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Good practice in energy efficiency

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency

{COM(2016) 761 final}

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Glossary and abbreviations

BPIE	Buildings Performance Institute Europe
BAU	Business as usual
CA	Concerted Action
CoM	Covenant of Mayors
DH	District Heating
EED	Energy Efficiency Directive
EEOSs	Energy Efficiency Obligation Schemes
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
EnPC	Energy Performance Contracting
ESCO	Energy Service Company
ESIF	European Structural and Investment Funds
EFSI	European Fund for Strategic Investment
ERDF	European Regional Development Fund (part of ESIF)
GPP	Green Public Procurement
H2020	Horizon 2020
IEE	Intelligent Energy Europe
MS	Member State
MSA	Market Surveillance Authority
PDA	Project Development Assistance
PEC	Primary Energy Consumption
PPI	Public Procurement of Innovation
RED	Renewable Energy Directive
SEAP	Sustainable Energy Action Plans
SPP	Sustainable Public Procurement
SWD	Staff Working Document

1. Energy efficiency policy works

1.1. Executive summary

Energy efficiency and the "energy efficiency first" principle are at the heart of the Energy Union strategy[1]. Nevertheless, recent years' experience has shown that there are considerable barriers to full uptake of economically effective and technically feasible energy savings opportunities across the EU.[2]

Some commentators complain of a lack of political will in the drive towards energy efficiency, while others point to the complexity, cost, and technical difficulties of delivering large scale gains. While these arguments may to some extent be valid, they overlook the significant progress made in decoupling economic growth from energy use.

Since the first analysis of energy saving potential by 2020, set out in the 2005 Green Paper on Energy Efficiency[3], a major upgrade in energy efficiency capacity has taken place throughout the EU. Energy efficiency policies are working, and are delivering not only in terms of reducing consumption, but in terms of safeguarding Europe's security of supply, reducing CO_2 emissions and leading to monetary and non-monetary benefits for Europe's industry and consumers. This includes vulnerable consumers who are affected by energy poverty.

This Staff Working Document (SWD) presents capacity building activities and good practice derived from policy implementation, technology development and investment in energy efficiency across different sectors and throughout all EU Member States (MS). Projects carried out under the Horizon 2020 Energy Efficiency calls, the Intelligent Energy Europe programme, and the European Structural and Investment Funds programmes have produced many examples of good practice at national, regional and local level. These can serve as blueprints for similar initiatives in other Member States thus allowing for a more systematic uptake of good practice across the EU. The Commission has also recently established a number of support tools that facilitate further the sharing of good practices and capacity building. Furthermore, the projects provide valuable messages and 'on the ground' feedback for policy making.

The large body of evidence for this document on successful policies and measures was provided among others by: Concerted Actions on the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD), the ODYSEE-MURE[4] project, which developed databases on energy efficiency measures and policies across the EU; and the EEW3 project, which produced 10 specific case studies of good policy practice carried out by Member States providing market feedback from experts, business stakeholders, and local and regional actors.

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1 COM(2015) 80 final

2 See for example: ICF International (2015): Study on energy efficiency and energy saving potential in industry and on possible policy mechanisms. Contract No. ENER/C3/2012-439/S12.666002. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/151201%20DG%20ENER%20Industrial%20EE%20study%20-%20final%20report_clean_stc.pdf;
US Department for Energy (2015): Barriers to industrial energy efficiency. Report to Congress. Available at: http://www.energy.gov/sites/prod/files/2015/06/f23/EXEC-2014-005846_6%20Report_signed_0.pdf;
Cagno E et al (2015): Barriers and drivers for energy efficiency: Different perspectives from an exploratory study in the Netherlands, Energy Conversion and Management, Volume 102, pp. 26-38

3 Commission Green Paper, 22 June 2005, "Energy Efficiency - or Doing More With Less", COM(2005) 265 final. Available at: http://eur-lex.europa.eu/legal-content/RO/TXT/?uri=uriserv:l27061

4 Available at www.odysee-mure.eu

1.2. Introduction

- ***GDP has been decoupled from energy consumption in Europe***

In the context of this SWD it is worth noting the following key messages[5]:

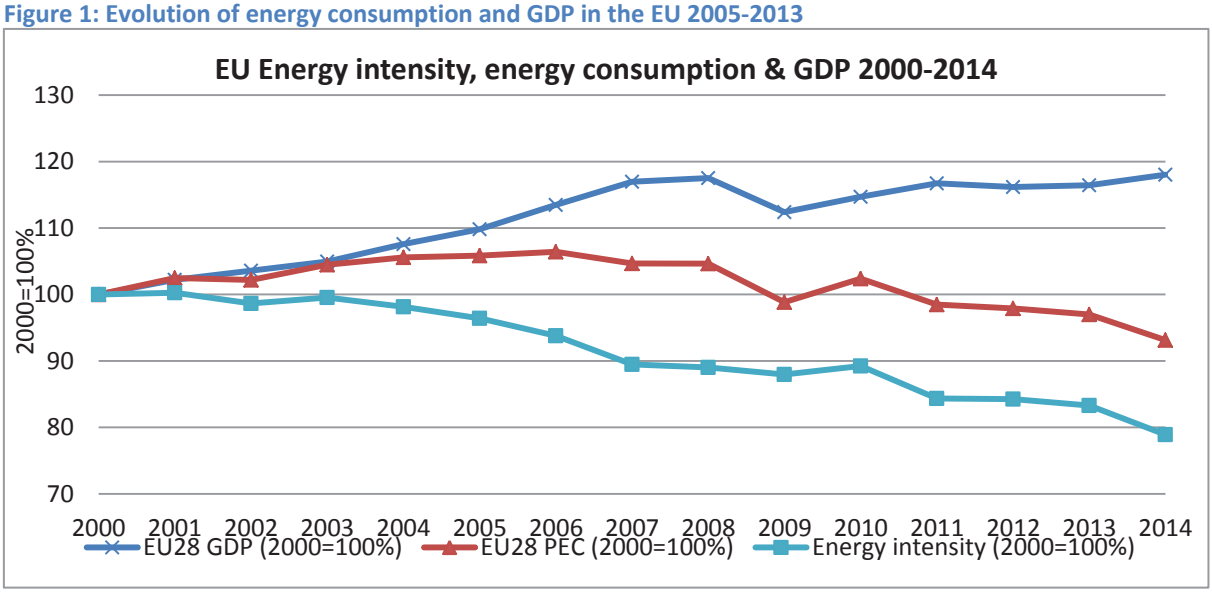
- The EU has managed to decouple energy demand and economic growth[6]. Whereas, in previous years, energy efficiency progress only kept energy demand stable despite economic growth, the present setting clearly underlines that Europe's economy can grow while at the same time achieving absolute energy savings in absolute terms (Figure 1).
- Even during the recent economic and financial crisis, energy savings gained through improved energy efficiency outweighed the demand reduction caused by the economic downturn. As discussed in a variety of literature on 'green growth', energy efficiency can counter the adverse effects of economic downturn and lead to economic growth. Several Member States' energy efficiency action programmes actively rely on this macroeconomic benefit to the economy[7].
- Consumption trends vary – sometimes significantly – from country to country. While this can largely be attributed to supply and demand structures of the energy system, it also reflects the successful experience and early adoption of energy efficiency measures in given sectors. This in turn implies that analysis and exchange of good practice is vital to achieving further energy savings by 2030.

5 COM(2014) 520 final; SWD(2014) 255 final; SWD(2014) 256 final; Saheb Y, Ossenbrink H – JRC (2015): Securing Energy Efficiency to Secure the Energy Union. How Energy Efficiency meets the EU Climate and Energy Goals. JRC Science and Policy Report, Report EUR 27450 EN. Available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97451/2015-12-09%20securing%20energy%20efficient%20to%20secure%20the%20energy%20%20union%20online.pdf

6 One could argue that energy embodied in imported/exported goods and services of EU28 need to be taken into account when assessing if energy consumption of EU28 decoupled from economic growth. Data on the energy embodies in the imported/exported goods is not available. However it is assumed here that the conclusion that EU28 decoupled energy demand and economic growth holds because Eurostat data shows that exports of goods and services from the EU28 increased more than imports from the EU28 from 2005 onwards.

7 See for example the analysis of the German National Action Plan on Energy Efficiency (NAPE) in Fraunhofer ISI (2015): Identifying instruments to realise final energy savings in Germany based on a cost-benefit analysis. Scientific support to develop the National Action Plan on Energy Efficiency (NAPE). Available at: http://www.isi.fraunhofer.de/isi-en/x/projekte/nape_331600.php; Ringel, Schlomann et al (2016): Towards a green economy in Germany? The role of energy efficiency policies. Applied Energy. doi:10.1016/j.apenergy.2016.03.063

Figure 1: Evolution of energy consumption and GDP in the EU 2005-2013

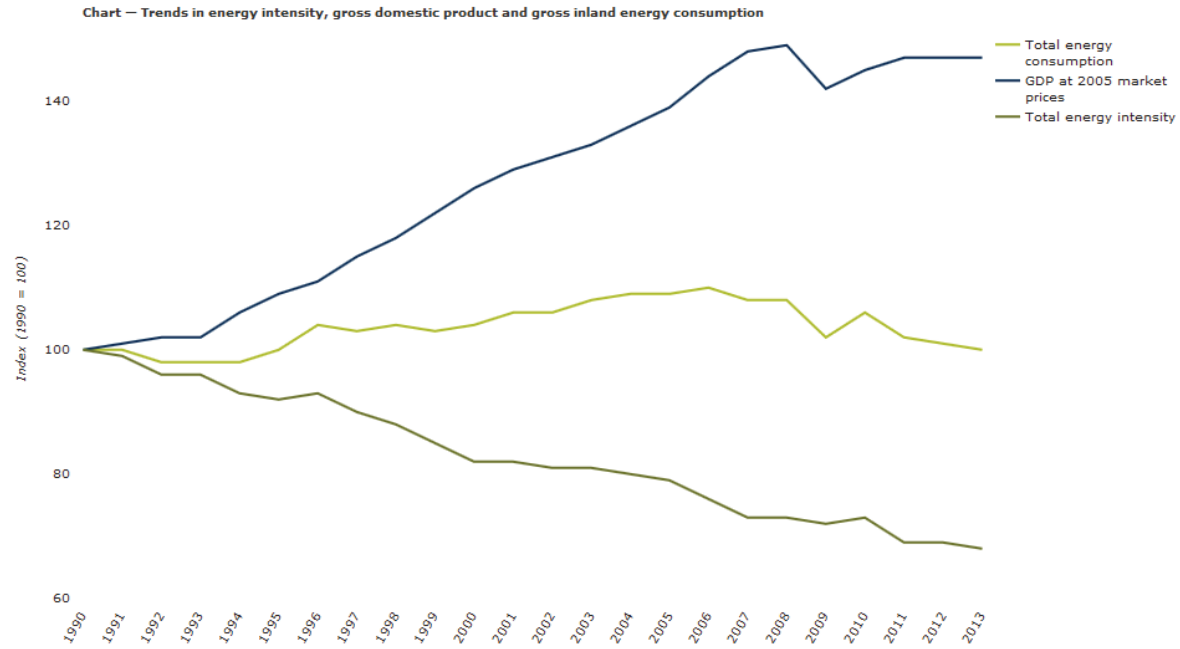


Source: Eurostat

- ***Decoupling: what happened and how it happened***

Decoupling of energy consumption from economic output (GDP) is confirmed by the decreasing indicator of 'energy intensity'. Between 1990 and 2013, energy intensity declined by 1.7% per year in the EU-28 countries. In 2013, energy intensity was 32% below the 1990 level in the EU-28. The period 1990-2005 is characterised by relatively high economic growth and the more modest growth of gross inland energy consumption. The period 2005-2013 is characterised by much smaller economic growth and decreasing gross inland energy consumption (Figure 3)[8].

Figure 2: EU Energy intensity, energy consumption & GDP 1990-2013



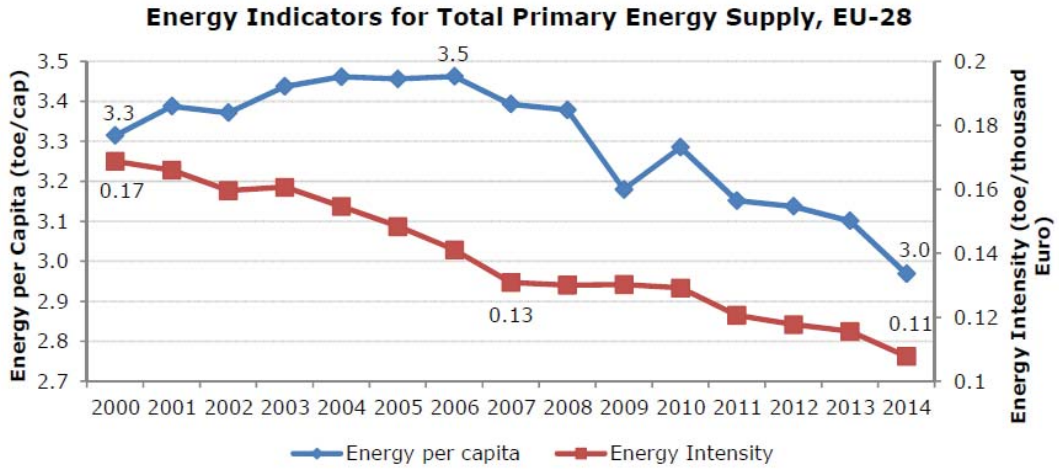
Source: EEA 2015 based on Eurostat data

8 European Environment Agency 2015, http://www.eea.europa.eu/data-and-maps/indicators/total-primary-energy-intensity-2/assessment

Clearly, 2006 marked a turning point in energy efficiency progress. Until then, gains in energy efficiency largely kept energy consumption steady against strong economic growth. From 2006 onwards, energy efficiency gains led to an absolute reduction in consumption while maintaining economic growth at the same time.

According to the recent report from the JRC[9], energy intensity declined from 0.17 to 0.11 toe/thousand Euro in the period 2000-2014 due to several factors such as structural changes in recent years in the overall economy and technological improvements, together with the positive impact of energy efficiency policies both at European and national level.

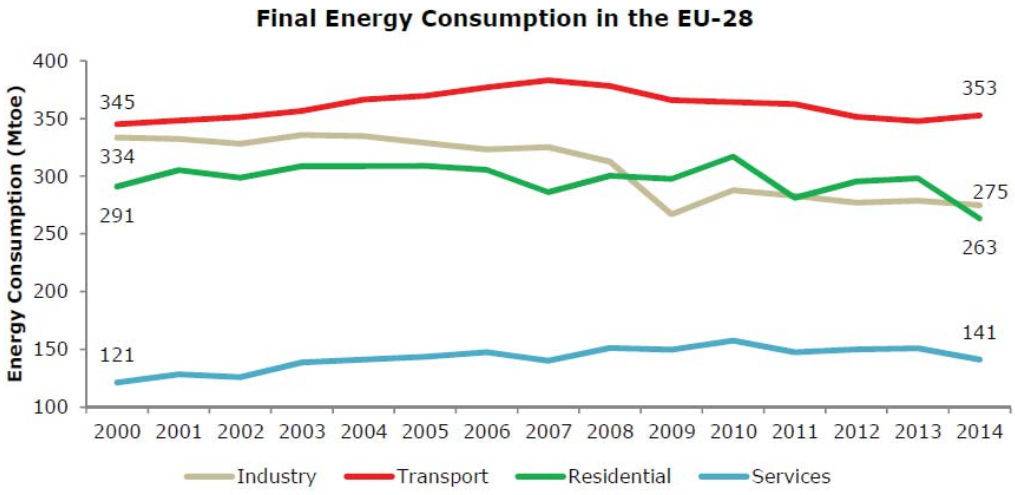
Figure 3: Energy indicators for total primary energy supply, EU-28



Source: JRC (2016): Energy Consumption and Energy Efficiency Trends in the EU-28 2000-2014

The final energy consumption in EU-28 shows a decrease of 6.3% between 2000 and 2014 and the following sectoral decomposition (Figure 4).

Figure 4: Final energy consumption in the EU-28



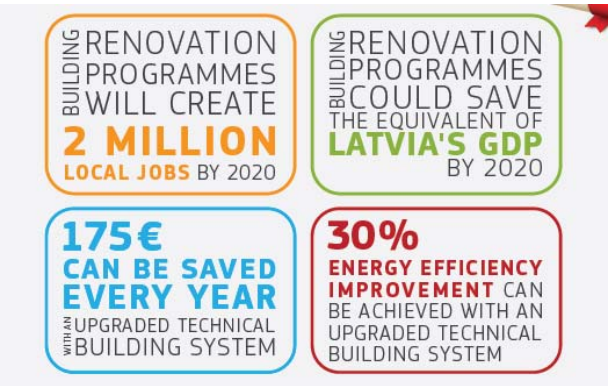
Source: JRC (2016): Energy Consumption and Energy Efficiency Trends in the EU-28 2000-2014

It is hard to distinguish a dedicated policy effect on the individual consumption sectors like

[9] Bertoldi P, Lopez Lorente J, Labanca N – JRC (2016): Energy Consumption and Energy Efficiency Trends in the EU-28 2000-2014; available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101177/report%20energy%20trends%202000-2014_19.05.2016_final-pdf.pdf

households and tertiary sector as this cannot be deducted from statistics. Still factual evidence can help to trace the large impact of energy efficiency policies:

- With the EU Directive on *Energy Performance of Buildings* in 2004, mandatory efficiency standards for new buildings were introduced and continuously tightened while becoming broader in scope. This implied that all new buildings in the EU needed to perform to minimum standards or above. In many countries this triggered private interest in going beyond the minimum standards or in broadening the perspective to energy-saving refurbishment of the existing building stock. This was for example largely the case with the KfW building programmes in **Germany**.
  The evaluation of the EPBD (2010/31/EU) in 2016 shows clear progress in tackling the efficiency of the buildings sector: the decrease in energy consumption per floor area (kWh/m²) accelerated markedly after 2006 (the application date of the 2002 EPBD), and was further sustained by the effect of the recast EPBD in 2013 and 2014. There is evidence of around 37 Mtoe additional final energy savings in 2013 compared to the 2007 baseline of the recast EPBD. This indicates that the Directive is likely to deliver the expected impacts by 2020.



- *Labelling* in terms of household equipment and office equipment (energy star) increased consumer awareness of energy consumption. This, combined with higher energy costs, led to a clear pull-factor for energy efficient appliances.
  With the *Ecodesign* Directive, minimum standards were subsequently introduced for product groups. The worst-performing energy guzzlers were gradually and very publicly taken off the market. This, in turn encouraged industry to come up with new products complying with or exceeding the minimum standards.

  Analysis of 35 product groups shows the following main results for the EU-28 in 2020[10]:

- Close to 6900 PJ (165 Mtoe, 1918 TWh) primary energy saving, i.e. a saving of 18% for the average product;
- Nearly 52% of the 2020 savings comes from the residential sector, 31% from the tertiary sector, 14% from the industry sector and 3% from other sectors[11].
- 319 Mt CO_2 equivalent (7% of 2010 EU-total) less greenhouse gas emissions;
- EUR 112 billion net saving on consumer expenditure;
- EUR 57 billion extra revenue for industry, wholesale, retail and installation sector;
- 0,8 million extra direct jobs for industry, wholesale, retail and installation sector[12].

Figure 5 shows that there is a good match of the Ecodesign impact accounting and the aggregate Eurostat energy balance data, which starts decoupling the 'business as usual' (BAU) scenario from 2006.

10 The study "Ecodesign Impact Accounting – Status January 2016" Van Holsteijn en Kemna B.V. (VHK)

11 Other sectors include e.g. the energy sector, and agriculture and forestry

12 Direct jobs means jobs in the value-added chain. Indirect employment effects may be higher by a factor of 3 to 5 higher, but no consensus agreed factor is available.

Figure 6 emphasises that, not unexpectedly, space- and water heating products and lighting are the main sources of savings.

Figure 5: Comparison of data from Ecodesign impact accounting (Ecodesign: coloured graph; BAU total: dotted orange line) versus Eurostat energy balance outcomes (dark blue line), for the EU residential electricity consumption in TWh/a (VHK, March 2016)

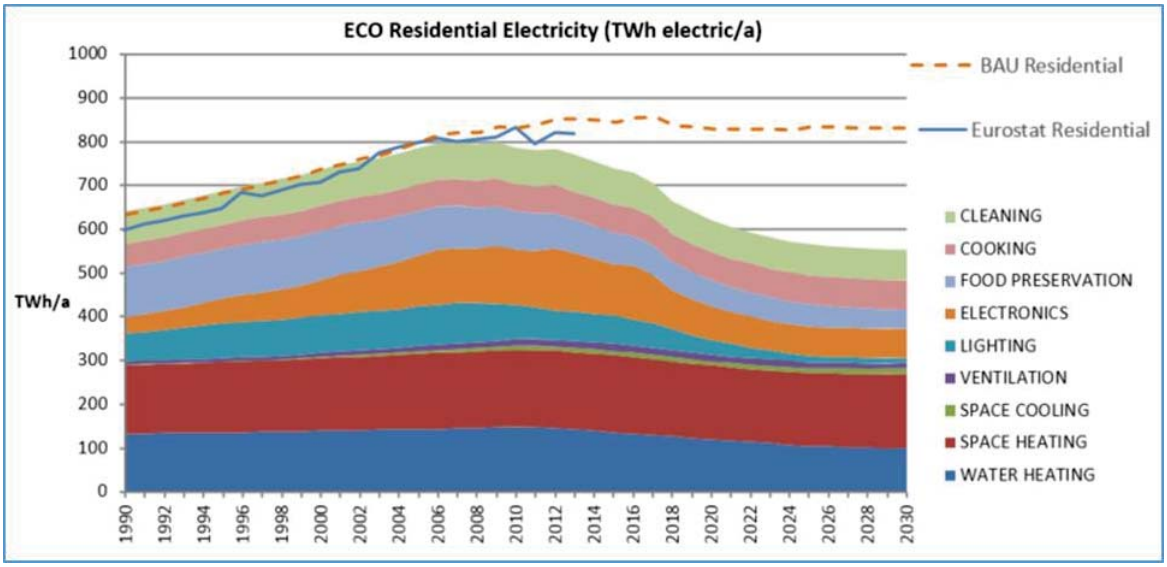
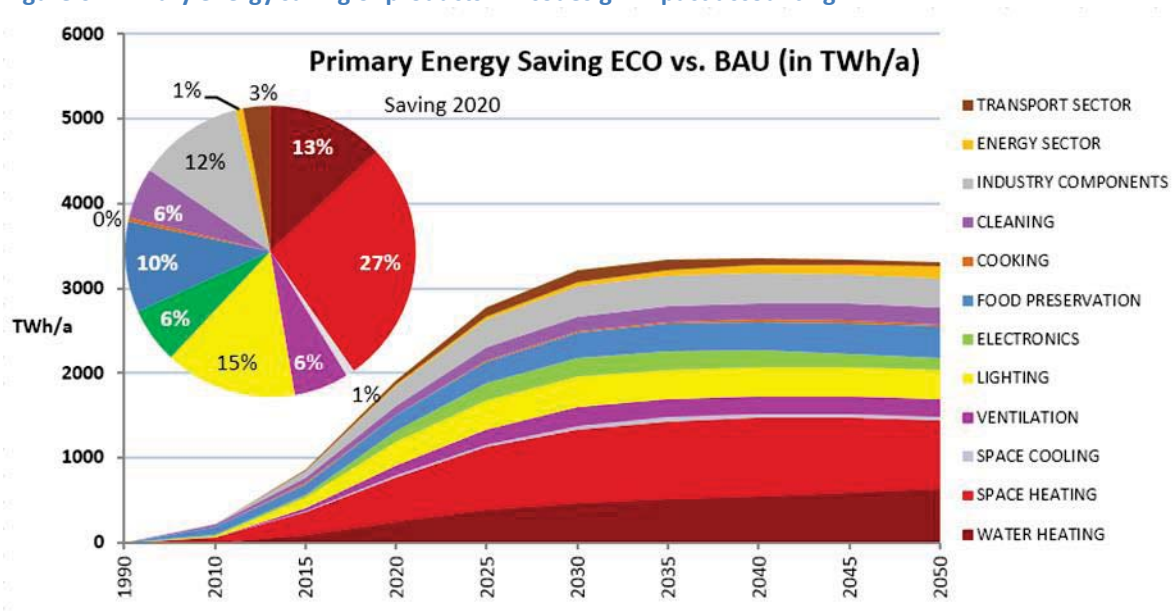


Figure 6: Primary energy saving of products in Ecodesign impact accounting



Source: "Ecodesign Impact Accounting – Status January 2016" Van Holsteijn en Kemna B.V. (VHK)

- Securing *political commitment for energy efficiency*: the 2006 Energy Services Directive introduced many measures and actions aimed at turning government attention for energy efficiency into concrete actions. It asked for the public sector to take a leading (exemplary) role.
- *Capacity building and aligning policies to EU best practice*: with the introduction of regular National Energy Efficiency Action Plans, governments started to systematically analyse and work on their energy saving potential. The process leads to stronger coordination between energy efficiency stakeholders both nationally and internationally. With the Concerted Actions on the EPBD and the Energy Saving Directive and later the EED, good governance and the exchange of best practice instruments became easier and more systematic than before.

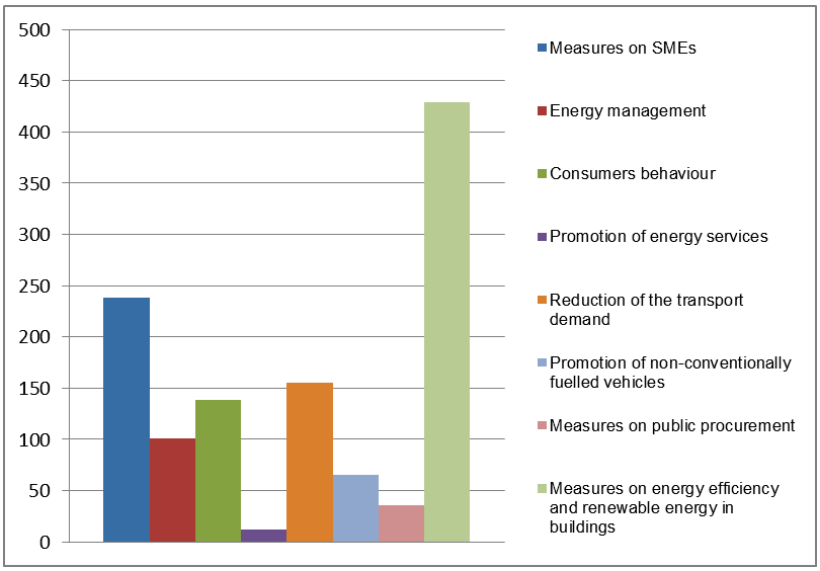
- *Developing marketable energy efficiency solutions*: with the obligation to foster energy service markets, to set up energy audits and notably to reduce energy consumption via energy efficiency obligation, strong signals have been sent to the markets that energy efficiency is a marketable good associated with many benefits for the consumer.

Repeated iterations to improve energy efficiency policy lead to a regulatory framework which delivers the decoupling of economic growth and energy consumption.

• *Energy efficiency opportunities: policies are working to a large extent and more could be done*

As discussed above, energy efficiency policies play a key role in the transition to a more competitive, secure and sustainable energy system. At present, the MURE database on energy efficiency measures lists some 995 energy efficiency policies and measures in the EU (for distribution see Figure 7 and Figure 8)[13]. This clearly shows the need for good policy coordination, but on the other hand the large pool of policy measures offers the advantage that best practices can be identified[14] and introduced in other countries. This creation of positive synergies and learning curves among Member States has been a central theme of the Horizon 2020 Energy Efficiency calls for proposals and the predecessor programmes Intelligent Energy Europe I and II. In turn, the projects funded under these programmes allow for feedback on policy design from the local level which can help to improve policy-making.

Figure 7: Energy efficiency measures in place in the EU 28- distribution per topic and target group (status 2016)

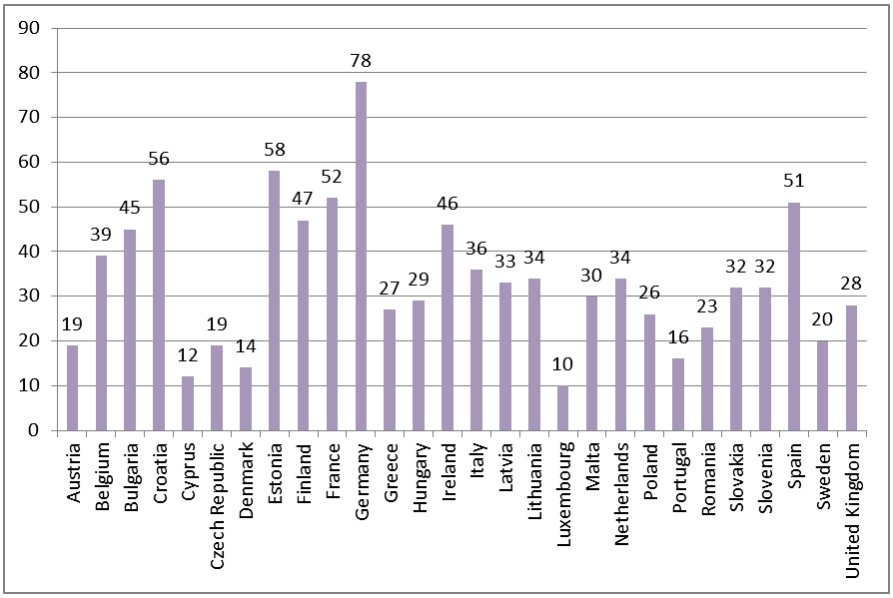


Source: Based on data from MURE database

13 ODYSEE-MURE Project (2016). Available at: http://www.measures-odyssee-mure.eu/

14 In the present tender ODYSEE-MURE has undertaken an in-depth analysis of best practice instruments per Member States based on a scoring system. The measures highlighted as best practices can be found in Annex I. Odyssee-Mure (2015): Synthesis: Energy Efficiency Trends and Policies in the EU. Available at: http://www.odyssee-mure.eu/publications/br/synthesis-energy-efficiency-trends-policies.pdf

Figure 8: Energy efficiency measures in the EU 28- distribution per country (status 2016)



Source: Based on data from MURE database

Barriers often hinder effective deployment of energy efficiency measures as is highlighted in the ODYSEE-MURE project[15]. By contrast to other energy policy fields, effective energy efficiency policies need to address dispersed saving potential in different sectors across the economy as well as dealing with a multitude of actors. This implies that the still considerable energy savings potential of the EU is a sum of many individual actions and projects which would be implemented nationally, regionally or locally.

In addition to applying energy saving measures to current infrastructures and systems, it is crucial to provide the basis for future efficiency gains through targeted research and development. New key enabling technologies need to be developed and deployed, e.g. by substituting currently used materials with advanced materials that inherently would guarantee better energy efficiency of houses or industrial transformation processes. New cost-efficient technological solutions for energy efficient buildings will enable the massive deployment of NZEB or energy-plus buildings, and innovation in resource- and energy efficiency in the process industry will permit to reduce its energy demand and its CO2-emissions.

[15] ODYSEE-MURE (2016). Policy Scoreboard - Output-based scoring (related to 2020 energy efficiency targets). For details on methodology see http://www.measures-odyssee-mure.eu/scoreboard-energy-efficiency-policy_mix.asp?cosa=3

2. Cross-cutting measures to support energy efficiency

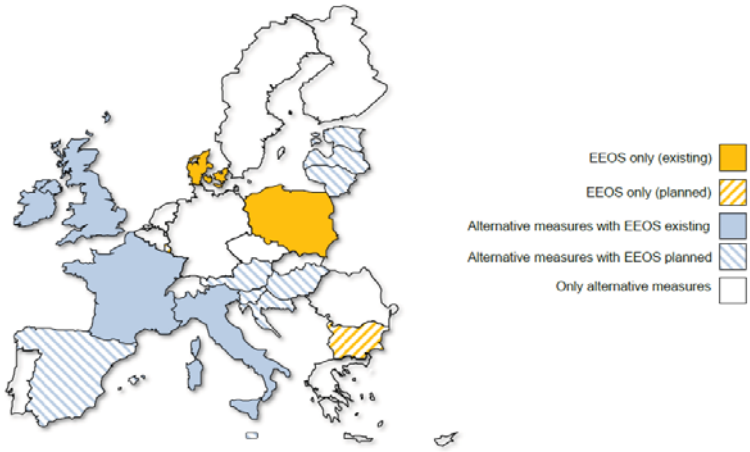
2.1. Energy Efficiency obligations

- ***Policy context***

In order to support final consumers to identify and implement energy savings, Article 7 of the Energy Efficiency Directive (EED) requires Member States to put in place Energy Efficiency Obligation Schemes (EEOSs) or use alternative policy measures to deliver a targeted amount of energy savings[16] amongst final energy consumers. Key rationale of the EEOSs is that energy suppliers, retailers and distributors are best placed to identify energy savings with their customers and will be able to achieve energy savings into business models for energy services.

All Member States have by now submitted their 2020 saving targets which amount to 230.2 Mtoe, out of which EEOSs are expected to deliver 86 Mtoe[17]. Four Member States (**Denmark, Bulgaria**[18], **Luxembourg**[19], **Poland**) intend to rely on EEOSs only, whereas 12 Member States have chosen to achieve the saving targets by a combination of EEOSs and alternative measures or alternative schemes alone (figure 9). The other Member States chose to fulfil Article 7 by using alternative measures[20].

Figure 9: Status of article 7 EED measures



Source: Ricardo AEA/CE Delft (2016)

Overall, some 480 measures have been notified.[21] The cumulative savings expected show that by and large, EEOSs would deliver the largest impact (34% of total savings), followed by financing

16 The energy savings to be achieved by EEOSs and/or alternative measures must be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final consumers of all energy distributors or all retail energy sales companies by volume averaged over the previous three consecutive years 2010-2012.

17 http://ec.europa.eu/energy/en/topics/energy-efficiency-directive/obligation-schemes-and-alternative-measures

18 For a description of the planned EEOSs in Bulgaria see Odyssee Mure (2015): BG 25: Energy Efficiency Obligation Scheme. Available at: http://www.measures-odyssee-mure.eu/public/mure_pdf/general/BG25.PDF

19 For a description of the planned EEOS in Luxembourg see Odyssee Mure (2015): GEN-LUX9 EU related : Directive 2012/27/EU – Energy Efficiency Obligation Scheme. Available at: http://www.measures-odyssee-mure.eu/public/mure_pdf/general/LUX9.PDF

20 Ricardo AEA/CE Delft (2016): Study on evaluating the implementation of Article 7 of the EED

21 361 measures are documented in detail in the Odysee Mure database. See http://www.measures-odyssee-mure.eu/output1A_all.asp

schemes or fiscal incentives (19% or 49 Mtoe) and energy or CO_2 taxes (14% or 34 Mtoe).[22] It remains to be seen which scheme will deliver the savings at the lowest prices (cost effectiveness) as this strongly depends on actual implementation on the ground in the different Member States.

- ***Project feedback on Energy Efficiency Obligations***

In order to facilitate and accompany the implementation of Article 7 EED, a number of projects in the Horizon 2020 Energy Efficiency programme have focussed on retrieving lessons learned and establishing best practices on the overall schemes or technical details of them[23]. Contrary to the five EEOSs existing before the EED (**Belgium** (**Flanders**), **Denmark, France**, **Italy** and **the UK**)[24], the seven new EEOSs are presently in their set-up phase which limits the number of lessons learned in these cases. The review and analysis of certain design and implementation features of the existing schemes allowed the projects to identify good practices, even though this is still work in progress.

The **Danish** Energy Efficiency Obligation Scheme (Box 1)[25] shows the following success factors: large choice for the obliged parties to opt for measures; recurring revision and adaptation of the scheme and incentives with target actions with longer lifetimes such as building refurbishment[26]. These success factors help to explain the overall positive mood of **Danish** energy efficiency experts in a survey on the achievement of the Article 7 EED target in Denmark performed by the Energy Efficiency Watch project[27].

22 Ricardo AEA/CE Delft (2016): Study on evaluating the implementation of Article 7 of the EED

23 Concerted Action on the EED; ENSPOL, Energy Efficiency Watch III, Odyssee-Mure, EU-Merci, among others.

24 See ENSPOL (2015): Energy Saving Policies and Energy Efficiency Obligation Scheme. D2.1.1: Report on existing and planned EEOSs in the EU – Part I: Evaluation of existing schemes. Available at: http://enspol.eu/sites/default/files/results/D2.1.1%20Report%20on%20existing%20and%20planned%20EEOs%20in%20the%20EU%20-%20Part%20I%20Evaluation%20of%20existing%20schemes.pdf?v=2.

25 Analysed by the *Energy Efficiency Watch 3* project among its 10 case studies on best practices in the Member States*; Energy Efficiency Watch (2015): Energy Efficiency Policies in Europe: Case study: The Danish Energy Efficiency Obligation Scheme*. Available at: http://www.energy-efficiency-watch.org/fileadmin/eew_documents/EEW3/Case_Studies_EEW3/Case_Study_EEO_Denmark_final.pdf

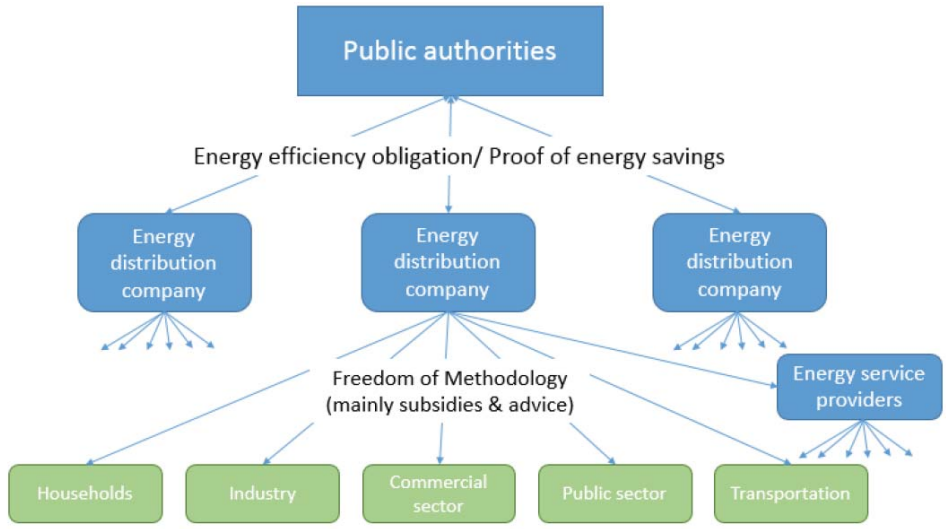
26 big EE (2013): Policy Guide. Online: http://www.bigee.net/en/policy/guide/buildings/policy_examples/42/; Bundgaard, S.S.; Togeby, M.; Dyhr-Mikkelsen, K.; Sommer, T.; Kjærbye, V.H.; Larsen, A.E. (2013): Spending to save: evaluation of the energy efficiency obligation in Denmark. ECEEE Summer Study Proceedings; ENSPOL (2015): Energy Saving Policies and Energy Efficiency Obligation Scheme. D2.1.1: Report on existing and planned EEOSs in the EU – Part I: Evaluation of existing schemes ; Fraunhofer ISI (2014): Kosten-/Nutzen-Analyse von Instrumenten zur Realisierung von Endenergieeinsparungen in Deutschland. Ausgestaltungsoptionen und Bewertung von Instrumenten und möglicher Instrumentenkombinationen für Deutschland; IEA (2012): Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes. Research Report, Task XXII of the International Energy Agency Demand Side Management Programme. Prepared by: The Regulatory Assistance Project

Box 1: The Danish Energy Efficiency Obligation Scheme in a nutshell

Profile

Country	Denmark
Name of policy	Energy Savings Agreement
Type of policy	Energy Efficiency Obligation Scheme
Target sector	All energy sectors (overarching EE governance framework)
Actions targeted	All actions leading to energy savings
Duration	Started in 2006, current period runs from 2012 – 2020, agreement is renegotiated every three years
Overall target and/or achievements	Target: more than 2% of total energy consumption measured as the first year savings relative to annual final energy consumption (0.287 Mtoe/yr (12PJ/yr) of first year savings each year
Overall aim of the policy	Promoting cost-effective energy savings in all end-user sectors of the economy
Innovativeness	Combination with energy audits

Functioning



Source: Energy Efficiency Watch (2015); Fraunhofer ISI (2014)

Given that the EEOSs operate in a national context to trigger additional synergies to other existing policy instruments, many schemes have particular features which can serve as role models or good practice for other countries. In this respect, **Italy** remains the only country which has tradable White Certificates in place. Certificates can be generated by energy managers implementing savings in the industry and buildings sectors, thus creating incentives for putting energy management systems in place[28]. According to the Ministry of Economic Development, from 1 January to 31 October 2013, more than 14 000 projects were completed and 5 million White Certificates were issued. From the

[28] Certificates are not only given to the obligated parties but also to voluntary participants (energy distributors with less than 50 000 customers, energy service companies, entities required to appoint an energy manager, entities which have voluntarily appointed an energy manager, entities that have implemented an energy management system conforming with ISO 500001 (Italian Energy Efficiency Action Plan 2014)). This enhances the effect of the Energy Manager Obligation. Particularly in the two years 2013 and 2014, the total impact more than doubled due to the changes that made the link with the energy manager obligation bear fruit and led to the majority of savings and certificates now originating from the industrial sector. The result was that the industry sector became a main participant in the system with a share of 95% of certificates. See Energy Efficiency Watch (2015): Energy Manager and White Certificate Scheme Italy. Available at: http://enspol.eu/sites/default/files/Lessons%20learnt%20from%20the%20Italian%20white%20certificate%20scheme.pdf

start of the programme until 2014, 6 Mtoe of additional savings were delivered, triggering investment of EUR 600 million per year[29]. Particularly in the years 2013 and 2014, the total impact more than doubled due to the changes that made the link with the energy manager obligation bear fruit and led to the majority of savings and certificates now originating from the industrial sector. The result was that the industry sector became an active participant in the system[30].

