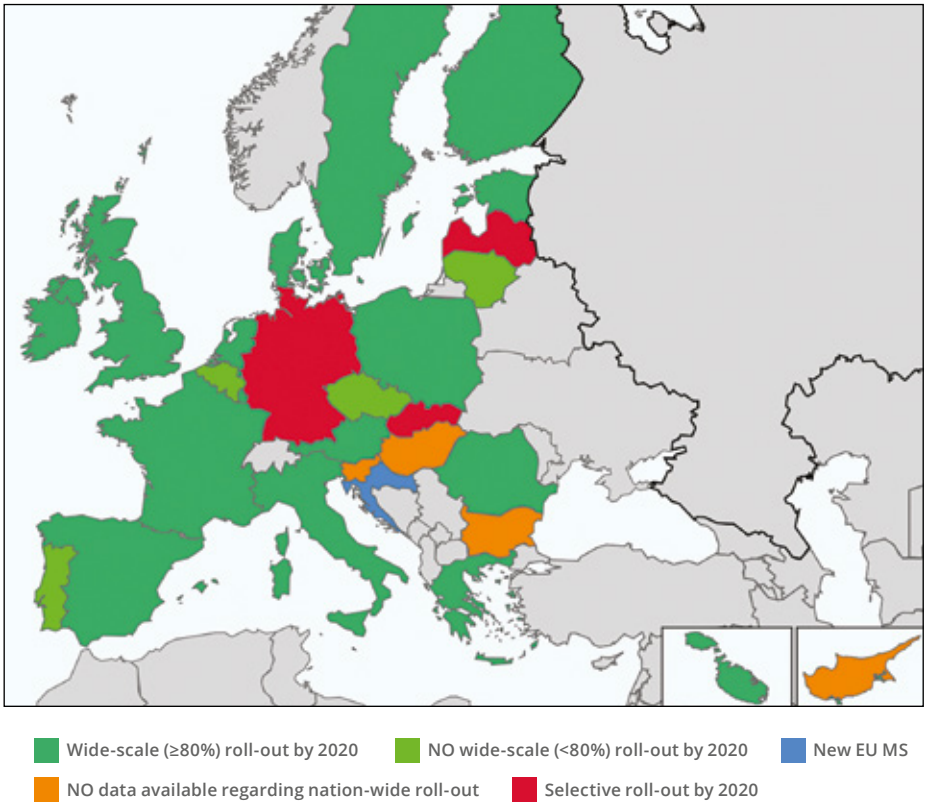


Figure 21: Smart meter roll-out in Europe[147], as expected by 2020

144 Dena, Introduction of smart meters in Germany, http://www.dena.de/fileadmin/user_upload/Projekte/Energiesysteme/Dokumente/140709_dena-Smart-Meter-Studie_Endbericht_final.pdf

145 Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Poland, Romania, Spain, Sweden and the United Kingdom

146 Belgium, Czech Republic, Germany, Latvia, Lithuania, Portugal, Slovakia

147 European Commission, JRC, Smart Metering deployment in the European Union, http://ses.jrc.ec.europa.eu/smart-metering-deployment-european-union

Besides the technical and economic elements, rolling out smart meters raises several questions:

- Who should own the smart meters? Who should pay for their installation? Smart metering costs should be borne by those who benefit from them.
  - The Distribution System Operators (DSOs) and energy suppliers can significantly decrease their monitoring costs thanks to smart meters, since data is transmitted automatically and there is no need to send an employee to read the meters.
  - Consumers can take advantage of smart meters only if they have a way of decreasing their energy consumption and if the resulting energy savings exceed the installation costs.

- Who collects and handles the data? How is the safety and privacy of private information taken care of? A report from the European Union Agency for Network and Information Security (ENISA) has outlined several security measures that would minimise the risk[148].
- How is this data used to promote energy savings? Smart meters generate a huge quantity of data on energy consumption but gathering data is not an end in itself. Innovative ways to convince end-users to decrease their consumption have to be developed on the basis of this massive data collection.

None of these questions has simple and definitive answers. As a consequence, different MS plan to roll out smart meters in different ways:

- In all MS, smart meters are owned by the DSOs, with the exception of the UK where the ownership is with the energy suppliers.
- In 20 MS, the DSO is likely to be the responsible party who has access to the generated data. In the other countries[149] (Czech Republic, Denmark, Estonia, Poland and UK), the responsible party is a central hub.
- In at least 17 countries, the roll-out is due to be financed through network tariffs. Only in the UK it is up to the energy supplier to finance the roll-out[150].

To make the EU smart metering programme cost-efficient, the roll-out needs to be accompanied by specific measures:
• Harmonisation (standardisation) work at EU level with respect to minimum functionalities, such as remote control, two-way communication and high interoperability;
• National measures to guarantee protection of personal data;
• Development and implementation of innovative ways to convince end-users to cut their consumption, on the basis of this massive data collection (see next section).
These measures will be necessary to attract market entrants and to promote the emergence of innovative services such as demand response or data protection solutions.

Closing the gap: professional home energy audits and energy management systems

A home energy audit can be the first step in making a building or flat more energy efficient. Such an audit can help owners or tenants assess their energy consumption, help understanding the potential for energy savings and what measures (investments or behavioural changes) will improve the energy performance of the building. Energy audits provide tailor-made recommendations based on individual energy consumption and a real context. They are usually performed by independent experts. Customers value this independence, since the experts have no incentive to provide biased information. Energy auditors need to go through specific training and to be certified (ISO 50001) to be able to perform energy audits.
These assessments usually comprise an evaluation of the thermal characteristics and the infrastructure, as well as the electronic appliances used by the household. Different professional appliances such as blower doors or infrared cameras are used to test the airtightness of buildings and to detect leaks.

148 *European Union Agency for Network and Information Security (ENISA), available at https://www.enisa.europa.eu/publications/appropriate-security-measures-for-smart-grids*

149 *No information available for Bulgaria, Croatia and Hungary*

150 *No information available for the other countries.*

Figure 22: Process of a typical energy audit

National and local authorities need to introduce more measures to encourage energy audits not only for SMEs, but also for households, by providing financial incentives.

One good example of how to incentivise energy audits can be seen in the programme offered by the German Federal Office for Economic Affairs and Export Control (BAFA). The BAFA offers grants for on-site advisory services amounting to 60% of the consultancy fees (max. EUR 800) for detached and semi-detached houses and max. EUR 1,100 for dwellings with at least three accommodation units. The cost of additional explanations of the energy consultancy report at the property owners' annual meeting are fully covered up to EUR 500[151].

Similarly, **an energy management systems (EnMS)** is a "set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives" (according to the ISO 50001 standard); it aims at enabling an organisation to follow a systematic approach to achieving a continual improvement in its energy performance, including energy efficiency, energy use and consumption. A recent study[152] showed that the benefit/cost ratio of such energy management systems can reach a factor of ten. So far the EnMS is mainly used by energy- intensive and large organisations, but only a few organisations are adopting strategies to capture all financially attractive measures.