A similarly outstanding feature of the **French** Energy Saving Certificates (ESCs or white certificates)[31] is the dedicated inclusion of the transport sector and the strong linking of the system to the end users. This link is established by incentives such as low interest loans for investments in eligible energy savings measures, direct subsidies that reduce the price of eligible measures or rebates[32] to beneficiaries that declare a measure they installed was a result of the obligated party, and bonuses to installers who promote the measures to energy users on behalf of the obligated party. A few chains of hypermarkets or DIY stores grant these rebates to their customers via vouchers exchanged against the invoices for works improving houses energy performance. During the period 2011-2014, the system lead to the installation of 1 million of energy efficient individual boilers, 480 000 wood-burning/biomass stoves and collective boilers in 400 000 apartments. It is expected that the ESC will trigger almost EUR 3 billion worth of investment in the present period (2014-2017).

Figure 10: Rebate voucher "prime énergie"

Source: http://www.hyper-actu.com/prime-energie

There is not one EEOS like the other, this, in turn, allows for the uptake of good practices to fit to national circumstances[33]. For example the **Polish** energy certificate scheme was set up after a thorough analysis of the existing schemes in place. **The UK** is planning to devolve its national EEO system to the regional level, allowing for the uptake of regional and local concerns in the system[34]. **Ireland** and **the UK** have ring-fenced a certain amount of actions triggered by the EEOSs to energy

29 Di Santo, Dario; Tomassetti, Giuseppe; D'Ambrosio, Stefano (2014): White Certificates in Industry. http://www.iepec.org/conf-docs/papers/2014/Dario%20Di%20Santo.pdf

30 EEW3 Case Study *Energy Manager Obligation and White Certificate Scheme – Italy* *http://www.energy-efficiency-watch.org/fileadmin/eew_documents/EEW3/Case_Studies_EEW3/Case_Study_Manager_White-Certificates_Italy_final.pdf*

31 The Energy Saving Certificates (ESCs or white certificates) were introduced in France in 2005 as a means of reducing final energy consumption in sectors with dispersed activity. While the main focus of this policy is to reduce energy uses in residential, commercial, and public buildings, the scheme also includes light industry, agriculture and transport activities. The scheme targets all final energy consumers: i.e. the residential, commercial, public, industrial, agricultural, and transportation sectors. Under the French ESC scheme, obligated energy companies must demonstrate they facilitated the achievement of energy savings in order to gain ESCs. The French energy efficiency obligation is implemented over individual "periods" which are set to run over 3 years with increased savings requirements. For the present period (2014- 2017) a target of 700 kWh cumac, twice as much as for the second period, is to be reached. See Odysse Mure. http://www.measures-odyssee-mure.eu/scoreboard-energy-efficiency-policy.asp

32 Prime-énergie of up to 2000€.

33 The ENSPOL project (http//:enspol.eu) cross-analysed various existing EEOSs

34 http://www.smith-commission.scot/wp-content/uploads/2014/11/The_Smith_Commission_Report-1.pdf

poor households. **Slovenia** intends to follow this stance[35].

The Concerted Action EED, implemented to support the Member States with best practices on the implementation of the Directive, analysed EEOSs in detail and produced a number of publicly available reports and presentations[36]. The 2015 report on Energy efficiency obligation schemes, monitoring impacts of eligible measures contains a collection of good practices identified with present policy actions[37]: Furthermore, the analysis allows to clarify and exchange practices on all technical aspects of article 7 EED, leading to common understanding between Member States and their respective policy instruments[38]. Apart from the support of the uptake of EEOSs by facilitating technical and practical aspects, several projects helped to carve out conclusions aiming at optimising the design of the EEOSs so as to maximise their energy saving impacts (Box 2).

Box 2: Successful design features of EEOSs

ENSPOL underlines "the flexibility of EEO as a policy instrument, and its adaptability to national circumstances and policy priorities. The challenge for EEOSs is adapting to continue to deliver savings, as the low-cost mass market technological savings opportunities reduce." and concludes[39]:

- An effective EEOS needs to achieve a **balance between rules and procedures that are simple enough** for obliged parties to work with, while being complex enough to **meet requirements for additionality, flexibility, auditability and transparency**. Having a catalogue of standardized actions listing best practices in terms of energy efficiency measures and deemed savings that can be expected from these measures can be very effective.
- Policy-makers - certainly in the building sector - have to pay attention to avoid setting up barriers or lock-ins for such interesting, long term solutions, by focusing on only low hanging fruits. In the long term, deep savings are required and therefore, a shift away from low hanging fruit will be inevitable. Therefore, the demand sectors, technology and energy service providers should be **oriented towards long term solutions**.

The above examples show that EEOSs can be combined with alternative measures such as energy audits, energy advice or financial support for energy efficiency improvements so as to create positive synergies[40]. At present it is too early to identify good practices in this field given the strong diversity of the individual policy packages and limited experience with the implementation. On the ground analysis shows that many Member States which have so far opted for alternative measures would

35 ENSPOL (2015): Report on existing and planned EEOSs in the EU - Part II Description of planned schemes. Available at: http://enspol.eu/sites/default/files/results/D2.1.1%20Report%20on%20existing%20and%20planned%20EEOs%20in%20the%20EU%20-%20Part%20II%20Description%20of%20planned%20schemes.pdf?v=2

36 CA EED – Core theme 8. http://www.ca-eed.eu/themes/obligation-schemes-and-monitoring-ct8

37 Thenius G/Concerted Action EED (2015): Energy efficiency obligation schemes, monitoring impacts of eligible measures. Available at: http://www.ca-eed.eu/themes/obligation-schemes-and-monitoring-ct8/energy-efficiency-obligation-schemes-monitoring-impacts-of-eligible-measures3

38 See for example Kulevska T / CA EED (2015): Methods for the calculation of energy savings. Available at: http://www.ca-eed.eu/themes/obligation-schemes-and-monitoring-ct8/executive-summary-8.6-methods-for-the-calculation-of-energy-savings-different-approaches-and-comparability

39 ENSPOL (2015): First Policy Brief. Available at:http://enspol.eu/sites/default/files/1st%20ENSPOL%20Policy%20Brief.pdf

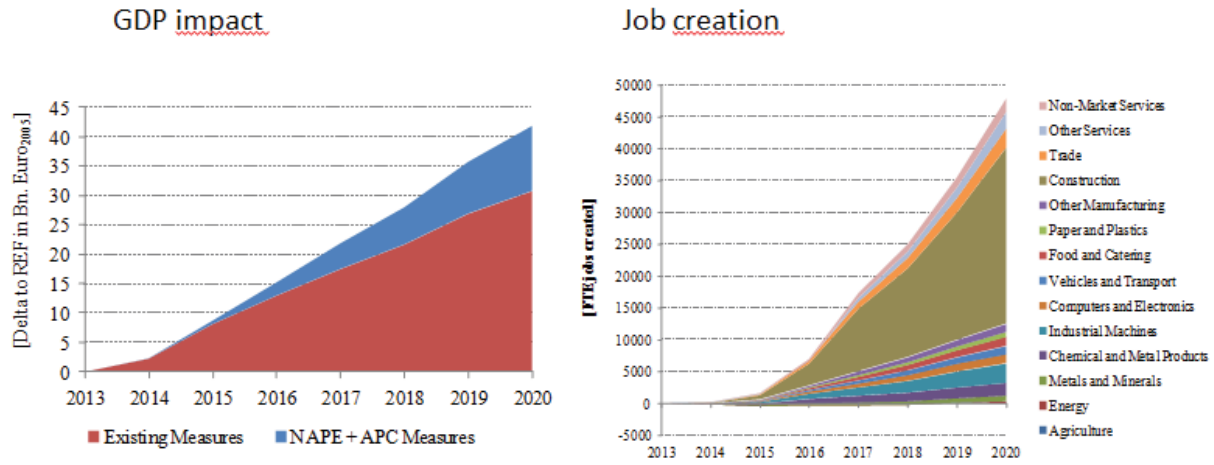
40 For a comprehensive review see ENSPOL (2015): Combining of Energy Efficiency Obligations and alternative policies. Available at: http://enspol.eu/sites/default/files/results/D5.1Combining%20of%20Energy%20Efficiency%20Obligations%20and%20alternative%20policies.pdf

have the institutional, operational and economic capacity to set up a national EEOS[41]. With this it can be expected that further hybrid systems combining EEOSs and alternative measures will be developed.

Whereas all Member States have identified energy saving targets and expected outcomes of the individual schemes, only few modelling estimates on the economic benefits triggered by Article 7 EED and the subsequent upgrade of energy efficiency policies exist. In case of the policy bundle assembled by the **German** NAPE (National Action Plan on Energy Efficiency) and the Action Programme on Climate Change (APC) macroeconomic modelling suggests that the benefits for economic growth and net employment increase are tangible (Figure 11)[42].

It can be expected that similar positive impacts will be triggered in most other Member States as well, underlining the role of Article 7 EED as a policy driver.

Figure 11: Overview of macroeconomic impacts of NAPE and APC policy bundle in Germany



Source: Ringel M, Schlomann, B et al. (2016)

- ***Key findings***

When analysing the set of alternative measures, it shows that many instruments have been upgraded or revised. The same can be found with the existing EEOSs. *"EEOSs have delivered in general very substantial improvements in energy efficiency within the member states. They have demonstrably been a factor in a large fraction of the energy efficiency improvement achieved. Placing obligations on energy suppliers in a competitive market has been successful in that targets have, with rare exceptions, been delivered. In addition, EEOSs have developed incrementally and grown steadily in scale, resulting in growing targets over the years (higher savings realized). Many of the existing schemes started with low targets, but were increased over time, allowing a "learning" period for*

41 ENSPOL (2015): Report on Context Profiles of EU MS countries - Part III Context analysis of countries with EEOSs. Available at: http://enspol.eu/sites/default/files/results/D2.1.2%20Report%20on%20Context%20Profiles%20of%20EU%20MS%20countries%20-%20Part%20III%20Context%20analysis%20of%20countries%20with%20EEOs.pdf?v=2

42 NAPE and APC instruments could achieve cumulated annual energy savings of 241,2 PJ FEC and 394,2 PEC by 2020, leading to a reduction in greenhouse gas emissions of 24,2 Mt CO_2e. Additional NAPE and APC measures could help consumers and industry to avoid fuel costs of EUR 90-100 billion, and trigger additional investments of at least EUR 70-80 billion. These investments in turn mean Germany's GDP would grow by 0,4% to 2,6% and about 48 000 additional full-time-equivalent jobs are created compared to a reference scenario. Ringel M, Schlomann B, Krail M, Rohde C (2016): Towards a green economy in Germany? The role of energy efficiency policies. Applied Energy, doi:10.1016/j.apenergy.2016.03.063

subject under the obligation"[43].

Policy feedback resulting from the good practice analysis

- **Article 7 EED has been a key driver for enhanced energy efficiency action** with tangible energy saving, economic, social and environmental benefits.
- The set-up of EEOSs has necessitated increased capacity building but the **availability of various national models has allowed for the uptake of good practice** features for additional EEOSs. **EEOSs are expected to deliver the highest amount of cumulative energy savings** by 2020.
- EEOSs put a strong emphasis on developing new business models for suppliers and the delivery of cost efficient energy efficiency services at competitive prices.
- Almost all existing EEOSs **were made more stringent by successive revisions** so as to fine-tune the systems.
- Key feature of the revisions where maintaining the cost-effectiveness of the EEOSs while at the same time setting a **framework for targeting long-term savings**, especially in the buildings sector.
- Given the technical complexity of EEOSs, the systems need to strike a balance between ambition and administrative burden. In this sense, a **simplification might be envisaged.**
- EEOSs put a strong emphasis on developing new business models for suppliers and the delivery of cost efficient energy efficiency services at competitive prices.
- With development of the demand-response market the obliged parties could have additional potential to fulfil, in a cost-effective manner, the EEOSs through smart energy management services ensuring energy savings and an optimised energy use.
- Based on the provided examples a conclusion can be drawn that a successful implementation of EEOSs is conditioned to **right channelling of measures** to targeted group of end-users and **building synergies** with other measures or programmes (e.g. central government and local authority funding).

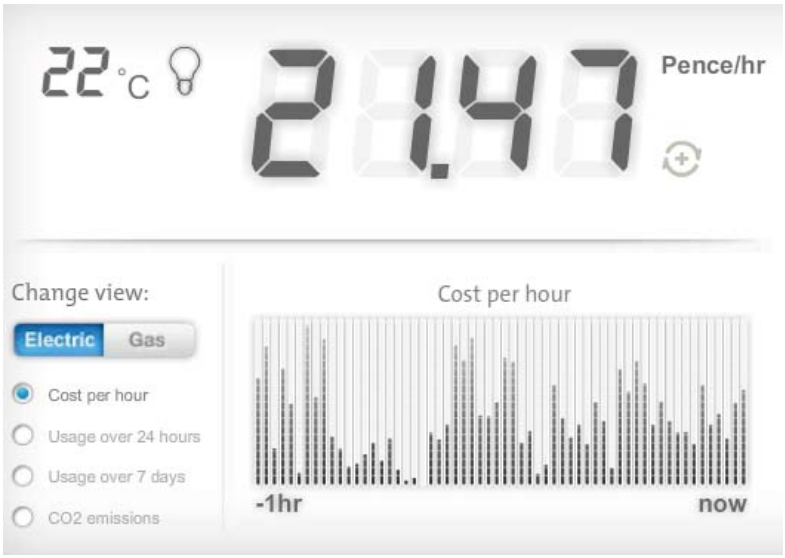
2.2. Informing and empowering consumers through metering and billing

Smart meters allow customers a real time feedback on their energy consumption (Figure 12). This in turn allows consumers to take control of their energy bill and identify and suppress unnecessary energy consumption. Rather than waiting for annual bills, consumers can have an immediate and accurate feedback on their spending on electricity and gas. They will be able to compare this feedback to previous consumption periods or benchmark values to detect and implement energy saving options.

Real time and direct feedback is necessary to harness the full energy savings potential of smart meters with the direct feedback through In-House Displays presenting the bigger savings[44].

[43] Source: ENSPOL

Figure 12: Smart meter display



Source: British Gas[45]

Art. 9-11 EED refer to the roll out of smart meters which is basically foreseen in the internal electricity and gas market directives (2009/72/EC and 2009/73/EC). As a consequence, a majority of Member States have started large-scale roll-out programmes (Figure 13). According to analysis by the European Commission, EUR 195 million electricity smart meters will be installed in 16 Member States covering 72% of consumers. The early actors have been Sweden and Italy, followed by Finland and Malta. For gas, 45 million smart meters will be installed in seven Member States with wide roll-out announced by 2020. These meters will cover 40% of gas consumers in the EU[46].

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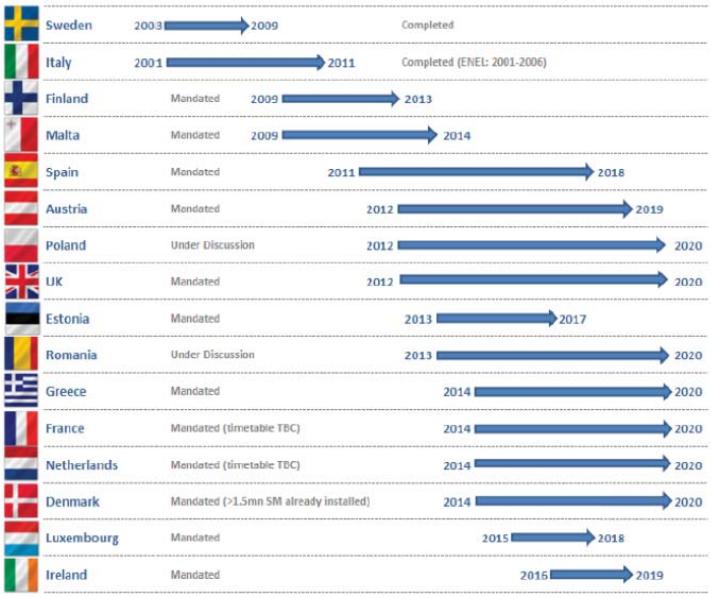
44 Serrenho T, Zangheri P, Bertoldi P – JRC (2015): Energy Feedback Systems: Evaluation of Meta-studies on energy savings through feedback, available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC99716/ldna27992enn.pdf

45 https://www.britishgas.co.uk/smarter-living/control-energy/smart-meters/benefits-of-smart-meters.html

46 SWD (2014) 189

Figure 13: Roll out timing of smart metering in EU Member States



Source: Odyssee Mure (2015)[47] *based on European Commission (2014)* [48]

The provisions of the EED on metering and billing largely aim at supporting consumers to become more aware of their actual energy consumption and consequently to change their use of equipment and their patterns of behaviour.

As the concept of smart metering is technically demanding and raises many implementation questions on legal and consumer protection issues, the Concerted Action EED found two cases of good practice[49]:

- In **Luxembourg**, mass rollout and meter replacement will start on July 1st 2016 and will end December 2019 for electricity and end of 2020 for gas. 95% of all e-meters will be replaced and 90% of all g-meters[50].
- **Finland** undertook a study on 'Cost Effectiveness of Individual Heat Meters and Heat Cost Allocators in Apartment Buildings in Finland' which helped to demonstrate heat metering costs and benefits for individual consumers[51].

Several projects from Horizon 2020 Energy Efficiency and Intelligent Energy Europe have been supporting innovative billing and smart metering[52].

47 European Commission, Borchard KD (2014): Benchmarking smart metering deployment in EU. European Conference on Smart Metering Deployment in the EU Brussels, 26 June 2014.

48 Odyssee Mure (2015): Energy Efficiency Trends and Policies in the Household and Tertiary Sectors. An Analysis Based on the ODYSSEE and MURE Databases. Available at: http://www.odyssee-mure.eu/publications/br/energy-efficiency-trends-policies-buildings.pdf

49 http://www.ca-eed.eu/themes/metering-and-billing-ct3

50 Concerted Action EED (2015): Smart Metering Project for Luxembourg, Luxembourg. Available at: www.ca-eed.eu/themes/metering-and-billing-ct3/smart-metering-project-luxembourg

51 CA EED (2015): Study of Cost Effectiveness of Individual Heat Meters and Heat Cost Allocators in Apartment Buildings in Finland. Available at: www.ca-eed.eu/themes/metering-and-billing-ct3/metering/study-of-cost-effectiveness-of-individual-heat-meters-and-heat-cost-allocators-in-apartment-buildings-finland

52 See for example: SMARTREGIONS which ran until 2013 http://ec.europa.eu/energy/intelligent/projects/en/projects/smartregions#results

The *EMPOWERING*[53] project developed a comprehensive, flexible approach for billing information service development at utility companies and a set of services and open source software tools adapted to the wide European market.

During the project development, the availability of the metering data from smart meters and the effective handling of the customer consent for data access have been identified as the main challenge for the widespread adoption of informative billing services for end-user efficiency. Feedback services based on smart metering data have been provided to 344 000 customers in six countries in Europe.

The project highlighted the possibilities for empowering consumers when receiving more information about their energy consumption. However, it also showed the limits of engaging consumers and that feedback about energy consumption needs to be well designed and tailored to the needs of the customer.

- In **Linz (AT)**, for example, the regional utility offered online information based on data by electronic meters. Customers could switch to a "smart metering" tariff with variable time of use tariffs. However, it was very difficult to get the customers' opt-in for these services and customers' interest in their detailed electricity consumption was low.
- The Spanish partner was a utility on the island of **Mallorca**. The utility offered detailed consumption information, monthly and yearly comparison, last year comparison and outdoor temperature comparisons on the website and also as printed consumption information. The average energy savings from billing information was around 6%. The achieved savings for both billing and online information was around 11% compared to the consumption of a control group. The project recognised not only the technical challenges but also the social aspects and the need to develop a stronger two way communication between customers and utilities.

USmartConsumer[54] (You are a smart consumer project) running until 2017 intends to empower 220 000 householders to benefit from smart meters services, saving average 10 % energy in their homes during project lifetime, over 125 000 MWh/year, in a cost-effective way. Thus, every euro from the budget of this project would save almost 100 kWh/year. The project works on developing at least 40 commercially available smart meter services to households clearly defined and promoted, so as to activate the market and transfer the best practises across Europe.

Energy data is a valuable asset not only for households or other end-user groups but also for policy makers to effectively monitor and target their measures and efforts on reducing energy consumption. Access to energy data has been a problem for public bodies across Europe often due to an insufficiently developed legal framework that is explicitly aimed at energy data sharing and that would foster cooperation between local authorities and energy data providers such as utilities/Distribution System Operators (DSO).

ENEL Distribuzione is the largest and first Distribution System Operator (DSO) in **Italy** that has put in place an energy data sharing system with municipalities developing their Sustainable Energy Action Plans within the EU's Covenant of Mayors (CoM) initiative. The company has elaborated an online template in line with CoM reporting requirements under the *MESHARTILITY*[55] project to share electricity consumption data and has established a unified way of sending data requests. ENEL provides data that can be used for the Baseline Emission Inventory development or for monitoring purposes assisting over 3 100 municipalities in better targeting their energy efficiency efforts and improving their reporting capacity. The portal is unique in Europe and illustrates effective voluntary

53 http://iee-empowering.eu/

54 http://www.usmartconsumer.eu/

55 http://www.meshartility.eu/

collaboration between the public and private sectors[56]. The *MESHARTILITY* project aims at the development of solutions and tools facilitating exchange of energy data between energy utilities and local authorities that are to help assessing local greenhouse gas (GHG) emissions and planning action to address this through energy savings, energy efficiency and the use of renewable energy.

Policy feedback resulting from the good practice analysis

- Strong **coordination mechanisms between all actors** involved are needed for effective roll-out.
- **Consumer engagement and consumer acceptance is key** to delivering energy savings by behavioural changes**.**
- More straightforward and unified **regulation of the data exchange** between DSOs, retailers, customers and service providers is necessary in order to assure easier market penetration of end-user energy efficiency and billing information services.
- **Energy data is a valuable asset also for policy makers** to effectively target, monitor and evaluate their measures and actions.
- Key barriers such as **data protection concerns** need to be taken into account in the rollout strategies.

[56] https://eneldistribuzione.enel.it/it-IT/Pagine/paes.aspx

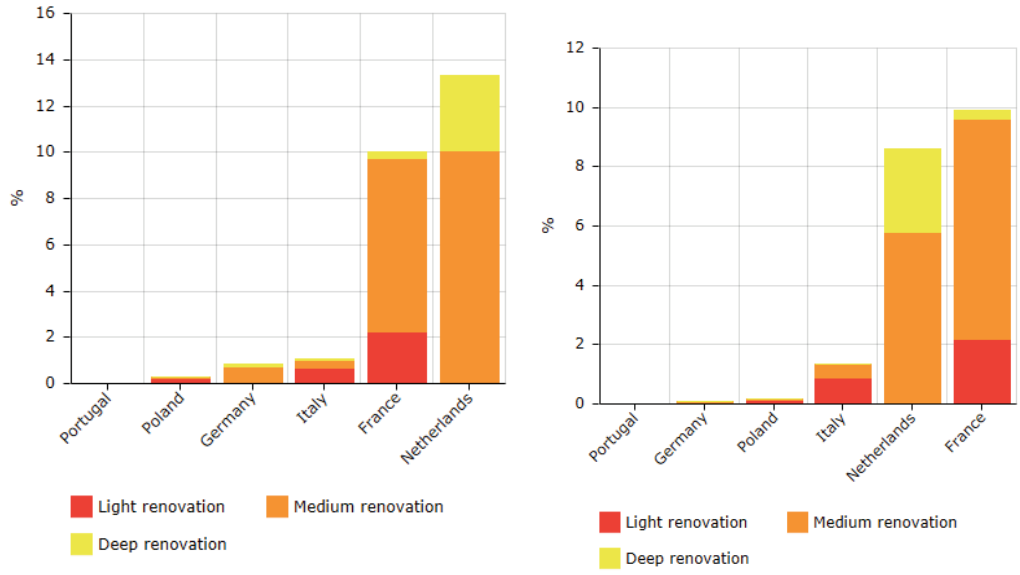
3. Energy efficiency in buildings

The European building stock is responsible for 30% of the EU greenhouse emissions[57] and approximately 404 Mtoe of final energy consumption in 2014, i.e. around 40% of the total consumption[58]. The building stock is expanding in size and its energy consumption and CO_2 emissions are bound to increase in absence of tighter energy performance minimum requirements. Hence, addressing the energy performance of buildings remains relevant to address the 2020-2030-2050 energy and climate policy objectives and boost energy security.

The construction industry provides 18 million direct jobs and contributes to about 9% of the EU's GDP. Up to 95% of construction, architecture, and civil engineering firms are micro-enterprises or small and medium-sized enterprise (SMEs)[59]. Improving Energy performance of the building stock can stimulate economic recovery and promotes growth and creation and retention of jobs.

Depending on the policy intensity at EU and National level, it is estimated that the 2030 energy saving cost effective potential for heating, cooling, ventilation and lighting of buildings ranges from 33 to 80,5 Mtoe[60], mainly in existing buildings. The challenge in achieving energy efficiency targets in Europe remains in the existing built environment. Residential buildings dating between 1945 and 1980 in particular have the largest energy demand. In the context of the economic crises the renovation rate of existing buildings is low.

Figure 14: annual stock renovated by level of renovation in residential in 2012 and 2015



Source: The project ZEBRA2020[61]

57 GHG emissions in the overall inland GHG emissions for Commercial/Institutional/Residential sectors (without LULUCF and without international aviation and international maritime transport). Source: Eurostat.

58 Source: calculations based on Eurostat's data

59 DG Growth, http://ec.europa.eu/growth/sectors/construction/index_en.htm

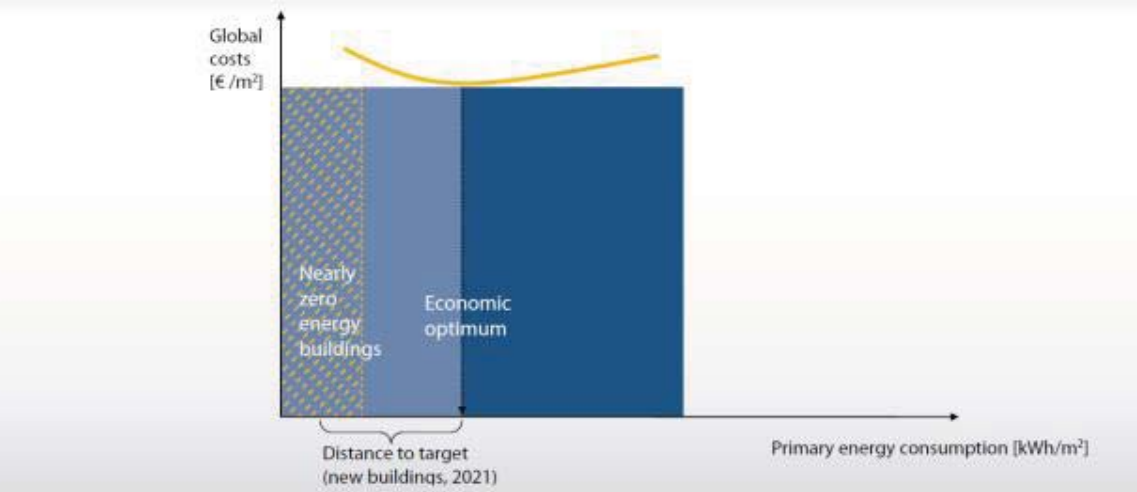
60 Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond, 2014, Fraunhofer ISI.

61 http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-residential-buildings-with-epc-labels-a-or-b.html#share-of-non-residential-buildings-with-epc-labels-a-or-b.html

The cost-optimal[62] level is the energy performance level which leads to the lowest global cost during the estimated economic lifecycle. This means that when assessing cost-efficiency of different packages of measures (combinations of compatible energy efficiency and energy supply measures) the whole lifecycle should be considered and not just the up-front investment.

In the figure below, the lowest part of the curve represents the economic optimum for a combination of packages, so these are packages of solutions with the lowest cost during their lifecycle. The area of the curve to the right of the economic optimum represents solutions that underperform in both aspects: energy performance and lifecycle cost[63].

Figure 15: cost-curve and beneficial areas in relation to cost optimum



Source: BPIE, Assessing cost-optimal levels within the new Energy Performance of Buildings Directive

Proper implementation of cost-optimal levels in national legislations, efforts in ensuring enforcement and compliance with the minimum requirements is crucial to reap the full benefits of the EPBD. The cost-optimal calculation should also be used to set the level of ambition of NZEBs[64].

As regards new buildings a significant number of Member States are falling short in their preparations to meet the Nearly Zero Energy Buildings (NZEB) target, mainly due to the need to adapt current practices in sufficient time to ensure that all new buildings by the end of 2020 are NZEB.

Therefore there is a need for continued and systematic research and innovation efforts with a strategic orientation to develop and promote new technologies. This requires a regular dialogue and cooperative activities of all stakeholders. The existing European Platform for such a cooperation is the Energy-efficient Buildings contractual Public-Private Partnership initiative (EeB cPPP), aiming to develop affordable breakthrough technologies and solutions at building and district scale. Funded by the EU under FP7 and Horizon 2020, EeB has demonstrated its value as a source of new knowledge and promising effective solutions[65,66].

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62 The cost-optimal level shall lie within the range of performance levels where the cost benefit analysis calculated over the estimated economic lifecycle is positive (EPBD, Article 2(14)).

63 BPIE, *Assessing cost-optimal levels within the new Energy Performance of Buildings Directive*

64 Commission Recommendation (EU) 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings.

65 http://ec.europa.eu/research/industrial_technologies/energy-efficient-buildings_en.html

66 http://e2b.ectp.org/fileadmin/user_upload/documents/E2B/EeB_PPP_Project_Review_2016.pdf

According to the Concerted Action on the EPBD[67] **Finland** provides good practice of early involvement of relevant actors also to increase acceptance of jointly developed measures. As the Finnish National Building Codes are developed, professionals and major organisations in the field are consulted and take an active part in the work, through preliminary studies and consultation forums. The proposals for national definitions and guidelines for NZEBs are being developed with active involvement of professional organisations from the construction industry, the building design and planning fields. The involvement of professionals is also visible in the implementation of EPCs. Organisations in the building ownership as well as the building maintenance sectors are involved in both developing the national transposition and disseminating EPCs. Cooperation with the building and construction sectors and active involvement of field professionals has ensured that there is a high degree of compliance with the legislation – laws, decrees and building codes.

In **Brussels-Capital Region** all new buildings and large renovations have to be built according to passive house standards[68], which is a result of the long-term vision and a wide range of measures taken to stimulate sustainable and high energy performance buildings in the region[69]. The Region has initiated numerous actions stimulating demand as well as improving supply such as training programmes for construction sector professionals and subsidy schemes.

From 2007 to 2012 **Brussels** launched a yearly "Exemplary Buildings" call with the intention of stimulating the construction or renovation of buildings. The selected projects received funding and support from experts. This initiative was a major driving force in the construction and renovation of buildings with very high energy and environmental performance. It resulted in more than 800,000 m2 of passive buildings, 2,365 buildings with high energy performance, 2 144 very low energy buildings. 90% of these results were achieved through renovations. First results show a 10% reduction in energy consumption between 2004 and 2010. It is encouraging evidence for **Brussels** energy policy which was rewarded with a EUSEW Award by the European Commission in 2012.

Based on three rounds of successful trials with Exemplary Buildings, on July 12 2009 the Brussels government passed an order imposing the passive standard on all regional new public buildings by 2010, and on May 3, 2011 adopted new energy target regulation for all new construction (housing, offices and schools) by 2015[70].

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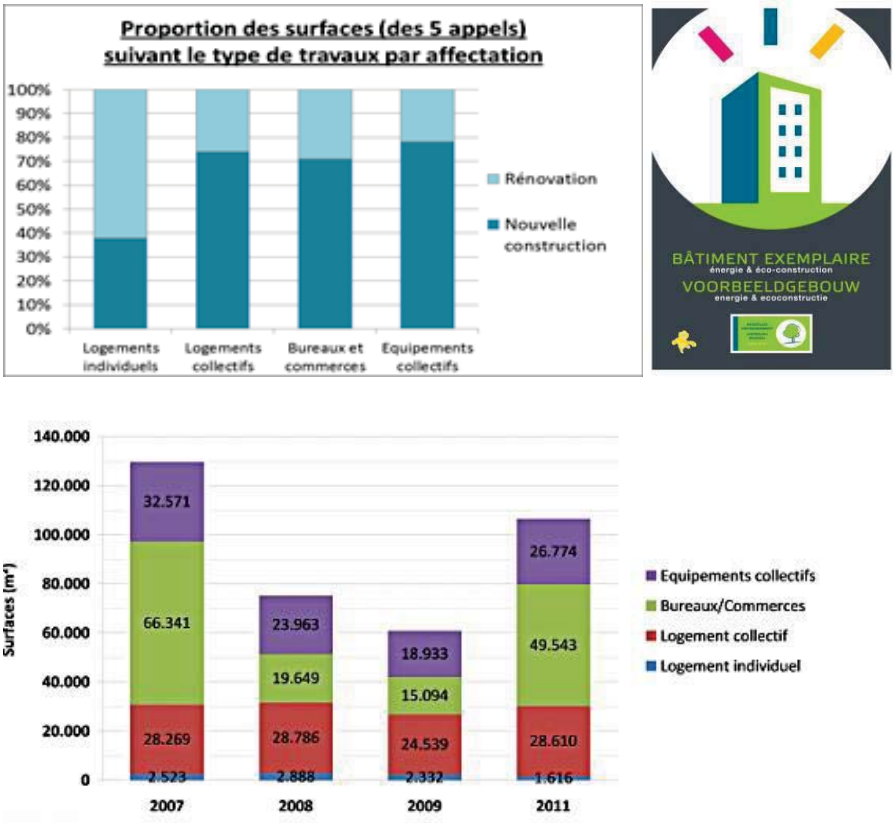
67 Implementation of the EPBD in Finland, CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

68 *23 Régions de Bruxelles-Capitale* – Brussels Hoofdstedelijk Gewest, Ministerie Van Het Brussels Hoofdstedelijk Gewest N. 2011 — 2445 [C − 2011/31430], May 5, 2011.

69 http://bpie.eu/wp-content/uploads/2015/11/The-Brussels-Region-Case-Joke-Dockx-Brussels-Environment-Belgium.pdf

70 *PassREg* project *Success Model of Brussels- Case Study*, available at: http://www.passreg.eu/index.php?page_id=374

Figure 16: Results of 5 "Exemplary Buildings" calls



Source: Bruxelles-environnement, Région de Bruxelles-Capitale

3.1. Renovations

- ***Long-term renovation plans and strategies***

Long-term renovation strategies are important to set a vision and mobilize actions in the renovation of national buildings stocks. While a pathway has been set by legislation for new constructions in terms of energy performance improvements, a similarly clear vision is needed for existing buildings. This was recommended in the Public Consultation on the Evaluation of the EPBD[71].

As reported by the Buildings Performance Institute Europe (BPIE)[72] the importance of energy renovation of buildings is exemplified by the fact that existing buildings are responsible for as much as 40% of the EU's energy requirements, and over a third of greenhouse gas emissions. Furthermore, as Europeans are spending 90% of their time indoors, it is important that energy renovation supports healthy indoor climates in buildings. The report chose best practice examples for each article's requirements. **The UK** strategy was commendable for its overview of the national building stock. Cost-effective approaches to renovations were the best in the strategy of the **Brussels Capital Region**. The **Danish** strategy had the strongest policies to stimulate deep renovation. The Spanish strategy was highlighted for its forward-looking investment perspective. A unique feature of the **Romanian** strategy is that it has sought to quantify the wider benefits of building renovation.

The ODYSEE-MURE project identifies as good practice the strategy for energy renovation for

71 Public Consultation on the Evaluation of the EPBD – Final summary report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

72 RENOVATION STRATEGIES OF SELECTED EU COUNTRIES a review of the implementation status of Article 4 EED published in November 2014 (BPIE 2014).

households in **Denmark**. The objectives of the Danish government are that the energy supply in 2050 must be based on renewable sources and that the electricity and heat supply must be independent of fossil fuels by 2035. As a major step towards the goals, the Strategy for Energy Renovation was adopted in May 2014. The strategy contains 21 initiatives which will promote the renovation of the Danish building stock and ensure that energy efficiency measures are implemented in buildings. These are: revision and upgrade of building regulations and energy requirements that apply to renovation and retrofitting of existing buildings; new requirements on the energy efficiency of windows; information to building owners, construction companies, financial institutions etc. on how to improve energy efficiency; revision of the energy certificates scheme to improve its efficiency, and promotion of the ESCO concept; measures to improve professional skills in the building sector, development and demonstration of new technologies. These are expected to reduce the net energy consumption for heating and hot water by 35% by 2050.

- The *BUILD UPON*[73] initiative, a two-year Horizon 2020 project, aims to help European countries design and implement long-term national strategies for the renovation of their existing buildings. Key stakeholders from all 28 Member States are actively involved, and an innovative 'Regional Action Network' model will evolve to scale and continue this work after the project's lifetime. A Wiki tool, "RenoWiki", providing a quick overview of the many diverse renovation initiatives in each country (e.g. regulation, finance, training, research), has been developed, in order to exchange best practices. The project commits a significant budget for each participating country to familiarize experts involved with best practice European renovation initiatives.
- The *EPISCOPE* [74] (Energy Performance Indicator Tracking Schemes for the Continuous Optimisation of Refurbishment Processes in European Housing Stocks) project aims to help maximise the effectiveness of energy refurbishment projects for European housing. Building on the work of IEE project *TABULA, EPISCOPE* has developed a common methodology to compare renovation rates of residential buildings across countries and to make recommendations for future monitoring activities. This is to be used as a basis for assessment and comparison of different refurbishment strategies and their impacts, using pilot projects at the local, regional and national levels. *EPISCOPE* helps to track the progress of renovation and to assess current and future policies. BPIE has been integrating the work of *EPISCOPE* into its Data Hub and also the Building Stock Observatory service contract. The final result should facilitate compliance with regulations, evaluation of real energy savings, and should ensure that energy refurbishments are carried out in an efficient and cost effective manner.
- City action plans have been developed in the *NeZeR*[75] project for the cities **Stockholm** (SE), **Rotterdam** (NL), **Helsinki** (FI), **Porvoo** (FI) and **Espoo** (FI), **Sestao** (ES) and for the municipalities **Amersfoort** (NL) and **Timisoara** (RO). Guidelines will be published for other European cities on how they can develop similar action plans. The action plans focus on decision makers (city authorities and real estate owners/housing associations) and their work on improving the energy efficiency of the existing building stock. The action plans will facilitate the implementation of the Energy Performance of Buildings Directive. In each participating country the most relevant building types have been identified where the biggest impact of Nearly Zero Energy Building Renovation is seen. The project's focus lies on residential buildings.

• *Promising stories of deep renovations initiatives*

The EPBD defines "major renovations" as renovations where the total cost of the renovation relating to the building envelope or its systems is higher than 25% of the value of the building, or if more than 25% of the surface of the building envelope undergoes renovation. Member States may decide to define a major renovation in terms of the value of the building; values such as the actuarial value, or

[73] http:// www.buildupon.eu
[74] http://episcope.eu
[75] http://www.nezer-project.eu/actionplansforcities

the current value based on the cost of reconstruction, excluding the value of the land upon which the building is situated, could be used.

The implementation of the "major renovation" definition differs a lot between Member States, and is in some cases not even transposed. The project ZEBRA2020[76] created a calculation method to compare renovation equivalents to overcome the limitations of various national definitions of renovation measures. As the EPBD requires a definition of major renovation, this renovation equivalent allows comparison between different countries[77].

- *Transition Zero*[78] is based on the Dutch concept 'Energiesprong' realising mass deep renovations with pre-fabricated, standardised modules in order to achieve major cost and time savings. In **the Netherlands**, Energiesprong[79] brokered a deal for bringing 110 000 buildings to a NZEB status. The initiative, thanks to a 3 years EU Horizon 2020 grant, is planned to be rolled out in other EU countries, e.g. the **UK** and **France** (planned deals for 5 000 houses in **the UK** and **France** and building a pipeline of more demand[80]). The approach is based on organising mass demand for cheaper (paid for by energy cost savings) and quick to install (one week) NZEB prefabricated refurbishment solutions with a long-term performance guarantee and no subsidies. The heart of the concept is an energy performance contract to guarantee the performance of the improvements over a long-term period (minimum 30-year). This provides financial security to the property owner, giving an assurance that the property will perform at the expected level. In order to reduce the costs and the construction time, only 5% of retrofit work is to be carried out on-site. The major retrofit elements (e.g. roof, facades, plants) are modular, industrialized, plug-and-play products. By creating a system that addresses regulations and financing in parallel, the construction sector is driven into a quick and transformative innovation process based on prefabrication and mass produced, but customised products.

- The project *BEEM UP - Energy Efficiency for Massive market Uptake*[81] develops the technology and all necessary collaboration schemes leading to reducing energy consumption in building by 70% with huge replication potential. This could considerably speed up the renovation of the EU building stock. The project demonstrated in one of the case studies that energy consumption can be reduced by 76% while increasing the rental payment by only EUR 50/month.

- An estimated 43% of the European population live in apartment blocks. Retrofitting apartment blocks tends to be more complex than other domestic buildings and there are additional challenges to overcome, mostly of a non-technological nature. Still, there are also great opportunities for replication and achieving significant energy savings and reductions in greenhouse gas emissions. Often, apartment buildings are rather similar in all EU Member States and represent a significant portion of the building stock. The *LEAF* project is working on overcoming technical, practical and organisational barriers when it comes to energy efficiency improvements in apartment blocks with mixed ownership. To that end, it has developed a technical and an engagement toolkit explaining not only the technical background, but also providing tools to support the decision-making and procurement process for energy-efficiency renovations in multi-owner buildings. A key challenge the

76 http://zebra2020.eu/

77 http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-new-dwellings-in-residential-stock.html#equivalent-major-renovation-rate.html

78 http://energiesprong.nl/transitionzero/

79 http://www.energiesprong.eu/index.php/what-we-do/

80 Transition Zero, financed under Horizon2020, no project website yet, but information can be found here: http://www.housingeurope.eu/section-100/transition-zero

81 http://www.beem-up.eu/

project has worked on is how to ensure quality of the EPCs to make them a reliable basis for financial calculations. The project worked with 24 case study buildings across six European countries. In **Saint-Etienne**, **France** for instance, a concreate buildings from 1951 was renovated achieving energy savings of about to 72%[82].

- The *Total Concept* [83] project developed smart packages for deep renovation of non-residential buildings by combining tailored energy efficiency measures to fulfil the profitability expectations of the investor. Implementing the *Total Concept* method opens up new opportunities for property owners to carry out major energy performance improvement retrofitting in a profitable way. The method thus creates a market driver for major refurbishment of existing buildings towards Nearly Zero-Energy Buildings. The approach overcomes one of the main non-technical barriers for finding economically profitable solutions for investments in energy performance improvements in the non-residential building sector.

Figure 17: *Total Concept* pilot building- Denmark

Source: Total Concept

The basic idea of the *Total Concept* is that the depth of energy efficiency measures during renovation can be increased by combining different energy efficiency measures into smart packages. A new *Total Concept* Tool features packages of measures which re-inforce each other and taken as a whole fulfil the profitability expectations of the investor. The package typically identifies measures enabling deeper savings than when only looking at the profitability of individual measures. Depending on the buildings energy performance before renovation, the refurbishment package can cut energy consumption by half or more. The method thus demonstrates how ambitious energy efficiency renovation measures can be profitable. In **Denmark**, the energy authorities plan to include the *Total Concept* method in their official guidebook for large retrofits.

The *Total Concept* tool has so far been applied to the renovation of more than 20 buildings in **Sweden, Norway, Denmark, Finland and Estonia**, amongst them offices, schools, a town and a concert hall as well as a prison. Estimated energy savings after renovation rage from 15-56%. One of the pilot buildings is the Tampere congress and concert hall. It was built in 1990 and is since then the largest congress centre in northern Europe with over 28 000m^2.

- The *COHERENO*[84] project looked into the strengthening of collaboration between companies in innovative business schemes for realizing nearly zero-energy building renovations for single family owner-occupied houses. The aim was to eliminate barriers for collaboration and

82 http://www.lowenergyapartments.eu

83 http://www.totalconcept.info, www.youtube.com/watch?v=0ns1Uo5x6R4

84 http://www.cohereno.eu

to provide companies with guidance on how to collaborate and develop services for different customer segments. The project covered five countries: Austria, Belgium, Germany, the Netherlands, Norway and two business collaboration events have been organised in each country gathering stakeholders from the supply chain i.e. architects, contractors, consulting or informing actors, manufacturers, policy actors etc.
In total, 24 very diverse collaboration structures/business models were set up between the various actors of the supply chain as a direct output of the project. Besides, the action triggered other businesses to do so as well.

- *STEP-2-SPORT*[85] aims to facilitate the step by step refurbishment of existing sports buildings to nearly zero energy levels. Energy audits have been performed on 22 sports facilities in seven countries in order to identify energy improvement opportunities as well as to determine their energy rating and produce an Energy Performance Certificate (EPC). Action Plans for renovation are being developed, identifying specific measures needed to become a NZEB, which will also be subject to monitoring. The project culminates in a Renovation Roadmap for sports buildings, together with a Replication plan with tools and training to support owners/managers of sports buildings. A number of pilot renovations are being carried out in the project. In total, more than 11 000 MWh per year can be saved in the 26 pilot sport buildings evaluated through the implementation of energy efficiency measures and renewable energies[86].

Policy feedback resulting from the good practice analysis

- The renovation of the building stock is an opportunity to improve energy efficiency, create jobs and to stimulate the market of energy services companies.
- The projects reviewed show that many possibilities exist to **incite home-owners to invest in deep renovations**.
- Governmental support is needed to ensure that the **many barriers** that still exist to building renovation can be overcome.
- **Tailor-made solutions** dedicated to particular building types (public buildings, sport facilities, etc.) can provide blueprints for scaling up refurbishment efforts.

3.2. Minimum energy performance requirements create a market and trigger innovation

According to the EPBD, Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels. The cost-optimal level is defined in Article 2.14 as "the energy performance level which leads to the lowest cost during the estimated economic lifecycle" from two different perspectives: financial (looking at the investment itself at the building level) and macro-economic (looking at the costs and benefits of energy efficiency for society as a whole)[87].

Minimum energy performance requirements shall be reviewed at regular intervals and updated in order to reflect technical progress in the building sector.

The pathway set towards nearly zero-energy buildings by 2020 is perceived as an important signal by

85 http://step2sport.eu

86 http://step2sport.eu/?page_id=30

87 Implementation of the EPBD in Finland, CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

the respondents to the public consultation on the Evaluation of the EPBD[88] that call for a similar vision for existing buildings.

It is expected that all MS will produce an NZEB definition before 2020. However, the late transposition in many MS might not give enough time for the building sector to adapt. The MS progress towards the establishment of NZEB definitions has been evaluated by the European Commission based on National Plans, the Commission reports of 2013 and 2014, as well as information from the EPBD CA, Energy Efficiency Action Plans (NEEAP), and National Codes. Progress may be seen in many EU Member States compared with the very first attempts to establish NZEB definitions (Table1).

Table 1: Status of NZEB definition development in EU Member States.

MS	Included in an official document	Under development	To be approved
AT	✓		
BE - Brussels	✓		
BE - Flanders	✓		
BE - Wallonia	✓		
BG			✓
CY	✓		
CZ	✓		
DE		✓	
DK	✓		
EE	✓		
EL		✓	
ES		✓	
FI		✓	
FR	✓		
HR	✓		
HU		✓	
IE	✓		
IT	✓		
LV	✓		
LT	✓		
LU	✓		
MT		✓	
NL	✓		
PL	✓		
PT		✓	
RO	✓		
SI	✓		
SK	✓		
SE		✓	
UK		✓	

[88] Public Consultation on the Evaluation of the EPBD – Final summary report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

Source: *JRC synthesis report on national plans for NZEB, 2016*[89]
Different system boundaries and energy uses are the cause of high variations within definitions. The level of energy efficiency, the inclusion of lighting and appliances, as well as the recommended renewables to be implemented vary among MS.

As demonstrated below, setting ambitious requirements for new buildings towards NZEBs and showing a clear direction of progressive tightening of energy performance develops markets for the building industry and investors as well as stimulating technological innovations and developments.

However, the challenge is also to ensure enough flexibility when defining the NZEB level to take account of these future market and technology developments, because energy performance requirements for NZEBs should be based on the cost-optimal level foreseen in 2021 (and 2019 for public buildings).

Within the EPBD CA MS reported[90] that when using current costs, technologies, and primary energy conversion factors the currently available national applications of the NZEB definition are not fully in compliance with the cost-optimal requirement, because there is no certainty about the evolving influence factors for the calculations for the year 2019/2021. Only one country, **Denmark**, reported that it had used the study on evolving factors to adjust its national application of the NZEB definition. The **Danish** example of setting minimum energy performance requirements for new buildings was analysed under the Case Study produced by the *EEW3* project[91].

Numeric indicators of energy performance expressed as primary energy in kWh/m^2/y use have been defined in MS and appear not comparable because different energy performance calculation methodologies have been used[92]. Some MS have included non-mandatory energy uses, e.g. energy use in appliances. Evidence shows how inclusion of lighting and appliances can result in more optimal solutions, especially for electricity use[93].

In 1960, **Denmark** was one of the first countries worldwide to introduce nationwide energy efficiency standards for energy use of buildings; today it has one of the most ambitious energy performance standards (MEPS) for new buildings among comparable countries[94]. The MEPS contain definitions of 'Low-energy Class 2015' and 'Building Class 2020' preparing the **Danish** industry for future requirements almost 10 years in advance, thanks to that new very energy-efficient components are main stream, e.g., windows or heat pumps. The energy requirements in the **Danish** Building Regulation for new buildings have been tightened by using a step-by-step approach and introducing the new requirements as voluntary energy classes before they become mandatory.

A number of initiatives and policies aim to increase the number of NZEBs, including energy saving initiatives for the energy supply companies, a strategy for the energy renovation of the existing building stock, the changeover to renewable energy, information campaigns and public action, a Knowledge Centre for Energy Savings in Buildings targeting the construction supply-side actors,

89 available at: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/synthesis-report-national-plans-nearly-zero-energy-buildings-nzebs-progress-member-states; doi 10.2790/659611

90 CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

91 http://www.energy-efficiency-watch.org/index.php?id=213

92 On-going standardisation work and projects such as the GE2O project (http://www.geoclusters.eu/) try to overcome this limitation while acknowledging natural differences such as climate

93 Modelling of optimal paths to reach NZEB for new constructions in Europe, D'Agostino D., WSED conference 2016 (http://www.wsed.at/en/programme/young-researchers-conference-energy-efficiency-biomass/).

94 Danish Energy Agency 2010; WWF Scotland 2011

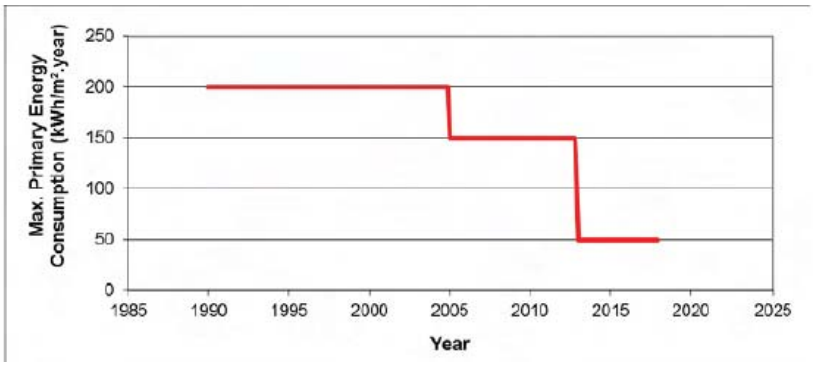
grants and subsidy programmes implemented by both the government and the energy companies.

Through the long-term goals, and especially by way of announcing a concrete roadmap for the further tightening of the Building Code early on, the **Danish** Government sends a clear signal to the building sector and allows its actors to prepare themselves for these next steps motivating them to make critical, long-term investment decisions.

France also provides a good practice example of step-by-step tightening of minimum energy performance requirements towards NZEB level and successful NZEB market introduction. The EPBD CA reported[95] that:

- the first thermal regulation, RT 2005 (Réglementation Thermique 2005), was introduced in 2006 and was replace by RT 2012, the result of a two year-long dialogue with all stakeholders, mandatory for all new constructions since 2013 setting maximum energy consumption along with minimum requirements on some elements (envelope insulation, HVAC systems).
- the next thermal regulation is planned for 2018 and it will require all new buildings to be "positive energy buildings" to be applied first in 2016 to public buildings.
- cost-optimality of the **French** thermal regulations has been analysed in compliance with the EPBD.

Figure 18: Evolution of energy performance requirements for new construction in France



Source : CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD)

In France, NZEBs are called "Low Consumption Energy Buildings" (Bâtiments Basse Consommation - BBC), and were originally a quality seal for buildings with very low energy consumption (maximum primary energy consummation of 50 kWh/m2/year) with a view to being generalised to all new construction by the regulation RT2012. In the case of individual houses, it included in particular a great proportion of Renewable Energy Sources.

Since 2013, all new buildings are mandatory NZEBs since requirements for 'BBC' match the RT2012. 335 000 new houses (300 000 apartments and 35 000 individual houses) were certified NZEBs (BBC) before the RT2012 enforcement and there have been around 465 000 new houses certified since then. Hence, the number of new NZEB houses can be estimated to be approximately 800 000.

The **introduction of the 'BBC' label** enabled the follow-up and scaling up of actions and best practices in NZEB before the requirements were extended to all new construction. The particular approach of the BBC label is that it can be applied to both new (BBC-Effinergie) and existing (BBC renovation) buildings, thus aiming to promote buildings' refurbishment to NZEB.

[95] CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

The EPBD CA also highlights experiences in **Norway.** They show that energy performance requirements set in 2007 have had various effects on the Norwegian construction market. The requirements were perceived as especially harsh on Norwegian window manufacturers, setting requirements for U-value to 1,2 on average. At the time, no manufacturers in Norway were able to deliver windows meeting this requirement. By the end of the transition period, most if not all producers had started developing new technology and were able to meet the new requirements. Continuing to develop new technology, producers were soon able to deliver windows that were good enough to help buildings fulfil the requirements set in the Norwegian passive house standard for residential buildings, NS 3700. This standard was published in 2011, followed by a standard for non-residential buildings published in 2012. Both standards were followed by public support schemes. Passive houses are now being built all over the country by a large variety of builders as opposed to being considered a rare special niche market only a few years previously.

Norwegian window producers continue to develop cutting edge technology, and are now developing windows to meet the NZEB requirements, which are set to be announced before 2020. This includes windows with integrated solar collectors.

- ***Introducing Nearly-Zero Energy Buildings (NZEB) into everyday life***

The previous chapter illustrated how long term target setting in terms of minimum energy performance requirements with a clear pathway and progressive tightening of requirements, helps to prepare the supply chain for new market conditions. This results in technological progress, innovation and market development.

On the demand side, consumer acceptance can be increased by information and awareness raising actions, demonstration projects but also preparation of market channels to deliver new products/services in appropriate way.

The EPBD CA provided some examples from **Germany, Latvia** and **Malta** where a clear indication of the NZEB level in the issued EPCs made consumers aware early on of the required level for new buildings by 2020 (or 2019 for public buildings), thus "pushing" the market.

Communicating with and educating various target groups (e.g. by providing information to the public, training builders, carrying out communication campaigns and involving energy agencies) will support rapid market introduction of NZEBs.

In **Belgium- Flemish region**[96], the NZEB level is proposed as a brand with practical guidance on how to build a NZEB. Online lists of NZEB frontrunners (architects, energy experts, construction companies, installation companies, manufacturers and banks), demonstration buildings, TV programmes and cheaper loans are available. Since the start of February 2014, a large number (300) of companies and organisations have become involved in this scheme.

Another key to success is aligning policies to support mechanisms (property tax reductions and subsidies). A software tool[97] for new buildings was developed and determines which NZEB requirements are fulfilled and which are not. When NZEB requirements are fulfilled, the label 'Ik BEN hier' ('I'm NZEB here') appears. This instrument might inspire energy experts and future homeowners to take the necessary measures to achieve the NZEB-level and receive the associated subsidy.

- *NZB2021*[98] project aimed at replicating an ongoing open-doors campaign on nearly zero-energy

[96] CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

[97] http://www.energiesparen.be/epb/prof/software

[98] http://www.nzebopendoorsdays.eu/

buildings in Flanders to 9 additional European countries (**AT, FR, GE, HU, IE, MT, PL, SE, SI**).During the project the Flemish campaign extended and teamed up with a Walloon partner in order to cover the whole of Belgium. The aim was for home owners to open their doors and explain how they have built or renovated their house in an energy efficient way. In this way, interested visitors could learn first-hand from others. Two campaigns were organised in 2013 and 2014 within the project duration.
Overall, the consortium attracted more than 25 000 visitors, 672/634 buildings and 106/134 public buildings were open for the 2013/2014 campaigns, 78%/75% of visitors voiced their intent to implement good practices by 2020 and more than 90% of the visitors were pleased with the information they received. When looking at the country breakdown, it is striking that most visitors (more than 11 000) were attracted to Belgian campaign where it has been known for many years
Many demonstration projects supported under FP7 and H2020 achieved outstanding results in terms of energy performance of buildings by applying and integrating innovative technological solutions. *DIRECTION*[99] is a four-year project that aims at demonstrating how the use of very innovative and cost-effective energy efficiency technologies can lead to the achievement of very low energy new buildings. Two new buildings are used as pilots in *DIRECTION*: NuOffice in **Germany** and CARTIF III in **Spain**. In their own climate conditions, each pilot building deploys a set of very innovative measures, constructive elements for energy optimization, high efficient equipment and advanced energy management. The NUOffice building, which was awarded the LEEDS certificate for most sustainable new office in the world, reached 30 kWh/m2/yr of primary energy consumption (with an average of 42kWh/m^2/yr in 2015). Other buildings including the Black Monolith in **Bolzano** (Italy), NuOffice2 and NuOffice3 in **Munich** (Germany) are drawing on solutions from the project *DIRECTION*.

- The *AIDA*[100] project aimed to promote and accelerate the development of NZEB in Europe by targeting two distinct groups: municipalities and building professionals. The main outcomes of the project were to raise awareness, inform and engage over 3 000 municipality representatives and building professionals by providing information on NZEB case studies and by facilitating study tours to experience these innovative buildings at first hand. Over 1 500 architects and master builders received guidance on the use of Integrated Energy Design including by accessing an IED software tool from the *AIDA* website. The project also provided technical support to municipalities to ensure the inclusion of NZEB characteristics in the public tenders for between 15-21 building projects.

  The project enabled the market uptake of NZEBs in Europe by assisting 28 municipalities in seven EU countries to develop tenders and feasibility studies for new and renovated nearly zero-energy buildings. It also supported 26 municipalities in the creation of roadmaps such as Sustainable Energy Action Plans (SEAPs) within their Covenant of Mayors membership.

- The *PassREg*[101] project found that large scale implementation of new NZEBs, in the form of policies that promote Passive House + Renewables, requires local and regional decision makers to be educated about difficult technical concepts such as NZEB and Integrated Design and proposed study tours to witness examples of best practice. The project found that political consensus, financial support, and capacity building of decision makers are all necessary and explained how the Passive House standard was adapted to fit NZEB criteria[102].

- *ENTRANZE*[103] and its follow-up project *ZEBRA2020* provide data and analysis on energy

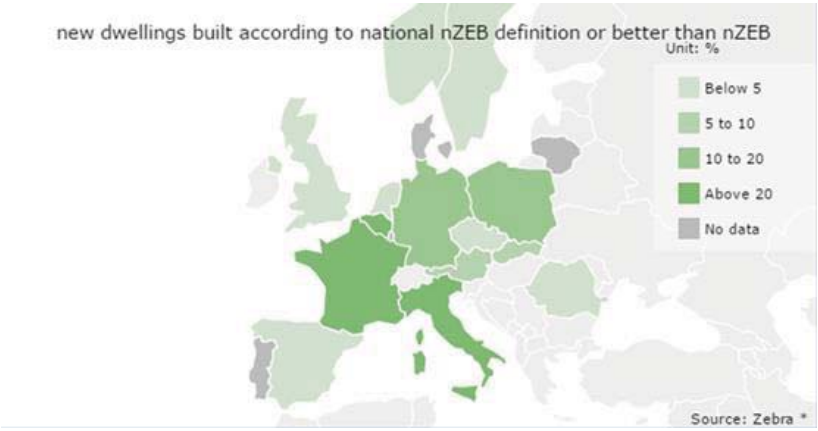
99 http://www.direction-fp7.eu/News/Most_Sustainable_Office_In_The_World.kl
100 http://www.aidaproject.eu
101 http://www.passreg.eu/
102 http://ec.europa.eu/easme/en/news/european-regions-reduce-emissions-passive-house-buildings-and-renewables
103 http://www.entranze.eu/

efficiency policies and market penetration across the EU with a particular focus on tracking NZEBs. The project developed scenarios, recommendations and strategies for the building industry and policy makers to boost the market uptake of NZEBs. To that end, it created data tools, displaying indicators on the status of building stock development in selected European countries focusing on general features of buildings, new construction, renovation activities, sales of energy efficient equipment and energy performance certificates. Another tool is in the making by *ZEBRA2020* to track the penetration of NZEBs into the European market.

- ***Checking and enforcing compliance with energy performance requirements***

Compliance rates of new buildings with national NZEBs requirements are still low across the EU.

Figure 19: Share of new dwellings built according to national NZEB definition (or better)



Source: zebra2020.eu

Compliance with energy performance requirements is checked at different stages of the building process in different MS. Some MS even check compliance several times during the building process. Compliance checks and quality control regarding airtightness, thermal bridges, summer comfort and availability of daylight in new buildings require increased attention as buildings move towards NZEB, since these topics account for an increasing share of buildings' total energy consumption[104].

As reported by the EPBD CA a special compliance check philosophy is in place in **Sweden,** based on an operational rating system applied to new houses or apartments after two years of operation. It is not necessary to measure single parameters as long as the measured value of energy consumption complies with the building code.

The **Flemish region** lays down administrative fines for infringements of the energy performance requirements. This leads to very high rates of compliance with energy performance requirements 'as-built'. The compliance rate with all requirements (including ventilation rates) has been around 97% since 2010.

[104] EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

- ***Minimum energy performance requirements when selling or renting a property as strong market driver***

The Energy Performance of Buildings Directive sets minimum efficiency standards only for new-builds or major renovations. Legal acts put in place in **Scotland, England and Wales**[105], have stepped up on this stance and introduced minimum standards for energy performance at point of letting.

In **Scotland**, housing associations are obliged to reach a "D class" rating when letting out apartments or to ensure that improvement work to reach this standard is carried out when a property is sold or leased to new tenants. Based on the rating of the Energy Performance Certificates (EPC), the Scottish Government has established a standard which implies that by 2020 no social property will be lower than a "D class" rating[106].

The Energy Efficiency Regulations in **England** and **Wales** have installed minimum standards for private and commercial rentals. In case a property is rated F or G class, tenants have the possibility to demand an energy refurbishment to minimum E class level from 1 April 2016 on. Almost 10% of **England** and **Wales**' 4,2 million privately rented homes currently fall below the E rating. The law obliges landlords to upgrade energy efficiency of homes currently rated F and G to a minimum of E by 1 April 2018 – or face being unable to let them until they improve the rating[107]. Unless an exemption applies, with effect from 1 April 2023, the owner of a property with an EPC rating of F or G must not continue to let out that property until works have been carried out to improve the energy efficiency to a rating of E or above[108]. The measure is expected to help around a million tenants who are paying as much as GBP 1 000 (EUR 1 292)a year more than the average annual bill of GBP 1 265 (EUR 1 637) because of poorly insulated homes[109]. The UK Department of Energy and Climate (DECC) won the Public Sector Leadership in Green Building award of the World Green Building Council for designing the Energy Efficiency Regulations[110].

Policy feedback resulting from the good practice analysis

- Minimum Energy Performance Standards (MEPS) is the strongest measure to increase the rate of renovations providing a clear signal to investors. It is also a way of solving the split incentives problem (owner/tenant dilemma).
- A clear follow-up on the standards in terms of legal enforcement and related sanctions is needed to safeguard an effective implementation.
- **The UK** examples of the inclusion of MEPS when renting houses is an interesting frontrunner which should be monitored closely and taken up in other Member States.

105 Energy efficiency and energy poverty are devolved matters in the UK.

106 This complements further energy performance targets for 2020 by the Scottish Government. Every home is to have loft and cavity wall insulation, a highly efficient boiler with appropriate controls; and for at least 100,000 homes some form of individual or community renewable heat technology. Committee on Climate Change, "Reducing emissions in Scotland: 2014 progress report", March 2015, available at: https://www.theccc.org.uk/wp-content/uploads/2014/03/1871_CCC_Scots_Report_bookmarked.pdf. Scottish Government, "Homes that don't cost the earth: A consultation on Scotland's Sustainable Housing Strategy", June 2012, available at: http://www.gov.scot/Resource/0039/00395756.pdf.

107 The Guardian, 5 February 2015. Landlords to be banned from letting draughtiest homes. http://www.theguardian.com/environment/2015/feb/05/landlords-draughty-homes-ban.

108 Shepherd & Wedderburn (2015): The new minimum energy efficiency standards: implications for real estate in England and Wales. Available at: http://www.shepwedd.co.uk/sites/default/files/MEE%20Briefing.pdf

109 The Guardian, 5 February 2015. Landlords to be banned from letting draughtiest homes. http://www.theguardian.com/environment/2015/feb/05/landlords-draughty-homes-ban.

110 World Green Building Council (2015): WorldGBC Leadership Awards. Available at: http://www.worldgbc.org/activities/govt-leadership-awards/europe.

3.3. Energy performance certificates- standardised information increases market visibility and transparency

Energy Performance Certificates (EPCs) are designed as an information-based instrument to inform prospective owners and tenants in particular about the performance of specific buildings and systems, and about ways of improving the energy performance through specific recommendations.

In implementation of the provisions related to EPCs some Member States have developed good practices to make the instrument user-friendly, reliable and, by ensuring access to EPC information to different stakeholders, to reap the full benefits of this instrument. In many countries the EPC is already being used as a document necessary to obtain financial support and subsidies or to confirm the result of supported actions.

However, as stated in the Evaluation of the EPBD, EPCs have not yet succeeded in supporting a comparable pan-European market for buildings energy efficiency investments, as they are not based on the same methodology. Indeed, the provisions for the EPCs do not require a harmonised methodology for calculating the energy performance of buildings. This was confirmed in the *STEP-2-SPORT* project[111] (see chapter 3.1.), which concluded that the differences between the calculation methodologies used in EU countries to determine the energy performance of buildings make it very difficult to compare the EPCs results of pilot sport buildings. Along this line, the Commission gave a mandate to CEN to elaborate and adopt the necessary standards for a methodology calculating the integrated energy performance of buildings, in accordance with the Directive (in particular Article 3 and Annex I of EPBD-recast). The on-going standardisation work is expected to make the CEN standards more usable as direct reference in national legislation and to give a higher transparency to national choices.

- ***Best-practices improving the quality, transparency and/or reliability of EPCs and making EPC more user-friendly for different kinds of stakeholders***

According to the EPBD CA[112] in a few MS (**Belgium - Flemish region, Portugal** and **Ireland**) guidelines were developed for the use of EPC data in advertisements, in collaboration with real estate agents, ensuring that the energy indicators could be easily identified.

In **the UK** the EPC layout was revamped in 2012 to ensure its user-friendliness:

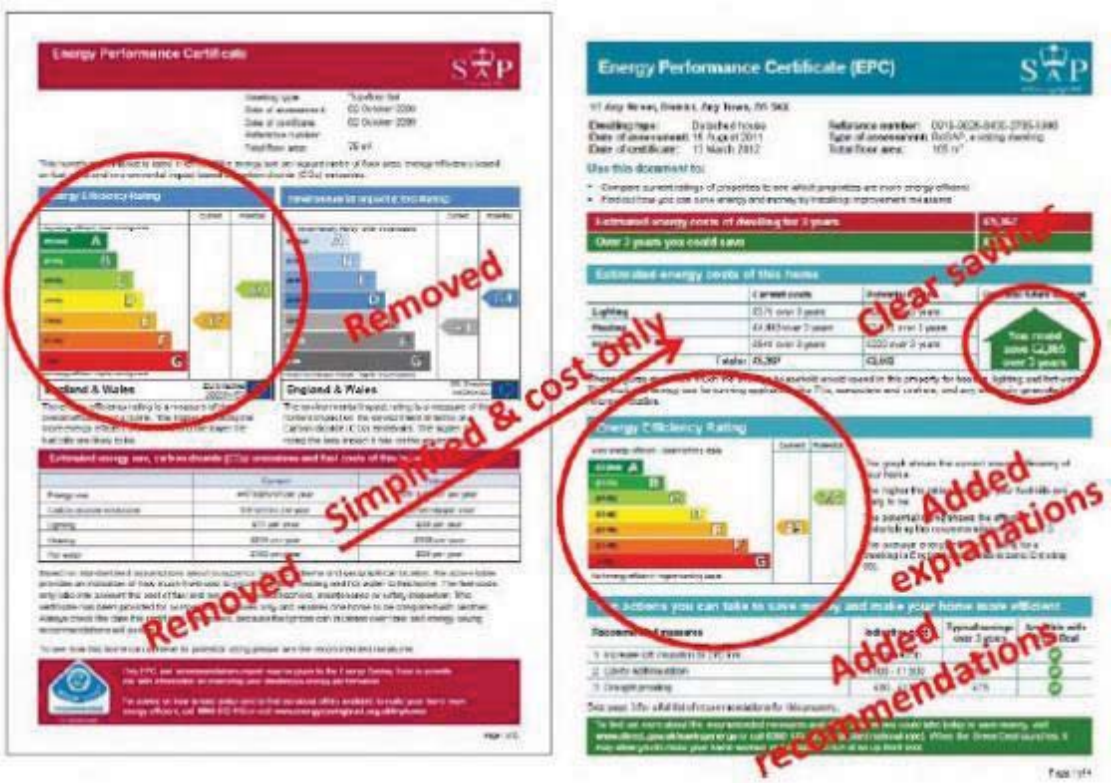
- The use of technical language has been reduced to a minimum on the first pages of the EPC and more self - explanatory icons are used.
- Technical sections, addressing experts and authorities, have been moved to the end.
- The energy rating of the current and potential energy efficiency of the building is provided. The potential rating shows the effect of undertaking the recommendations included in the EPC.
- Most EPCs recorded on the national register are freely accessible to the public through an address search (unless the building owner opts out).

All EPCs on the register are freely accessible through a unique reference number search.

111 www.step2sport.eu

112 EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

Figure 20: The old (before 2012) and new EPC in the UK



Source EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD)

The introduction of the new EPC in **the Netherlands** has changed the landscape of the Dutch built environment. While the previous EPC was merely technical and expensive, the new simplified EPC has empowered citizens to directly influence their energy use. The Energy Agreement of 2013 states that a **simple and affordable** EPC plays an important role in meeting the energy savings targets in the built environment. In June 2014, the House of Parliament agreed on a new EPC that should cost the Dutch citizen no more than approximately **EUR 25.**

After this decision, the new EPC for residential buildings was developed in cooperation with stakeholders. It consists of a user-friendly web-based tool where private homeowners can apply for an EPC for their house. Since 1 January 2015, all residential building owners (in total 4.5 million) received a temporary EPC (calculated on the basis of the national cadastral data) by mail. This certificate gives an indication of the energy performance of the residence. The owner can digitally change or add extra information on energy measures. Owners are also obliged to provide evidence of the measures taken, such as invoices and photos. This data is quite accurate, so the owner only needs to add limited modifications. Both existing and new data are checked by a qualified expert who is in charge of producing the definitive EPC registered in the database. The Dutch energy performance certification process for residential building owners comprises the following 4 steps shown in figure 21:

Figure 21: Infographic describing the 4 steps of the Dutch labelling process for residential building owners: 1) login, 2) uploaded proof, 3) validation by a recognised expert and 4) registration.

Source: EPBD CA (2016) Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports[113]

The results of the simplified web‑based approach from its introduction in January 2015 to December 2015 are:

- 4,5 million houses received a letter with information about the EPC and a personal pre‑setting in the EPC web tool;
- over 630 000 individual log-ins;
- over 510 000 registered definitive EPCs;
- costs were kept low because of competition, with an average of EUR 25 per EPC;

In **Czech Republic** a special tool for verification of the quality of issued EPCs was developed under the state subsidy programme EFEKT. The EPC quality verification tool is intended for non‑professional users and it allows verification of the EPC by a simple and clear calculation in case of any suspicion of intentional manipulation. The user of the verification tool enters the basic building's parameters (ideally acquired from the project documentation) and boundary condition values defined in the processed EPC. The boundary condition values are stated in the issued EPC protocol. The tool compares the boundary condition values for the assessed building and zones, against the values defined in the publicly available specifications and displays the discrepancies in a well‑structured graphic form. At the end, the verification tool compares the building parameters used by the expert who issued the EPC with the building parameters typed in and calculated by the verification tool. Depending on the size of the deviations, the colour of the fields changes from green (minor discrepancy) to red (radical differentiation). A simple and clear manual for proper verification has also been developed. The manual explains in a simple way the basic definitions (energy reference area, U value, delivered energy, etc.), shows which values are to be completed for successful verification and where these values can be found in the original EPC. The tool is accessible free of

[113] Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

charge. The website serves as a guide for building owners obliged to process an EPC. It also explains the meaning of each part of the EPC, how to read the EPC itself, and where to find the relevant legislation and links. In case the user discovers that the EPC was wrongly calculated, the State Energy Inspectorate is informed who may then carry out a deeper verification and depending on the outcomes may impose a penalty, or require corrections.

In **Hungary** the independent control system for EPCs was set up in 2013. A sample of 2.5% of the EPCs are randomly selected and checked by independent controllers every 6 months. A significant amount of useful information is obtained through this process about the experts, the controlled buildings, the typical mistakes and the general quality of the EPCs. Several recommendations have already been formulated and forwarded to the responsible Ministry of Interior including advice on improving the legislation. The system is regularly upgraded based upon the controllers' opinion. The share of incorrect EPCs is below 10%. The experts are also evaluated, particularly those who were checked more than twice. Afterwards, an evaluation list is carried out about 'good' and 'bad' experts which forms a basis for sanctions. If an EPC fails with an error of more than two energy classes, the expert loses his or her license for 3 years. Since the sanction is very strict, any suspicious EPCs have to be verified by at least two independent controllers.

The project *QUALICHeCK*[114] aims to provide a basis to better understand best practices regarding EPC input data in its report: "Towards compliant and easily accessible EPC input data"[115].

In order to arrive at correct assessment of energy performance, it is highly desirable that:

- the input data for the energy performance calculation are compliant (i.e. they have been obtained with the definitions and procedures of the applicable legislation) and evidence of this compliance exists;
- these input data can be found, seen and used by the experts in charge of the calculations by taking reasonable time, effort and money.

Possible approaches to improve compliance of EPC input data - best practices include:

1) Internet database of product performance characteristics

The "EPB product database" in **Belgium**[116] is an effective scheme to improve the compliance and easy access to product characteristics used as input data for the Energy Performance Certificate (EPC) calculation. This scheme has been successfully accepted by the market for many years.

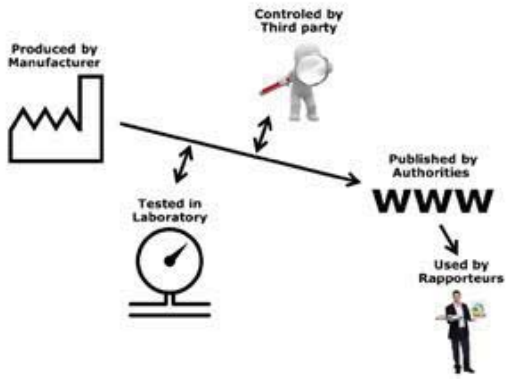
The product database provides the characteristics of hundreds of ventilation and thermal insulation products, as well as sunscreens. This scheme provides data about the energy performance of products with a recognition process (i.e. verification and publication of the data) based on third-party control.

114 http://qualicheck-platform.eu/

115 http://qualicheck-platform.eu/2016/03/report-compliant-and-easily-accessible-epc-input-data-final

116 http://www.epbd.be

Figure 22: Roles of the main parties involved in the product database in Belgium



Source: QUALICHeCK, report Towards compliant and easily accessible EPC input data

The database can provide input information for both new and existing buildings. Nevertheless, this is only useful for relatively recent renovations of existing buildings because the available data only covers products which are currently available on the market.