To promote energy audits and energy management systems, Member States should:

- **develop programmes that raise awareness among retail consumers about the potential benefits of energy audits and energy management systems;**
- **make sure that professional energy audits are widely available, especially by encouraging training programmes to guarantee that enough qualified persons are available to undertake such energy audits[153].**

4.2. Inform consumers through direct or indirect feedback

Home automation (domotics)

Smart home automation is the technological use and control of home appliances **that enable automation and remote monitoring of residential homes**. It includes smart devices to **improve comfort and optimise energy consumption by regulating temperature and light**, to **ensure safety** (alarms, systems to lock doors) and other functions. Its development in the early 2010s was made possible by the rise of **electronics in home appliances, Big Data and the Internet-of-Things** (connected devices). One of the most well-known examples of a company offering such home automation is Nest. Founded in 2010, it was acquired

151 BAFA, Federal Office for Economic Affairs and Export Control, http://www.bafa.de/bafa/en/index.html

152 Waide (2016), The scope for energy saving from energy management – draft report.

153 European Commission (2013), Article 8: Energy audits and energy management systems, [SWD(2013) 447 final], http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0447&rid=1

by Google for EUR 3.2 billion in 2014[154]. Many other players are competing on this market: Evohome (United States), Tado (Germany), Hive, Heatmiser, Heat Genius and Connect (United-Kingdom), or Istabai (Latvia). Tado claims its product can cut heating bills by up to 31%[155], Evohome by 40%[156], Istabai by 30%[157] and Nest by 20%[158].

The market for smart home appliances, such as smart thermostats, is developing fast in the United States and in Europe and provides efficient solutions for households to save energy and money.

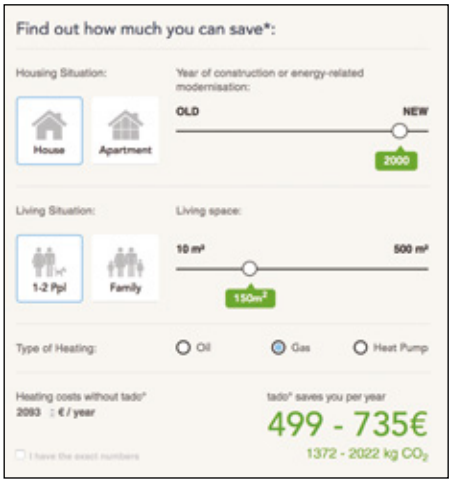


Figure 23: Heating savings and CO_2 emissions avoided calculator, Tado[159]

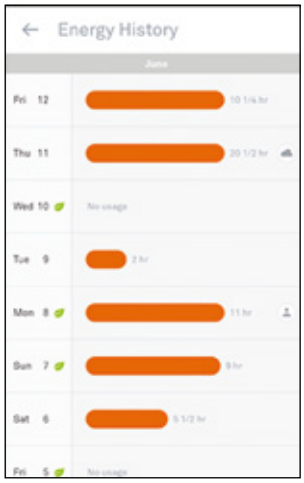


Figure 24: Thermostat showing the detailed energy summary (orange bars indicate the heating system was on), Nest[160]

These appliances are, however, associated with security risks (since they can be compromised by hackers) and privacy ones (related to data handling and privacy). These risks will need to be better addressed in the coming years.

Feedback and "gamification"

Based on the concept "what gets measured, gets managed" (Peter Drucker), **regular detailed feedback to households on their detailed energy consumption, either through energy bills, or digitally via their online accounts or applications for smartphones or tablets could help to reduce energy consumption. These feedback mechanisms should be promoted.** The more information is available, for instance thanks to smart metering, the easier it is to calculate relevant indicators to provide end-users with relevant feedback. This feedback should be transparent and easily understandable, and provide benchmarks that help end-users to understand their relative consumption with respect to their past consumption and the consumption of their peers. Direct feedback refers to immediate (real time) and easily accessible consumption feedback (e.g. smart meters, in-house displays), while indirect feedback consists of processed data that the end-user receives at a later stage (energy bills, emails, etc.)[161].

A study analysing 39 literature sources on feedback on energy consumption came to the conclusion that **"savings of 2-3 % can be achieved when considering a variety of studies with both direct and indirect feedback as well as different levels of information detail"**[162].

While information provision is key, it will not be enough to overcome inertia and behavioural barriers. The effect of this feedback can be enhanced through mechanisms that innovate and incentivise, such as competition, gamification (e.g. "are you performing better than your neighbour?") and rewards (e.g. gift cards in selected stores or online shops).

154 C. C. Miller (2013), For Google, a Toehold Into Goods for a Home, in the New York Times. Available at: http://www.nytimes.com/2014/01/14/technology/google-to-buy-nest-labs-for-3-2-billion.html?_r=0

155 Fraunhofer (2013), IBP report, Simulation study on the energy saving potential of heating control system featuring presence detection and weather forecasting, http://www.ibp.fraunhofer.de/content/dam/ibp/en/documents/ResearchNews/IM-527_englisch_web.pdf

156 Honeywell's website: https://honeywell.com/sites/environment/Produits/Pages/evo-styledevie.aspx

157 Istabai CEO, Janis Lindermanis

158 Nest (2015), White Paper "Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results", available at: https://nest.com/downloads/press/documents/energy-savings-white-paper.pdf

159 Tado's website: https://www.tado.com/de-en/heatingcontrol-savings

160 Nest's website: https://nest.com/uk/support/article/How-to-read-the-Nest-Energy-History-on-the-Web-and-Mobile-apps#!

161 S. Darby (2006), The effectiveness of feedback on energy consumption, http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf

162 Energy Analysis (2015), Impact of Feedback about energy consumption; http://www.ea-energianalyse.dk/reports/1517_impact_of_feedback_about_energy_consumption.pdf

Successful examples of customer feedback programmes using the concept of relative performance and enhancing energy efficiency can be seen in software-as-a-service (SaaS) companies that provide customers with better information about their energy consumption, along with individual ways to save energy (e.g. Opower, MyEnergy – bought by Nest in 2013).

Such companies offer utilities cloud-based software, allowing them to inform their customers about their energy use through personalised analysis, target setting and rewards.

The following figures show an example of such comparative information and rewards provided to consumers:

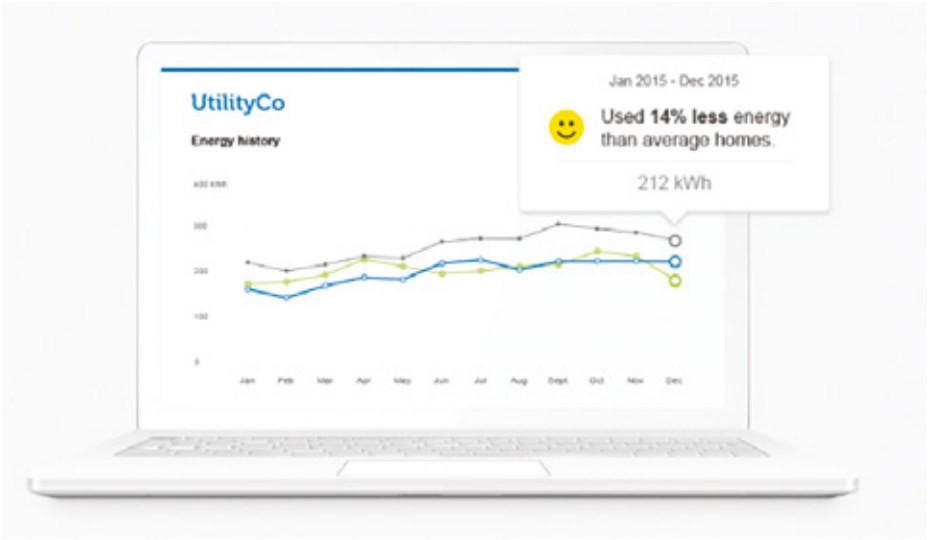


Figure 25: Comparative energy efficiency information provided to end-users[163]

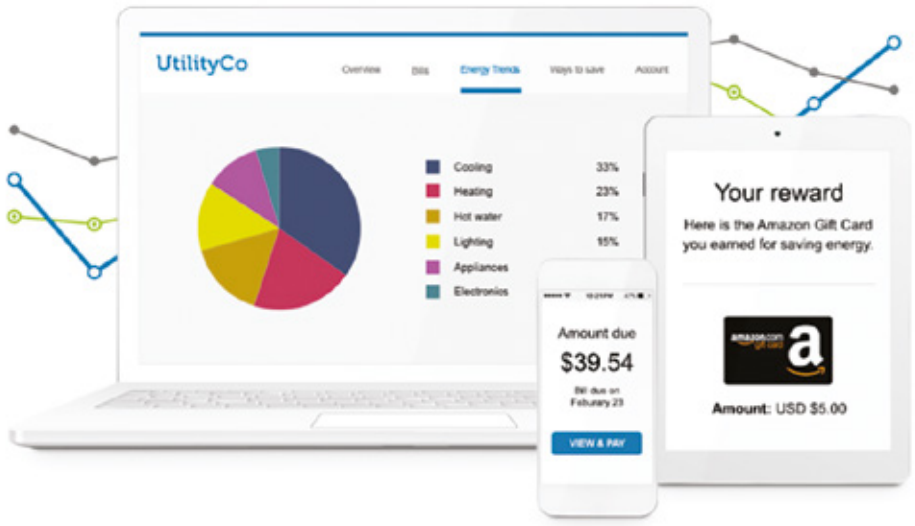


Figure 26: Detailed consumption information and rewards for energy savings[163]

163 Source: OPower, https://opower.com/products/digital-engagement/

Aesthetic smartphone, tablet and computer applications that promote gamification have been developed to incentivise people into adopting sustainable behaviours by making it fun to save energy and reduce CO_2 emissions while incorporating a social component. For instance, in JouleBug or EcoIsland, consumers perform energy saving actions to win virtual rewards and to compete with others. In addition, some applications are **connected with smart home appliances**, e.g. JouleBug offers a set of actions which include simple things like turning off lights, monitoring and taking shorter showers, as well as making energy efficiency purchases, such as a smart thermostat or LEDs.[164] **Companies offering energy services can also develop their own games** (e.g. Lockheed Martin[165]).

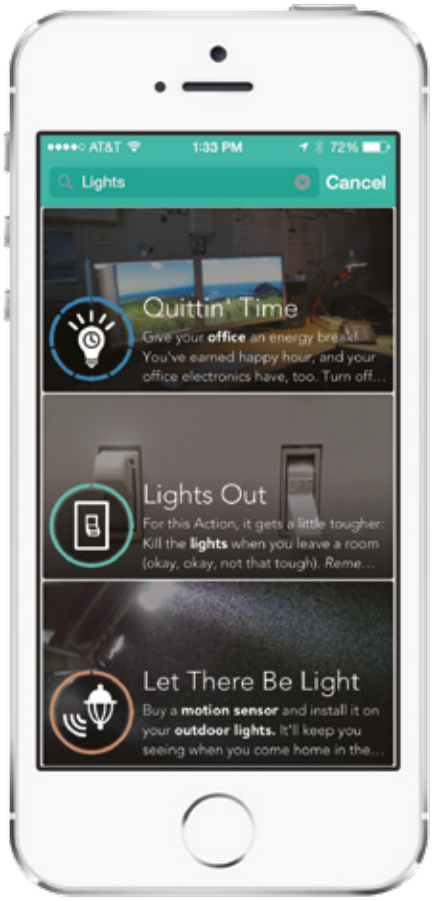


Figure 27: Connection with smart home appliances (Example JouleBug)

However, gathering data (for instance, through smart metering) is not enough. Energy suppliers have to calculate relevant indicators and provide transparent and understandable feedback to end-users. Innovative ways of incentivising them into benefiting from of potential energy savings are developing and should be made even more widely available.

164 Joulebug's website: https://community.joulebug.com/products/nest/

165 Lockheed Martin's website: http://www.lockheedmartin.com/us/news/features/2014/gamification-energy-use.html

4.3. Convince end-users to become pro-active

Encourage "enablers" via fiscal incentives

Enablers (such as Energy Management System (EnMS), smart meters, etc.) have a key role in improving energy efficiency. They do not create energy savings by themselves but enable end-users to have an accurate view of potential energy savings and how to benefit from them. They usually cost little compared to other energy efficiency measures, but can be the "first step" towards a more complete energy efficiency strategy. **Promoting such "enablers" could raise awareness and be a good way to trigger further action.** Public support to enablers, e.g. via fiscal incentives (tax reductions), can have a double effect:

1) Encouraged by this fiscal incentive, companies or households would start implementing an EE strategy. In this first phase, investments would be focused on 'enablers' that help assess the potential gains.

2) These enablers would help companies and households to design efficient EE measures that would be implemented in a second phase.

A recent study found that as far as specific instruments dedicated to EnMS are concerned, fewer countries tend to address this area as compared to funding mechanisms for energy audits[166]. A good example of encouragement to install an Energy Management System can be found in Germany, where energy intensive industries (> 1GWh) that have a certified Energy Management System are exempted from the EEG surcharge[167].

The Swedish "Energy Efficiency in Energy Intensive Industries Programme" is another example where energy-intensive industries receive a full rebate of the energy tax on electricity if they introduce an energy management system and regularly perform energy audits. No new entrants have been accepted since 2012, since this programme will be replaced by a new programme in 2017[168].

Foster demand side management

The goal of demand side management is to encourage consumers to use less energy during peak hours, or time-shift energy use to off-peak times. Demand side management improves the reliability and flexibility of the energy system as it can absorb some of the shocks coming from the generation mix. Demand side management can offer solutions to issues such as energy efficiency, load management, or strategic conservation and related activities.

Controlled consumption through demand side management could help improve energy efficiency, and achieve energy efficiency and environmental targets. The technologies required for demand-side response and demand-response services are developing quickly[169] and demand-side management programmes have shown positive results over the last ten years. However, such programmes need to be adapted to individual needs and behaviour[170].

Evidence, education and professional training

Providing end-users with relevant energy related information (energy use, lifetime, etc.) is the first step to raising awareness and increasing energy efficiency through behavioural changes, especially in households. Through specific energy-efficiency campaigns, end-users can be informed about simple practices in daily life that could save money and improve their energy and environmental footprint. These campaigns should also be part of school education in order to demonstrate current best practices to younger generations whose parents might not be aware of these best practices; this could enhance inter-generational knowledge transfer from the younger to the older generation ('reverse monitoring'). Similarly, training programmes should be developed such that professionals propose the most

166 European Commission (2016), A Study on Energy Efficiency in Enterprises: Energy Audits and Energy Management Systems, available at: https://ec.europa.eu/energy/sites/ener/files/documents/EED-Art8-Implementation-Study_Task12_Report_FINAL-approved.pdf

167 The German EEG is the difference between the wholesale market price for electricity and the fixed higher price for renewable energies.

168 IEA, Programme for Improving Energy Efficiency in Energy-Intensive Industries (PFE), http://www.iea.org/policiesandmeasures/pams/sweden/name-22448-en.php

169 European Commission (2013), Delivering the internal electricity market and making the most of public intervention [C(2013) 7243 final] http://ec.europa.eu/transparency/regdoc/rep/3/2013/EN/3-2013-7243-EN-F1-1.PDF

170 C. Bergaentzlé, C. Clastres, H. Khalfallah (2014), Demand-side management and European environmental and energy goals: An optimal complementary approach

energy-efficient products and services to their clients whenever relevant.

Many online sites already provide information about best practices, but only a small percentage of the population actively looks for them. **For this reason, the information needs to be channelled directly to the end-users. An efficient means of conveying such specific and tailored information could be transmitted through a monthly "did you know-section" on the household's energy bill, based on scientifically proven facts.** This information on energy-efficiency potential should also be translated into monetary terms by providing calculators or showing calculations that might incentivise people to opt for an energy-efficiency investment or behavioural changes.