Although the EPB product database in Belgium is voluntary, the approach is successful and market acceptance is very high. Moreover, the manufacturers themselves are requesting this scheme as well as recognition of their products in the currently available categories. They are also interested in the development of new product categories.

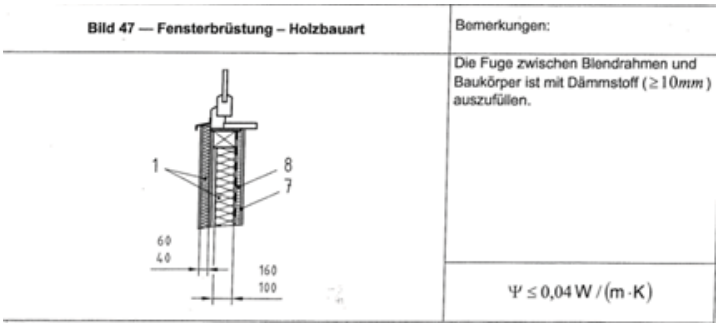
2) Easily accessible products performance data provided by the manufacturer

A voluntary scheme has been implemented in **France** by ventilation system manufacturers under the umbrella of their national association. For 19 types of different ventilation and air handling products, requirements have been defined regarding performances to be announced in the manufacturer's documentations (technical sheet, website, catalogue, and packaging).

3) Pre-calculated values for thermal bridges

In **Germany**, a set of pre-calculated values of heat transfer coefficients (or extra heat losses) for building thermal bridges has been implemented. The values are included in a dedicated DIN standard[117], which makes these values easily accessible. The German standard is regularly updated to include new construction techniques and currently very high-performance constructions are being added.

Figure 23: Example from the German standard DIN 4208, Beiblatt 2 (window parapet in a wood frame house)



Source: Qualicheck, report "Towards compliant and easily accessible EPC input data"

4) Qualification schemes for building airtightnesstesting

[117] DIN 4108, Beiblatt 2

In order to reduce variability in building airtightness test results between different experts and to improve consistency between test results and EPC input data, several countries (the **Czech Republic, Denmark, France, Germany, Ireland, Sweden, the United Kingdom**) have implemented schemes to qualify experts.

Figure 24: Number of qualified experts for buildings airtightness testing, January 2014

Source: Qualicheck, report Towards compliant and easily accessible EPC input data

The *LEAF*[118] project addresses information and trust barriers to maximise the impact of EPC recommendations. It aims to stimulate uptake and investment in retrofit by ensuring easy access to accurate, trustworthy data about EPCs, bringing together market actors – households, suppliers and policy makers - through a one-stop shop model entitled "Retrofit Action Hubs''. Good practices identified to render EPCs more end-consumer friendly include providing information on: financial savings on energy bills; potential maintenance costs; grant levels; and costs (both upfront and bill saving) of energy performance measures as compared with similar maintenance measures (e.g. external insulation as compared with simple façade painting). The langue used should also be user friendly, for example, talking about running costs rather than energy efficiency.

- ***Electronic databases for wider access and use of EPC data***

Buildings certification and technical building systems inspections, stemming from the EPBD, have the potential to yield a comprehensive data source on the energy performance of buildings. EPC schemes are a tool for policymakers that could be used for mapping and monitoring the national and European building stock and, if properly implemented, they could allow for assessment of real market needs in terms of investments and the potential for energy efficiency improvements in the building sector[119].

The EPBD CA provides the example of **Denmark** and **Ireland** where the potential of central registers of certificates and reports was exploited to determine the effectiveness of policy interventions.

Ireland in 2008 launched a pilot grant scheme for home energy efficiency upgrades which was based on 'before and after' EPC data, calibrated with EPC data modelling, assessment of energy bills from a sample of participants. It informed the final design and evaluation system of a full grant scheme.

In Denmark, an EPC database was used to calculate scenarios for potential energy savings in different

118 http://www.lowenergyapartments.eu/

119 EPCs across the EU, 2014, BPIE

building types and ages and the necessary investments, informing the government's energy saving strategy established in 2012.

The Danish database gathers a very wide range of information with respect to the building stock allowing analysis of the impact of certification scheme on the price of buildings. A study[120] made in 2013 showed that sales prices of single‐family houses increase in line with improved EPC ratings. The result is reached by statistically comparing the energy certificate and the price of all single family houses sold in 2011 and 2012. By doing the same with the sales of houses between 2006 and 2012 it became clear that, over time, the energy certificate has had a growing and strong effect on sales prices[121].

In the same field, Copenhagen Economics produced a study[122] on the relationship between house prices and energy ratings based on an econometric analysis of 365 000 sales of single-family houses in Denmark from 2006 to 2014. The input data for the study came from energy valuation of houses in Denmark since 2006, obtained from the EPC central register. The main conclusions were:

- There is a clear correlation between a high energy rating and a high sales price.
- However, the energy rating is not yet fully reflected in the sales price: the higher sales price induced by a higher energy rating is not as high as the saved future energy cost over time would justify.
- The energy label's effect varies with different buyers and houses (the effect of energy rating depends for example on heating type, it is considerably greater for houses where the source of heating is more expensive, e.g. gas more than DH).

Apart from EPC information stored in the central database, EPCs can be used in various other contexts, e.g., by adding the EPC as a supporting document to the national Green Building Council assessment scheme (e.g., in **The Netherlands, Austria**), using the EPC for specific programmes (e.g., "fresh schools" programme in The Netherlands), or as a supporting document for subsidies rewarding improved energy efficiency (e.g. **Cyprus, Austria**).

For example in **Greece**, detailed data from building energy audits are being used by an ad-hoc national steering committee for updating the national EPBD legislation to gain additional insight for the building stock. In addition, over the years EPC data have been analysed for research purposes. Recently, in the framework of the project *EPISCOP*E[123], EPC data were exploited for clustering available information in terms of the critical parameters that characterize Greek residential buildings. EPC data with actual and calculated energy consumption were also used to derive empirical adaptation factors to improve normative calculations from the EPCs for more realistic estimates.

EPISCOPE carried out monitoring activities to track the progress of housing stock energy performance and, by obtaining data for measured energy consumption via surveys, and cross-referencing these with EPC data, it was able to analyse future policy scenarios. The project found a persistent problem with availability of reliable primary data on Europe's housing stock, despite the improvements made on this with the advent of EPCs. Only **the UK** has put in place a comprehensive regime of measured data collection, via its annual National Housing Survey – an approach which the project strongly recommends to be replicated in other countries. Nevertheless, given the expense and effort, **the UK**

120 Jensen, O.M., Kragh J. & Hansen A.R., 2013. Energy label and sales price (In Danish: "Energimærke og salgspris"). Danish Building Research Institute, Aalborg University.
EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at:
https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

122 Copenhagen Economics *Do homes with better energy efficiency ratings have higher house prices?,* Danish Energy Agency 18 November 2015

123 See EPICOPE project www.episcope.eu

approach is unlikely to be replicated elsewhere; the project also puts forward recommendations for a reduced sample survey approach that would give the minimum acceptable level of useful data[124]. Such an approach would help to close the current gaps in building performance data.

A major output of *EPISCOPE* was its data tool for the residential building stock[125] which features on the BPIE Data Hub[126] residential building stock statistics, modernisation trends, and also national building policies and regulations including NZEB definitions. The tool also includes steps to harmonise Europe's building stock statistics, for example to account for the different ways of measuring building floor areas.

The *Request to Action* project[127] identified best-practices related to the EPC databases in **Portugal** and **Austria.**

In **Portugal**, the EPC database is used to verify the effectiveness of some EE policies and to measure the impact of new regulations and energy performance improvements including of public buildings. It helps to identify and analyse the financial cost and potential savings from the recommendation stated in the EPC. Based on around 1,1 million recommendations made so far by Qualified Experts, the average findings per building are as follows: EUR 4 500 of estimated investment costs and EUR 450 of potential yearly energy cost reduction. The information available in the EPC database is used to clearly validate the need and effective implementation of recommendations for the purpose of finance programmes (under the 2020 programme eligible measures must comply with minimum energy performance requirements from EPBD and lead to an improvement of at least 2 energy ratings) and for designing funding schemes for building refurbishment. EPC information was used to assist the redesign of the building codes in particular the new energy performance of buildings regulation by providing real values of buildings elements and technical systems. It provides credible information for Real Estate market. ADENE (Agencia Para A Energia) allows access to databases via a website. EPCs are used for a home Energy Efficiency Portal for Consumers. Consumers can obtain detailed information about the energy performance of their house and a One-Stop-Shop to receive proposals for improvements.

In **Austria**, the implementation of the Energy Performance of Buildings Directive offered the opportunity to start an EPC harmonisation process within Austria, aiming to develop a common calculation methodology, and to implement further elements like HVAC systems, as well as to enhance regular inspections.

In 2007 a database for collecting EPCs and inspection protocols was established in the **Austrian provinces of Salzburg, Styria and Carinthia**. Automatic plausibility checks and random checks took place for the uploaded data. The database is internet based and is used for registering EPCs, as well as for analysing the available data for different monitoring activities. The database is also used by research institutions and it was successfully used in European and national projects (e.g. *EPISCOPE, TABULA, Request2Action, R-Bau*) to enable national pilot actions: developing building typologies, adapting energy strategies in the building sector, calculating energy savings.

An EPC register was established in 2008 in **England and Wales[128]**. It is a legal requirement to enter the EPC on the register before giving it to the person who requested it. All documents recorded on

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124 See EPICOPE report "Tracking of Energy Performance Indicators in Residential Building Stocks" available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR4_Monitoring.pdf

125 Available at: http://www.buildingsdata.eu/data-sources/episcope-data

126 Available at: http://www.buildingsdata.eu/

127 Request to Action project IEE/13/789, European Best Practice meeting on EPC Databases, 04.11.14, Brussels

128 CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

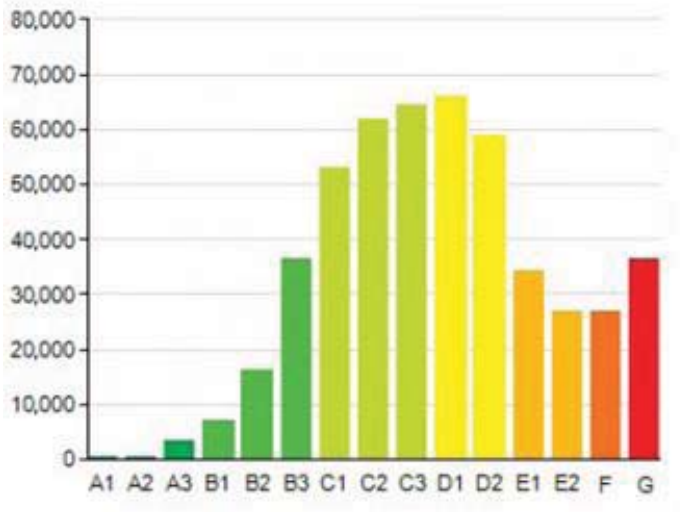
the register are retained for at least 20 years. The register also supports enforcement activities, reduces fraudulent issue of certificates/reports, and allows statistical analysis to inform policy making and improve understanding of the building stock.

An effective use of the EPC database lies in combination with other databases. For example, in **Scotland** the local authorities need effective data on the housing stock to plan their energy saving programmes. They focus on areas with high levels of fuel poverty. Reliable information on buildings' energy performance, in combination with the data from other relevant databases in these areas, enables them to negotiate with energy suppliers accordingly[129].

Ireland provides a good practice example in terms of harmonised IT environment for the EPC (BER) scheme with a number of distinct but integrated IT systems to facilitate its regulatory role. These systems are interconnected with internal systems including an internal finance system, the BER quality assurance management system, and the Better Energy Homes grant management system. They are also used for derived publications by the Central Statistics Office.

To give researchers access to statistical data from the scheme, a BER Research Tool was developed. This tool provides access to information on all aspects of construction that affect the energy performance of residential units. This research tool has already been widely used by local authorities, Non-Governmental Organisations and researchers[130]. It provides key input data to the building energy model for the calculation of technical energy savings potential, informing the content of Ireland's national strategy for mobilising energy renovation of the building stock pursuant to Article 4 of the EED. The profiles of EPCs published from the initiation of the scheme up to the end of September 2014 are shown below[131].

Figure 25: Profile of residential EPCs in Ireland

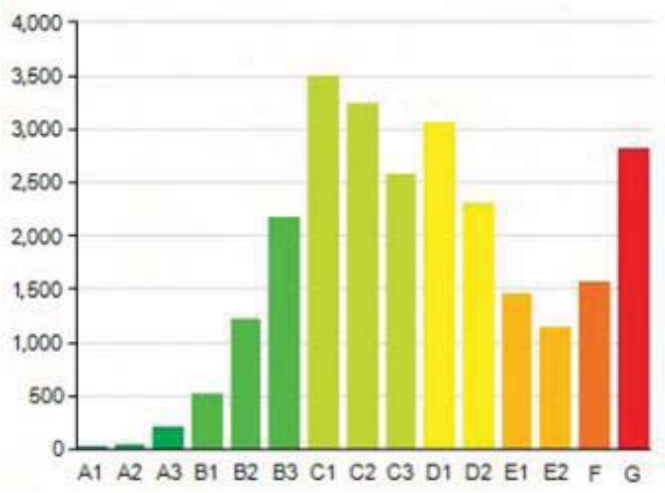


129 EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

130 For example the *EPISCOPE* project

131 EPBD CA (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports.

Figure 26: Profile of non-residential EPCs in Ireland



Source: CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports[132].

Policy feedback resulting from the good practice analysis

- **EPCs** and their underlying data have become the **key information source** to inform the general public about the energy quality of a building. Many good practices show that this instrument is performing better once it is simplified and **customized to local needs.** The present off-line information can trigger **further benefits** once an **online-provision of data** allows for comparisons **and online-support**.

3.4. Cross cutting issues

- ***Single energy performance calculation methodology for multiple users***

Today there are 35 different national and regional methodologies to calculate the energy performance of buildings. Such a variety prevents comparisons of potential building investments and their efficiency throughout the EU. This is also costly because it increases market fragmentation and creates barriers to the ability of technologies to be applied in similar conditions across the EU. A harmonised energy performance calculation method would have a positive effect on market readability providing appropriate market information for property valuation for the investors.

As reported by the CA EPBD[133] the **German** transposition of the EPBD resulted in an exemplary all-in-one calculation method DIN V 18 599 for energy performance of buildings.

The German government instigated the development of a holistic calculation method covering all the aspects mentioned in Annex I of this directive. The method is presumed to be suitable for differentiating between the different uses and combination of uses identified in typical German non-residential buildings. It combines knowledge from the areas of building physics, heating and hot-water systems, AC and ventilation systems and lighting.

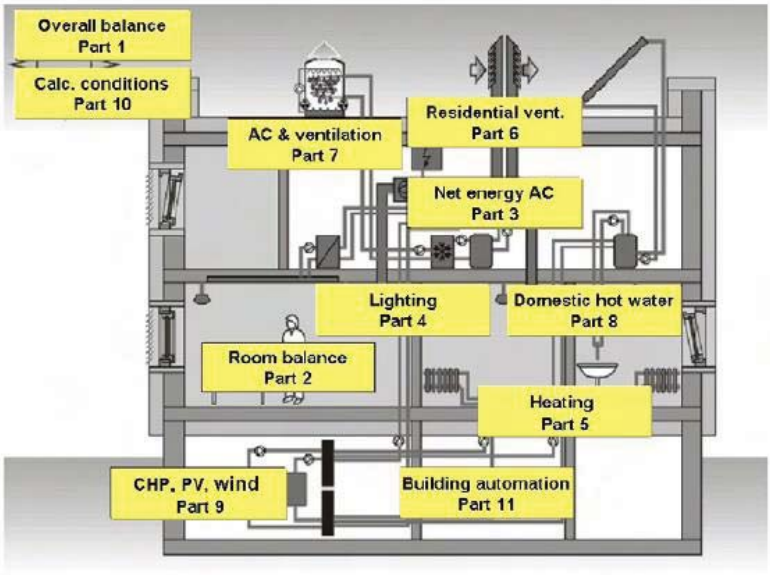
132 Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

133 CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

The standardisation process led to a fruitful and exemplary cooperation of experts from very different backgrounds together with a common goal, i.e., to achieve energy performance calculation.

The technical basis for DIN V 18599 comprises several approved international standards (e.g., EN ISO 13 789, EN ISO 13 790). The calculation procedure is in principle in line with other CEN standards from the mandate 343, however they are much more consistent, unambiguous and clear to the users because of the 'all in one place' approach. Moreover, the 'common language' and consequent use of indicators and indices throughout this unique standard facilitates its use for legal purposes.

Figure 27: Structure of German calculation standard DIN V 18599



Source: CA EPBD (2016)

- ***Making energy efficiency a win-win game (best practices in addressing split incentives)***

Many potentially cost-effective investments in energy efficiency in buildings do not take place due to well-documented market failures, of which one of the most important is the so-called split incentive or owner/tenant dilemma. In the context of building-related energy, it refers to a situation where the building owner pays for retrofitted energy efficiency upgrades but is unable to recover savings from reduced energy use that accrue to the tenant[134].

The EPBD evaluation informs that split incentives play an important role. 30% of the EU population lives as tenants, according to Eurostat. Landlords may have little incentive to invest in housing stock improvements as return on capital employed can be limited.

In 2009, **France** passed a law ('loi MOLLE') which allows social housing companies to recoup energy savings from tenants when they invest in the energy retrofit of the building, thus overcoming the split incentive. Through this mechanism, 50% of the energy cost savings generated by the investments are invoiced to the tenant through what is called a 'third line of invoice' (on top of the rent and usual rental charges). This third line can be charged for 15 years but remains a fixed amount even if energy cost savings tend to increase over time.

134 JRC report (2014) Overcoming the split incentive barrier in the building sector; available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC90407/2014_jrc_sci_pol_rep_cov_template_online_final.pdf
See also the presentations of the JRC workshop on "Unlocking the energy efficiency potential in the rental & multifamily sectors" available at: http://iet.jrc.ec.europa.eu/energyefficiency/node/9115

This mechanism was used by ICF Habitat, one of the biggest French housing companies with 100 000 dwellings, in the implementation of the first energy performance contract (EnPC) in social housing in France, funded through the project *FRESH* (Financing energy Refurbishment for Social Housing)[135].

In a 64-dwelling estate in **Schiltigheim** (**Alsace** region), the EPC signed in 2011 with SPIE[136] reduced energy consumptions by 47% and provides a guaranteed level of energy consumption for 19 years. In Schiltigheim, tenants agreed to return 50% of the energy savings. However, due to the long payback time of the project, this represents only 27% of total expected savings and around 8% of investment costs.

The 'third line of invoice' thus allows owners to recoup part of the energy savings from tenants, however the amounts are limited to 50% over 15 years, whereas most investments have an energy payback time around 25 years in social housing. Additionally, tenants need to give their agreement through a vote, which complicates the use of this mechanism, and in consequence it is not used as much as it could be. In private housing, the amounts that can be recouped are a lump sum between EUR 10 and 20, which represents an even lower contribution for the landlord[137].

In **Reggio Emilia (Italy)**, the social housing company ACER Reggio Emilia implemented an energy performance contract with 50% energy savings, guaranteed over 12 years. 60% of the energy savings were allocated to the ESCO whereas tenants received the remaining 40%, representing a 20% lower bill every month. This pilot project was possible because 100% of tenants gave their agreement.

As a result of the project *FRESH*[138], the regional legislation (law 24/2001) was modified in 2013 in order to make it easier to recoup energy savings from tenants when implementing energy performance contracts. In 2016, several social housing companies in **Emilia Romagna** are preparing a large-scale programme to retrofit their buildings through energy performance contracts, through the project *LEMON*[139].

Public authorities are often confronted with a challenge when it comes to using energy more efficiently in their buildings: they may own the buildings, but often do not occupy the buildings themselves. There is a split incentive between the day-to-day users of the buildings and the owners, usually local municipalities, which pay for the energy bills.

- The project *EURONET 50/50 MAX*[140] is an example of how this challenge can be successfully addressed thanks to an innovative concept that helps change the behaviour of public building users and enables sharing of the savings achieved on the energy bills between the municipalities and the building users. Thus, employees, and in the case of schools, the pupils have a direct incentive to save energy.
  EURONET 50/50 MAX is the strategic roll-out in 13 countries of the 50/50 concept: municipalities and schools collaborate to share the benefits of energy savings achieved by buildings users (via a financial pay-out of 50% of the energy savings to the schools/ the other 50% is a net saving for municipalities who pay the energy bills).
  The project has so far been implemented in 516 schools and 45 other public buildings. It has involved more than 88 430 pupils, 6 450 teachers and 100 city councils working together to save energy. Preliminary figures show that in 2014 most of the participating schools managed

135 https://ec.europa.eu/energy/intelligent/projects/en/projects/fresh

136 SPIE SAS operates as a multi-technical services company in France and internationally. It offers electrical, mechanical, and HVAC engineering services; and ICT services, www.spie.com

137 For more information: www.buildup.eu/en/practices/publications/energy-performance-contract-64-social-dwellings-schiltigheim-france

138 https://ec.europa.eu/energy/intelligent/projects/en/projects/fresh

139 http://cordis.europa.eu/project/rcn/200000_en.html

140 http://www.euronet50-50max.eu/en/

to reduce electricity consumption, heat consumption or both. The 50/50 methodology has been integrated into 148 local strategies (most of them are SEAPs of the Covenant of Mayors); into 11 regional strategies, most of them energy strategies; and finally in 4 national strategies.

- A key part of the *RentalCal*[141]project is on regulatory barriers, especially split incentives between landlord and tenant. Initial results prove that only three participating countries (**Czech Republic, Germany, Spain**)[142] offer a formal regulatory regime that allows for legal rent increases for improved energy efficiency. While one key concern of RentalCal is to render these regulatory deficits transparent so that national law makers can address the issues, another is to open up the discussion within the industry regarding green value drivers beyond rent premiums. Based on these guidelines a modular calculation tool will be developed, together with a web based information platform. Thus*, RentalCal* aims to contribute to a harmonization of the methodologies and calculation standards in the field of profitability assessments for energy retrofitting investments in the private rental housing sector.
  The eleven partners of the *RentalCal* consortium represent housing markets from eight EU member states (**Czech Republic, Denmark, France, Germany, Great Britain, Poland, Spain and the Netherlands**), each with a distinct regulatory and socioeconomic framework for housing provision, *RentalCal's* consortium members cover a majority share of the EUs largest rental housing markets with a total of about 33 million dwellings in the private rental sector, with about 46 % of it dating from 1980 or earlier. With an estimated increase in refurbishment rates of about 10 % directly or indirectly induced by *RentalCal,* this will lead to an estimated impact of about EUR 190 million in additional investment in deep refurbishment with a total of 474,25 GWh in saved energy over a five year period.

- ***Tackling fuel/energy poverty e.g. in residential accommodation such as social housing***

Among the first programmes to tackle energy poverty was the "Warm Front" programme in **the UK**, introducing *inter alia* energy efficiency measures in dwellings to reduce the common adverse effects of energy poverty. Even though the programme ceased to exist after 2013, its review suggests that every single GBP invested into Warm Front produced as much as GBP 1 to GBP 36,3 in benefits over a 20-year period in terms of monetary savings and excluding indirect benefits such as improved health and living conditions[143]. A total of 2,3 million households received assistance from the Warm Front scheme since it was launched in 2000. Grants were available for improvements such as: loft insulation, cavity wall insulation, hot water tank insulation, heating system improvements.

141 http://www.rentalcal.eu

142 Czech Republic: http://www.rentalcal.eu/The%20Czech%20rental%20market; Germany: http://www.rentalcal.eu/The%20German%20rental%20market ; Spain: http://www.rentalcal.eu/The%20Spanish%20Rental%20market

143 Sovacool B (2015): Fuel poverty, affordability, and energy justice in England: Policy insights from the Warm Front Program. Energy 93, pp. 361-371

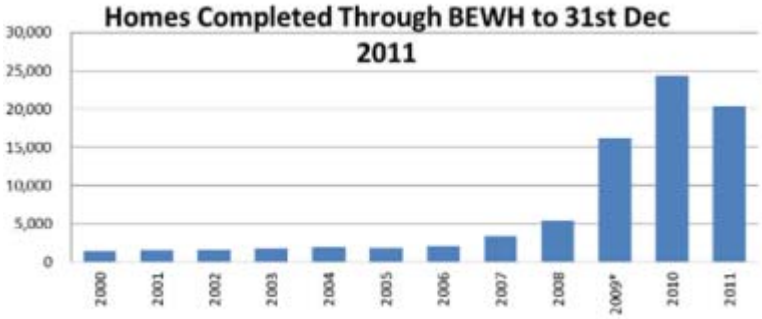
Table 2: Coping strategies undertaken by fuel poor households in the United Kingdom

	% households surveyed
Turned heating off, even though would have preferred to have it on	35%
Turned the heating down, even though would have preferred it to be warmer	33%
Turned out lights in my home, even though would have preferred to have them on	22%
Turned the heating down or off in some rooms but not others, even though would have preferred not to	20%
Only heated and used one room in the house for periods of the day	14%
Used less hot water than would have preferred	15%
Had fewer hot meals or hot drinks that would have liked	4%
None	37%

Source: Sovacool B (2015)

Other examples from **the UK** and **Ireland** combine the energy efficiency obligations under article 7 of the EED obliging utilities to undertake energy efficiency improvements with actions targeting vulnerable consumers (see chapter 2.1.). Following the Irish government's Energy White Paper of 2007 and several in-depth studies of energy poverty in the country , the programme 'Better Energy Warmer Homes' has been established in Ireland and lead to a significant number of refurbishments to date (Figure 28).

Figure 28: Homes completed through the BEWH scheme



Source: SEAI[144]

The **Irish** pilot action of the project *EPISCOPE*[145] has produced an interactive map of north **Dublin** that combines data from Energy Performance Certificates with other data from the population census. In this way it is possible to map areas of fuel poverty, by identifying districts that overlap poor energy performance with low income households. Additionally, **the UK** partner BRE supports the annual UK housing surveys, which track both energy performance and fuel poverty. Presentations on both these pilot actions were presented in the EPISCOPE Workshop 'Towards an energy efficient European housing stock –mapping, modelling and monitoring refurbishment processes'[146].

Romania has implemented an 'Improving Energy Efficiency in Low-Income Households and Communities programme' in recent years to address fuel poverty effectively. The programme, originally designed to support 110 000 people and to reduce emissions in the amount of 660 000 t CO_2e, has overachieved its original targets and helped some 160 000 people in Romania to live in more energy efficient apartment blocks and reduce their heating bills.

144 Available at: http://www.seai.ie/Grants/Warmer_Homes_Scheme/WHS_Statistics/

145 http://episcope.eu

146 http://internal.episcope.eu/fileadmin/episcope/internal/meeting/pm5/workshop/EPISCOPE_ExpertsWorkshop_Presentations.pdf pages 88-122

A number of EU-funded projects, such as *POWER HOUSE*, *POWER HOUSE NZC* [147]and the new *TRANSITION ZERO* project (see chapter 3.1.) focus on working with (social) housing associations to boost the energy efficiency of housing of this vulnerable group of consumers. The *POWER HOUSE NZC (nearly-Zero Energy Challenge)* project provided a platform for a pan-EU knowledge exchange among public, cooperative and social housing practitioners to learn from each other. The project was coordinated by Housing Europe, the European Federation of Public, Cooperative and Social Housing, working with its network of 42 national and regional federations which together gather about 43 000 public, social and cooperative housing providers in 22 countries. Altogether they manage over 26 million homes, about 11% of existing dwellings in the EU. More than 30 case studies of Nearly-Zero Energy Buildings across the EU are documented and energy consumption before and after the nearly-zero energy refurbishment monitored[148].

- ***Best practices on skills improvements of buildings professionals***

Development of skills in the construction sector is crucial to meet NZEB targets and secure performance in the long term, since negative experiences have an impact on the whole market uptake. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. Schemes to upgrade the quality of the works have been developed through initiatives like *BUILD UP Skills*.

The training of energy experts is also essential in ensuring the transfer of knowledge on issues related to the EPBD. Within the framework of Article 17, Member States must ensure that the energy performance certification of buildings and the inspection of heating and air-conditioning systems are carried out in an independent manner by qualified and/or accredited experts. The EPBD CA identified the following good practices in ensuring high qualifications of accredited experts:

- **Germany:** the national list of energy efficiency experts for the support programmes of the Federal Government in the field of energy efficiency aims to improve the quality of local energy consulting services by means of uniform qualification criteria, proof of regular advanced training and random checks of the results.
- **Slovenia**: a common training/certification article in its legislation for all three Directives EED, EPBD and RES and is achieving synergies by implementing a co-ordinated modular training approach.
- **Croatia:** training programmes on energy efficiency for professionals (architecture, construction and building services) have been implemented since 2009. The objective is to enhance knowledge of engineers that, with their competencies, are able to consider construction works and buildings as a whole in terms of energy. Since the beginning of programme implementation, more than 2 200 engineers have completed these training programmes, of which the majority are authorised to carry out energy audits, energy certification of buildings and regular inspections of heating and cooling or AC systems in buildings. This Croatian model of creating professional and competent staff for carrying out energy audits and energy certifications of buildings has also been implemented by other countries in the Balkan region.

BUILD UP Skills is an initiative implemented under the framework of the IEE programme[149] to unite forces and to increase the number of qualified workers in the building workforce in Europe.

The project focuses on the continuing education and training of craftsmen and other on-site workers

147 http://www.powerhouseeurope.eu/home/power_house_nearly_zero_energy_challenge_partners/the_project/

148 Power house and Power house Nearly-Zero Challenge financed under Intelligent Energy Europe: http://www.powerhouseeurope.eu.

149 IEE Calls for proposals 2011, 2012 and 2013

in the field of energy efficiency and renewable energy in buildings and has three main components:

1. **Establishment of national qualification platforms and qualification roadmaps to 2020 (Pillar I: 2011-2013)**

   The aim was to gather all relevant stakeholders in a country in order to develop and agree on a strategy and roadmap, after having identified and quantified needs and priority measures. The national reports include information on current characteristics of the building workforce, skill needs and gaps, barriers to training, existing strategies and policies. Thirty national projects have been supported in the 28 EU Member States as well as in Norway and the Former Yugoslav Republic of Macedonia which are now all completed.

2. **Development and upgrade of qualification and training schemes (Pillar II: from 2013)**

   This funding component invited proposals to introduce new or upgrading existing qualification schemes. These should be based on the *BUILD UP Skills* national roadmaps developed under Pillar I.

   Ten national projects (first batch) started in October 2013 in Austria, Cyprus, Estonia, Finland, Germany, Ireland, Latvia, the Netherlands, Romania and Spain. Twelve additional projects (second batch) were recommended for funding in March 2014. These projects have started in September 2014. They cover the following countries: Bulgaria, Croatia, Greece, Former Yugoslav Republic of Macedonia, Hungary, Italy (two projects), Lithuania, Luxembourg, Portugal, Slovakia and Sweden.

3. **Europe-wide coordinated support activities (EU exchanges)**

   The objective is to support the exchange of best practices through meetings of all participating *BUILD UP Skills* projects. Six EU exchange meetings were organised by the EASME between 2011 and 2014. In addition projects were gathered in peer review teams and also set up separate peer review meetings and activities.
   The achievements of the project are the accreditation of 17 training centres, the mobilisation of more than EUR 40 million for the implementation of the training schemes; the training of >120 trainers, the triggering of +/- 2 000 trainings reaching around 10 000 persons.
   The evaluation[150] of the initiative concluded that *BUILD UP Skills* has been a success in the way that the initiative has managed to create national platforms gathering various construction sector actors and stakeholders throughout Europe including representatives of the construction industry, the training sector, the energy sector, politicians and decision makers.

The evaluation recommended maintaining the momentum of the *BUILD UP Skills* Initiative and to continue the platform work and the launch of more Pillar II projects.

Additionally, the World Economic Forum[151], has highlighted *BUILD UP Skills* as an example of best practice in construction.

Other *BUILD UP* success stories include:

- *BUILD UP Skills Construye2020* **(Spain):** The project developed an app for mobile devices[152] which can be used as a training tool on good practices for the renovation of buildings related to different activities covering notably aluminium carpentry, insulation, renewable energy systems, energy efficiency and efficient installations. Moreover the project is working with the

150 COWI, Evaluation of the BUILD UP Skills initiative under the Intelligent Energy Europe Programme

151 http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report_.pdf, p. 46

152 https://play.google.com/store/apps/details?id=com.esampedro.simuladorApp

national qualification institute in the development of a new qualification for the installer of ground source heat pumps.

Figure 29: *BUILD UP Skills Construye2020* infographic

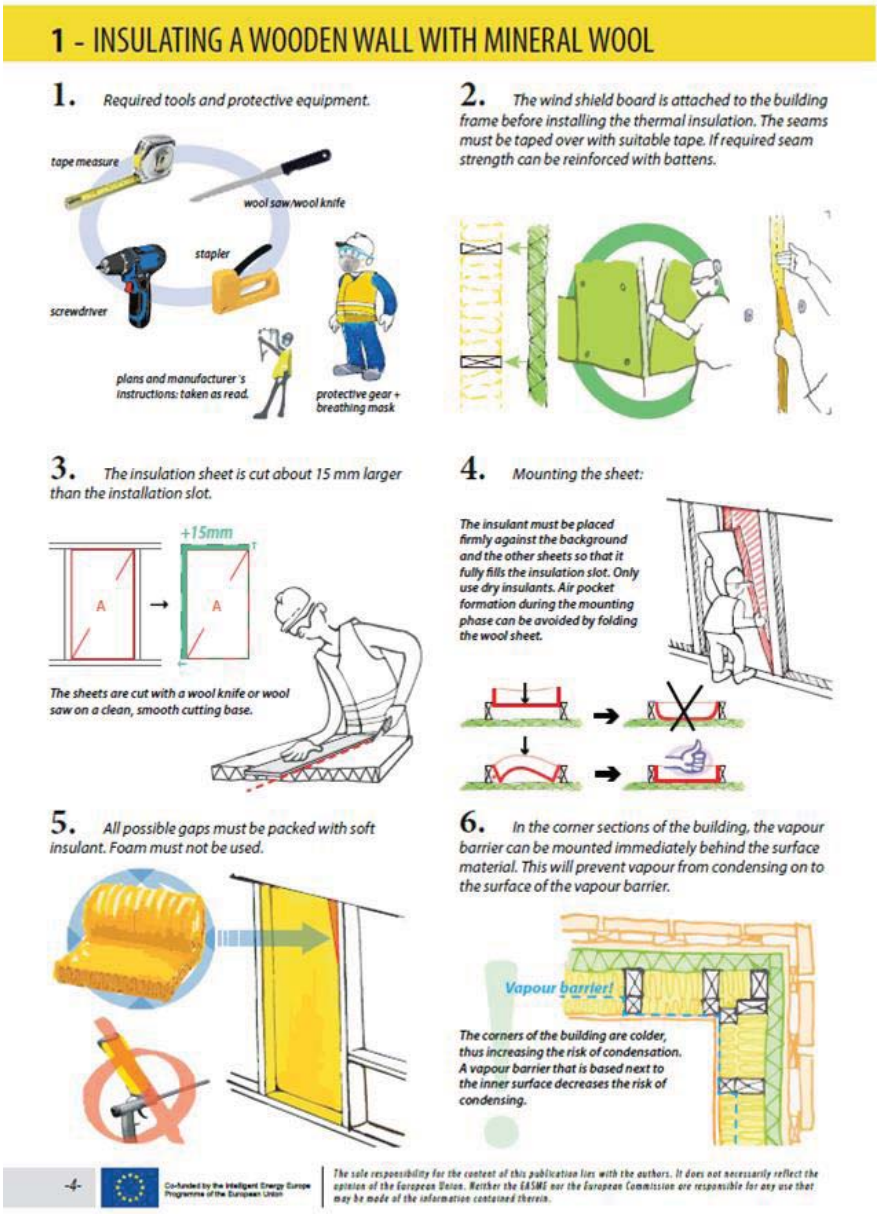
Source: *BUILD UP Skills Construye2020*

- *BUILD UP Skills Netherlands@Work* **(Netherlands):** Eight profiles of blue collar professional competences have been created constituting competence profiles for an occupation including the skills required when building energy-neutral buildings. The project developed an app[153] for mobile devices which enables blue collar workers to choose the adequate course based on their previous knowledge.

- *BUILD UP Skills BEEP* **(Finland):** the BEEP partners have developed an innovative training concept (both for trainers & workers) based on best-practice of energy-efficient construction, based on a comprehensive toolbox including: sets of slides and didactic videos in 5 languages, material dedicated to workers self-learning, a pilot training for 'change agents' (experienced workers/mentors who can help to set an example and explain how to improve the quality of the work) and an on-site training ambassador who plays a critical role in attracting workers' to the pilot trainings.

153 https://play.google.com/store/apps/details?id=bus.app.apk

Figure 30: Training material BEEP



Source: BUILD UP Skills BEEP

- *BUILD UP Skills Qualishell* **(Romania):** The project supported the implementation of national qualification schemes for installers of thermal insulating systems and high efficiency windows systems to ensure high performance building envelopes and support the move towards the implementation of NZEBs.
  The project also developed effective mechanisms to ensure a large-scale and long lasting implementation of the two developed qualification schemes, by use of existing networks, evaluation of competences acquired, and promotion of effective partnerships between education system and construction sector[154].

An open training and qualification platform for professionals (architects, engineers, building

[154] The results of the project have been included in the QUALICHeCK's report (p.40) on "good practices for improving quality of the works".

managers) has been developed within the Horizon 2020 project *PROF-TRAC*[155] to focus on multi-disciplinary skills cutting across traditional professional disciplines. It has carried out a skills mapping exercise, which is an equivalent of a BUILD UP Skills Pillar I status quo report, but for professionals instead of blue collar workers. In addition, PROF-TRAC has created a free online repository of training materials, enabling potential trainers to design their own course.

The **Alsace** region in France is setting up an integrated service for energy renovation of private homes, including the provision of tailored financing, in the frame of the project *MLEI PSEE Alsace*. On the supply side, it is developing a training programme on deep renovation of detached homes, which aims to encourage craftsmen to create consortia that are able to deliver a holistic offer for deep renovation rather than individual contracts. This approach, called DOREMI, allows each craftsman to better estimate the cost of his own lots and thus reduce the risk of over-pricing when craftsmen make a quote, while increasing the delivered energy performance. The DOREMI approach has been successfully implemented in the South of France and has proved to keep deep renovation costs under EUR 400/m2, instead of EUR 500-600 without coordination of the craftsmen.

Technically, craftsmen are taught to use a so-called 'Universal Technical Solution' which has been modelled specifically for the detached housing stock of Alsace. It consists of a standard package of solutions which allow reaching the low energy renovation standard with a relatively good accuracy, without using a thermal engineer for each project which represents excessive costs.

Training of craftsmen consists of 2 training modules: module 1 is 3 days of training for all professionals, after which the expectation is that some of the craftsmen will create consortia. These consortia can then follow module 2, during which they are accompanied for 30 hours on actual renovation projects.