End users' awareness, data gathering and communication play an important role in reaching overall energy efficiency targets. End-users need to be mobilised to adapt their everyday habits and become more aware of their energy consumption and of the potential savings they could generate. Several inter-related categories of action have to be undertaken to

1. **Measure: Measuring precisely what end-users consume and quantifying what they could realistically save is the first step in raising their awareness;**
2. **Inform:** measuring and quantifying potential savings is not enough; **providing proper direct or indirect feedback is a key complement: potential gains need to be presented in a way that is clear, transparent and easy to understand; achievable targets have to be proposed; progress has to be monitored, etc.** Gamification techniques (such as customer-feedback programmes comparing energy performance between neighbours) can be used to make this feedback more attractive;
3. **Convince:** On top of this, convincing end-users either to take the first step (measuring energy consumption and quantifying potential gains) or the last (investing in energy efficiency measures) is critical. **For instance, more measures need to be implemented to encourage energy audits or Energy Management Systems (EnMS) not only for SMEs, but also for households.**

These measures provide opportunities to develop new business models (smart metering, smart home appliances, consumer-friendly bills, etc.), which can be taken up either by traditional actors (power utilities, energy providers) or by innovative, quite often IT-focused, new companies.

5. Send the right price signals

Another straightforward way to increase awareness among energy consumers is to act on price signals, either through energy or carbon prices.

One of the main barriers to energy efficiency measures is a relatively low price of energy. Better internalisation of the negative externalities related to energy use (e.g. GHG emissions and wasted energy) would send right price signals to public and private actors and help reach the EU's energy efficiency and GHG emissions goals. Reforming the EU-ETS, complementing it with a carbon tax and expanding white certificate systems are three effective ways to do so.

5.1. ETS: current reform plans might not be enough

Review the quota allocation system

The EU emissions trading system (EU ETS) [171], which is a cornerstone of the EU's policy to fight climate change, is not a sufficient incentive to decarbonise the economy: the price of allowances (representing GHG emissions) has undergone significant variations, going as low as EUR 6 per tCO_2eq. in May 2016[172]. The low carbon price is not a strong enough signal to provoke a fuel switch to lower CO_2 emitting fuels. For instance, coal is still much cheaper than the relatively less carbon-intensive gas. Coal prices plummeted in the aftermath of the US shale-gas revolution and due to decreased Chinese demand, leading to an increased coal supply on the global market. Since a carbon price of around EUR 30 t/CO_2 would be needed to trigger a fuel switch to gas, coal has seen a renaissance in Europe in recent years.

There are several reasons why European carbon prices are low, such as the decrease in industrial activity in the aftermath of the 2008 economic crisis, and an over-allocation of quotas. The latter is partly due to the fact that the impacts of energy efficiency (EE) and renewable energy (REN) policies were not taken into account when setting annual European Emission Allowance (EUA) quotas. Evidence exists that the Energy Efficiency Directive (EED) will be contributing to an EUA surplus of 500 $MtCO_2eq$ by 2020[173].

It is therefore essential to take into account the impacts of all policies (EE, REN) when defining emission quotas. This should especially be borne in mind when setting the ETS Linear Reduction Factor[174] for the 4th trading phase (2021-2028).

The EU wants to address over allocation by cutting the number of allowances on the market[175]:

- As a short-term measure, the Commission postponed the auctioning of 900 million allowances until 2019-2020 ('back-loading' of auctions in Phase 3): The auction volume was reduced by 400 million allowances in 2014, 300 million in 2015 and 200 million in 2016, and will be put back on the market in later years (300 million in 2019 and 600 million in 2020).
- As a longer-term solution, a market stability reserve will be established as of 2018 with the objective of addressing the current surplus of allowances and improving the system's resilience to major shocks.
- Additionally, the EC proposed in July 2015 that, starting in 2021 and till 2030 (i.e. for phase 4 of the ETS), the number of allowances — the total cap on emissions — will decrease each year by 2.2% compared to 1.74% currently; this amounts to an additional emissions reduction in the sectors covered by the ETS of some 556 $MtCO_2eq$ during this phase.

This initiative is a good step in the right direction, but probably not stringent enough to get CO_2 prices high enough to incentivise EE investments.

171 The European Union Emissions Trading Scheme (EU-ETS) is cap-and-trade scheme for GHG emissions in 31 European countries. Covered entities receive European emission allowances (EUAs). For each allowance they can emit 1 ton of CO_2. If their CO_2 emissions exceed the number of allowances they have, an entity can purchase EUAs from other entities. Conversely, if an entity has significantly reduced its carbon emissions, it can sell its leftover EUAs. After Phase I (2005-2007) and Phase II (2008-2012), the EU ETS is currently in its Phase III (2013-2020).

172 www.eex.com, information retrieved on 30/05/2016

173 I4CE (2015), Carbon Pricing: Perspectives for the EU emissions trading scheme by 2030, http://www.i4ce.org/wp-core/wp-content/uploads/2015/12/15-12_10-I4CE_COPEC-side-event.pdf

174 The Linear reduction Factor is the rate by which the overall emissions cap is reduced each year. It amounts to 1.74% for the period 2013-2020 and is planned to amount to 2.2% for the period 2021 to 2030.

175 European Commission, Structural reform of the European carbon market, http://ec.europa.eu/clima/policies/ets/reform/index_en.htm

Integrate diffuse emissions into the ETS

55% of overall GHG emissions are not covered by the EU ETS. These are mainly diffuse emissions i.e. emissions coming from scattered sources such as buildings, transport, etc. According to the EC, buildings are responsible for 36% of CO_2 emissions in the EU[176].

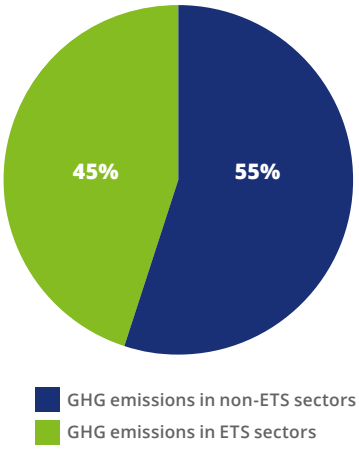


Figure 28: EU GHG Emissions by EU ETS and non-ETS sectors

There is a need to envisage extending the scope of the EU ETS to include diffuse emissions, at least from the private households, and possibly from other sectors such as freight transportation.

Such inclusion has long been discussed, but was mostly a theoretical discussion until recently, since quantifying the GHG emissions from private households is very challenging. It was considered that the cost of such quantification would be too high, and outweigh potential benefits of an inclusion. However, with the rolling out of smart meters and the potentialities behind big data, it should soon be possible to assess households' energy consumption more precisely and continuously, and to relate the consumption to the primary energy source. With this information it will become possible to quantify related GHG emissions and to calculate the EU allowances required by each individual energy consumer.

Another key point relates to where in the value chain diffuse emissions can be quantified and integrated in the ETS? At which stage is monitoring and verification of emissions easiest and the most cost-efficient?

In California, for instance, the ARB (Air Resource Board) Emissions Trading Program covers 85% of California's GHG emissions, and establishes a price signal needed to drive long-term investment in cleaner fuels and more efficient use of energy. Coverage of diffuse emissions is achieved by actions targeting energy suppliers and not end-users directly. It started in 2013 with electricity generators and large industrial facilities and has included distributors of transportation, natural gas, and other fuels since 2015.[177]

5.2. Introduce a carbon tax

Taxes levied on the carbon content of fuels (carbon taxes), could complement the ETS by:

- **setting a minimum carbon price if it is too low on the ETS market; and/or**
- **covering GHG emissions not included in the ETS.**

A carbon tax could contribute to reaching a sufficient level of incentive to trigger

176 European Commission, available at https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

177 California Environmental Protection Agency (2015), Overview of ARB Emissions Trading Program, http://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf

fuel switching and behavioural change. Additionally, it is much more stable than an emission market and can provide the industrial and financial sector with more visibility.

Several European countries have already enacted a carbon tax including Denmark, Finland, Ireland, the Netherlands, Norway, Slovenia, Sweden, Switzerland and the UK.

Finland was the first country to institute a carbon tax in 1990. In Finland, energy taxes are placed on electricity, coal, natural gas, fuel peat, tall oil and liquid fuels; overall duty rates are composed of three categories: an energy content tax, a carbon dioxide tax and a strategic stockpile fee. The carbon tax can reach significant levels: for instance, for natural gas it amounts to EUR 8.71/MWh, almost 50% of European day-ahead prices in November 2015[178].

Just one year after Finland, Sweden introduced a carbon tax in 1991, as a complement to the existing system of energy taxes. The CO_2 tax was increased stepwise from EUR 29 per tonne of CO_2 in 1991 to EUR 125 in 2014 for households and services[179]. The carbon tax is coordinated with the EU ETS, so that industrial installations which are subject to the EU ETS are not subject to the CO_2 tax.[180] **The revenues from Sweden's carbon tax in Sweden are used to finance a reduction in income tax rates; this made public acceptance easier.** This use of the carbon tax revenues to reduce other distorting taxes (such as taxes on labour) are a good example of the "double dividend hypothesis" which claims that increased taxes on polluting activities can yield two kinds of benefits. The first benefit is an improvement in the quality of the environment, and the second one is an improvement in economic efficiency, since environmental tax revenues are used to reduce other taxes such as income taxes which distort labour supply and saving decisions.

The UK Electricity Market Reform consultation introduced a Carbon Price Support (CPS) mechanism from 1 April 2013 to drive investments in low-carbon energies. The carbon floor price doubled in 2015 from £9.54 to £18.08 per tonne of CO_2, increasing the cost of carbon for UK power plants to £23 per tonne, when EU's EUA were added *(compared to EUR 6 for the EU EUA in May 2016)*.

In France, President François Hollande announced in April 2016 that he intends implementing a similar carbon floor price for power production, targeting a price of around EUR 30/tCO_2eq.

Italy introduced a carbon tax provision with Law n.23 March 11 2014, article 15. However, this provision has not been applied due to its correlation with Directive 2003/96/EC and was later repealed. Following a recommendation received from the European Council in May 2015, Italy shall implement the relevant measures in order to introduce a functional carbon tax. **A carbon tax should be designed in such a way that it is coordinated with the EU ETS and include as many emissions as possible such as diffuse emissions not currently covered by the ETS**.

5.3. White certificates as a specific market instrument for energy efficiency

White certificates are another effective way of stimulating energy efficiency initiatives through price signals. White certificates, or "Energy Efficiency Certificates" (EEC), refer to a tradable instrument issued by an authorised body proving end-use energy savings through energy efficiency improvement initiatives and projects. Each certificate is unique and traceable, and provides a right over a certain amount of additional energy savings, guaranteeing that these savings have not been accounted for somewhere else. These certificates can be traded on specific markets.

A white certificate thus directly links energy savings to a market value. Such schemes were introduced in Great Britain in 2002, in Italy in 2005 and in France in 2006.

178 *Platts, European Gas Daily Volume 20 / Issue 215 / November 5, 2015: https://www.platts.com/IM.Platts.Content/ProductsServices/Products/eurogasdaily.pdf*

179 *The World Bank, Sweden: Decoupling GDP growth from CO_2 emissions is possible, http://blogs.worldbank.org/climatechange/sweden-decoupling-gdp-growth-co2-emissions-possible*

180 *CPL, Sweden: Decoupling GDP growth from CO_2 emissions is possible http://www.carbonpricingleadership.org/news/2015/5/24/sweden-decoupling-gdp-growth-from-co2-emissions-is-possible*

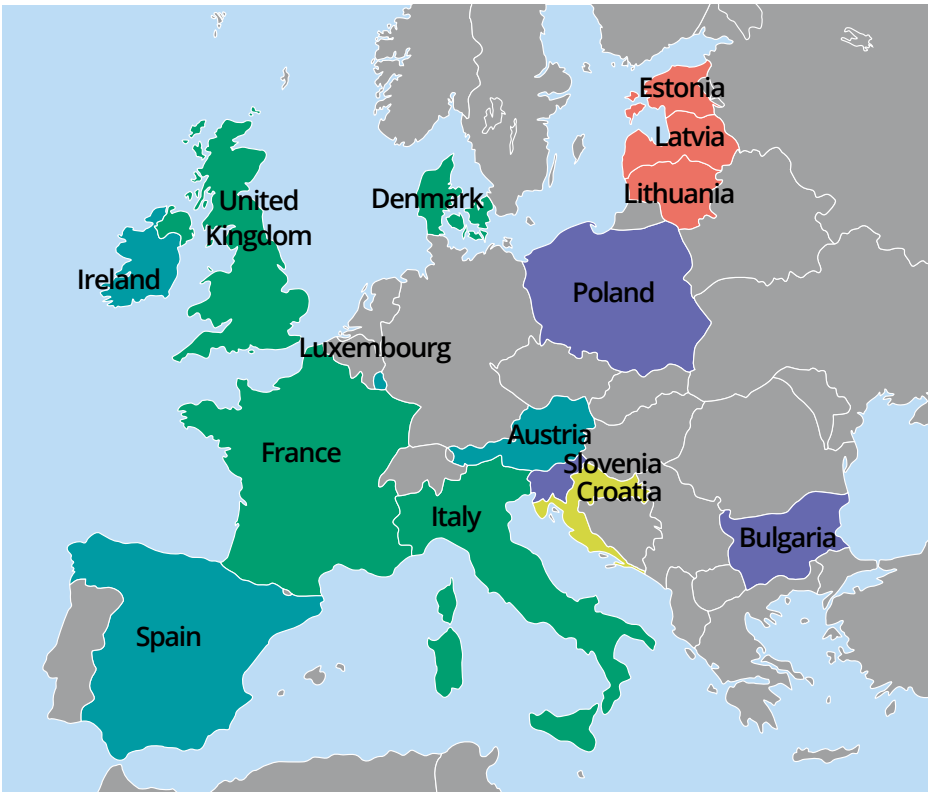


Figure 29: EEC schemes in Europe[181]

The French system is based on tradable certificates which by law are defined as "negotiable moveable property"[182]. The scheme has been in spurring actions in the residential and service sectors, but the py private actors are still reluctant to invest in energy efficiency measures, especially in the context of low energy prices[183]. A key success of this scheme has been to encourage strongly energy providers to promote energy savings among their customers. Nonetheless, estimations of energy savings were often very generous, leading to an excess of white certificates when compared to real energy savings. As a consequence, their prices decreased and the number of actions undertaken to gain certificates was significantly reduced in early 2016 as compared to previous years.

Italy updated its legislative framework in 2012 with the Ministerial Decree 28 December 2012. The scheme, similar to the French system, sets quantitative goals for electricity and gas operators with more than 50,000 final clients with reference to the period 2013 – 2016. Respectively, the operators must fulfil the issuance of 16.23 and 13.29 million certificates in the aforementioned period.