- ***Smart homes& buildings – not a distant future (IT solutions for better buildings energy performance, multiple benefits for occupants and better integration of the building in the energy system)***

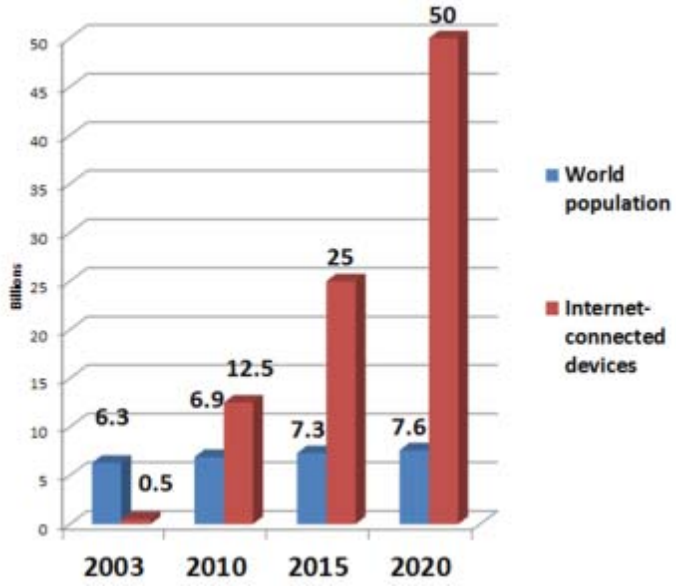
Information and telecommunication technologies have an increasingly important role in the transition towards a more sustainable future: dematerialisation, saving of resources by disrupting existing business models towards shared economy with higher efficiency. ICT also has the potential to change behaviour, reduce travel, improve the efficiency of products, systems and processes, and specifically to accelerate energy market transformation enabling demand-response, real time energy management and integration of intermittent renewable energy sources. The implementation of appropriate ICT solutions will enhance network efficiency and improve overall system operation by better matching local supply and demand.

At building level ICT ensures an optimised **energy management** supporting design, **monitoring and control** with smartness and self- learning capacities; **user information, enhancing comfort** and ensuring optimal indoor conditions for building occupants; real time communication and **interactions with the grid** allowing active demand-side services to energy system (demand response and integration of renewable energy sources).

The underlying challenge is to keep the energy consumption of the growing amount of internet-connected devices under control as a large share of the electricity is consumed in network-enabled "standby".

[155] http://proftrac.eu/open-training-platform-for-nzeb-professionals.html

Figure 31: Number of internet-connected devices comparing to the world's population



Source: "The Internet of Things – How the Next Evolution of the Internet is Changing Everything", Dave Evans, Cisco, April 2011, p3

Development of standard communication protocols is also crucial as well as the challenge related to data protection and security.

Building Information Modelling (BIM) appears as an instrument to help structure, manage and integrate building project information, facilitating the design, simulation, analysis and operation of energy efficient solutions. This effectively contributes to increased collaboration, efficiency in terms of materials, costs and time as well as enhanced project quality. BIM is a digital representation of the characteristics of a building and its systems. It is intended to be used to save and share information before and during construction. The true benefits of BIM are obtained when the technology is applied throughout the project life cycle, from design to demolition. Many projects funded under H2020 EeB PPP address the energy efficiency of buildings and infrastructures through the use of ICT and novel BIM approaches[156].

One of the principal innovations being developed in the project *MORE-CONNECT*[157] is to link data from existing buildings with manufacturing tools for an automated construction process: data on building characteristics, potential for energy efficiencies, and end-users demands are linked using **BIM systems** to steer industrial process and to enhance quality control. The benefits include:

- tailor-made solutions for individuals in a mass production way to optimize costs, environmental aspects and quality
- a nearly zero energy performance of the total modular renovation
- a maximum return on investment less than 8 years and with a limitation of the total renovation time of 5 days
- plug & play connection of modular components communicating by integrated (wireless) sensors and control components for performance diagnostics and control ensuring performances guaranty but also healthy indoor environment, safety and accessibility.

156 EeB PPP Projects Review 2016 : http://www.ectp.org/cws/params/ectp/download_files/36D3750v1_EeB_PPP_Project_Review.pdf

157 http://www.more-connect.eu

ZERO-PLUS[158] aims to develop entire districts of new high energy performance buildings, with interactive RES production and consumption. To this end the project is developing design, decision and support IT tools. ICT for smart energy management and demand-side services at district level (peak shaving for the DSO) is also developed under the *Rennovates*[159] project. The project develops a holistic systemic deep renovation concept developing smart energy-based communities resulting in energy-neutral housing maximizing the use of renewable energy. The procedure comprises several steps:

- A physical renovation installing a new façade, new roof. The roof contains PV panels (5-6 kW).
- All consumption is electrified (reduce dependency on gas), to this end, a pre-fabricated energy module is attached to the building, containing hot water storage, heat pump etc.
- The equipment in the energy module is foreseen with a gateway allowing for smart control of the equipment[160].

Figure 32: holistic systemic deep renovation concept- *Rennovates*

Source: http://rennovates.eu/

As stated in the EPBD CA report[161], IEE projects show that electronic monitoring and control has the potential to find energy saving opportunities more cheaply and effectively than regular inspection alone. A large number of buildings can be monitored continuously, with reports generated automatically when certain conditions are detected. The increasingly wide use of BMS may be the key to further progress, though standard data formats and transmission protocols will have to be agreed to ensure interoperability between devices and equipment from different manufacturers and the networks infrastructure.

- The *HARMONAC*[162] project had found that the average energy savings potential for individual AC systems was 35-40% of their measured consumption and indicated that monitoring was more likely to be cost-effective than universal inspection.
- The *iSERV*[163] project was designed to look at the prospects for automatic monitoring of buildings on a larger scale (data from 733 systems in 16 countries).

These projects concluded that automatic monitoring revealed many installations had much greater potential for savings than the inspections had suggested. The combination of inspections and monitoring helps to find measures that an inspection on its own would not be able to identify.

158 http://www.zeroplus.org/

159 http://rennovates.eu/

160 https://www.eebus.org/en/about-us/

161 *Concerted Action EPBD Report www.epbdca.eu/outcomes/Report_Automatic_Monitoring.pdf*

162 *HARMONAC* – Energy Consumption in European Air Conditioning Systems and the Air Conditioning System Inspection Process http://ec.europa.eu/energy/intelligent/projects/en/projects/harmonac
iSERV – Inspection of HVAC Systems through continuous monitoring and benchmarking http://www.iservcmb.info/

Monitoring as a partial substitute for inspections was assessed in the CA EPBD report[164] which concluded *Even if not always feasible at present, it is important that national legislation does not block the opportunity for automatic monitoring in future*.

The Province of Torino provides a good practice[165] by developing an IT tool (ENERCLOUD) to better support local authorities in monitoring and reducing their energy consumption. The analysis carried out by ENERCLOUD produces an understandable report, based on benchmarking data, useful for monitoring real improvements obtained by actions implemented by the local authority. Key success factor of this initiative was the presence of dedicated technical resources and an effective partnership between municipalities and energy providers. ENERCLOUD is a web-based cloud-computing software that enables monitoring and evaluation of the thermal/electric energy consumption of public buildings and of the electricity consumption of public lighting systems, using the data from energy bills. The software enables comparison of energy consumption with target values, identifying abnormal values and potential improvement areas[166].

The Energy Efficiency part of H2020 addresses the challenge of end-user behavioural change to achieve greater energy efficiency taking advantage of ICT:

- the *PeakApp*[167] project aims to develop and validate innovative ICT based system connecting energy markets and end-users. Although the focus will be on achieving energy savings through behavioural change, the solution will also enable increased consumption of renewable and low-priced electricity from the spot market using a dynamic electricity tariff. Validation under real life conditions in social housing will be carried out in Austria, Estonia, Sweden and Finland, involving 2 500 households, connecting them to social networks, motivating them through serious gaming, and boosting the efficacy of Smart Home building energy management systems.
- the *ORBEET*[168] project aims to develop an IT ecosystem for real-time energy performance monitoring and displaying. Users will be engaged with IT tools through intrinsic/extrinsic human motivators. The validation is foreseen in 4 public buildings in 4 countries. The action aims at triggering a 20% energy demand reduction per building, a 30% CO_2 emission reduction with a 2 years pay-back period.

Policy feedback resulting from the good practice analysis

- Addressing energy efficiency in buildings can have a positive impact not only in economic terms (in terms of the energy bills), but also improve public health and safety, by reduced mortality and morbidity due to poor indoor climate.
- With enhanced efficiency, there is a corresponding need for significantly increased technical skills. **Dedicated training and qualification schemes** need to make sure that worker qualifications keep pace with the technical complexity of buildings and building components.
- The **very dispersed nature of building performance calculation methodologies** is a **clear barrier** to ongoing uptake of best practices.

164 Concerted Action EPBD Report www.epbdca.eu/outcomes/Report_Automatic_Monitoring.pdf

165 identified by the *COOPENERGY* project http://www.coopenergy.eu/

166 For more information:
http://www.coopenergy.eu/sites/default/files/good_practice_files/39_Province%20of%20Torino%2C%20IT%20-%20ENERCLOUD%20software.pdf
http://www.cittametropolitana.torino.it/cms/ambiente/risorse-energetiche/progetti-energia-sostenibile/enercloud/enercloud

167 http://www.peakapp.eu/

168 http://orbeet.eu/

EUROPEAN
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Brussels, 30.11.2016
SWD(2016) 404 final

PART 2/4

COMMISSION STAFF WORKING DOCUMENT

Good practice in energy efficiency

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency

{COM(2016) 761 final}

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4. Energy efficiency in industry, businesses, and services

4.1. Industry

The 28 EU Member States' final energy consumption by industry decreased in absolute terms from 327 Mtoe in 2005 to 277 Mtoe in 2013 (15% decrease). Due mainly to quantity-based effects (economic growth) and structural effects, all Member States reduced their levels compared to 2005, with the exception of Austria, Germany, Hungary and Latvia. Both of these effects also have an impact on energy intensity, i.e. the relation of energy input to output produced (usually displayed in terms of final energy in ktoe/ GDP in million EUR), which is a key indicator for the industry sector[1].

Since 2000, European industry has cut its energy intensity twice as fast as the US. The improvement rate is steeper in energy intensive sectors[2] for a clear reason: energy is an important cost. By putting a price on CO_2 emissions, the EU Emissions Trading Scheme has provided an incentive to use low carbon fuels and to invest in energy efficiency. However, significant potential remains and by using existing technologies, it is possible to reduce energy costs in industry by 4-10% with investments that pay for themselves in less than five years[3].

The "Successful policies" facility of the MURE database[4] contains several new initiatives which are being launched by Member States to enhance energy efficiency in industry, including mandatory industrial **energy audits**, development of **industrial energy efficiency networks**, **energy efficiency management** in industrial enterprises, and development of **public-private partnerships** for implementation of energy efficiency measures[5].

- ***Energy audits***

Article 8 of the EED requires Member States to implement mandatory energy audits for large enterprises and safeguard the availability of audits for SMEs by the end of 2015. The survey conducted by the JRC[6] identified three types of compliance towards the transposition of the Article 8. First are the countries with mandatory programmes in place that oblige large energy consumers to perform energy audits on a regular basis and that come nearest to the requirements of the article 8 of the EED. Secondly, the countries with voluntary programmes in place that can also meet the requirements of the Directive by the promotion of energy audits in agreements signed normally between sectorial associations and the governmental bodies and finally the Member States that still have a great amount of work to develop in order to meet the deadlines established for the transposition of the Directive into national law.

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1 For further details see SWD(2015) 245 final

2 The chemical sector halved its energy intensity over the last 20 years.

3 An EU Strategy on Heating and Cooling SWD (2016) 24 final

4 http://www.measures-odyssee-mure.eu/
Energy Efficiency Trends and Policies In Industry - An Analysis Based on the ODYSSEE and MURE Databases, September 2015

6 Serrenho T, Bertoldi P, Cahill C, JRC (2015): Survey of energy audits and energy management systems in the Member States, available at:
http://publications.jrc.ec.europa.eu/repository/bitstream/JRC95432/survey%20of%20energy%20audits%20and%20energy%20management%20systems%20in%20the%20member%20states_pub.pdf

Figure 33: Energy auditor at work

Source: Source One Energy[7]

Accordingly, the **Concerted Action EED** devoted many discussions and best practice exchanges to the set-up of energy audits and the introduction of energy management systems. The Concerted Action successfully established a large number of good practice examples from Austria, Croatia, the Czech Republic, Finland, Germany, the Netherlands, Slovakia, and Sweden (see Annex II). These examples include[8]:

- **Finland** has a long-standing tradition of successful **energy auditing**. The guiding principle is that the energy audit must be attractive for clients, and cost effective for both the client (thanks in part to subsidies) and for the government (cost effectiveness of the energy audit framework). There are three guidance levels: guidelines, models for client groups, and handbooks. More stringent minimum requirements are set for buildings, while minimum requirements for other sectors are left to bilateral negotiations. The audit model contains requirements for a comprehensive audit and its results, including a spreadsheet template to be completed with data, delivered to the national energy agency, and uploaded to a database. This database is used, inter alia, to calculate the average saving potential of different measures, to evaluate the audit programme, and to inform users.

  Between the years 1992 and 2006, subsidy decisions were made for 748 energy audits in the industry sector (with 1 139 facilities). By the end of 2006, the estimated annual savings in energy and water costs achieved through audits in the service and industry sectors (excluding process industry) was estimated to be circa EUR 25 million. The audit subsidies totalled EUR 1,5 million, and the total cost of the audits was EUR 3,5 million in industrial facilities with annual energy use less than 500 GWh/year. The percentage of realised savings out of the potential savings were, on average, 52% for heat and fuels, 59% for electricity, and 67% for

7 http://www.sourceone-energy.com/Portals/104976/images/Biogen%20025.jpg

8 Forni D, Concerted Action EED (2015): Energy services and ESCOs, energy auditing, solving administrative barriers. Available at: http://www.ca-eed.eu/themes/energy-services-ct5/energy-services-and-escos-energy-auditing-solving-administrative-barriers3

water[9].

- In the **Netherlands,** the 'Friendly energy audit'[10] started in 2004 and focussed on the paper industry which decided to work together to survive in the highly competitive international environment. Their vision for 2020 is to become a 'world champion', reducing their consumption by half. Many paper mills were keen to implement an energy management structure and ISO 50001 was chosen to become the standard for the paper industry. However, no experienced consultants were available or trained for this industry. A working group was formed to ensure that ISO 50 001 would not become excessively bureaucratic to implement, but would raise awareness. One of its activities was the organisation of friendly energy audits, with eight companies participating in the pilot. The eight mills were each visited for one day and a presentation or report was prepared at the end of each visit and shared in the working group. Such a report would include, for example, the vision (target) of every mill. Many ideas were also shared on ways of communicating with mill personnel. After this first experience, the mills asked to repeat the friendly audit again the following year.

The effectiveness of energy audit recommendations is dependent upon people's behaviour and the improvement of enterprises' energy cultures and supply chains. As mentioned in the EEFIG report[11], to ensure that energy audit recommendations lead to actual implementation, it is necessary to change the approach in order for the results of energy audits to provide relevant financial data, and for them to be addressed at Board level.

- *EUREM*[12] is a standardised training course. The courses specifically target energy managers of companies with significant energy consumption, as well as people working for energy consultancies. The course consists of a theoretical part (160 units) and each trainee needs to develop and present a final project (so-called Energy Concepts) with the support of a professional coach. Today, the network proposes courses in 30 countries and the concept has been extended to Latin America, North Africa, and India (without EU support), and alumni include up to 4 000 energy managers. It covers nearly all energy-relevant issues which can arise in companies. Some Energy Concepts defined by trainees have actually been implemented or will be installed in their respective plants, resulting in concrete and immediate energy savings (e.g. the optimisation of a HVAC system or compressed air system, the adjustment of frequency converters, or the implementation of a solar thermal system).
- The European industry has a cost-effective energy saving potential of 13% - 75%, estimated from industries that use steam and electrical motor systems.[13] The *STEAM-UP*[14] project aims to develop a tailor-made steam audit tool and a methodology embedding a participatory approach where company (top) management would be involved from the beginning of the audit process. A specific focus will be put on the technical and financial elements which should be included in the audit reports in order to ensure actual implementation of the identified measures. The development of business cases is foreseen, taking non-energy benefits into account. A total of 400 energy managers and auditors will be trained and 75 companies will be audited by the end of the project.

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9 *ODYSSEE-MURE* project : http://www.measures-odyssee-mure.eu/public/mure_pdf/industry/FIN3.PDF

10 CA EED Good Practice Factsheet (Friendly Audit NL)

11 "Energy Efficiency – the first fuel for the EU Economy", Energy Efficiency Financial Institutions Group, February 2015 (http://www.eefig.com/index.php/the-eefig-report)

12 The EUREM project: www.eurem-plus.eu

13 ICF International (2015): Study on energy efficiency and energy saving potential in industry and on possible policy mechanisms available at: https://ec.europa.eu/energy/sites/ener/files/documents/151201%20DG%20ENER%20Industrial%20EE%20study%20-%20final%20report_clean_stc.pdf

14 https://www.steam-up.eu/

- The *IND-ECO*[15] project aims at promoting energy efficiency in the leather production industry, removing barriers to information and capital access. Two sectors were particularly targeted: tanning and footwear, which gathered a total of 13 000 companies in Europe in 2011, mostly SMEs. A total of 75 audits have been implemented, 267 efficient technologies have been gathered in an online database, and 40 agreements with technology providers have been established, allowing companies from Bulgaria, Italy, Portugal, Romania, Spain, and the UK to improve their energy efficiency[16]. Half of the audited companies defined investment plans resulting in concrete implementation of the identified measures, meaning a reduction of 32,4 million kWh p.a. of primary energy and 9 050 tons of CO_2e emitted.
- The *TESLA* (Transferring Energy Save Laid on Agroindustry) project focussed on four agro-food sectors: olive oil mills, fruit and vegetable processing plants, wineries, and animal feed factories. Trained auditors performed 110 energy audits in the selected agro-food cooperatives. The project produced Best Practices and Best Available Techniques in energy management, handbooks, and an online tool to carry out the self-assessment and benchmarking for each agro-food sector targeted in four countries[17]. The project has triggered investment in EE measures of circa EUR 10 million (Investments in energy efficiency directly or indirectly due to *TESLA* during the project period), achieving primary energy savings of 1 800 toe/year.

- ***Energy efficiency networks, benchmarking, and voluntary agreements***

Several Member States have launched energy efficiency networks to support the industry and the service sector in learning from best practices and discussing the implementation of energy efficiency programmes, frequently also including large enterprises with their often advanced knowledge of energy audits and energy management. Examples include **Sweden, Germany, Belgium, and Ireland**.

Sweden set up the Energy Management System Light within the ENIG energy efficiency network, managed by the iron sector association. This involves five stages inspired by ISO 50001, but simplified for SMEs: an energy audit, targets, an action plan, an energy policy, investment methods, and finally improvement methods. In two pilot projects the average energy saving of management schemes was five percentage points higher than in a comparison group undertaking an energy audit only[18].

The **German** National Action Plan on Energy Efficiency foresees the installation of 500 *Learning Energy Efficiency Networks (LEEN)* until 2020. The scheme is not solely for SMEs, but works well with SMEs. The originally **Swiss** model was introduced at a smaller scale and has been quite successful. The model should work without public support, but at the moment there are KfW subsidies for implementing energy management systems. The model requires a local host (e.g. a city, chamber of commerce, energy distributor), a moderator, and an engineer counsel. Participants receive an audit according to EN 16 247 and the work covers the most important parts of ISO 50 001. On average, the enterprises in the network invested twice as much as similar companies outside the network. This is also due to lower transaction costs as a result of the fact that it is possible to check directly how

15 http://www.ind-ecoefficiency.eu/

16 Testimonials of companies can be found on pages 23 and 24 of the Final publishable report http://www.ind-ecoefficiency.eu/viewdoc.php?id=110

17 http://www.teslaproject.org/

18 Forni D, Concerted Action EED (2015): Energy services and ESCOs, energy auditing, solving administrative barriers. Available at: http://www.ca-eed.eu/themes/energy-services-ct5/energy-services-and-escos-energy-auditing-solving-administrative-barriers3

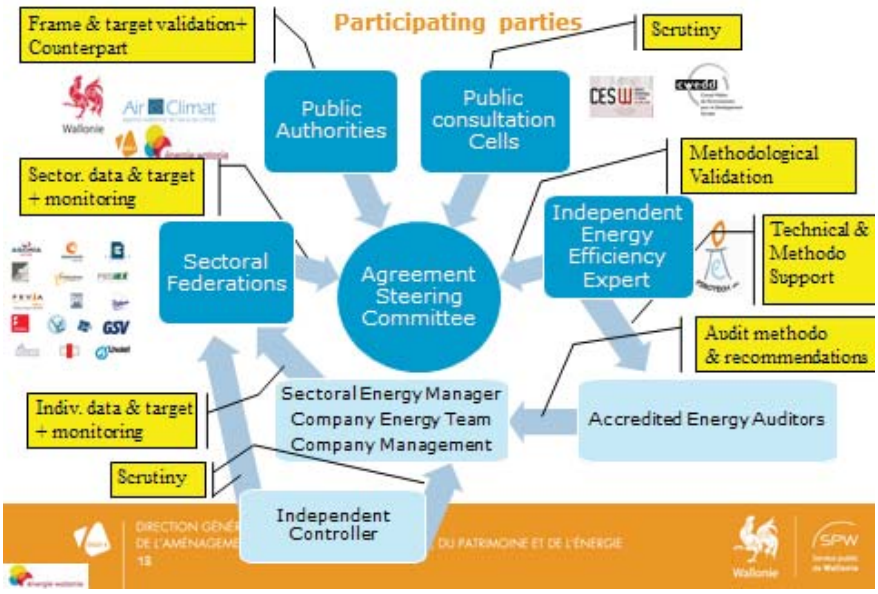
other members of the network have achieved energy savings[19].

The participants' motivation to participate in the networks was, beside the final aim of reducing energy costs, to gather information about energy use in their production sites and identify suitable measures. Most of the identified measures addressed cross-cutting electrical technologies, and more than 30% of the measures addressed process heat and space heating. Although measures concerning process heat and energy carrier changes deliver the highest expected savings, they are also the most costly ones.

The quantitative monitoring, performed jointly by the energy manager and the consulting engineer, showed that the annual average efficiency improvement of the participants was 2.1%. In absolute terms this resulted in energy savings of ca. 5 PJ/a after four years of operation of the 30 networks.

Since 2003 **the region of Wallonia in Belgium** put in place voluntary agreements in the energy intensive industry. In the first period (2003-2010), 16 agreements covering 80% of industry consumption resulted in 7,94TWh of energy savings and 2,29Mt of CO_2 reduction. A simplified version of sectorial voluntary agreements has been developed for SMEs.

Figure 34: Participants to the voluntary agreements in industry – Wallonia



[19] Forni D, Concerted Action EED (2015): Energy services and ESCOs, energy auditing, solving administrative barriers. Available at: http://www.ca-eed.eu/themes/energy-services-ct5/energy-services-and-escos-energy-auditing-solving-administrative-barriers3

Table 3: The Irish LIEN scheme

Country	Ireland
Name of policy	Large Industry Energy Network (LIEN)
Type of policy	The LIEN belongs to the policy type "Voluntary Agreements". The aim of the programme is not only to define energy saving targets for large industries but also to provide information and advice to the participants and to establish an energy management system. Therefore the LIEN also belongs to the policy types "Information and advice" and "Energy Management System".
Target sector	The industry sector is the target group. Companies can join the LIEN if they spend more than € 1 million on energy yearly.
Actions targeted	Members of the LIEN have to introduce an energy management system, define individual energy saving targets, conduct annual energy audits and publish annual energy consumption reports. Workshops and seminars are organised on special issues of energy efficiency improvements. The focus of these educational measures is on energy efficient technologies, awareness raising, monitoring & evaluation and energy management approaches. Some technologies, which were already discussed within the network, are e.g. energy efficient refrigeration, lighting, motive power, compressed air, building management systems and combined heat and power (CHP).
Duration	The LIEN was established in 1995 and is ongoing. An end date is not envisaged.
Overall target and/or achievements	According to the EED Article 7 notification, which was published in 2014, projections for the years 2014 - 2020 result in expected energy savings of 3,153 GWh in 2020.
Overall aim of the policy	The overall aim of the LIEN is to support companies to build up or to further improve an energy management system and to achieve ISO 50001 certification. Furthermore, the LIEN also supports companies to identify implementation gaps, to broaden the existing (technical) knowledge, and to exchange experiences between the participants.
Innovativeness	The LIEN is accepted by the companies in the industry sector. In the past, significant energy savings were already realised by network participants. Evaluation activities are supported; the energy targets are recalibrated every year. A gap analysis is included in the Energy Agreement Programme to identify the existing barriers and missing tools to implement an energy management system.

Source: Energy Efficiency Watch (2015): Case study: Large industry energy network. Available at: http://www.energy-efficiency-watch.org/fileadmin/eew_documents/EEW3/Case_Studies_EEW3/Case_Study_LIEN_Ireland_final.pdf

EuPlastVoltage[20] gathered the plastics converter associations of eight EU countries (NL, HU, ES, PT, UK, DE, FR, and BE), covering over 60% of European plastics production. The partners managed to prepare and launch a long-term voluntary agreement[21] on energy efficiency for the European plastics converting industry. This 2011-2020 agreement involves the European Plastics Converters (EuPC) and national plastics converting associations (the Association of the Hungarian Plastics Industry (AHPI), the Spanish Association of Plastics Producers (ANAIP), the British Plastics Federation (BPF), the German Plastics Packaging Industry Association (IK), the Belgian Association of Manufacturers of Plastic and Rubber Products (Federplast), the Dutch Federation for Rubber and Plastic (NRK), the French Federation of Plastics (Plasturgie), and the Portuguese Plastic Industry Association (APIP)). The objective is to improve the energy efficiency of the European plastics converting industry by 20% between 2007 and 2020, thanks to mandatory energy efficiency

[20] http://www.euplastvoltage.eu

[21] http://www.euplastvoltage.eu/uploads/downloads/voluntary-agreement.pdf

measures in the production process, and voluntary measures in the product chain and the use of renewable energy. The Agreement, signed in 2011, defines obligations for both the EuPC and the national plastics converting associations and foresees the definition of National Long-Term Energy Efficiency Plans (NLTEPs).

The *SESEC*[22] project was designed to address the energy efficiency needs of the European clothing industry and of the upstream part of its value chain: the textile industry. 99% of clothing companies are SMEs, mostly located in southern and eastern EU Member States. The project established a structured database of energy consumption in specific mills (47 products of 7 categories) which could be used to calculate energy efficiency and benchmarking, allowing comparison of production units within similar product groups. The Energy Saving Scheme allows companies to make a first assessment on their energy efficiency, and to collect and calculate consumption data for each machine and each production phase. It also allows them to compare their production on monthly basis in terms of energy consumption, greenhouse gas emissions, and energy costs. The tool allows companies to achieve savings from 5% to up to 30% of thermal energy consumption, with a payback time of two years. Twenty-seven audits have been implemented in clothing factories in Portugal, Italy, Romania, and Bulgaria. The tool has been extended to the textile sector as part of the *SET*[23] project.

- ***Support to sustainable energy use and waste heat recovery in processing industries***

According to the *ODYSSEE-MURE* analysis of 'Energy Efficiency Trends and Policies In Industry'[24], the most important policy addressing the energy-intensive industry is the EU ETS. Only a few countries have introduced additional national policies specifically addressing the energy-intensive industry, some of which were already described above.

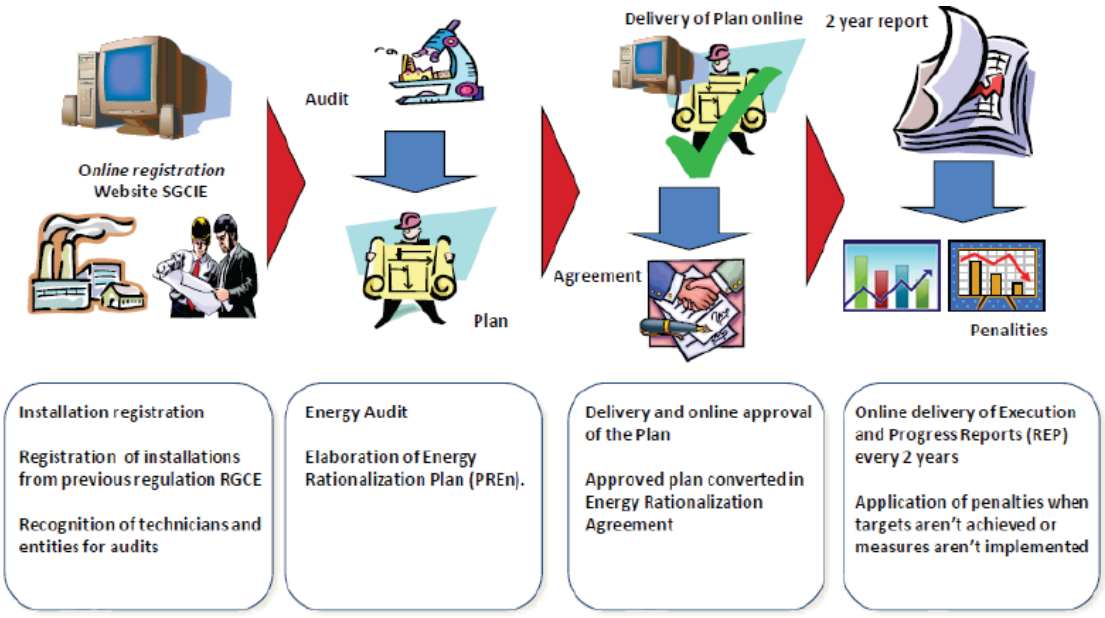
In **Portugal** the Intensive Energy Consumption Management System has specific provisions for energy-intensive companies. This system promotes increases in energy efficiency through changes in production processes, technologies, and behaviour. It applies to all companies that have an annual consumption over 500 toe/year, imposing binding periodic (every six or eight years) energy audits. Energy intensive users are obliged to elaborate and execute Energy Consumption Rationalisation Plans (PREn), establishing targets for energy and carbon intensity and specific energy consumption, and also outlining energy rationalisation measures. The Portuguese Energy Agency (ADENE) is in charge of monitoring and evaluation of the PREn.

22 http://www.euratex.eu/sesec

23 http://www.euratex.eu/pages/set

24 *ODYSSEE-MURE*, Energy Efficiency Trends and Policies In Industry, An Analysis Based on the ODYSSEE and MURE Databases, September 2015

Figure 35: Energy Intensive Consumption Management System in Portugal



Source: ADENE 2015

Fossil fuels are often less expensive than renewables when used for production processes, in particular in industries using high temperature process heat. In **Denmark**, a subsidy scheme has been set up to promote energy efficient use of renewable energy in industrial production processes. The new investment scheme will bridge the price gap between renewable and fossil fuels. The state subsidy scheme will support industries in transitioning to renewable energy sources or district heating to power manufacturing processes, thereby replacing fossil fuels with renewable energy such as wind, solar, biogas, or biomass. The third part of the scheme involves support for energy efficiency improvements made in direct connection with the transition to renewable energy or district heating. An ex-ante analysis shows that this would result in a reduction in the use of fossil fuels of approximately 16 PJ/year until 2020. CO_2 reduction is expected to be around 1 million tonne CO_2e/year until 2020[25].

According to the Commission Communication on an EU Strategy on Heating and Cooling, 73% of energy in industry is used for heating and cooling. Industries generate heat as a by-product. Much more of this could be reused within plants or sold for heating nearby buildings. The technical potential has been estimated to cover all the EU's space heating demand; the economically recoverable potential, however, requires analysis of local conditions. The barriers to the use of these resources are lack of awareness and of information on the resource available; inadequate business models and incentives; a lack of heat networks; and lack of cooperation between industry and district heating companies.

Further good practices include:

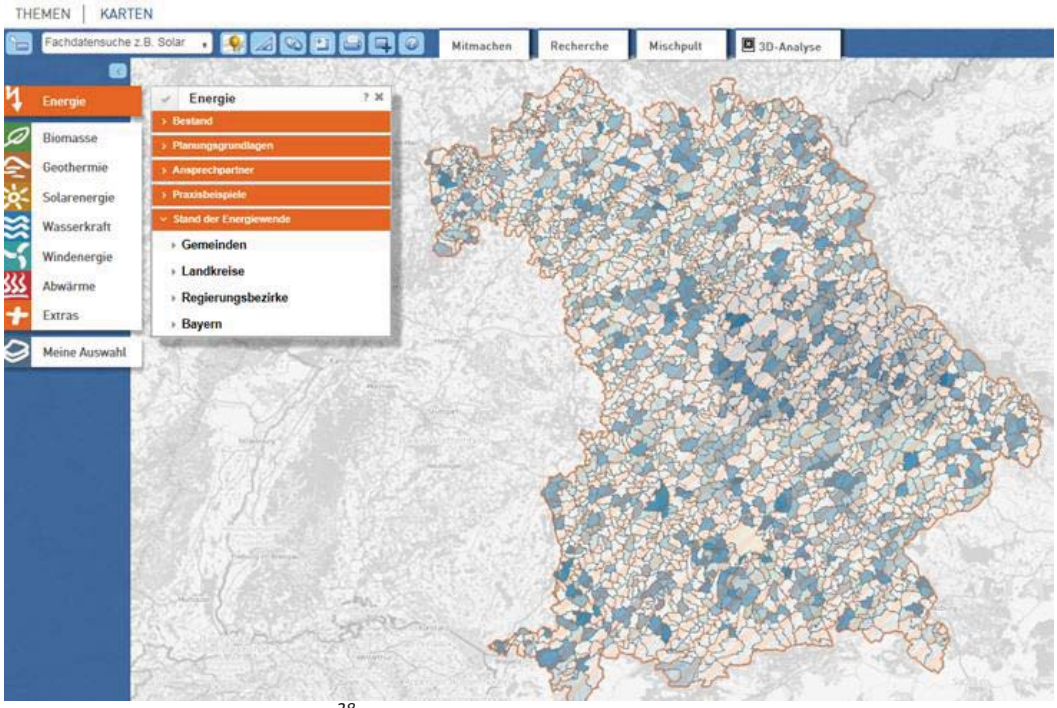
- The **German** federal state of **Bavaria** launched 'Energie-Atlas'[26]**,** a web platform supporting citizens, municipalities and companies with information on how to realise energy savings and increase energy efficiency, and on the use of renewable energy technologies. The core content is an interactive map integrating and showing, on-demand, different layers of georeferenced

[25] Odyssee-Mure Energy Efficiency Trends and Policies In Industry, An Analysis Based on the ODYSSEE and MURE Databases, September 2015

[26] https://www.energieatlas.bayern.de/

information such as installed energy plants, potential for new capacity, infrastructure, tools for project delivery, information on efficient techniques, etc. There is also a stock exchange for surplus heat, and an integrated tool to visualise potential surplus heat and demand for additional heat. At present, nearly 300 sources of surplus heat are identified, alongside the additional sources of heat from municipal wastewater and waste incineration[27].

Figure 36: Energieatlas Bayern – geoinformation system



Source: Energieatlas Bayern[28]

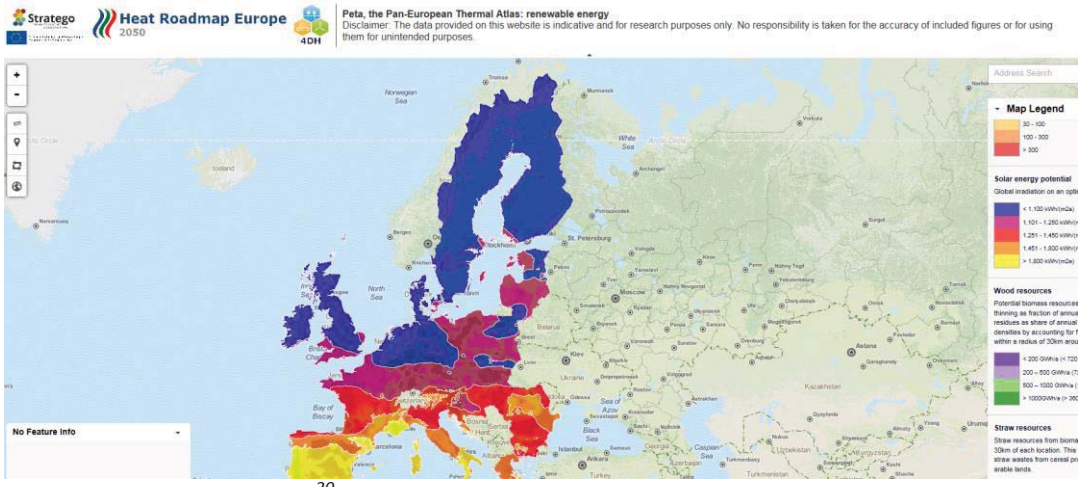
- The *STRATEGO*[29] project aims at supporting national authorities in the preparation of National Heating and Cooling Plans. For this purpose a thermal atlas of the 28 EU Member States including demand and supply sources for heating and cooling will be produced. At national level, an in-depth assessment of the potential of efficient heating and cooling will be undertaken for five countries (CZ, HR, IT, RO, and UK). Moreover, national advisory groups will be set up in eight countries (CZ, HR, IT, RO, UK, BE, AT, DE). In these countries, the project will also support 23 cities/regions in mapping their local heating and cooling demand and supply and to define areas of priority for intervention. Moreover, a coaching scheme will be established between 23 learning regions/cities and eight experienced regions/cities.

27 For further information see the CA EED good practice factsheet at: www.ca-eed.eu/goodpractices/good-practice-factsheets/energyservices/energy-services-energie-atlas-bayerngermany

28 https://www.energieatlas.bayern.de/

29 http://ec.europa.eu/energy/intelligent/projects/en/projects/stratego; www.stratego-project.eu

Figure 37: STRATEGO, the Pan-European Thermal Atlas



Source: STRATEGO project[30]

- **The Moravian-Silesian region**, and specifically the area of Ostrava that has the highest concentration of emissions within the Czech Republic, is an industrial region with coal mines, iron and steel production, chemical production, metallurgy, paper mills, and other heavy industry. Primary energy sources for district heating systems in large cities include coal, biomass, coke, and gas.
  STRATEGO partners have initiated many discussions among local/regional authorities and heating and cooling industries and looked for more effective solutions for heat generation and reduction of emissions in the Moravian-Silesian region. During the coaching sessions, attended by representatives of regional authorities and heating and cooling industries, participants were trained on how the DHC system works in Sweden, and discussed the current situation in the field of DHC in the Czech Republic. They defined areas of potential for efficient heating and cooling projects and decreasing emissions in the region.[31] At the national level, *STRATEGO* partners have organised meetings with a national authority (Ministry of Industry and Trade) and an energy industry consulting company (EuroEnergy) in order to evaluate the potential for high-efficiency cogeneration and efficient district heating and cooling. This contributed to the development of the document „Comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling in Czech Republic"[32].

The contractual **Public Private Partnership on Sustainable Process Industry (SPIRE)** is a European initiative funded under H2020 that focuses on a number of sectors which are key to the European manufacturing value chain: cement, ceramics, chemicals, engineering, minerals and ore, non-ferrous metals, steel, and water. SPIRE supports, amongst others, the development and demonstration of new technologies or innovative solutions for the recovery residual heat in large industrial systems.

30 http://maps.heatroadmap.eu/maps/31157/Renewable-Resources-Map-for-EU28?preview=true#

31 http://stratego-project.eu/wp-content/uploads/2016/03/3a-STRATEGO-local-cases-CZ-Moravia_Silesia-v201603.pdf

32 https://ec.europa.eu/energy/sites/ener/files/documents/Art%2014%281%29%20assessmentCzechrepublic.pdf

- The project *TASIO*[33] is working on the demonstration of solutions to recover the waste heat produced in processes of industrial sectors such as cement, glass, steelmaking, and petrochemicals, and transform it into useful energy. These solutions will be designed after an evaluation of the energetic status of these four industries and will deal with the development of Waste Heat Recovery Systems (WHRS) based on the Organic Rankine Cycle (ORC) technology. Three additional projects, *ITherm, SUSPIR*[34]*E,* and *Indus3E*, are also carrying out research on new technologies for the utilisation of heat recovery in large industrial systems.