White certificates have proved to be a potentially efficient means to push forward energy savings in several European countries and should be further developed and disseminated to reach the ambitious 2020 and 2030 energy efficiency targets.

181 *Atee (2015), Snapshot of Energy Efficiency Obligations schemes in Europe: main characteristics and main questions http://atee.fr/sites/default/files/1-snapshot_of_energy_efficiency_obligations_schemes_in_europe_27-5-2015.pdf*

182 *These certificates are quantified with the artificial unit "kwh CUMAC" Cumac stems from the combination of the words cumulé and actualisé (cumulated and updated)), lifetime cumulated discounted final energy savings.*

183 *Atee (2015), Snapshot of Energy Efficiency Obligations schemes in Europe: main characteristics and main questions http://atee.fr/sites/default/files/1-snapshot_of_energy_efficiency_obligations_schemes_in_europe_27-5-2015.pdf*

Higher carbon prices would contribute towards making energy efficiency measures more economically attractive. A reform of the EU ETS was recently decided but will probably not be sufficient to solve all the current difficulties of the ETS. Further action is needed to set price signals at a level that really induce actors to invest in energy efficiency:

- **Make sure that the long-term reform of the ETS, currently under discussion, is ambitious enough and does not lead to over-allocation of CO_2 allowances; this implies, inter alia, when calculating the future allocations of EU allowances, taking all the energy and climate policy measures implemented at EU and national levels into account** (especially those favouring low-carbon energies and energy efficiency since they have a significant impact on future GHG emissions);
- **Implement a carbon tax, similar to UK's carbon floor price, to complement the ETS for as long as the CO_2 price set by the EU ETS is not high enough;**
- **Integrate diffuse emissions into these price setting mechanisms as much as possible; this can be either be done by integrating more sectors into the ETS (buildings, road transport, etc.) or by implementing ambitious carbon taxes targeting diffuse emissions.**

While the EU ETS and carbon taxes target GHG emissions, other market-based mechanisms, such as white certificates, target energy savings directly;

- **Quantification standards to quantify energy savings should be implemented to avoid unrealistic energy saving calculations;**
- **Such schemes should be harmonised throughout the EU to create a bigger and more efficient white certificate market.**

6. Facilitate financing of energy efficiency measures

Facilitating the access to energy efficiency financing needs to become a key priority at the EU and Member State level, and a set of key actions needs to be taken to get on track to meet the EU's long-term targets.

Since various barriers (long payback period, uncertainty about energy prices, lack of relevant and understandable information for investors, etc.) are undermining the attractiveness for traditional investors of financing energy efficiency measures, an efficient financing framework needs to be developed that ensures an optimal interplay between public and private actors.

Public funds alone cannot finance all necessary energy efficiency measures.

The public sector needs to act as a catalysts, boosting private financing to close the investment gap.

6.1. Ramp up public funding

Many European funding schemes exist, but it will not be enough

The EC estimates that the investments needed to meet the EU's 2020 energy efficiency targets could add up to EUR 100 billion per year[184], corresponding to the annual GDP of Slovakia.
The EU is funding energy efficiency through several European schemes (ESIF, Horizon 2020, PDA, EEEF, PF4EE, etc.). These five major ones are presented below:

Table 2. Major EU funding schemes for energy efficiency

Initiative	Description	Funds
European Structural & Investment Funds (ESIF, created in 2013)	The European structural and investment funds (ESIFs) are the EU's main investment policy tool. Six main funds work together to support economic development across all EU countries, in line with the objectives of the Europe 2020 strategy: • European Regional Development Fund (ERDF) • European Social Fund (ESF) • Cohesion Fund (CF) • European Agricultural Fund for Rural Development (EAFRD) • European Maritime and Fisheries Fund (EMFF) • Youth Employment Initiative (YEI)	EUR 454 billion for 2014-2020, of which EUR 45 billion (10%) are assigned to support the shift towards a low-carbon economy. **In total EUR 17.6 billion have been allocated to energy efficiency (incl. EUR 13.3 billion, dedicated to energy efficiency improvements in public and residential buildings), i.e. around EUR 2.5 billion per year.**
Horizon 2020 Programme	Horizon 2020 (successor of the EC's FP7 programme) is the major EU Research and Innovation programme for the years 2014-2020 aiming to support and encourage research in the European Research Area (ERA). It is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness.	In total EUR 80 billion over 7 years (2014 to 2020). EUR 674 million is for 'Secure, Clean and Efficient Energy' in 2016. **The total budget for the Energy Efficiency calls amounts to EUR 93 million in 2016 and EUR 101 million in 2017[185].**

184 *European Commission, Financing energy efficiency, available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency*

185 *European Commission (2016), Horizon 2020, Work Programme 2016-2017, 10. Secure, Clean and Efficient Energy, available at: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-energy_en.pdf*

Table 2. Major EU funding schemes for energy efficiency

Initiative	Description	Funds
Project Development Assistance (PDA)	The EC has set up several facilities funding Project Development Assistance (PDAs) with the aim of supporting public authorities in developing reliable sustainable energy projects. These can be divided into two structures: • European Local ENergy Assistance (ELENA). The overall objective is to help local and regional authorities develop and kick-start large-scale sustainable energy investments. This programme can cover up to 90% of the technical support costs. Different sub-projects exist, managed by either the European Investment Bank (EIB), KfW (the German development bank), the Council of Europe Development Bank (CEB) or the European Bank for Reconstruction and Development (EBRD): - EIB-ELENA - KfW-ELENA - CEB-ELENA - EBRD-ELENA. • Mobilising Local Energy Investments – Project Development Assistance (MLEI-PDA). This is operated by the Executive Agency for Competitiveness and Innovation (EACI) and helps public and private project promoters develop sustainable energy investment projects ranging from EUR 6 million to EUR 50 million.	Projects ranging from EUR 6 million to EUR 50 million. EIB-ELENA also supports projects > EUR 50 million. The allocated budget is part of H2020 and amounts to EUR 8 million. **ELENA is funded at EUR 20 million in 2016**
European Energy Efficiency Fund (EEEF)	The main objective of the EEEF is to support the EU's 2020 goals. It aims to provide market-based financing for public energy efficiency and renewable energy projects for the Member States. The fund provides tailor-made debt and equity instruments to local, regional and sometimes also national public authorities or public or private entities acting on their behalf. It acts as a risk-sharing facility that works with financial institutions to provide finance to local authorities and energy service companies (ESCOs).	EUR 265 million in total (2014-2020). In 2014 the fund invested EUR 121 million[186].

186 *European Energy Efficiency Fund, Annual report 2014, http://www.eeef.lu/tl_files/downloads/Annual_Reports/EEEF_Annual_Report_2014.pdf*

Table 2. Major EU funding schemes for energy efficiency

Initiative	Description	Funds
Private Finance for Energy Efficiency (PF4EE)	The PF4EE is a joint agreement between the European Investment Bank (EIB) and the EC aiming at addressing the limited access to suitable and affordable private financing for energy efficiency investments. It should help the MS implement their National Energy Efficiency Action Plans (NEEAPs) or other programmes in line with EU Directives related to energy efficiency. Its two main objectives are[187]: • **To enhance energy efficiency lending within European financial institutions;** • **To increase the availability of debt financing for energy efficiency investments.** PF4EE is managed by the EIB and funded by the Programme for the Environment and Climate Action (LIFE programme, DG Clima). The instrument provides three types of support: **1.** A portfolio-based credit risk protection (Risk Sharing Facility); **2.** Long-term financing from the EIB (EIB Loan for Energy Efficiency); **3.** Expert support for financial intermediaries (Expert Support Facility).	The programme has committed EUR 80 million for 2014-17 anticipating a 6-fold leverage effect (EUR 480 million).

The amounts attributed to energy efficiency under these schemes are far from being enough to meet the estimated needs: European funds explicitly targeted towards energy efficiency amount to only EUR 3 billion per year (3% of the required sum). The main component comes from the European Structural & Investment Funds (ESIF), created in 2013 as a successor to earlier funds, with EUR 17.6 billion allocated to energy efficiency over the period 2014-2020 (and, more widely EUR 45 billion assigned to support the shift towards a low-carbon economy). Several funds, dedicated to energy efficiency exist (EEEF and PF4EE), but their total amount is much lower (EUR 265 million for 2014-2020 and EUR 80 million for 2014-17 respectively).

National and local funds as a complement to European funds

These European funds need to be complemented by further national financing mechanisms. Well-designed national and local funds can be a key driver of energy efficiency investments.

The Netherlands, for instance, implemented a revolving fund for energy efficiency in households in 2013, with EUR 150 million of public and EUR 450 million of private finance[188]. A revolving fund has the characteristic that the expenditures of the fund will be returned to the fund in the form of interests and repayments over time.

187 *Financement privé pour l'efficacité énergétique (PF4EE), http://www.eib.org/products/blending/pf4ee/index.htm*

188 *ODYSSE MURE project, Energy Efficiency trends and policies in the Netherlands, 2015, http://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-netherlands.pdf*

As another example, France's Deposits and Consignments Fund (CDC) launched the 5E fund (Energy efficiency and environmental footprint of companies) in July 2014. This programme aims to invest EUR 600 million over 5 years, targeting industrial projects, mainly on French territory, of the order of EUR 2-50 million. The projects need to envisage reducing greenhouse gases or energy consumption by at least 20%, based on proven technologies such as efficient energy generation or heat recovery.

Some local authorities have also developed their own funds, in addition to European and national ones. An example of such a local initiative can be found in the Picardy renovation pass in France. In 2013, the Picardy region adapted a climate-air-energy scheme, estimating the number of dwellings that need to be renovated each year at 10,000. Today, the number of renovations completed is around 2,000 per year, still far from what is required. From 2006-2010, around 10,000 zero-interest loans were granted to families who wanted to improve the energy efficiency of their homes. Overall, this mechanism triggered total expenditures of EUR 120 million.

Public finance as a stimulus to private finance

Public finance will not be able to provide enough funding to cover all necessary investments. For this reason there is an urgent need to enhance private energy efficiency investments in the EU. This can be done by setting up proper incentive schemes (for instance through green investment banks, development banks, etc.) and targeted use of public funds to get the best leverage effect.

In recent years, Green Investment Banks (GIBs) have evolved successfully to tackle the problem of insufficient private financing in low-carbon investment. GIBs are public institutions that use capital to leverage private investments in sustainable and 'green' infrastructure, such as energy efficiency. Since GIBs can help meet domestic emission reduction targets and send a strong signal to private investors to engage in low-carbon investments, their development should be strongly supported by policy makers.

Figure 30: Green investment banks around the world [189]

189 OECD (2015) – Green Investment Banks, available at https://issuu.com/oecd.publishing/docs/green-investment-banks-policy-persp/2?e=3055080/31715374

In Germany, different governmental and bank programmes such as the Energy Efficiency Programmes from the German development bank KfW have turned out to be successful in promoting energy efficiency investments for households and companies. In 2010, the energy efficient building programme had **direct programme costs of EUR 1.4 billion, but triggered total investments of EUR 21.3 billion**[190]. In 2014, more than EUR 22.6[191] billion was invested in building energy efficiency through these programmes, of which two thirds went into residential buildings[192].

6.2. Promote innovative financing mechanisms

Since energy efficiency projects usually have a relatively long and uncertain return on investment, **new and innovative financing structures need to be developed to encourage investments**.

Boosting ESCOs and EPCs

Energy Service Companies (ESCOs) use specific contracts where the remuneration is directly tied to the energy savings generated at their clients'. Such schemes enable energy-users to invest in energy efficiency measures without paying for the whole investment. What distinguishes ESCOs from traditional energy consultants or equipment suppliers is their capacity to finance or arrange financing for the operation of energy saving measures.

In its latest ESCO market report (2014), the JRC[193] concludes that the average European ESCO market is improving, but that markets are far from reaching their potential. Relatively mature markets can be found in Austria, the Czech Republic, France, and Germany. Markets in Spain and Denmark are on the rise[194].

ESCOs sometimes implement relatively innovative financing schemes, such as energy performance contracting (EPC). An EPC makes it possible to fund energy upgrades from cost reductions. Under such a contract, an external organisation (mostly an ESCO) implements an energy efficiency project and uses the stream of income from the reduction in energy consumption to repay the up-front costs of the project. The energy-using company only receives payment if the measures implemented deliver the expected energy savings. The Figure below explains the concept of EPC financing.

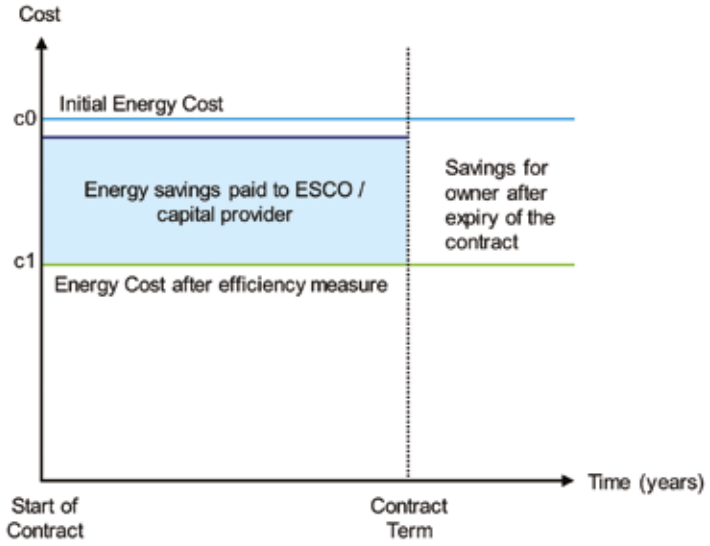


Figure 31: EPC scheme

190 *KfW (2013), Mobilizing Private Sector Investment: KfW Case Studies and Conclusions, https://www.oecd.org/env/cc/CCXG%20March%202013%20Katrin%20Enting.pdf*

191 *USD 17 billion, converted using an average exchange rate of 1.33 USD/EUR for the year 2014 (http://www.x-rates.com/)*

192 *IEA (2015), Energy Efficiency Market Report 2015, p. 76, http://www.iea.org/publications/freepublications/publication/MediumTermEnergyefficiencyMarketReport2015.pdf*

193 *The Joint Research Centre (JRC) is the European Commission's in-house science service*

194 *JRC (2014), ESCO Market Report 2013, http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/jrc_89550_the_european_esco_market_report_2013_online.pdf*

EPCs have a longer tradition in the US, but their popularity is increasing in the EU.

Despite positive developments in the last few years, EPC markets still face some severe barriers in Europe. The most important relate to **regulation and the lack of support from governments** as well as **policy uncertainties and structural barriers**. Structural barriers can be linked to insufficient information or the complexity of the overall concept. JRC's survey also found that there is significant lack of trust in the whole ESCO industry.

As EPCs can be an efficient way to contribute to the European energy efficiency targets in 2020, regulation should be adapted to facilitate the development of ESCOs and prospective clients should be provided with better information about different kinds of contract.

Green Bonds need a better policy framework

Green bonds are bonds which are usually issued by private companies, local or regional authorities or international organisations for the development of projects with environmental benefits. While 46% of the proceeds from Green Bonds are used to support renewable energy, only 20% go into energy efficiency[195].