- Waste heat recovery systems can offer significant energy savings and substantial greenhouse gas emission reductions. Here, the overall aim of the *I-Therm*[35] project is to develop and demonstrate technologies and processes for efficient and cost effective heat recovery from industrial facilities in the temperature range 70ºC to 1000ºC, and the optimum integration of these technologies with the existing energy system, or for over the fence export of recovered heat and generated electricity, if appropriate. It is projected that technologies developed or used alone, or in combination with the HP technologies will lead to energy and emissions savings well in excess of 15%, as well as attractive economic performance with payback periods of less than three years.
  The main objective of the project is to develop and demonstrate innovative heat exchangers and energy storage technologies for heat recovery within the process of a casting foundry, producing quality castings for gas turbine and industrial markets (such as nozzle guide vanes).

- The overall objective of the *INDUS3ES*[36] project is the development and demonstration of an innovative, compact and economically competitive system based on absorption heat transformer technology for recovering and revaluing low-energy waste heat from industrial processes. The developed system could be easily adapted to various industrial processes and heat sources.

• *Contribution of environmental legislation to energy efficiency in the industry sector*

The Industrial Emissions Directive (IED - 2010/75/EU), by aiming to achieve a high level of protection of human health and the environment in reducing harmful industrial emissions across the EU, also contributes to energy efficiency. Indeed, one of the pillars of the IED is the integrated approach, meaning that the permits granted under the IED must take into account the whole environmental performance of the plant, covering e.g. emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure. The IED provides that the BAT (Best Available Techniques) conclusions shall be the reference for setting the permit conditions of the industrial installations it covers. The BATs aim to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole, which includes the reduction of energy consumption. These BAT conclusions are included in the so-called BAT reference documents **(BREFs), one of which is specifically dedicated to energy efficiency**. **In addition, most of sectorial BREFs contain BAT conclusions about energy efficiency**. For instance:

- Chlor-alkali (CAK) BREF: The production of chlorine and caustic is highly electricity-consuming: approximately 1 % of the total final energy consumption in the form of electricity in the EU. The BREF describes a number of good practices to reduce this electricity consumption, but also on how to use the co-produced hydrogen.

33 http://www.tasio-h2020.eu/
34 http://suspire-h2020.eu/
35 http://www.itherm-project.eu/
36 http://www.indus3es.eu/

Moreover, it sets the energy-efficient membrane cell technology as BAT thereby triggering the conversion of old mercury cell plants which results in electricity savings of around 30 % at installation level (depending on the plant configuration).

- Large Combustion Plants (LCP) BREF: This BREF addresses combustion plants with a rated thermal input of 50 MW or more operating in a variety of sectors including several industries as well as the power sector, and as such covers a major share of the primary energy consumption of the EU. This BREF, currently at the stage of formal final draft consultation in view of adopting the "BAT conclusions" as implementing decision, sets around 20 techniques, to be used in appropriate combination, as BAT to increase the energy efficiency of combustion units. In addition, for each plant category the BAT conclusions include performance levels associated with the use of BAT for electrical efficiency (electricity-generating plants) and for total fuel efficiency (heat or combined heat and power plants). These performance levels are key references for permitting authorities throughout the EU.

Policy feedback resulting from the good practice analysis

- Energy audits provide individual companies valuable feedback on their energy consumption. Especially the combination with other incentives to **enhance the audits to energy management systems** has proven very effective.
- Project feedback and Member State examples suggest that **energy efficiency networks are a very effective multiplier** for informing about best practices and engaging industries in further energy saving efforts.
- On the ground feedback seems to suggest that industries often focus on their key energy source (electricity or heat) but miss out on **capturing the full savings potential available with all energy sources used**.
- Public support for non-mandatory energy audits delivers cost-effective savings which would have otherwise remained locked in, and contributes to an effective energy efficiency policy in the industry sector.

4.2 Service sector

The Commission's review of 2015 showed that the energy intensity of the service sector (normalised with heating degree days) of the 28 EU Member States decreased by 5% between 2005 and 2013. The 16 Member States that most improved their energy intensity in the service sector (heating degree day normalised) between 2005 and 2013 were Austria (-20%), Hungary (-26%), Ireland (-37%), and Portugal (-21%). Bulgaria, Croatia, Finland, Greece, Italy, Luxembourg, and Spain increased their energy intensity over this period[37].

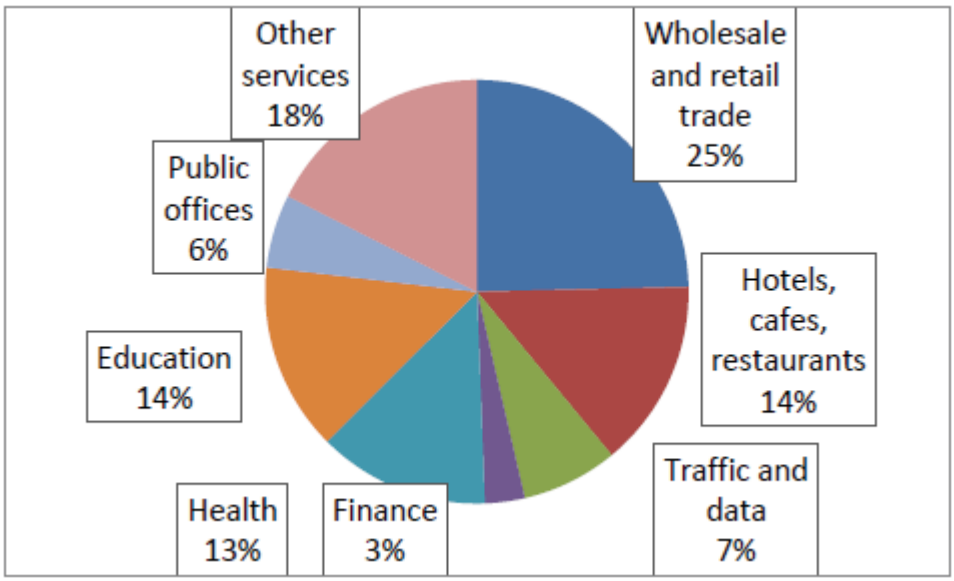
Many measures described in other parts of this document will also apply to the service sector. The measures are quite mixed, including building codes, renovation plans for the public sector, mandatory audits, third party financing, and rules for outdoor lighting. They are complemented by eco-design and energy labelling focusing on devices or appliances, such as computers, food coolers in stores, bakery ovens, cleaning machines, etc. Some measures address certain subsectors such as the hotel industry: subsidies for efficiency improvements in Slovakia and Spain, eco-certificates and

[37] SWD(2015) 245 final

subsidies for CHP/tri-generation in Malta, and a voluntary energy efficiency agreement for the hospitality industry in Finland[38] (see also the *neZEH* project described in chapter: 4.3).

The service sector contributes significantly to the EU's economic activity. If we consider the final energy consumed for heating and cooling across the tertiary subsectors, it becomes evident that, overall, the biggest consumers are the wholesale and retail trade sectors which account for 25% of consumption[39].

Figure 38: EU 28 heating and cooling consumption in services per sector (2012)



Source : SWD Heating and Colling strategy

The *Night Hawks*[40] project has raised awareness about energy efficiency in the retail sector. 123 energy checks during off production hours - so called "night walks"- were undertaken in order to identify idle losses in shopping centres, retail parks, and shops. The project aimed at reducing the energy consumption of these establishments in eight Member States. A total surface area of 1 143 000 m^2 was surveyed using this novel approach, with a total annual consumption of 142 GWh and an identified average energy saving potential of 10%. The project reported significantly higher potential primary energy savings than initially expected during its lifetime – 1 192 toe/year compared to 220 toe/year - as well as potential annual savings on energy bills of EUR 2 220 000 for the participating companies. The findings of these "night walks" were compiled in a guidebook and used for the training of over 1 500 personnel in the respective businesses. In more concrete terms, easy to implement, cost effective energy efficiency measures were highlighted, including a number of best practice case studies carried out during the project. In addition, follow up actions stemming directly from the Night Hawks project include the establishment of a Saxony-wide network of energy advisors focusing on the retail sector, as well as input to the Latvian Ministry of Economics concerning the development of criteria for mandatory energy audits in shopping centres.

In its report 'Energy Efficiency Trends and Policies in the Household and Tertiary Sectors', the *ODYSEE-MURE* project provides an example of a successful measure in France addressing tertiary buildings. According to a regulation which came into force on 1 July 2013[41], lighting installations of

38 Odyssee-Mure Energy Efficiency Trends and Policies in the Household and Tertiary Sectors

39 SWD(2016) 24 final

40 https://ec.europa.eu/energy/intelligent/projects/en/projects/night-hawks

41 Arrêté du 25 janvier 2013 relatif à l'éclairage nocturne des bâtiments non résidentiels afin de limiter les nuisances lumineuses et les consommations d'énergie NOR: DEVP1301594A

non-residential buildings must be switched off during the night, in order to reduce both energy waste and light pollution. Indoor lighting emitted outwards (offices, shops etc.) must be switched off at 1 am or one hour after closing time if this is later, and can only be switched on after 7 am or one hour before the activity begins if this is earlier than 7 am. Outdoor lighting of building facades (shops, monuments, schools, city halls etc.) must be switched off at 1 am at the latest and cannot be switched on before sunset. Indoor lighting of buildings for professional use must be switched off one hour after closing time. Exceptions apply for eves of public holidays, the Christmas season, local events, and certain tourist areas. This measure will contribute to energy savings comparable to the annual electricity consumption of 750 000 households, meaning a total of 2 TWh per year[42], lowering CO2 emissions by 250 000 t and saving EUR 200 million[43].

Figure 39: Night-time switching-off of lighting in non-residential buildings in France

Source: http://www.developpement-durable.gouv.fr/Eteindre-la-nuit-c-est-faire-des.html

The project *EE MUSIC*[44] aimed at raising awareness about energy efficiency in the music sector, i.e. at festivals and clubs. Energy audits were organised in clubs as well as for the 2015 Eurovision Song Festival in Vienna, 24 EE MUSIC workshops with 400 participants from the music sector were organised across Europe, 180 clubs and 184 festivals registered on the project's Industry Green Tools[45] which help them save energy, EE MUSIC Ambassadors were identified in 18 European cities to support the organisation and promotion of EE MUSIC launches and workshops, and almost four million music event and festival goers were reached across Europe. Also, cooperation has been established with the 2015 Eurovision Song Festival in **Vienna**, thanks to which more than 440 000 litres of diesel have been saved.

Electricity consumed in data centres (including enterprise servers and storage, telecommunication equipment, cooling equipment, and power equipment) is expected to account for a large proportion of electricity consumed in the EU service sector in the future.

Studies have estimated that the European data centre services market will see a growth of 16% by 2018 from the 2012 levels (i.e. 2,5% per year) due to the growth in enterprise cloud computing, content-heavy applications, and machine-to-machine (M2M) connectivity. It is also estimated that the UK, Germany, and France will be the largest data centre markets in Europe[46].

42 http://www.performance-publique.budget.gouv.fr/sites/performance_publique/files/farandole/ressources/2016/pap/pdf/jaunes/jaune2016_politique_energetique.pdf

43 http://www.developpement-durable.gouv.fr/IMG/pdf/2013-07-01_-_DP_Exctinctions_lumineuses_3_.pdf

44 http://www.ee-music.eu

45 http://www.ee-music.eu/ig-tools

46 Computer Weekly (Thursday 17 July 2014) Growth in cloud and IoT lend momentum to European managed datacentres available at

If no energy efficiency improvements occur, energy consumption is assumed to grow in tandem with market growth, i.e. 2,5% per year until 2050. This reflects the increase in data volumes due to the growth of mobile computing, social networks, and the spread of ICT in all aspects of private and work life. This has resulted in a continuous increase in both energy densities within the typical data centres and increased cooling requirements. However, there is a growing global trend towards green data centres. It is estimated that the green data centre market will grow at a compound annual growth rate of nearly 28%[47].

The main focus of the currently running FP7 research projects, providing support to sustainable data centres, is renewable energy sources, heat reuse, and smart grid integration of data centres (6 projects: *RenewIT, GreenDataNet, Dolfin, GENiC, DC4Cities, GEYSER*[48]), as well as the individual efficiency of one data centre versus the efficiency of a cluster of data centres (4 projects: *CoolEmAll, All4Green, Fit4Green, GAMES*[49]).

Under H2020, support has been provided to public authorities in procuring fast-evolving information and communication technologies such as Green Data Centres (see chapter 6.4).

For the H2020 Energy Efficiency Work programme 2016-2017[50], a specific action was designed to holistically address sustainable data centres: EE-20- *Bringing to market more energy efficient and integrated data centres*. The action covers all three areas: the increase of energy efficiency, the use of renewable energy sources, and the integration of data centres in the energy system, with a focus on aspects related to market and business models in order to accelerate market uptake of sustainable data centre solutions. The European Code of Conduct for Data Centres[51] includes over 300 examples of highly efficient data centres showcasing many energy efficient solutions such as free-cooling, integration of renewable, re-use of exhaust heat, efficient servers, virtualisations.

Policy feedback resulting from the good practice analysis

- Given the broad range of the service sector, there is a clear need for targeted energy saving solutions focusing on the individual sectors.
- All sectors need to focus on a clear prioritisation of energy saving measures. For this, targeted energy advice solutions need to be put in place.
- With the growing energy consumption of IT and data centres, further work on best practices for heat and electricity reduction in this area will be crucial for the coming years.

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http://www.computerweekly.com/news/2240224750/Growth-in-cloud-and-IoT-lend-momentum-to-European-managed-datacentres

47 Pike Research (2012) Green Data Centres in Navigant Research (2012) The Green Data Center Market Will Surpass $45 Billion by 2016 available at http://www.navigantresearch.com/newsroom/the-green-data-center-market-will-surpass-45-billion-by-2016

48 http://www.renewit-project.eu/; http://www.greendatanet-project.eu/ ; http://www.dolfin-fp7.eu/ ; http://projectgenic.eu/; http://www.dc4cities.eu/en/ ; http://www.geyser-project.eu/

49 CoolEmAll: http://tricoryne.man.poznan.pl/; http://www.all4green-project.eu/; http://www.fit4green.eu/; http://www.green-datacenters.eu/

50 http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-energy_en.pdf

51 http://iet.jrc.ec.europa.eu/energyefficiency/ict-codes-conduct/data-centres-energy-efficiency

4.3 SMEs as a specific target group

The more than 22,4 million SMEs are the backbone of the European economy, accounting for 99,8% of all enterprises in the non-financial business sector in the 28 EU Member States (2014). SMEs in Europe generated some EUR 3,7 trillion of the EU's value added, representing almost 30% of GDP. SMEs employ almost 90 million people and generate about 1,1 million new jobs per year. Almost all SMEs (93%) are micro-SMEs employing less than 10 people[52].

Collectively, SMEs' energy demand is considerable. Still, many energy efficiency barriers such as lack of finance, short term economic optimisation decisions, and mainly focussing on core business investments, are especially pronounced with SMEs[53]. They often have fewer resources and less access to finance to make improvements. They may lack the capacity and, not having a direct carbon-price incentive, they rarely view energy efficiency as a priority, especially in their early years[54].

Eurochambres estimated in 2014 that the short-term energy consumption reduction potential among its 20 million EU members could range from 10% to 20%[55].At the national level, SMEs in Spain could save 26%, or 307 petajoules (PJ), by implementing efficiency measures. This would equate to an economic saving of over USD 5,9 billion[56]. In the United Kingdom, it is estimated that potential energy expenditure savings for SMEs range from USD 2 billion to USD 4,1 billion. It is estimated that 40% of these savings are achievable with no capital investments but involve no-cost and low-cost measures, such as eliminating energy waste by turning equipment off when not in use and fixing sources of energy losses such as leaks[57].
SMEs as a target group are addressed by measures in both industry and the tertiary sector, and the number of measures varies significantly between countries.

By now, all Member States have adopted supporting policies to enhance SMEs. The MURE database lists a total of 220 active policy measures both in industry and in the tertiary sector. Whilst there are many measures addressing SMEs in Germany, the Netherlands, or Norway, SMEs are only targeted with very few or no measures in countries such as Austria, Cyprus, the Czech Republic, Greece, or

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52 International Energy Agency (2015): Accelerating Energy Efficiency in Small and Medium-sized Enterprises. Available at: https://www.iea.org/publications/freepublications/publication/SME_2015.pdf; European Commission (2014 and 2015), A Partial and Fragile Recovery: Annual Report on European SMEs, European Commission, Brussels, Available at: http://ec.europa.eu/DocsRoom/documents/16341/attachments/2/translations/en/renditions/native.

53 DECC (UK Department of Energy and Climate Change) (2014): *Research to Assess the Barriers and Drivers to Energy Efficiency in Small and Medium Sized Enterprises*, www.gov.uk/government/uploads/ system/uploads/attachment_data/file/392908/ Barriers_to_Energy_Efficiency_FINAL_2014-12-10.pdf; Deneff (2016): Branchenmonitor Energieeffizienz. Available at: http://www.deneff.org/fileadmin/user_upload/Branchenmonitor2016.pdf

54 An EU Strategy on Heating and Cooling

55 Eurochambres (Association of European Chambers of Commerce and Industry) (2014), Smart energy for growth: SME actions on energy efficiency powered by Chambers of Commerce and Industry, Eurochambres, Brussels, http://www.eurochambres.eu/custom/Smart-Energy-For-Growth_FINAL_light-2014-00462-01.pdf .

56 International Energy Agency (2015): Accelerating Energy Efficiency in Small and Medium-sized Enterprises. Available at: https://www.iea.org/publications/freepublications/publication/SME_2015.pdf

57 DECC (UK Department of Energy and Climate Change) (2014): *Research to Assess the Barriers and Drivers to Energy Efficiency in Small and Medium Sized Enterprises*, www.gov.uk/government/uploads/ system/uploads/attachment_data/file/392908/ Barriers_to_Energy_Efficiency_FINAL_2014-12-10.pdf

Romania[58].

The *ODYSEE-MURE* project classifies policy measures specifically targeting SMEs into two broad categories:

1) Financial Measures:

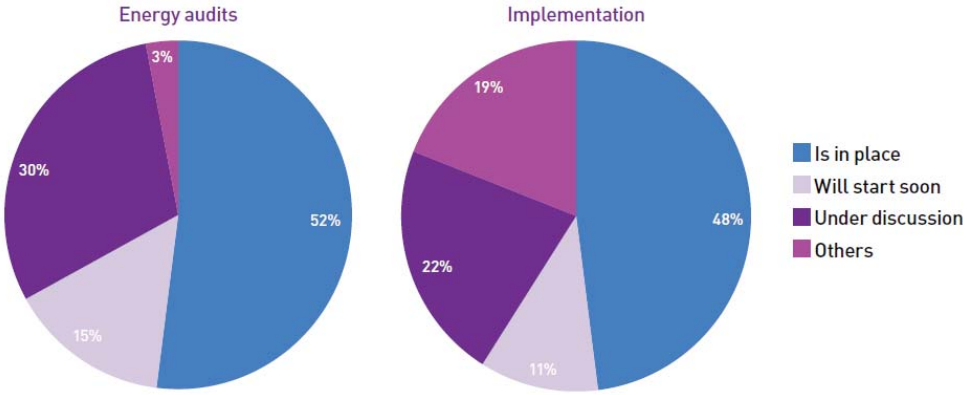
Majority of the measures related to SMEs fall into this category. It includes measures dealing with funds, loans, subsidies, financial support schemes, consultations, financial incentives, and aid for SMEs.

2) Information/Educational/Training Measures:

These measures encompass **education and training** activities for SMEs on how to enhance energy efficiency, resource planning and management, and the behavioural training of employees towards more responsible energy-related actions.

Given that many energy efficiency barriers are higher with SMEs (for example information and financial barriers), many Member States took advantage of the EED provision to support SMEs with tailored audit schemes. Following a survey by the Concerted Action EED, the situation in Member States showed that a majority of Member States have audits in place and work on their implementation (Figure 40).

Figure 40: Schemes to encourage SMEs to undergo energy audits, and encourage implementation



Source: Forni D/ Concerted Action EED (2015)

A good practice cited by the Concerted Action EED is the *TREND* project in Italy. **Italy's Region Lombardia** launched the *TREND* project[59], financed by the European Regional Development Fund. *TREND* was aimed at promoting awareness, competencies, and tools for energy efficiency in SMEs in **Lombardia**. It was carried out in three steps:

- Matching demand/supply of experts in energy management to carry out energy audits in 500 SMEs.

58 ODYSSEE-MURE Energy Efficiency Trends and Policies In Industry- An Analysis Based on the ODYSSEE and MURE Databases, September 2015

59 For further information see the CA EED good practice factsheet at www.ca-eed.eu/goodpractices/good-practice-factsheets/energyservices/energy-services-trend-programme-italy

- Analysing the energy efficiency measures for improving the energy performance of SMEs by sector and size in terms of energy savings and cost effectiveness.
- Matching demand/supply of clean technologies and energy efficiency services and funding in 100 of the audited SMEs, and implementation of the most effective measures in terms of innovation, energy saving, environmental benefits, competitiveness, and repeatability. The estimated energy savings for the funded measures is 4000 toe. Data showing the results of the efficiency measures is required one and two years post-implementation.

The data from the energy audits (collected via specific electronic templates) are also used for the industrial section of the regional energy balance and for regional energy planning.

Within the *STEEEP*[60] project, European Chambers of Commerce and Industry (CCI) provide SMEs from all sectors with tailored support, training, and guidance on effective energy management tools and practices. A Transnational Learning Network of energy advisors has been established in order to improve and harmonise capacities within CCI. The project provides 630 multi-sector SMEs with tailored training and guidance leading to energy consumption reduction of the participating SMEs by 10 – 15%. The approach combines individual coaching and collective support at the local level. The project establishes Local Energy Communities of SMEs in different countries supported by the relevant local CCIs, with the involvement of local authorities, energy providers, and industrial park managers.

The main objective of the *PInE*[61] project was to establish a cross-sectoral, large-scale system based on auditing schemes and professional technical advice to implement energy efficiency measures in SMEs. A two-stage auditing procedure was developed. It includes a scouting phase, aiming to identify the most promising companies in which full audits would then be implemented. The main criteria were their energy consumption, energy intensity, and willingness to invest in energy efficiency. A total of 280 preliminary audits were implemented, followed by 140 full energy audits. Most of the companies began to implement the identified energy efficiency measures, leading to more than EUR 8 400 000 of investments in three years, 6 056 toe/year primary energy savings, and 12 505 tCO_2/year of GHG emissions reduction. Most of the energy actions were focused on cross cutting technologies (such as compressed air, lighting, electric motors, thermal insulation, and waste heat recovery) and on soft measures (such as automatic process control, temperature and pressure settings, and behavioural issues such as switching off equipment when it is not used).

BESS[62] (Benchmarking and Energy management Schemes in SMEs) developed and implemented a web-based toolkit and e-learning scheme for benchmarking and energy management in SMEs. It is a set of tools to implement energy management, including suggestions for concrete energy saving measures and best practices. The toolkit further offers a benchmarking scheme with other SMEs in Europe. The e-learning scheme was based on the Plan Do Check Act (PDCA) cycle, respecting ISO 14001 standards. 81 SMEs participated in the pilot projects.

Several European projects developed specific measures for SMEs to achieve energy efficiency in different sectors of activity.

The food and beverage sector has recently been analysed more closely in literature. According to latest Eurostat statistics, the European food and beverage industry consumes more than 10 % of the final energy demand of the industry in the EU-28. The over 287 000 companies are almost exclusively (99.1%) small and medium-sized enterprises. A recently conducted analysis covering six countries

60 http://www.steeep.eu/

61 http://www.pineaudit.eu/eng/resources.aspx

62 https://ec.europa.eu/energy/intelligent/projects/en/projects/bess

(Austria, Spain, France, Germany, UK, and Poland) shows that overall energy savings of 30% of the sector's consumption can be triggered by systematic audits and their implementation[63].

One of the projects implementing energy savings in the sector is the *GREENFOODS* project.[64] Among other objectives, the project will develop special funding schemes in order to facilitate the implementation of identified energy efficiency potential and renewable energy sources in SMEs. Through the comparison of existing funding and financing systems in the participating countries and the analysis of best practices, *GREENFOODS* will develop a tailored funding scheme including national needs based on financial and technological potentials. For this aim a mapping exercise was carried out by the project identifying 78 different funding and financing schemes from Poland, Germany, Austria, UK, France, and Spain[65].

EMSPI (*ENERGY MANAGEMENT STANDARDIZATION IN PRINTING INDUSTRY)*[66] is a project funded under IEE that aims to promote actions for increasing energy efficiency in European SMEs in the printing industry. The main objective is maximum energy savings in the target group by promoting the implementation of an Energy Management System based on the European standard EN 16001 and/or the global standard ISO 50 001. In concrete terms, the project aims to implement the specific energy management standard in 100 SMEs during its lifetime by using previously developed guidelines for the printing industry.

EE-METAL[67] aims to provide SMEs in the metalworking manufacturing industry with managerial (EnMS, ISO 50 001), technical (EMS/SCADA, EE technologies and benchmarks), and financial tools (ESCOs), and training to overcome barriers that hinder the adoption of energy saving measures. The activities include audits in 80 companies, implementation of ISO 50 001 EnMS in eight of them, training of their staff, and establishment of contacts with ESCOs and financial institutions.

Go-Eco [68]aims to promote energy efficiency and "Integrated Energy Concepts" including the development of cooperation and joint procurement by several SMEs located in eight targeted business parks[69]. Measures foreseen include energy audits, promotion of energy saving technologies, feasibility studies, and support to access finance.

The *neZEH*[70] project aims to provide technical advice to SME hotel owners in order to accelerate the refurbishment rate of existing hotel buildings to nearly zero energy standards. The project proposes to do this by gathering data on existing case studies showcasing exemplary energy refurbishments, and delivering pilot demonstration projects as "living" examples of Nearly Zero Energy Hotels. The project also proposes a practical online tool for hotels to identify appropriate nZEB renovation solutions, and to set up an EU neZEH network linking hotel owners with building energy professionals. The project is developing a toolkit aimed at SME hotel owners to assist them in

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63 Myers S et al. (2016): Energy efficiency, carbon emissions, and measures towards their improvement in the food and beverage sector for six European countries. Energy (104), pp. 266-283. http://dx.doi.org/10.1016/j.energy.2016.03.117

64 http://www.green-foods.eu/. For detailed description see: Glatzl W, Brunner C, Fluch J (2015): GREENFOODS – energy efficiency in the food and beverage industry. Eceee summer study proceedings, pp. 397-402.

65 GREENFOODS- the Report on Mapping of Funding/Financing Opportunities http://www.green-foods.eu/funding-and-financing-schemes/

66 http://www.emspi.eu/

67 http://www.ee-metal.com

68 http://go-eco.info

69 Final report with testimonials of the business parks: http://go-eco.info/wp-content/uploads/2016/04/D6.6_final_publishable_report_BEA_web.pdf

70 http://www.nezeh.eu/home/index.html

planning the renovation of their hotel buildings. It is an updated version of the HES tool produced under the *Hotel Energy Solutions*[71] project which is reportedly highly successful and used globally via the UN World Tourism Organisation.

Policy feedback resulting from the good practice analysis

- Despite individually low energy savings per company, the SME sector as a whole offers **considerable cost-effective savings potential**.
- Barriers to energy efficiency improvements are particularly pronounced among SMEs, necessitating **enhanced policy support**.
- Across Europe, many good practice projects and initiatives exist. However, their findings **need to be further promoted and energy saving efforts scaled up** to reach the full savings potential.
- Information, **project bundling, and networking instruments seem to be a promising way forward** in this respect.

4.4 Agriculture and rural areas

Agriculture and fishing represent 25 Mtoe or some 2.3% of final energy consumption of the EU. The share in the overall consumption is especially pronounced in France (4.2%), Poland (3.6%), the Netherlands (3.5%), as well as Spain and Italy (each 2.8%)[72], making energy savings in these sectors especially interesting for these countries.

The ODYSEE-MURE project provided an example of a successful measure for the agricultural sector in **Germany.** The Agricultural Bank provides low-interest loans for agriculture-related investments, including investments to improve energy efficiency. Eligible establishments are production plants in agriculture and forestry, viticulture and horticulture, as well as producers of agricultural equipment, and trade and service companies closely connected with agriculture. Up to 100% of the eligible investment costs can be financed, with a cap of EUR 10 million.

The bank finances investments in:

- Energy use of renewable raw materials and other organic compounds (e.g. biogas plants, biomass cogeneration plants, and plants for the production of biofuels)
- Photovoltaic, wind, and hydro power plants of companies in the agri-food sector, including farming, whose power is fed into a public electricity network
- Wind turbines of wind energy companies, whose shares are mainly held by citizens, businesses and property owners on the spot ("civil and farmers' wind-farms") and whose power is fed into a public electricity network.

Measures and projects carried out in the agricultural sector aim at the efficient use of local, residual resources and agricultural waste for energy production.

Tipperary is a rural county in Ireland that has a large agricultural industry (dairy, tillage, wind, and forestry). It also has a large energy bill of near EUR 500 million that has a very small local renewable energy component. The county has a small natural gas share and a high portion of kerosene used for

71 http://hotelenergysolutions.net/

72 DG Energy (2015): Energy in figures. Statistical Pocketbook.

heating. The Municipality of Tipperary has developed a future renewable energy strategy for the county. This strategy calls for the establishment of district heating networks in dense urban areas as key to utilising waste agricultural residues for higher value products that support the local economy. The *SmartReflex*[73] project funded under the Intelligent Energy Europe Programme is supporting the optimisation of the existing system and investment in its future development.
The *SmartReflex* project is also providing support to the rural town of **Claremorris** in County **Mayo**, located in the northwest of **Ireland.** Mayo and Claremorris have significant local renewable energy resources in terms of biomass and agri-residues. The citizens of Mayo have established a citizen-owned energy co-operative that wishes to utilise the renewable energy resources locally and displace their imported energy.

Through supply chain support and stakeholder networking opportunities, the *Agriforenergy 2*[74] project has supported Cooperativa Agricola Livenza COAL to convert agricultural residue from vine cultivation into a low cost fuel source for onsite wood drying.

Figure 41: residual vine residue is chipped and transferred to a heat conversion plant onsite

Source: Agriforenergy 2 project

Cooperativa Agricola Livenza COAL is a farm in **Italy** that produces agricultural products and was motivated to switch to biomass production to capitalise on the residues from vine cultivation. It now runs two heat biomass plants onsite, with capacities of 150 kW each. It annually generates 1 440 MWh of heat, which is used to dry wood logs on site. As a result of the project, the site has transformed what was once agricultural waste into an essential low cost source of energy.

Figure 42: the site generates 1 440 MWh of heat energy annually from 3 000 metric tonnes of biomass

73 http://www.smartreflex.eu/en/home/

74 https://ec.europa.eu/energy/intelligent/projects/en/projects/agriforenergy-2

Source: Agriforenergy 2 project

The support provided by the *BIOMASTER*[75] project has helped Biogazownie Małopolskie to generate heat and power from manure and agricultural waste in **Wielopole, Poland** - attracting new investors for its long term bioenergy ambitions.

Figure 43: Biogazownie Małopolskie is converting manure into bioenergy, with a long term goal of also selling biogas for transport use

Source: BIOMASTER project

Since March 2016, the site has produced 500 MWh of energy, which has been sold to the region's power network and used for the farms' heating needs. The plant has also produced 300 000 cubic meters of biogas and is exploring opportunities for biomethane and compressed natural gas (CNG) processing for transport fuel.

BIOMASTER provided technical and strategic guidance, including feasibility studies for the farm's long term goal of producing biofuel for transport, and opportunities to network with interested stakeholders with a view to also securing further investment for the project.

[75] http://biomaster-project.eu/

Romanian horticulturist SC Dalia used the knowledge and technical guidance provided by the *PromoBio*[76] project to support conversion to highly efficient biomass energy production, significantly reducing the cost of heating its greenhouses.

Figure 44: With the support of the IEE II PromoBio project, SC DALIA has reduced the cost of heating its greenhouses

Source: PromoBio project

The company was motivated to convert to highly efficient biomass energy generation due to the possibility of combining low level production costs with maximum energy efficiency. This was particularly valuable for SC Dalia, as energy represented more than 50% of the company's total operating costs. Sawdust, wood chips, and plant residue were identified as ideal fuel sources. The sustainability of the woodchips is ensured by the supplier. SC Dalia now produces 10 000 MWh/year from sustainable fuel sources using efficient equipment, clean fuel, and the ability to use their own residual plant waste for energy generation.

Policy feedback resulting from the good practice analysis

- The agriculture sector still holds **many energy saving options** which can be spread to other countries.
- In particular the **combination of energy efficiency and locally produced renewable energy sources** can deliver tangible, combined benefits for both policy fields in this sector.
- Findings on **best practices are still very limited** and need to be scaled up to reach the full savings potential.

[76] http://www.promobio.eu/en/

5. Energy efficiency of products

The Ecodesign and energy labelling measures in place are effective in that they produce tangible and substantial energy and cost savings by bringing more energy efficient products to the market. Ex-post evaluation during the reviews of specific energy labelling measures in place since the 1990's showed rapid market transformation towards more efficiency in most labelled product groups. The implementation of the two Directives is estimated to save 175 Mtoe primary energy per year by 2020 (around 15% of these savings are due to energy labelling measures, bearing in mind that around half of product groups are only covered by Ecodesign). This corresponds to 19% savings with respect to business-as-usual energy use for those products. These policies will deliver almost half of the 20% energy efficiency target by 2020. Dependency on imports of energy would be reduced by 23% and 37% for natural gas and coal, respectively. In total, Ecodesign and energy labelling measures in place to date are estimated to save end-users of products EUR 100 billion per year in 2020[77].

Under IEE and H2020 many actions were funded supporting directly Market Surveillance Authorities (MSAs) in Member States for a better enforcement of the EU products regulations. The activities aim at building capacities and skills of MSAs whom are responsible for all or parts of the Energy Labelling and Ecodesign Directives and helps overcome one of the most important barriers to market verification and enforcement. These MSAs need to have a remarkable breadth of expertise ranging from in-depth technical knowledge of more than 30 different product groups with a corresponding expertise in document examination and legal procedures – this is a challenge for many MS.

- The project *ECOPLIANT*[78] piloted and established successful ways to carry out and co-ordinate market surveillance activities and an effective method to communicate these findings to MSAs in Europe.
  A collection of existing national strategies and practices for Ecodesign market surveillance were examined to identify barriers to monitoring, verification and enforcement. The project consisted in a pilot coordinated exercise carrying out the practical activities of monitoring, verification and enforcement in order to validate the best practice recommendations. The project created a best practice guide, common formats and procedures for sharing information and a database which were used to coordinate monitoring, verification and enforcement activities. It also developed a training tools package based on a set of best practices for MSA personnel. These were delivered through four EU-wide workshops for MSAs both from consortium members and other EEA countries. In addition, each project partner delivered National workshops to disseminate project findings and the best practice guide. The projects *EEPLIANT* and *MSTyr15*[79] took those training materials to embrace them and develop them further. Training materials are disseminated via seminars and an e-learning portal and will be available even after the end of the projects.
  For the purpose of supporting the coordinated market surveillance exercise, project ECOPLIANT created a database for MSAs to share test data for products covered by Ecodesign implementing measures and voluntary agreements. This database has been taken over and enlarged by project *EEPLIANT*[80].

- The *ComplianTV*[81] project was designed to assess the compliance of TVs in the framework of the new Energy Labelling and Ecodesign Regulations, through verification procedures. In doing that, it improved the expertise and testing capability of laboratories with regards to the new

77 COM(2015) 345 final and SWD(2015) 143
78 http://www.ecopliant.eu/
79 http://cordis.europa.eu/project/rcn/200156_en.html
80 http://eepliant.eu/
81 http://www.compliantv.eu

and complex measurement method for measuring energy efficiency of televisions. This capacity building action was carried out through harmonisation and coordination between laboratory partners of this project and other laboratories. After the project conclusion, this best practise is being taken forward and followed by laboratories across the EU to facilitate and leverage TV test results.

- The project *ATLETE* [82]was the first among EU funded projects to test a substantial number of products (refrigerating appliances), to test the full scale of required performance parameters (Ecodesign and labelling) and to publish the test results up to the level of technical reports from laboratories. The project also managed to negotiate numerous remedy actions in close contact with manufacturers, leading to updating of product declarations, energy labels or even to discontinuation of some specific models. The project was also very important for raising awareness and collaborating with manufacturers towards meeting Ecodesign and labelling requirements. The compliance rates in project ATLETE were of 43% while in subsequent projects (*ATLETE II, PremiumLight, ECOPLIANT, MarketWatch,*[83] etc) compliance rates were much higher with several product groups in the range of 80-100%.

For an effective implementation of Ecodesign and energy labelling measures the right preparation of all actors of the supply chain is crucial including clarification on their respective roles, in order to increase acceptance and compliance.

- The proper implementation of a number of Ecodesign and energy labelling rules by manufacturers and retailers (such as for televisions and fridges) was verified over 3 years by 16 civil society organisations across 11 Member States. The project *MarketWatch*[84] has identified possible lost energy savings of 6,2 Mtoe/a from 2020, due to the underperformance of various household products checked and tested against these requirements. Part of the mitigation actions taken, included the publication of a retailer's guide on labelling of appliances, with a view to facilitating the proper display of energy labels when offered to consumers and consequently, the successful market uptake of energy efficient products on the market.

- Energy efficient heaters and water heaters, subject to EU Ecodesign and energy labelling requirements, can save European consumers over EUR 60 billion by 2020 and some 600 TWh of electricity per year[85]. The *LabelpackA+*[86] project, in progress since March 2015 in six Member States, addresses one of the main challenges in the implementation of these labelling rules: the issuing of the so called 'package labels' by installers, applicable to a system, i.e., the combination of different components, such as a water heater with solar. Aiming at the smooth implementation of these requirements while boosting their impact, the project will provide to all actors of the supply chain a validated, tested and operational set of tools, information and training to support those in charge of issuing the package label. Concretely, a user-friendly online calculation tool for suppliers is under development as well as tailor-made information for end consumers, respectively.

- In response to the need concerning consumer guidance towards high-quality energy efficient lighting products, supportive measures and consumer information services were required to support a smooth and effective transition from old inefficient lighting technology to highly

82 http://www.atlete.eu/

83 http://www.atlete.eu/2/; http://www.premiumlight.eu/; http://www.ecopliant.eu/; http://www.market-watch.eu/

84 http://www.market-watch.eu/about-us/

85 https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products/heaters

86 http://www.label-pack-a-plus.eu/

efficient LED-lighting. *PremiumLight*[87] set out to tackle this challenge in 12 Member States, by developing and implementing a number of tools (ranging from apps to animated presentations at the point of sale), supporting consumers as well as professional buyers towards efficient and quality product selection; some of these actions will be continued after the end of the project. In terms of impact, the project reached out to more than 10 million consumers whereas concerning energy consumption, about 0,15 Mtoe/a could be saved during the project period and approximately 0,35 Mtoe/a are expected to be saved in 2020.

- *Topten*[88] is an independent online search tool that presents the best appliances in various product categories in 16 national markets, helping consumers and large buyers identify top performing products and compare costs for products ranging from domestic appliances and lighting equipment to consumer electronics and vehicles. Key criteria are energy efficiency, impact on the environment, health, and quality. Products are selected based on existing EU regulations and international energy measurement standards, and product information provided by manufacturers is independently verified by national teams. The individual product listings are compiled by looking at the specific market for each product category, accounting for national consumer preferences and product availability. The tool also acts as an instrument to influence manufacturers and retailers to shift the market towards energy efficient products. The T*OPTENACT* project covers 16 national Topten sites, providing up-to-date information to 2 million visitors a year, and triggering annual savings of 600 GWh of final energy, and 276 000 tons of CO_2.

Odysee-Mure[89] provides an example of national energy labelling imitative from **Finland** for windows energy labelling. Energy efficiency of windows is significant for the total energy consumption of a building because the contribution of windows to total heat demand in a building is 15–25%. Windows are actually the weakest link in the thermal efficiency of buildings. Windows are also manufactured in large quantities because they are used both in new and renovated buildings.

The development of a national window energy labelling scheme in Finland started with studies and led to a pilot phase in 2004-2005 when 160 windows produced by eight manufacturers were rated. The actual voluntary labelling scheme started in 2006. First the label classes ranged from A to G but classes A+ and A++ were added in 2011. Today 12 manufacturers sell windows with an energy label.

Another interesting example provided from the same source is the measure setting the national minimum efficiency standards for condensing boilers in **Ireland**. The measure set a minimum seasonal efficiency of 86% for boilers installed in existing or new dwellings from 2008 and 90% from 2011. For existing dwellings, if a boiler is replaced with an oil- or gas-fired boiler it must also meet this efficiency standard where practicable. The expected savings by the measure are 800 GWh/year by 2016 and 1200 GWh/year by 2020.

87 http://www.premiumlight.eu/

88 www.topten.eu

89 Energy Efficiency Trends and Policies in the Household and Tertiary Sectors
An Analysis Based on the ODYSSEE and MURE Databases June 2015

Policy feedback resulting from the good practice analysis

- The combination of energy labelling and minimum performance standards is clearly delivering tangible results in terms of energy savings.
- Both instruments can be the basis for further targeted information which make use of the data available.
- **National labels** can work as an additional trigger to increase consumer awareness in case that EU labels are not in place.
- **Additional customized information** targeted at final consumers would be appropriate e.g. by developing online databases based on the product information sheets which allow for the live comparison of products.

6. Setting the right public policy framework

6.1. Energy efficiency targets drive the transition

Setting measurable targets is key to guiding and coordinating policy interventions at different levels. It also helps to keep track of policy progress.

All MS have set national targets for energy efficiency for 2020.[90] In many cases these targets are supplemented by long term targets (time horizon 2030 or 2050), sub-targets for individual sectors, or 'action targets' like the acceleration of building refurbishment or the diffusion of sustainable transport modes.

Many regional and local authorities have also adopted ambitious energy efficiency and sustainable energy strategies.[91] In many instances, this was done through voluntary commitments to the Covenant of Mayors, an initiative launched by the European Commission in 2008 to endorse and support the efforts made by local authorities in the implementation of sustainable energy and climate policies. As of today, this successful initiative counts over 6600 local authorities, 5500 Sustainable Energy Action Plans submitted and 315 reports which have been monitored following a robust scientific methodology. These results have also been published through JRC scientific and policy reports namely: the 5 and 6 year assessment of the Covenant of Mayors, a monitoring report and an in-depth analysis of 24 Sustainable Energy Action Plan.[92] These regional and local strategies or targets are in some cases more ambitious than their national equivalents.

[90] See the overview on indicative national targets available at: https://ec.europa.eu/energy/en/content/article-3-eed-indicative-national-energy-efficiency-targets-2020

[91] For example Holtfrerich/BDEW (2014) shows that the German national energy transition is by now underpinned with regional energy and climate policy legislation setting targets and dedicated actions in all 16 federal states. See: http://www.polsoz.fu-berlin.de/polwiss/forschung/systeme/ffu/forschung-alt/projekte/laufende/11_energytrans/konferenz2014/programm/1_bdew-Holtfrerich.pdf

JRC publications see:
http://iet.jrc.ec.europa.eu/energyefficiency/publication/covenant-mayors-figures-5-year-assessment
http://iet.jrc.ec.europa.eu/energyefficiency/node/9078
http://iet.jrc.ec.europa.eu/energyefficiency/node/9123
https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/covenant-mayors-depth-analysis-sustainable-energy-action-plans

Figure 45: Covenant of Mayors signing ceremony

Source: Covenant of Mayors, http://www.covenantofmayors.eu/IMG/rubon14.png?1300468432

Case studies identified by Horizon 2020 and IEE Energy Efficiency projects help to illustrate the guiding role that an energy efficiency target can have for local and regional authorities – as well as private actors once the targets trigger additional energy saving policies and measures.

An illustrative case is the strategic planning of **South Dublin** County Council[93]. The Government of **Ireland** has committed to deliver 20% savings in energy demand calculated against the consumption baseline 2001-2005 across the whole economy through a range of energy efficiency measures[94]. For the public sector an energy saving target of 33% was established. To contribute to this target, South Dublin County Council signed up to the Covenant of Mayors in 2012. In order to reach its objectives it has put in place different measures, such as the implementation of combined heat and power district heating, and energy efficiency and renewable energy requirements for the construction of new residential and non-residential buildings[95]. Between 2012 and 2014, 244 dwellings were refurbished, of which 149 under the Sustainable Energy Authority for Ireland's (SEAI) Warmer Homes project. 545 homes had their windows and external doors replaced with thermally efficient units under the Windows Replacement Program. 777 dwellings had their Attic and Cavity wall insulation works carried out. More than 21 000 boilers were serviced by the Council[96].

93 *SPECIAL* project (Spatial Planning and Energy for Communities In All Landscapes) aims at fostering the exchange of experiences and competence building amongst national and regional town planning associations and organisations for the integration of sustainable energy aspects into spatial planning strategies at local and regional levels. See the project overview available at: https://ec.europa.eu/energy/intelligent/projects/en/projects/special

94 Irish Government, Department of Communications, Energy & Natural Resources (2014): National Energy Efficiency Action Plan 2014. Available at: http://www.dcenr.gov.ie/energy/Lists/Publications%20Documents/NEEAP%203.pdf

95 Gartland D, South Dublin County Council, Codema (2015): South Dublin spatial energy demand analysis. Available at: http://www.southdublindevplan.ie/sites/default/files/documents/9_South%20Dublin%20Spatial%20Energy%20Demand%20Analysis.pdf

96 http://www.sdcc.ie/the-council/policies-and-plans/annual-reports

Typically, energy efficiency targets lead to integrated urban energy planning. Examples include[97]:

- **Amsterdam**: the City has set an ambitious goal in its Agenda for Sustainability: 20% reduction in energy use by 2020, 40% by 2025 and 75% by 2040. Measures to achieve these targets include insulation of the existing housing stock and stimulating reduction of energy use by businesses.
- **Berlin**: the City aims to be climate neutral by 2050. Measures to achieve the target include the increase of renewable energy production, clean transports and energy efficiency measures.
- **Stockholm**: the City aims to be climate neutral by 2040. One of the implementing measures is energy reduction / efficiency increase by 50% for the city's own building stock until 2050.

The **City of Zagreb** was one of the first European capital cities to join the Covenant of Mayors initiative. It committed to reduce CO_2 emissions by at least 21% by 2020 through the application of energy efficiency measures and the use renewable energy sources. The *ZagEE* project[98] supports energy savings with clear focus on building refurbishment, as building energy consumption represents some 65% of the total energy consumption of Zagreb[99]. The project aims at renovating 87 public buildings and retrofitting public lighting, which will result in energy savings of 49% in average in the retrofitted buildings and 72% in public lighting. So far (March 2016) approximately 40 buildings, representing an investment of EUR 15 million have been renovated. The planned total investment amounts to EUR 29,4 million.

The **Ile-de-France** Region has set a target of 38% reduction in buildings' energy consumption by 2020 (baseline 2005)[100]. In order to achieve these results, the region launched a public-private venture in order to develop a semi-public Energy Service Company (ESCO). The ESCO is able to provide additional financial instruments to support the establishment and implement a comprehensive deep retrofit programme for condominiums, social housing and public buildings in the region through Energy Performance Contracting (EnPC).

The **Emilia-Romagna** Region joined the Under2MOU International[101] initiative in November 2015 and committed to achieve an 80-95% greenhouse gas emission reduction by 2050 against the baseline 1990. 294 out of 340 municipalities of the Region representing 95% of the regional population already put in place Sustainable Energy Action Plans (SEAP). Emilia-Romagna is also preparing a new Regional Energy Plan that intends to set a mid-term strategy with objectives towards 2030, designed to reach and surpass the EU 2020 targets. The *LEMON*[102] project will develop an innovative, bankable and aggregated sustainable energy investment scheme as a pilot project for the Emilia-Romagna Region Social Housing Programme, creating a new financing model for energy retrofit interventions and developing EnPC model contracts in order to reduce the social housing buildings energy demand and therefore contributing to reach the targets through EE measures. Two social housing associations have pledged a total of EUR 15,29 million worth of investment in 622 private and public social dwellings[103].

The Province of **Limburg** (Belgium) which is also a Covenant of Mayors Territorial Coordinator, aims

97 As demonstrated by the *URBAN LEARNING* project http://www.urbanlearning.eu/

98 https://ec.europa.eu/energy/intelligent/projects/en/projects/zagee

99 ZagEE (2013): About ZagEE. Available at: http://zagee.hr/?page_id=520&lang=en

100 In the context of the project POSIT'IF (*Promote, Organize, Support, Imagine the energy Transition in Ile-de-France territory (2014): Pour faire des économies d'énergie*) available at : http://www.energiespositif.fr/?page_id=374 also described in chapter 7.2

101 The Under 2 MOU unites states and regions willing to commit to reducing their greenhouse gas emissions. For further details see: http://under2mou.org/

102 http://cordis.europa.eu/project/rcn/200000_en.html

103 http://www.housingeurope.eu/resource-577/the-sweet-taste-of-a-lemon

at becoming climate neutral by 2020. In turn, the project *ESCOLIMBURG2020*[104] helps concretising this target by strengthening an existing ESCO-offer. This enables to relieve the local authorities from complex investment processes. The project will accelerate a large scale retrofitting of the public building stock of the 44 municipalities and the province itself, allowing the implementation of energy efficiency and renewable energy measures in the stock. Since the start of the project in April 2013, it has delivered the following cumulative results: 28,9 GWh of energy savings, 7,0 Kt CO_2 reduction and triggered investments in the amount of EUR 5,8 million[105].

The Swedish town of **Växjö** is one of a few cases of energy conscious spatial planning. The town took the decision in 1996 to stop using fossil fuels by 2030, being the first municipality in the world to go that far. To this aim a large part of the heating and electricity delivered is generated from forest residues, increasing the use of district cooling when cooling is needed, subsidies for conversion of oil burners to pellets, food residues are collected in households for biogas production, free local energy advice, improving cycling infrastructure (lanes, parking, pump spots). Cycling has high priority in city planning, biogas busses, improved public transport, free parking for environmentally friendly cars, promoting new business based on environmental technologies and solutions. The target set for organic and/or locally produced foods is 80% in schools and care homes by 2020. In 2013 the figure was 40 per cent[106]. Already in the first years of the programme, the total use of energy was reduced by 3% or 5,7 GWh compared to 1993 and the energy used per capita lowered by 7,2%[107], highlighting that energy savings can comprehensively take place even in a short term period if an ambitious local policy stance is taken. CO_2 emissions have fallen by 48% in the years 1993-2014.[108] In the 2015 'Växjö declaration', the city urged the government of Sweden and the European local authorities to take "meaningful action to go fossil fuel free".[109]

The City of **Heidelberg** is one of 19 pilot cities participating in the „Masterplan 100 % Climate Protection", a program of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. The goal is to become a climate-neutral City by 2050. The aim of Heidelberg is to reduce CO2 emissions by 95 percent and the energy demand by 50%. This requires high energy and resource efficiency, a supply of renewable energy and changes with regard to lifestyle and consumer behaviour. Strategies and measures were developed through a Board for Climate Protection an efficient network that consists of craftsmen, architects, city planners, NGOs and administration.

As one of the largest passive house area in the world, the new "Heidelberg-Bahnstadt" has a protagonist role. The Passive-House-Regulation is the standard for the whole Bahnstadt-district. Such a large and for all investors binding method of construction is outstanding, not only in Germany. An innovative feature of this large-scale Passive House development of an urban district for commercial and residential use is that it has zero-emissions (or is CO_2-neutral)[110].

The energy consumption in the public buildings owned by the City has been reduced by 78 GWh

104 http://www.escolimburg2020.be/en/

105 For impact overview see: http://www.escolimburg2020.be/en/esco

106 City of Växjo: Fossil fuel free Växjö. Available at: http://www.vaxjo.se/upload/www.vaxjo.se/Kommunledningsf%C3%B6rvaltningen/Planeringskontoret/Milj%C3%B6dokument%20och%20broschyrer/08%20FFF%20V%C3%A4xj%C3%B6.pdf

107 UNEP (2003): The Ciity of Växjjö – a successfull sustaiinablle energy programme in Sweden. Available at: http://www.unep.org/GC/GCSS-IX/Documents/Swedish-1A.pdf

108 City of Växjo (2015): Fossil Fuel Free Växjö. Available at: http://www.vaxjo.se/-/Invanare/English/Engelska--English1/Sustainable-development/Fossil-Fuel-Free-Vaxjo/

109 City of Växjo (2015): Växjö Declaration. Available at: http://www.energy-cities.eu/IMG/pdf/vaxjo_declaration_2015_eng.pdf

110 PassReg project report *Passive House Regions with Renewable Energies* http://www.passreg.eu/

(63%) since 1993. This has been reached through consequently using energy efficient technologies and renovations achieving a reduction of electricity consumption (including street lights) of 17,8 GWh (48,7%), a reduction of gas consumption of 26,7 GWh (78%), a reduction of district heating of 27,6 GWh (60%) and a reduction of heating oil consumption of 6,4 GWh (86 %).

London is one of the European Capital Cities with the highest emission reduction targets. London joined the Covenant of Mayors initiative and set ambitious targets for climate change mitigation and energy transition: 60% CO_2 reduction and 25% decentralized energy targets by 2025. Project *TRANSPARENSE* offers a good example of financing big infrastructural improvement to a hospital in London - Guy's and Thomas' NHS Fundation Trust (GSTT) - through the use of an Energy Performance Contract (EnPC). GSTT is one of the largest public healthcare organisations in the UK owning an extensive estate with buildings ranging in age from 150 years old to present day. The EnPC method was chosen to expedite the savings and to deliver an extensive range of energy conservation measures. Thanks to the improvements, the guaranteed annual savings amounts to EUR 1,5 million, i.e. 10% of total energy costs and the foreseen CO_2 reduction is 8 000 t/year. By 2025, London is aiming not only to be one of the world's leading Low Carbon Capitals but also the world's leader on low carbon finance. The city's plan is to turn the energy transition and climate challenges into opportunities for businesses, inward investors and Londoners to participate in the global low carbon economy.[111]

Figure 46: London Energy Plan

Source: The Mayor's Climate Change Mitigation an Energy Strategy, October 2011[112]

An international review of good practices of urban heat planning cites **Gothenburg**, **Paris**, **Frankfurt** and **London** as examples for innovative local heating systems.

In the case of **London** low temperature district heating recovering waste energy from urban infrastructure is an integral part of the London Energy Plan – Scenarios to 2050 which explores how

111 The chapter 7.2.2 provides a good practice example from London in energy transition financing: the RE:FIT programme established with the support of the EU Project Development Assistance grant (ELENA instrument).

112 https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Energy-future-oct11.pdf

much energy London would need in the future.

Within the *CELSIUS*[113] project, Islington Council and Transport **for London** will demonstrate innovative waste heat recovery from the London underground ventilation system. The challenge of cooling down the tube will turn into opportunity to reuse available waste heat and supply it to Islington Council's Bunhill Heat and Power Heat Network. Not only new heat sources will be integrated into the district energy system, of which phase 1 was completed in 2012, but at least an additional 500 homes will be connected in the 2nd phase.

London together with 4 other *CELSIUS* partner cities has an exemplary role in the deployment of smart district heating systems. The *CELSIUS* partner cities **Gothenburg**, **Cologne**, **Genoa**, **Rotterdam**, **London** and Islington Council teamed up to demonstrate innovative solutions, to share their experiences, their best practices with 50 interested cities offering them practical support for replication and for further roll-out of efficient DHC systems.

Figure 47: London & Islington Borough, extension of district heating system

Source: CELSIUS project

If the *CELSIUS* vision is implemented in the 50 interested cities it would lead to 100 TWh primary energy savings and 20 Mt of CO_2 emission reduction yearly across Europe. The project total investment is close to EUR 60 million and the EU contribution is EUR 14 million. The challenging and complex demonstrators are important part of the project, representing 65% of the budget.

The energy transition in Germany poses special challenges to the German State of **Baden-Württemberg**. As a strong industrial region, there is a particularly high demand for energy.

Nevertheless, Baden-Württemberg has set ambitious goals for CO_2 reduction in its climate protection law. These goals can only be achieved with increased energy efficiency and perceptible savings of energy. Baden-Württemberg has put its energy policy goals for the year 2050 in a 50-80-90 formula:

- 50 % less energy consumption,
- 80 % renewable energy,
- 90 % less greenhouse gas emissions (compared to 1990).

113 http://celsiuscity.eu

Figure 48: Baden-Württemberg minister of energy presenting 50-80-90 strategy

Source: Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg, https://energiewende.baden-wuerttemberg.de/typo3temp/GB/322a873c14.png

In order to achieve these goals, Baden-Württemberg is politically active in many fields. One focus is on energy-efficient district heating (DH) systems. On this area, the IEE project *SmartReFlex*[114] is providing direct support to the Baden-Württemberg, for example the project contributed to design the subsidy programme 'Energieeffiziente Wärmenetze' (energy-efficient DH systems).

Further good practices show that the targets and commitments undertaken in the context of cities and regions committing to climate and sustainable energy goals help to align interests and trigger a broad commitment from local actors. The *MESHARTILITY* project[115] triggered the development of some 70 SEAPs with municipalities in Italy, Poland, Romania, Spain, Cyprus, Croatia, Latvia, Estonia, Malta and Bulgaria. These SEAPs comprise:

- The municipality of **Aguilas** in Spain (31% target of CO_2 reduction in SEAP) substituted 63 street lighting lamps by LED lamps in one of the main streets of the municipality, lowering the installed power from 14,5 to 2,5 kW / Public Lighting;
- The municipality of **Kyperounta** in Cyprus (30% target of CO_2 reduction in SEAP) reduced the period of the Christmas Lighting Decoration from 37 days to 18 days and replaced the HPS luminaries with new more efficient lighting (LED);
- The municipality of **Episkopi** in Cyprus (32% target of CO_2 reduction in SEAP) replaced the HPS luminaries with new more efficient lighting (LED);
- The municipality of **Melpignano** in Italy (28% target of CO_2 reduction in SEAP) implemented efficiency programs in the local school and in the council building.

The project plans to put a key focus on development of solutions and tools facilitating exchange of energy data between energy utilities and local authorities. Similarly, the provision and enhancement of regional and local energy efficiency data is discussed in *ODYSEE-MURE*[116], highlighting that valid

114 http://www.smartreflex.eu/en/home/

115 For the MESHARTILITY project (Measure and share data with utilities for the Covenant of Mayors) see: http://www.meshartility.eu/en/about-meshartility

116 Lapillonne D, Pollier K (2015): Energy efficiency indicators and tools for buildings and transport from ODYSSEE. Available at: http://www.odyssee-mure.eu/news/workshops/brussels/buildings-transport-indicators.pdf; Viénot E (2015): Dat4Action. Energy efficiency indicators at regional level. Lessons on energy efficiency

energy efficiency targets can only be set once a reliable set of data is established.

Policy feedback resulting from the good practice analysis

- Successful energy efficiency practices implemented at local level can be found in many case studies represented by cities which are signatories of the Covenant of Mayors initiative.

- Setting an energy efficiency **target is a strong incentive and impetus for triggering additional energy efficiency measures** and following up on their delivery.
- Many good practices showcased in the IEE and Horizon 2020 Energy projects demonstrate a **strong political commitment to contribute or even surpass national targets**. Many targets were indeed set to demonstrate that an overachievement of comparable national, regional or local targets is possible.
- The good practice examples highlighted by the projects once again underpin the **key role of regional and local actors** in implementing energy efficiency policies and delivering concrete actions.
- As shown with the case of Växjö local actors can take a significant lead as lighthouse communities and by that function take over the role of driver for national energy efficiency policies.
- **Data availability and data analysis** clearly facilitates setting and monitoring ambitious local or regional targets.

6.2. Coordinating energy efficiency efforts – multi-level governance

Effective European and national energy efficiency measures are implemented regionally and locally. This implies that for a proper functioning, an operational energy efficiency governance needs to be put in place which coordinates energy efficiency efforts between the different layers of government, allows for the exchange of good practices horizontally between the regional and local entities and finally allows for feedback mechanisms to the policy makers where measures fall short of delivering energy savings and need to be revised (vertical coordination).

The H2020 project *HERON* for instance aims at facilitating policy makers of multi-level governance in EU to develop and monitor energy efficiency policies in building and transport sectors through forward-looking socio-economic research in seven EU and one candidate country[117]. Similarly, project *FosterREG*[118] investigates multi-level governance at local, regional, national and EU levels to foster sustainable energy uptake in urban regeneration initiatives. Also the COOPENERGY[119] project, funded by the IEE Programme, has supported the development of collaborative work between regional and local public authorities to develop and deliver Sustainable Energy Action Plan (SEAPs) in partnership, thus avoiding duplication and maximising positive energy planning outcomes.

Informal exchange of good practice is a key factor in the successful implementation of the technically demanding provisions of the EED, the EPBD and the RED. The Concerted Actions (CA) bring together the implementing bodies of the 28 EU Member States and Norway in order to contribute to the

monitoring in buildings and transport - from national to local level. Available at: http://www.odyssee-mure.eu/news/workshops/brussels/indicators-in-regions-RAEE.pdf

117 http://www.heron-project.eu

118 http://www.fosterreg.eu

119 http://www.coopenergy.eu/

effective implementation of methodologies and legislation regarding these Directives. Several governance mechanisms have been analysed within the *MultEE* project.[120] The project found that policy coordination and feedback structures in terms of energy saving measurement and verification structures are well established in **Croatia**, **France**, **Germany**, **Italy**, the **Netherlands**, **Slovakia**, **Spain** and **the UK**.

The Commission has recently established a number of support tools that facilitate further sharing of good practices and capacity building, with a particular focus on sustainable energy investments, such as the network of Energy and Managing Authorities[121], the Smart Specialisation Platform on Energy[122], the fi-compass advisory services platform for financial instruments[123], and the TAIEX REGIO PEER TO PEER[124] for short exchanges between public administrations for hands-on-experience.

Each country's coordination mechanisms are adapted to their specific national circumstances and institutional setting, but contain elements which might be replicated in other countries. In France a dedicated consultation body, the CNEN (Conseil national d'évaluation des normes) aims to take local points of view into account. In Italy, the Conferenza Stato Regioni is a joint committee established by the State, the regions and the autonomous provinces of Trento and Bolzano. The aim of this committee is to foster cooperation between central and regional administrations and to deal with all aspects of EU policy, constituting the basis for the conduction of political negotiations among the central and regional governments.

The **Greater Region of Copenhagen**[125] set up a large regional engagement process with all relevant stakeholders resulting in an ambitious plan to make the region completely fossil free in 2050. This will be achieved with the implementation of energy efficiency measures and a higher exploitation of renewables. The strategic plan is supported by national, regional and local governments and by businesses and research institutes in the region. It will serve as a road map for the implementation of measures in the coming years; the project plans to mobilise EUR 1 to 2 billion of investment each year.

The IEE programme overall supported 34 projects focusing on developing Sustainable Energy Communities across the continent in order to build institutional capacity at a local and regional level. Support has been given by associations or active networks such as Local Governments for Sustainability[126] in the 1990's, Climate Alliance[127] and Energy Cities. Projects influenced 650 local authorities to join the Covenant of Mayors and helped to develop more than 500 SEAPs (*Mayors in Action*[128]*, 50000&1 SEAPs*[129]*, CASCADE, BEAST*[130]*, ManagEnergy*[131]).

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120 MultEE (2016): Synthesis report on European best practices for M&V schemes and coordination mechanisms. Available at: http://multee.eu/system/files/EU_Best_Practice_for_M%26V_schemes_%26_Coordination_Mechanisms_0.pdf

121 https://ec.europa.eu/energy/en/events/meeting-european-network-energy-and-managing-authorities-cohesion-policy-2014-2020

122 http://s3platform.jrc.ec.europa.eu/s3p-energy

123 https://www.fi-compass.eu/

124 http://ec.europa.eu/regional_policy/en/policy/how/improving-investment/taiex-regio-peer-2-peer/

125 partner of the SUSREG project – empowering sustainable urban planning aims at stimulating the use of sustainable energy resources and energy efficient methods in urban and regional planning by improving knowledge, skills and attitudes of professional planners at regional authorities, local organisations and national associations. For further details see: http://susreg.eu/

126 http://www.iclei.org/

127 http://www.climatealliance.org/

128 http://www.mayorsinaction.eu/home/

129 http://www.50001seaps.eu/home/

Some municipalities have become voluntarily involved in Local Climate Plans, energy-transition experiments, eco-district projects, voluntary agreements, the European Innovation Partnership on Smart Cities and Communities, the European Sustainable Energy Week, and similar national activities, and more recently, the global forum "Resilient Cities"[132].

A new concept gaining momentum is 'post carbon cities'. Post carbon cities must reach a massive reduction of greenhouse gas emissions by 2050, a near self-sufficiency in fossil fuels and develop the capacity to adapt to climate change. A national example of a post carbon initiative is the French foresight programme 'Rethinking cities in a post carbon society', launched in 2008 by the Ministry of Sustainable Development and the French Environment and Energy Management Agency (ADEME)[133].

Because of their geographical location, islands face explicit challenges: the need for specific energy infrastructure (e.g. in electricity, in case there is no connection to the mainland), fluctuation of the population, etc. The *SMILEGOV* project formed clusters to facilitate exchange and cooperation between islands that share similar characteristics, and thereby supported the development of sustainable energy projects. In total, 55 projects were supported. **Madeira** (PT), **Malta** and **Cyprus,** for example, started with the development of street lighting projects. **Samsø** (DK) developed a feasibility study for a biogas to LNG plant to fuel a new ferry between the island and the mainland.

Setting up local projects on energy efficiency and sustainable energy usually involves advancing a considerable amount of human and financial resources in the pre-project phase. In order to overcome this barrier, Project Development Assistance (PDA) facilities have been set up to support ambitious public authorities and bodies to develop bankable sustainable energy projects (see chapter 7.2.)**.**

Policy feedback resulting from the good practice analysis

- Whereas the projects show that coordination mechanisms and energy efficiency governance strongly depend on the national context, they underline the **need for a structured dialogue between national, regional and local actors** to systematically deal with all aspects of energy efficiency. With the implementation of the Energy Union and its reporting and review cycles, enhanced coordination with the European level will also play a key role.
- Both the MultEE project and the reports of the Concerted Actions on EED, EPBD and RES highlight the need for enhanced **informal coordination mechanisms** that allow for open discussion of bad as well as good practice. This facilitates policy learning and helps to avoid mistakes in implementation.
- The EU should continue funding capacity building and policy implementation support programmes because they have demonstrated their effectiveness.
- Voluntary links between local authorities via the Covenant of Mayors for Climate & Energy are an effective means of establishing horizontal coordination and good practice exchange, but similar initiatives for **cooperation on a regional level have not been established systematically by authorities beyond the Covenant**.
- Project development assistance at all levels is key enabler of up-scaled investment. More support at all levels is needed- see chapter 7.2.

130 http://www.beastproject.eu/

131 http://www.managenergy.net

132 http://resilient-cities.iclei.org/

133 Commissariat Général au Développement Durable (2015): Repenser les villes dans la société post-carbone. Éclairages d'un programme de prospective. Available at: http://www.developpement-durable.gouv.fr/IMG/pdf/ED119.pdf

6.3. Capitalising on energy efficiency multiple benefits

Since the work of the International Energy Agency on the Multiple Benefits of Energy Efficiency[134] and a subsequent study of UNEP[135], it is widely recognised that the energy savings triggered by energy efficiency policies represent only one of the many benefits of energy efficiency. Both studies cite, *inter alia*, lower consumer bills, decreased public spending, CO_2 reduction and health benefits from improved thermal insulation of buildings (increased indoor comfort by stable temperatures and improved air tightness) as positive co-benefits. The IEA argues that those co-benefits translate into tangible economic gains on both macro- and microeconomic levels.

Key IEA findings on including co-benefits of energy efficiency measures in overall economic appraisal:

- An initial evaluation of initiatives to advance energy efficiency in buildings, for example, calculated a value of USD 41 billion to USD 55 billion (EUR 30 billion to EUR 40 billion) to the European public budget; adding tax revenues and reduced unemployment payments increased the value to USD 91 billion to USD 175 billion (EUR 67 billion to EUR 128 billion).

- […] Industrial energy efficiency measures deliver substantial benefits in addition to energy cost savings – enhancing competitiveness, profitability, production and product quality, and improving the working environment while also reducing costs for operation and maintenance, and for environmental compliance. Introducing multiple benefits can help to better align energy efficiency with strategic business priorities, thereby strengthening the business case for investment. The value of the productivity and operational benefits derived can be up to 2,5 times (250%) the value of energy savings (depending on the value and context of the investment).
- […] Realised health improvements generate downstream social and economic impacts, including lower public health spending. Addressing indoor air quality through energy efficiency measures could, in a high energy efficiency scenario, save the European Union's economy as much as USD 259 billion (EUR 190 billion) annually[136].

In a study carried out by Copenhagen Economics[137], health benefits are associated with several other benefits so as to estimate the overall impact of building energy efficiency measures on public budgets. According to the study, the overall annual improvement of public budget ranges from EUR 30 to 40 billion.

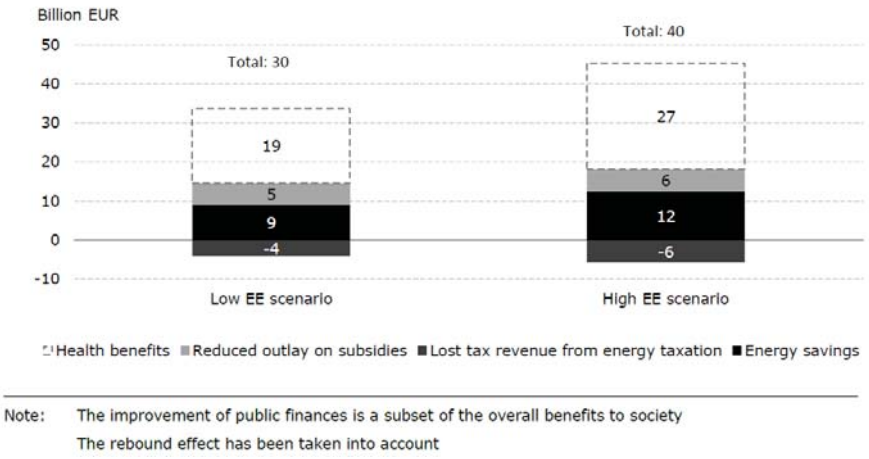
134 IEA (2014): Capturing the Multiple Benefits of Energy Efficiency. Available at: http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf

135 UNEP (2015): The Multiple Benefits of Measures to Improve Energy Efficiency. Available at: http://www.unepdtu.org/Newsbase/2015/10/UDP-releases-new-report-on-Energy-Efficiency?id=b42b0a4b-a436-4c71-b8d4-cab4eb8e6928

136 IEA (2014): Capturing the Multiple Benefits of Energy Efficiency

137 Copenhagen Economics (2012): Multiple benefits of investing in energy efficient renovation of buildings: impact on public finances. Available at: https://www.copenhageneconomics.com/dyn/resources/Publication/publicationPDF/8/198/0/Multiple%20benefits%20of%20EE%20renovations%20in%20buildings%20-%20Full%20report%20and%20appendix.pdf

Figure 49: Annual improvement of public finances, 2020[138]



Source: Copenhagen Economics (2012)

To date, many projects, programmes and measures have actively encouraged so-called co-benefits by creating synergies and combining energy efficiency policies with other areas of policy[139]. The most often cited examples include:

- Reduction of energy poverty;
- Measures that trigger additional health benefits;
- Efficient use of public funds by triggering private financing in the medium to long term.

In recent years energy poverty has emerged as a key issue for energy efficiency policies[140].

Improved public health is regularly cited as a tangible co-benefit of building refurbishment that improves indoor air quality. A household refurbishment in **Kirklees (UK)** provided for carbon monoxide monitors to be installed at the same time as energy efficiency interventions. Overall in the Kirklees programme GBP 3,5 million (or EUR 4,7 milion) worth of health benefits are estimated to have been achieved with the 65 000 energy efficiency installations[141].

Some further examples of programmes and projects addressing energy poverty through improvements of energy performance in residential buildings are described in the chapter 3.4.

Alongside deeper building renovations, smaller-scale low-cost measures provide an opportunity to assist vulnerable households quickly and cheaply. These low-cost measures have little or no up-front

138 Period 2012-2020. In total, annual permanent net revenue gains to public finances could reach EUR 30 – 40 billion in 2020 if health-related benefits from energy efficient renovations are included such as less hospitalisation. This gain is made up from reduced outlay on government subsidies, reduced energy bills, and less hospitalisation need. In this estimate, the loss of government tax revenue from energy taxationis included.

139 Ürge-Vorsatz et al. (2015): Literature review on Multiple Impact quantification methodologies. COMBI project. Available at: http://combi-project.eu/wp-content/uploads/2015/09/D2.1_LR-methodologies.pdf

140 For a literature review on energy poverty and the link of energy efficiency policies to social welfare impacts see: Mzavanadze N, Kelemen A, Ürge-Vorsatz D /Combi Project (2015): Literature review on social welfare impacts of energy efficiency improvement actions. Available at: http://combi-project.eu/wp-content/uploads/2015/09/D5.1.pdf

141 Killip G (2016) Multiple impacts of energy efficiency – a critical review of different approaches, REPORT D2.2, IN-BEE project.

cost (and hence can be provided relatively cheaply to a large number of households) and include: lighting, draught-proofing or information provision on saving by optimal heating behaviour. Low cost energy efficiency measures for vulnerable customers can deliver both reductions in energy consumption and subsequent financial savings. The schemes can also have broader benefits in terms of improvements in the health of household members.

An example of combining energy efficiency policies and support for vulnerable consumers is the German on-site support scheme for vulnerable consumers ("*Stromspar-Check*").[142] With government funding, vulnerable consumers are trained to work as energy auditors implementing a catalogue of directly tangible energy saving measures and consumer advice. The scheme which started in 2008 involved training for unemployed people to become energy advisors and in turn apply their knowledge to low-income or unemployed households. An evaluation of the first phase (2008-2010) of the programme showed overall annual energy savings of some 22 GWh, combined with annual CO_2 savings of 10 755 tonnes. For the 43 300 participating households this translated into energy bill savings of 516 kWh/a or 151 Euro[143]. This initiative was successful in reaching more than 157 000 households[144] by 2014, which led to it forming the starting point of two IEE projects *ACHIEVE* and *EC-LINC* to pilot similar schemes to other cities and regions across Europe.

In *ACHIEVE*[145] over 150 people were trained and carried out about 3000 home visits in **Bulgaria, Germany, France, Slovenia, United Kingdom** where they provided free-of-cost installation of devices to save water and energy and gave advice on energy saving behaviour. The project achieved primary energy savings of just under 250 toe/year, with an average decrease of 10% for electricity, 6% for heating, and 18% for water consumption per household. Some 920 kWh were saved annually by each household in electricity and heating.

In the project *EC- LINC*[146] over 1 000 on-site consultations in low income households were carried out in **Austria, Belgium (Flanders), Germany and Hungary**. Annual savings per household amounted to 1 310 kWh in electricity and heating, and 412 kg of CO_2 emissions.

Building on these projects, *REACH*[147] addresses energy poverty by training teachers and students in vocational schools to become energy advisors. In cooperation with social actors who help to identify the energy poor households, energy advisors will carry out 1 600 home visits and distribute tailor-made advice, energy saving device kits, guidebooks and post-visit support to fuel poor households. It is expected that *REACH* will achieve energy savings of nearly 300 toe/year. The project is running in 4 South East European countries **Bulgaria, Croatia, Slovenia** and the **former Yugoslav Republic of Macedonia**. Adverse effects of energy poverty are particularly evident in South-East European (SEE) countries. It is estimated that in SEE countries 30%, or more, of households, are struggling with energy poverty.

142 Seifried D and Albert-Seifried S. (2015) 'Stromspar-check for low-income households', Proceedings of European Council for an Energy Efficient Economy Summer Study, paper 2-392-15, pp. 467-476

143 Tews, K / Forschungszentrum Berlin (2012): Evaluierung des Projektes „Stromspar-Check für einkommensschwache Haushalte". Ergebnisse zur erzielten Energieeinsparung/Klimawirkung in Phase 1 und 2 (2008-2010). Available at: http://www.stromspar-check.de/fileadmin/user_upload/Dokumente/Hintergrund/Stromspar-Check_Evaluation_2012.pdf

144 "Feasibility study to finance low cost energy efficiency measures in low income households", study from Ricardo for DG ENERGY

145 http://www.achieve-project.eu/

146 http://www.ec-linc.info/

147 http://reach-energy.eu

To support these positive synergies, many Energy Performance Contracts (EPC) are focussing their communication on non-energy benefits such as reduced maintenance costs or increased comfort[148]. Further analysis and quantification of co-benefits for the EU can be expected with the *COMBI* project which started in 2015 and runs until March 2017[149].

Policy feedback resulting from the good practice analysis

- Energy efficiency policies should capitalise on **synergies and positive externalities with existing measures and correlated policy fields**.
- The project and literature analysis underlines that energy efficiency policies can have a significant **impact on tackling energy poverty**. When updating or designing energy efficiency policy measures, social policy aspects should be taken on board more systematically.
- **Analysis of co-benefits** such as improved health and reduced public spending related to energy efficiency can strengthen the case for building refurbishment and energy efficient procurement. When revising national regulations and support schemes in those fields, co-benefits should be included in the investment calculation.
- Energy efficiency co-benefits should also be incorporated into risk and value assessments for financing- see the chapter: 7.3.

6.4. Exemplary role of the public sector

The Energy Efficiency Directive (EED) states explicitly that public bodies at national, regional and local level should fulfil an exemplary role as regards energy efficiency. The requirements fall into two categories: the exemplary role of public bodies regarding buildings, and purchasing by public bodies. Central governments should also have an exemplary role that can be followed by public bodies at regional and local levels.

More than 250 000 public authorities in the EU represent a spending power of around EUR 2 trillion per year, corresponding to some 3,1% of the EU's total GDP[150]. This significant purchasing power allows them to push for greater adoption of sustainable measures, for instance, by including energy criteria in all public procurement procedures. Green public procurement raises awareness of environmental issues and creates incentives for industry and citizens to innovate. Public procurement and service contracts can be used to boost emerging green markets.