Until 2013, the green bond market was dominated by multilateral development banks, such as the World Bank and the International Finance Corporation (IFC). **However, the green bond market has gained momentum in the last years with more and more corporates getting involved.** Corporate green bond issues from companies like Electricité de France (EDF), Engie[196], Iberdrola or Toyota Finance have been growing very rapidly.

According to the Climate Bonds Initiative, USD 37 billion of bonds labelled as green were outstanding in 2014, more than three times the amount in 2013 (USD 11.5 billion)[197]. In 2015, this figure increased by another 13%, reaching almost USD 42 billion worldwide (Figure 32). Almost half the green bonds are issued in Europe (USD 18.4 billion in 2015), followed by the US with 25% (USD 10.5 billion).

Issuer	Value
1. KfW	**$1.66bn**
2. ING Bank	**$1.3bn**
3. Electricité De France (EDF)	**$1.25bn**
4. Toyota Finance	**$1.25bn**
5. TenneT Holding BV	**$1.12bnw**

Table 3: Top 5 largest green bonds by value, 2015[192]

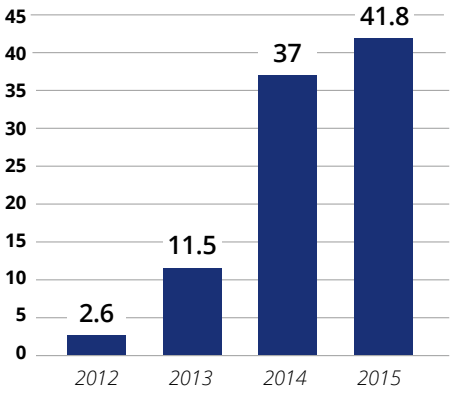


Figure 32: Annual Green Bond Issuance (USD bn)[192]

195 Climate Bonds (2016), 2015 Green Bond Market Roundup, available at: http://www.climatebonds.net/files/files/2015%20GB%20Market%20Roundup%2003A.pdf

196 Engie issued EUR 2.5 billion green bonds in 2014.

197 Climate Bonds Initiative, 2015 Green Bond Market Roundup, http://www.climatebonds.net/files/files/2015%20GB%20Market%20Roundup%2003A.pdf

At the COP21 in December 2015, 27 global investors (asset owners, investment managers and individual funds) representing USD 11.2 trillion of assets signed the Paris Green Bonds Statement, supporting the green bond market. According to Moody's senior Vice President, Henry Shilling, the trend in the market will continue in 2016: "Green bonds issuance could exceed $50 billion by a significant margin"[198]. In the aftermath of COP21, the development of green bonds during the first quarter of 2016 was three times quicker than over the same period in 2015.[199]

Despite this positive development in recent years, the green bond market still faces various barriers, such as low liquidity, lack of benchmark indicators or dependency on external guarantees. **Standardising the issuance process and technical aspects related to environmental performance measurement could increase reliability and trigger further private investment. This should be accompanied by better reporting processes and governance, and in particular third party verification, increasing credibility.**

6.3. Ease access to energy efficiency funding for SMEs

Policy makers should also turn their attention to small and medium-sized enterprises (SMEs) enabling them to obtain easy access to energy efficiency financing, inter alia by aggregating smaller energy efficiency projects until they reach a critical size. This can be done with the help of local or regional authorities or other intermediates with a well-established network.

SMEs represent 99% of all companies in the EU[200]. However, only 64% of all SMEs are taking action to save energy compared to 82% of large companies[201]. One of the reasons for this discrepancy lies in the fact that accessing energy efficiency finance requires particular knowledge and expertise. Access to public funds can be particularly difficult for SMEs due to a variety of barriers, such as project size considerations, high transaction costs or simply too much red tape.

One successful example for a model that combines access to capital with business information, technical support and capacity building for SMEs is the Sustainable Energy Financing Facility (SEFF) created by the European Bank for Reconstruction and Development (EBRD) in 2006. Since 2006, the EBRD had provided over EUR 3 billion in sustainable energy financing, involving more than 104 financial institutions and reaching 75,000 clients in 22 countries[202]. The EBRD uses the SEFF to extend credit lines to regional and local financial institutions, such as banks or microfinance institutions in order to support specific sustainable energy projects. As a second step, the partners of EBRD on-lend these funds to their clients, of which many are SMEs.[203]

Project grouping or collective solutions bringing together several SMEs should be used to facilitate fund raising.

One good example of a collective solution is the Norwegian Industrial Energy Efficiency Network (IEEN) which was established in 1999 by the Ministry of Petroleum and Energy in Norway with the objective of encouraging energy efficiency measures[204]. Around 900 companies, of which around two thirds were SMEs, joined the programme. The companies had access to grants from the government to cover a significant part of their costs related to energy audits or energy efficiency measures. A web-based benchmarking tool helped the companies to compare their performance to the other participants and to detect inefficiencies.[205]

Aggregation of projects can be achieved through pooling mechanisms, if one single company has several projects or through bundling mechanisms when comparable projects are undertaken by several companies.

198 Moody's, https://www.moodys.com/research/Moodys-Green-bond-issuance-could-exceed-50-billion-in-2016--PR_343234

199 Pialot D., (2016), La France peut-elle devenir un leader de la finance verte ?, http://www.latribune.fr/entreprises-finance/industrie/energie-environnement/la-france-peut-elle-devenir-un-leader-de-la-finance-verte-568594.html

200 European Commission, What is an SME?, http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/index_en.htm

201 European Commission, Eurobarometer survey: SMEs are important for a smooth transition to a greener economy, http://europa.eu/rapid/press-release_MEMO-12-218_en.htm

202 EBRD, http://seff.ebrd.com/about-seff.html

203 EBRD (2015), Moulded plastic manufacturer benefits from energy efficiency, http://seff.ebrd.com/case-study/plastic-moulding-company.html

204 EEA (2013) - Achieving energy efficiency through behaviour change: what does it take? http://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour

205 This programme was recently ended and a successor programme has been implemented.

Facilitating the access to energy efficiency financing needs to become a key priority at the EU and Member State level, and a set of key actions needs to be taken to get on track to meet the EU's long-term targets. Since various barriers (long payback period, uncertainty about energy prices and lack of relevant and understandable information for investors) are undermining the attractiveness to traditional investors of financing energy efficiency measures, it should be partly up to the public sector to gather specific funding for energy efficiency. The amount that needs to be invested each year to achieve Europe's 2020 energy efficiency targets is EUR 100 billion[206], while current total annual investment by public banks is estimated at EUR 15-20 billion only[207].

- **Ramping up funds and facilitating the access to energy efficiency financing needs to become a key priority at the EU and at Member State level.**

Nonetheless, these public funds should not aim at financing all energy efficiency measures but at creating a momentum, stimulating private financing to close the investment gap.

- **Tailor-cut solutions provided by closer public-private collaborations need to be developed to drive broader investments in energy efficiency.**

Innovative financing mechanisms are currently being developed: energy performance contracting schemes (EPC) offered by Energy Service Companies (ESCO), green bonds, etc.

- **Such innovative mechanisms need to be put in place or promoted to gain momentum throughout Europe.**
- **Last but not least, SMEs deserve particular attention: specific support needs to be offered, among others, through intelligent project pooling structures and bundling mechanisms.**

206 *European Commission, Financing energy efficiency, https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency*

207 *DIW (2013), Financing of Energy Efficiency: Influences on European Public Banks' Actions and Ways Forward, http://www.diw.de/documents/publikationen/73/diw_01.c.422405.de/hudson_financing.pdf*

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