Articles 5 and 6 of the EED ask Member States to demonstrate the exemplary role of the public sector by renovating central government building stocks at an annual rate of 3% and by integrating energy efficiency in public procurement. In line with EU procurement legislation[151] these provisions reach out to central government only. Given the differing governance structures in the Member States this implies that the full market leverage of public sector procurement would not be achieved

148 For example *EPC Streetlight* project, PDA project SUNSHINE – see chapter: 7.2.

149 *COMBI* - Calculating and Operationalising the Mulitple Benefits of Energy Efficiency Improvements in Europe. http://combi-project.eu/

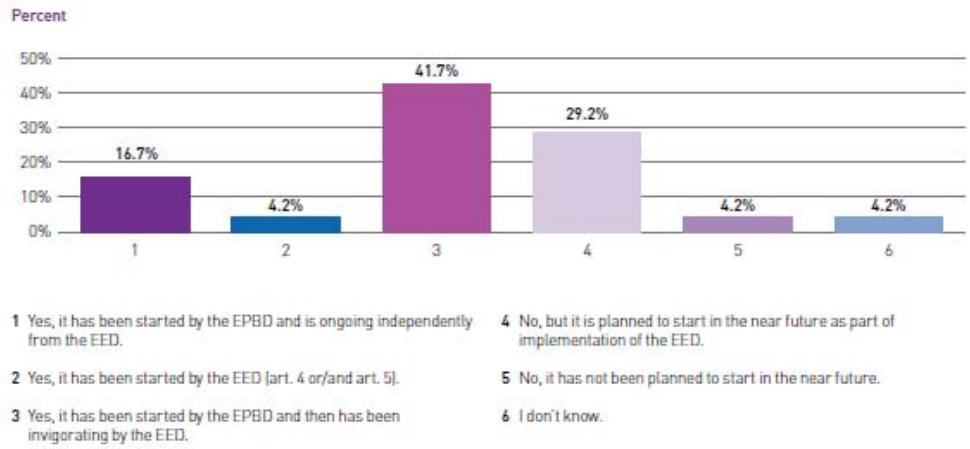
150 PWC, London Economics, Ecorys (2011): Public procurement in Europe: Cost and Effectiveness; Dimitri N et al. (2006): Handbook of procurement. Cambridge University Press, Cambridge.

151 Directive 1014/24/EU, covering contracts with a value of EUR 134 000 for products and services and a value of EUR 5 186 000 for works.

if the provisions were implemented only at this minimal level.[152]

Overall, *ODYSEE-MURE* listed some 80 measures on the exemplary role of the public sector, comprising the refurbishment of public buildings and public procurement.[153] Feedback from Member States on the role of the EED and the EPBD clearly shows that both Directives worked as a trigger for enhanced refurbishment of public buildings (Figure 49).

Figure 50: Impact of EED and EPBD on refurbishment of public buildings



Source: Skoczkowski T, CA EED (2015): Public sector – public buildings and public purchasing. Report of 11/09/2015.

It also emerges that despite different implementation strategies, many Member States have adapted the strategy to relay the EED provisions also to regional and local entities, at least in terms of giving out guidelines, bundle procurement activities or showcase best practices[154].

In the *Mure*-database, several good practices[155] regarding public building refurbishment are listed:

- Energy management systems in ministries and municipalities - **Slovenia** (energy managers, smart metering and, in buildings larger than 500 m^2, energy audits and energy accounting)
- A voluntary energy efficiency agreement for municipalities **- Latvia** (at least 10% of energy efficiency improvements within five years after signing the agreement)
- Refurbishment to nearly zero energy building standard – **Croatia**

The EPBD Concerted Action provides several successful examples of the exemplary role of the public

152 Overall the share of public procurement is estimated to be some 16%, but varying between 5-86% for central government in the individual Member States. PWC, London Economics, Ecorys (2011): Public procurement in Europe: Cost and Effectiveness. Available at: http://ec.europa.eu/internal_market/publicprocurement/docs/modernising_rules/cost-effectiveness_en.pdf

153 http://www.measures-odyssee-mure.eu/fastsearch_all.asp?cerca=OK. The Concerted Action EED has dedicated core theme 2 to this subject and issued a number of reports on practices in Member States and relevant issues such as financial support, model contracts or the uptake of energy performance contracts (EPCs). See: http://www.ca-eed.eu/themes/public-sector-ct2.

154 Skoczkowski T, CA EED (2015): Public sector – public buildings and public purchasing. Report of 11/09/2015. Available at: http://www.ca-eed.eu/themes/public-sector-ct2

155 For the criteria and method applied to select good practices see: http://www.measures-odyssee-mure.eu/successful_info.asp

sector in the refurbishment of buildings.[156] The **French** "Grenelle de l'Environnement" laws include a goal of reducing primary energy by 40% by 2020 for all buildings owned by the French Government. Based on results of energy audits of a representative sample of the building stock, this would represent 10 131 GWh primary energy saved. In comparison, the 3% annual rate of renovation proposed in the EED would lead to only 2 477 GWh[157]. Several countries such as **Germany, Denmark, Italy** and **the UK** use prominent or highly frequented public buildings like schools, kindergartens or town halls as lighthouse and demonstration projects. [158] The **German Federal Government** has already committed since 2012 for its new buildings to achieve NZEB performance. An interesting measure is the installation of an energy commissioner responsible for the energy efficiency of all federal buildings of **Germany**. As regards the display of energy performance certificates in public buildings, the EPBD Concerted Action 2016 report[159] provided results of analysis done in **England** and **Wales** which suggests that overall energy consumption has fallen for public sector buildings that display energy certificates.

The EMAS environmental management plan (eco-management and audit scheme) was launched for the European Commission buildings in Brussels in 2005. Since then significant results have been achieved. Between 2005 and 2015 final energy consumption per square meter has been reduce by 45%. The 2020 objective is a 5 % reduction compared to 2014, in line with the Energy Efficiency Directive goals for the exemplary role of the public sector.

The action plan combines measures including:

- Using resources more efficiently (energy audits, energy savings actions, building management system adjustments, etc.).
- Reinforcing energy efficiency and environmental criteria in public procurement.
- Reducing CO_2 and other pollutants emissions (electric car installations, elimination of HFC and HCFC gaz equipment).
- Awareness campaigns and training on environmental responsible behaviour of staff and contractors.
- Communication campaigns and dialogue with external partners (local authorities).

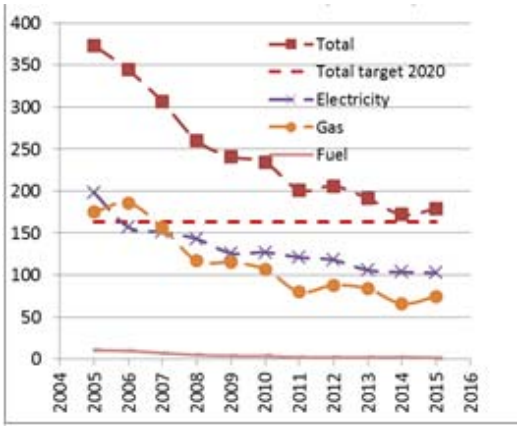
Figure 51: Evolution of total annual energy consumption indicators for Brussels EMAS area offices (kWh/m2)

156 http://www.epbd-ca.eu/ca-outcomes/2011-2015

157 https://www.legifrance.gouv.fr/affichTexte.do;jsessionid=36B33D2C71AF79CD5EE2E4A1394585F0.tpdila17v_2?cidTexte=JORFTEXT000031044385&categorieLien=id

158 The national approaches are supported by several EU projects, e.g., the EU FP7 'School of the Future', see *EU FP7 demonstration project School of the Future (260102), available at www.schoolofthefuture.eu or the IEE ZEMedS project, see www.zemeds.eu*

159 CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports. Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0;



Source: Environmental Statement 2015 results - Version 1.3 - Working Draft for Verification – European Commission

Since 2014, the **Dutch** Sustainable Public Procurement (SPP) system "*PIANOo*" (Professional and Innovative Tendering Network for Government Contracting Authorities) was installed as a central contact point for SPP for all **Dutch** public procurers[160]. A key aim is the professionalization of procurement and notably the inclusion of life-cycle cost calculations in procurement decisions. To date, *PIANOo* has assembled a network of some 3 500 public procurement professionals and contracting authorities[161].

Many projects supported public authorities across Europe in taking up energy efficiency in public procurement, often by analysing and replicating elements of procurement from countries that were assessed to be best performers[162].

- *Green ProcA*[163]: collects examples of best practice in Green Public Procurement (GPP). It will promote and monitor GPP in SEAPs and support the SEAPs signatories in implementing their GPP measures. This will be done via capacity building and networking activities, as well as 42 lighthouse projects in lighting, buildings and information technology. The programme builds on the experiences of its predecessor *Buy Smart+* which developed a large number of tools and guidance documents and achieved over 900 consultations and 300 trainings.[164] Within this project 39 pilots focusing on different product groups (building components, green electricity, lighting, office equipment etc.) clearly indicated the investment and savings resulting from their Green Public Procurement activities, the total cost savings were EUR 56 171 610 compared to investments of EUR 24 158 121 totalling a positive balance of EUR 32 013 489.
- *CEPPI2*[165] assembles five European cities[166] to demonstrate how can make more rapid progress towards achieving their energy-related objectives through the strategic use of public procurement of innovation (PPI). Aim is to develop at least one PPI project with the combined potential to reduce energy consumption by at least 33 GWh/year.

160 A good practice described by the project *Energy Efficiency Watch 3*

161 PIANOo (2016): Public procurement in the Netherlands. Available at: https://www.pianoo.nl/public-procurement-in-the-netherlands/sustainable-public-procurement-spp

162 Identified as front runners for green public procurement wereDenmark, the Netherlands, Norway, Sweden and the UK. Adelphi (2010): Strategic Use of Public Procurement in Europe Final Report to the European Commission. MARKT/2010/02/C. Available at: http://ec.europa.eu/internal_market/publicprocurement/docs/modernising_rules/strategic-use-public-procurement-europe_en.pdf

163 http://gpp-proca.eu/.

164 For further details on Buy Smart+ see: http://www.buy-smart.info/index.php/cat/1/title/Home

165 http://www.ceppi.eu/home/

166 Birmingham (UK), Budapest (Hungary), Castelló & Valencia (Spain) and Wrocław (Poland)

- *SPP Regions*[167] assembles 7 regions in the EU coordinating the publication of 42 tenders in the areas of energy use in public buildings, vehicles & transport, and foods and catering services, which would lead to 54,3 GWh/year of primary energy savings and 45 GWh/year of renewable energy production triggered.
  The project also transformed the *Procura+* Campaign, launched in 2004, into a wider, permanent European Network[168], to foster direct peer-to-peer exchange between at least 100 public authorities, and providing a platform for policy makers for expert consultation on SPP.

- *GreenS*[169] aims to provide long-term support and technical assistance on green public procurement (GPP) to local authorities, by the establishment of permanent supporting structures, called G.PP.S. – Green Public Procurement Supporters (Supporting Units) within Energy Agencies in 7 EU countries. A "pool" of experts in each of those Energy Agencies will give institutional bodies, at regional/local and municipal level, technical support on GPP. 21 Pilot GPP projects will be implemented by public authorities to test on the field the technical support by the GPP Supporters.
- *EURECA*[170] support energy and resource efficient and environmentally sound procurement actions within the European Public Sector for data centres and related products and services. The project, in its *'Report on impact analysis of greed data centre procurement choices'*[171] described such procurement good practice examples. The public authorities of the city of Amsterdam decided to start the projects that led to energy reduction of Amsterdam's own public data centres. Innovative solutions like the use of an existing ATES (Aquifer Thermal Energy Storage) installation, enabling the reuse of data centre heat for the heating installation of the City Hall and the Opera of Amsterdam, and the free data centre cooling with the help of the water flow of the nearby river Amstel, were introduced.

Figure 52: Innovative solutions applied to Amsterdam's own public data centres- use of an existing Aquifer Thermal Energy Storage (ATES)

Source: EUREKA project Report on impact analysis of green data centre procurement choices

Extensive guidance[172] and best practices[173] of public procurement in green data centres were also

167 http://www.sppregions.eu/home/
168 http://www.procuraplus.org/
169 http://greensproject.eu
170 http://eureca-project.eu/
171 http://eureca-project.eu/resources/EURECA_D1.2.pdf
172 https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/primeenergyit_procurement_guidance_en.pdf

developed by the IEE project *PrimeEnergyIT*.

GPP 2020[174] implemented more than 100 low-carbon tenders, which directly resulted in substantial CO_2 savings.

Figure 53: GPP2020 project results

Source: GPP2020 project

Most PDA projects include the procurement of energy efficiency works and/or services by local and regional authorities, mainly in the field of building renovation, street lighting and district heating (see below and chapter: 7.2).

Regarding Energy Performance Contracting (EnPC), there is a clear lack of skills in procurement departments as the logic is very different to the traditional procurement of design on the one hand and works on the other hand. Large-scale capacity building is very much needed, as well as facilitation services. Moreover, in some countries public procurement rules make it difficult to procure EnPC, for instance by excluding the use of negotiated procedures or competitive dialogues[175]. In addition project developers perceive as a barrier the fact that in some cases EnPC in public sector could affect government's deficit and debt.

Policy feedback resulting from the good practice analysis

- The exemplary role of the public sector can **mobilise a substantive amount of energy savings, especially if extended to regional and local authorities**.
- Many good practice examples featured actively engaged regional and local stakeholders, or used capacity-building mechanisms to support and empower these entities.
- **IEE and Horizon 2020 Energy Efficiency projects** provide a comprehensive set of **good practices and tools** for energy efficient procurement which can be **used in the framework of the EED and EPBD concerted actions.**
- **Project Development Assistance facilities** support the public sector to purchase energy efficient products, services and buildings- see chapter: 7.2.)
- **A close monitoring of the impact of the public accounting rules on the development of the EnPC market might be needed, as well as an eventual review of the existing accounting guidance in consultation with Member States, if appropriate.**

173 https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/primeenergyit_best_practices_en.pdf

174 http://www.gpp2020.eu/

175 For instance in Italy, the **Province of Teramo** was refused the right to use a competitive dialogue by the Superior Council of Public Works (*MLEI PARIDE* project, see chapter: 7.2.).

EUROPEAN
COMMISSION

Brussels, 30.11.2016
SWD(2016) 404 final

PART 3/4

COMMISSION STAFF WORKING DOCUMENT

Good practice in energy efficiency

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency

{COM(2016) 761 final}

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7. Energy efficiency investment market: On the move!

Underpinned by a comprehensive regulatory framework, the **European market for energy efficiency is already sizeable and is expected to grow over time**. Each year, it generates around 15 Mtoe of primary energy savings[1] attributable to increased energy efficiency, mainly in transport, followed by households and industry. At the same time, it represents a significant flow of investments, as most energy efficiency projects require the mobilisation of up-front capital in order to benefit from lower energy bills in the future.

The exact size of the market is difficult to estimate. Energy efficiency investments can be accounted for in different ways and the market size varies significantly, depending on their definition[2]. Nevertheless, a number of sectorial bottom-up and top-down studies broadly outline the market.
In the building sector for instance, it is estimated that, each year, around EUR 120 billion[3] is invested into building envelopes and heating, cooling and ventilation systems. This capital expenditure should be compared with the overall EU market for building renovation which represents annually around EUR 500 billion and the market for new construction of around EUR 400 billion[4]. When looking at incremental costs, meaning the costs strictly due to energy efficiency improvements, a study[5] estimates the energy efficiency related market at around EUR 80 billion per year in the residential sector. In the area of products, a recent study[6] shows that in the EU 2020 extra acquisition costs for more efficient products will represent approximately EUR 62 billion and will result from EUR 173 billion gross savings on running costs (91% energy).

Energy efficiency measures are **mainly financed by private capital** in the form of savings from households, equity from companies, commercial debt originating from small consumer loans by retail banks to large-scale green bonds issued on the capital markets[7]. The importance of private financing is also highlighted by specific national studies[8]. This mobilisation of private financing is reinforced by a number of public schemes (around 200) across Europe which primarily take the form of grants, low interest rate credit lines[9], tax rebates or guarantees. A large share of these public support schemes target the building sector (around 80%), and estimates show that around EUR 12 billion[10] of public funds is invested each year to support the sector. At the EU level, the most important financing streams for energy efficiency are the European Structural and Investment Funds (ESIF), representing around EUR 18 billion over the period 2014-2020 for energy efficiency investments, in particular in public and residential buildings and in enterprises. Energy Efficiency has also been a beneficiary of the European Fund for Strategic Investments (EFSI) during its first year of operation, catalysing EUR

1 SWD(2014) 255 final
2 That is for example: incremental costs or full capital expenditure or motivated energy efficiency measures or autonomous investments or energy efficiency products or energy efficiency services
3 BEAM² model
4 Estimations based on the Euroconstruct data
5 Supporting study for the fitness check on the construction industry draft final report main text
6 Ecodesign impact accounting, Final – Status May 2015
7 For example, ABN Amro case presented below.
8 In France for instance, in 2013[8], 43% of the additional energy efficiency investments came from savings and equity, 34% from commercial debt, 12% from concessional debt, and around 10% from public subsidies. In Germany, in 2011, corporations and households were the most important investors in climate-specific finance, largely based on commercial loans acquired on the capital markets and concessionary loans from public banks
9 For example, Energy Efficiency Fund operated by VIPA in Lithuania, presented below.
10 Concerted Action EPBD

2.7 billion investments and accounting for more than 10% of the EFSI guarantee usage[11]. In addition, there are two specific EU financial instruments for energy efficiency, the European Energy Efficiency Fund[12] (initial capital of EUR 265 million), which provides market-based financing to public projects and PF4EE (Private Finance for Energy Efficiency)[13] which combines lending from the EIB to private banks together with guarantees and technical assistance with a view to trigger EUR 1 billion of investment.

The energy efficiency market operates in a dynamic context with different drivers, most important being macro-economic activity, energy prices and regulatory signals. All of them can stimulate or hamper the development of the market. In the current situation, low investor confidence and low energy price tend to reduce the flow of energy efficiency financing. In the longer run, the **market** will also be affected by the energy saving opportunities, which are likely to be **different to what we have experienced in the past**. Energy efficiency measures will become more complex to implement: the potential of economically-viable energy savings in areas such as products will shrink as time goes by and more savings will have to come from the renovation of existing buildings (where there is still a significant potential for cost-effective energy savings but projects are more complex and more challenging to finance). On the other hand, changes in the role of consumers, the growing share of renewables and decentralised generation, energy storage, fast-changing ICT technologies, new products, materials or construction processes will open new horizons and create opportunities for existing and new market actors. These will trigger new business models developed around services, with new financing models exploiting the multiple benefits of energy efficiency, as well as new revenue streams from demand response mechanisms.

Taking advantage of these new energy efficiency business opportunities will require the establishment of an appropriate policy framework together with attractive financing solutions to secure the mobilisation of sufficient private capital. It will require addressing a number of market failures and **finance allocation patterns**. The following chapter presents market good practise and inspiring examples supporting the three key pillars of the **Smart Finance for Smart Buildings Initiative**, namely:

- more effective use of public funding;
- aggregation and project development assistance; and
- de-risking of energy efficiency investments market.

7.1. Effective use of public funds to mobilise EE investments

Energy efficiency is not and cannot be financed purely from public funds as benefits are predominantly private and there will never be sufficient availability of public funds. A key challenge is to maximise the impact of public funding by leveraging private capital and developing financing instruments (such as loans and guarantees), while using non-reimbursable grants in cases where needed to address market failures. Due to the nature of energy efficiency investments (high upfront costs and stable long-term revenues) debt financing instruments have been progressively developed and launched, enabled by public finance.

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11 Under the EFSI Infrastructure window.

12 Set up in 2011, the initial capitalization of the fund is EUR 265 M and it aims at attracting private investors, to reach a total size of EUR 700 million.

13 Launched in January 2015, PF4EE is a financial instrument to drive investment in energy efficiency. It combines lending from the EIB to intermediary banks in Member States with guarantees and technical assistance provided by the Commission's budget (€80 million from LIFE+ committed for 2014-17). It is anticipated that it could finance around EUR 650M.

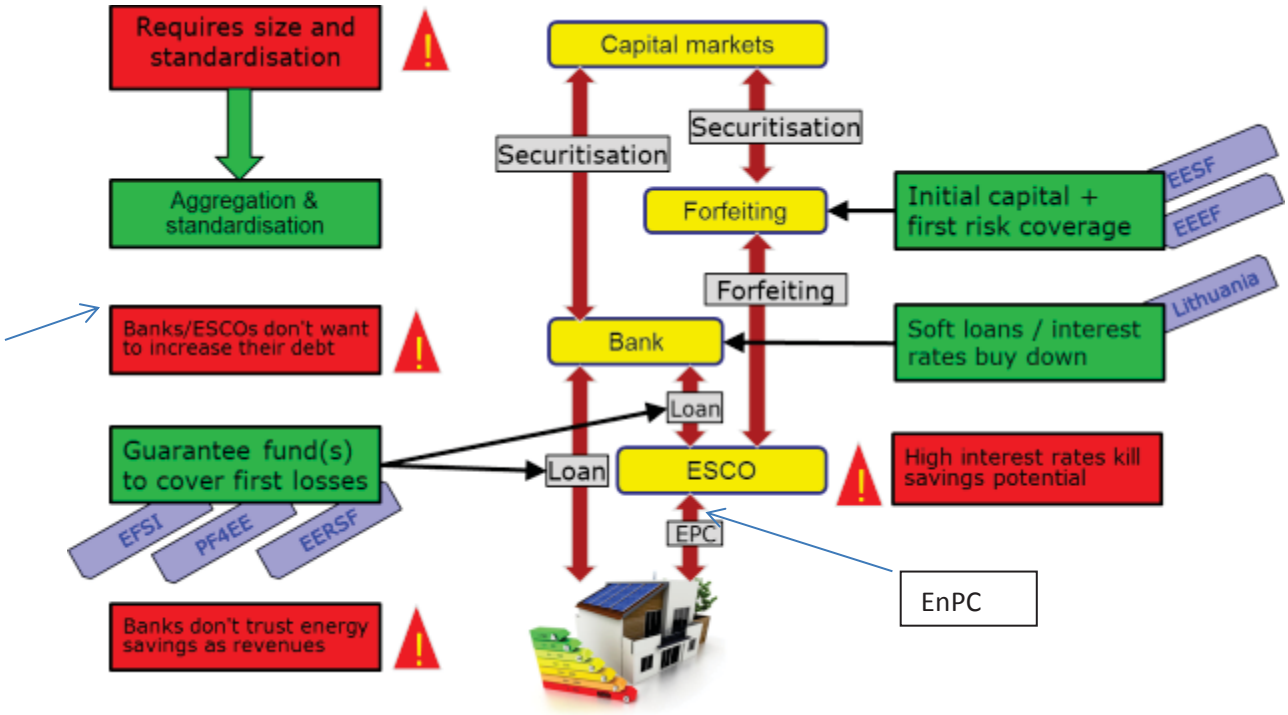
Public funding can be used in many different schemes, which frequently include the establishment of new legal and administrative mechanisms. Experience has shown that financing schemes need to be customised to regional/local socio-economic, legal and banking conditions. Typically, these schemes involve a combination of EU funding bodies, national or regional governments, energy agencies, municipalities, public financial institutions, commercial banks, local retail banks, energy companies, installers, housing agencies and associations, home owners, ESCOs and project consultants. The key issue is the proximity of financing schemes to their final users and usage of natural money distribution channels that are known and trusted by borrowers.

As illustrated in figure 52 below, public money can be used to reduce the cost of capital (which means lending money at rates below market prices), to provide loans with longer maturities or lower collateral requirements. Such "soft loan" schemes are increasingly used across the EU and have demonstrated their effectiveness, as can be seen below in the examples of Lithuania, Germany and Slovakia.

Public funds can also be used to absorb the risk of default on energy efficiency loans, which is traditionally perceived as rather high by financing institutions (this is further explained in chapter 7.3). This can be addressed through risk sharing instruments, such as guarantees on loans to project owners or to ESCOs.

A secondary (re-financing) market for energy efficiency investments needs to be created in order to allow investors/lenders to refinance their assets and invest their money into new projects. This is especially important in the period post-COP 21, where large institutional investors are keen to re-allocate their asset holdings in areas such as renewable energy sources or energy efficiency (refinancing is further explained in chapter 7.3).

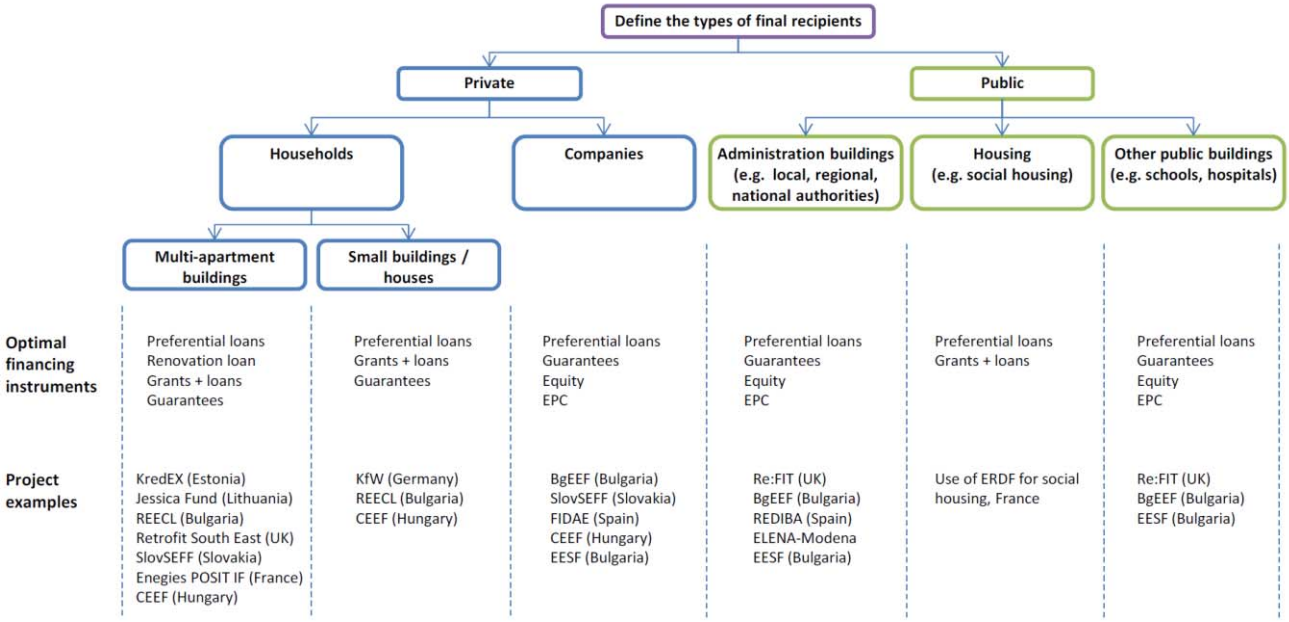
Figure 54: Public schemes to support energy efficiency finance



Source: adapted from Adrien Bullier, ECEEE 2013

For the building sector, the figure below provides an overview of different schemes which are being implemented across Europe, depending on the target group and type of financing instrument chosen.

Figure 55: Financing options depending on type of final recipients



Source: Technical guidance – Financing the energy renovation of buildings with Cohesion Policy funding, Final report- A study prepared by the European Commission DG Energy, 2014

7.1.1 Loan schemes co-financed by public funds

- ***Revolving loan fund for multifamily building renovation (Lithuania)[14]***

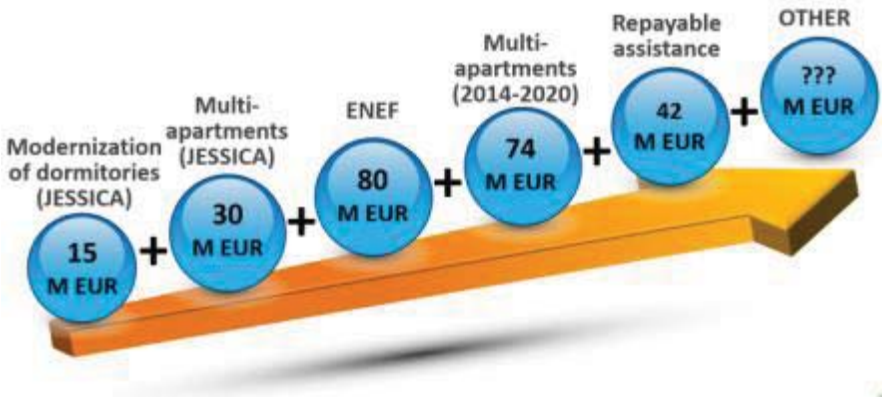
The Public Investment Development Agency (VIPA) is fully owned by the Lithuanian Ministry of Finance and was established to develop and implement innovative financial instruments for public infrastructure development. VIPA's objective is to foster energy efficiency market funding independently from the state and the European Union by recycling its initial funding, and by strengthening capital markets' presence, to broaden and diversify funding sources. VIPA only acts in sectors where funding gaps and market insufficiencies exist.

VIPA is involved in assessment and evaluation of the market, creation of financial models, developing innovations for financing energy efficiency and other (sector) projects, development and implementation of financial instruments funded by European structural and investment funds, identifying, evaluating, promoting and financing projects.

VIPA implements financial instruments in the public sector using a variety of resources including ESIF. In February 2015, the first fund of funds in the European Union using ESIFs 2014-2020 was established. The current priorities are energy efficiency in public infrastructure (e.g. municipal and state buildings, street lighting) and residential apartment buildings. Since its establishment, up to the second quarter of 2016 VIPA has mobilized and managed more than EUR 240 million.

[14] Source: VIPA presentation *'Financial instruments in Lithuania for energy efficiency and public infrastructure development*' available at: http://www.betalt.lt/wp-content/uploads/2014/01/Financing-VIPA-20151210.pdf

Figure 56: VIPA funds under management



Source: VIPA, 2016

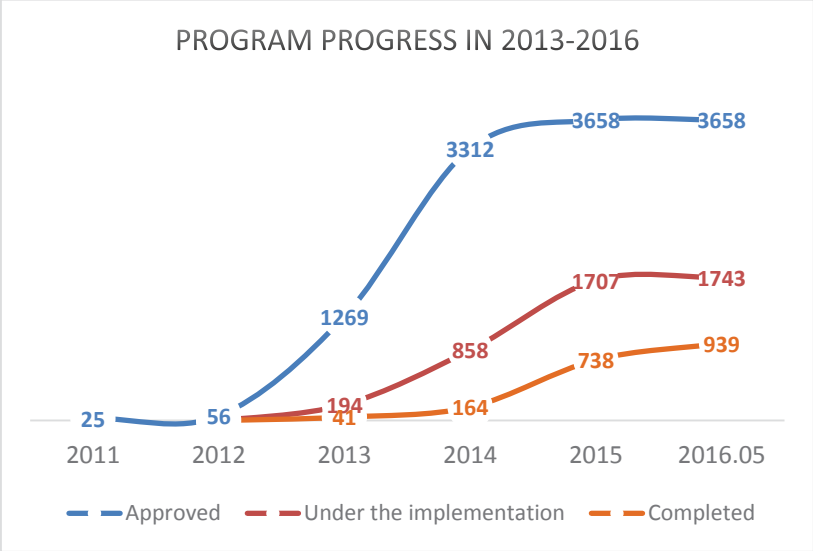
The main features of the most successful residential building modernisation financial product are:

- fixed interest rate at 3%;
- maturity up to 20 years;
- up to 2 year grace period (during construction);
- no collateral;
- 15% written-off if 20 % savings attained and energy efficiency Class C achieved (upon completion);
- extra 25% (gradually decreasing to 15% in 2018) subsidy from national sources if savings reach 40%.

The residential building modernisation programme became extremely successful when corrective measures were introduced by the Lithuanian government:

- municipalities were involved by drawing a list of the worst-performing buildings and mandating/requiring them to appoint renovation administrators, who could do off-balance borrowing on behalf and in favour of apartment owners;
- to implement modernisation project it is sufficient that 50% +1 of apartment owners vote in favour;
- compensation of monthly loan instalments to indigent apartment owners;
- gradual phase-out of heating bill compensation for indigent apartment owners who vote against modernization;
- technical and financial support for all related parties for preparation and implementation of projects (paid from national funds).

Figure 57: Residential building renovation project pipeline, in units



Source : VIPA, 2016

Due to investment demand being substantially higher than available funds, VIPA works on potential schemes to attract additional sources.

Combination of loans, technical assistance and grants for renovation of multi-apartment buildings (Estonia)

In 2009, at the height of the financial and economic crisis, **Estonia** established a loan fund for multi-apartment buildings – becoming the first MS to channel cohesion policy funding into apartment building renovation programmes. The instrument brought together EUR 17,7 million from the ERDF, a EUR 28.8 million loan from the Council of Europe Development Bank (CEB) and EUR 20,2 million from national resources, and was implemented by KREDEX, a national promotional development bank, as holding fund manager and two commercial banks as financial intermediaries. So far (at November 2014), more than 600 buildings have been renovated resulting in improved energy efficiency and living conditions in more than 22 000 apartments. The renovation loan programme, combining advantageous loans with project development assistance and performance based grants, is continued in the 2014-2020 period, with private sector financing and reflows from the previous period[15]. The scheme is a prime example for the sustainable financing through financial instruments, as public support to the guarantee scheme comes exclusively from reflows of the previous period.

[15] Source: DG REGIO, European Commission

Figure 58: A financed project example- renovation of the apartment block in Tallinn (before and after)

Source: Renovation loan programme- Case Study; Fi compass[16]

- ***KfW loans for energy renovation (Germany)***

The **German** state-owned Bank for Reconstruction manages two programmes to improve the energy efficiency of residential buildings, one targeting the construction of new buildings and the other the refurbishment of existing buildings. Both programmes offer a choice of upfront grants or soft loans, which may have a grant component. The amount of grant depends on the energy efficiency level achieved: the higher the energy efficiency, the better the financing arrangement[17].

To be eligible for the programme, it is a precondition that the efficiency standards achieved by the project are better than the minimum requirements as set out in the German Energy Savings Ordinance. Eligibility is based on two key parameters: (1) the annual primary energy demand compared to the demand of a new building (the so-called "reference building") and (2) the structural heat insulation (specific transmission heat loss) compared to the reference building.

Based on monitoring reports[18], final programme energy savings for the period between 2009 and 2013 amounted to more than 28 000 GWh by the end of 2013. Additional employment effects are estimated to be 79 000 person years due to total investments of EUR 6,5 billion, of which EUR 1 billion directly returns to the state in the form of VAT.

In terms of key success factors, KfW makes use of a scaling system for building energy efficiency, according to which the amount of funding is tied and linked to Germany's minimum energy performance standard (MEPS). If the MEPS is tightened, the scaling system's criteria nearly automatically become stricter. In addition, KfW makes use of established structures (local commercial bank offices) to facilitate loans. A benefit for the investor is that the system is transparent with all information available online.

KfW's programmes can be seen as unique instruments, as it is able to raise capital at low costs thanks to the implicit guarantee of the German government, which makes KfW bonds very attractive to investors.

- ***SlovSEFF (Slovakia)***

SlovSEFF, conceived and managed by the EBRD in cooperation with the **Slovak** National Authorities and local retail banks, has successfully financed investments in residential and industrial energy efficiency and renewable energy since its start in 2007. SlovSEFF was launched with an amount of

16 https://www.fi-compass.eu/sites/default/files/publications/case_study_renovation_loan_programme_estonia_0.pdf

17 EEW Case Study http://www.energy-efficiency-watch.org/index.php?id=213

18 Diefenbach et al. 2010, 2011, 2012, 2013, 2014

EUR 60 million and was extended in 2010 with an additional EUR 90 million in EBRD financing to local banks. Donor funding was initially provided by the Bohunice International Decommissioning Support Fund (BIDSF) for incentive payments and technical assistance (Phase I and II), followed by the use of proceeds from the sale of Slovak greenhouse gas emission allowances (Phase III, just started).

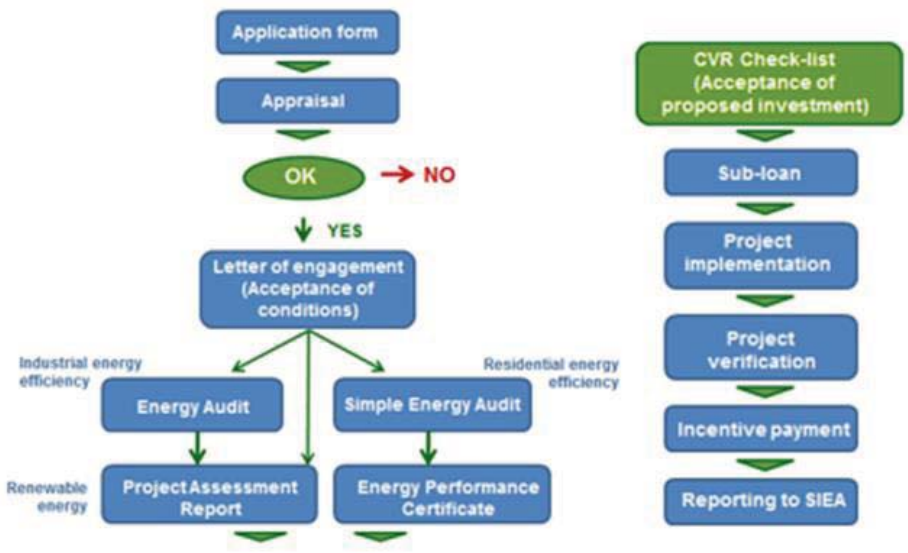
The EBRD extends credit lines to local financial institutions to develop energy financing as a permanent field of business. Local financial institutions act as intermediaries and lend the funds to their clients (small and medium-sized enterprises, corporate and residential borrowers) to undertake energy efficiency savings projects or to invest in small-scale renewable energy generation.

SlovSEFF also provides technical assistance to financial institutions and their clients. Borrowers are provided with assistance in identifying energy saving opportunities through energy audits and are advised on high performing technologies. Technical assistance is provided by external, local consultants: the Project Consultant and the Verification Consultant.

Incentive payments are provided to kick-start markets by incentivising financial institutions and borrowers to comply with higher standards for energy efficiency and renewable energy projects. The main barrier to the implementation of energy efficiency projects are long payback times and a large upfront investment. Incentive payments have helped to correct these market barriers. In SlovSEFF II, for housing projects 10% of the loan was paid as an incentive if 15% of energy savings were achieved and 15% of the loan if savings were larger than 25%. For industrial energy efficiency projects, incentive payments represented 7,5% of the loan amount once the IRR was larger than 10%[19].

Audits are the integral part of the programme (energy audits for industrial energy efficiency, simple energy audits for residential energy efficiency) to identify and confirm best energy/carbon saving measures. The release of incentive payment follows a rigid verification structure: the independent consultant verifies the project and notifies the participating bank which then approves it and notifies the EBRD. Following the project verification, the incentive payment of Carbon Reduction Compensation is disbursed. Annual GHG emissions and energy savings have to be reported to the Slovak Innovation and Energy Agency (SIEA) for a period of 5 years after project completion. The following figure provides an overview of how SlovSEFF works.

Figure 59: SlovSEFF scheme



Source: EEW3 Case Study: The Slovak Energy Efficiency and Renewable Energy Finance Facility[20]

19 (EBRD 2014).

20 http://www.energy-efficiency-watch.org/index.php?id=213

SlovSEFF also aims at transferring and building expertise among banks and companies related to sustainable energy investments. By improving energy efficiency and utilisation of renewable energy, it also aims at mitigating electricity price increases.

It is estimated that 31 184 households and therewith 86 376 residents benefitted from the refurbishments[21].

In total 688 projects were funded under SlovSEFF I and II. A 2014 evaluation by the EBRD shows that the largest share of projects took place in the housing sector (87%) followed by the industrial sector (11%) while renewable energy projects represented only 2%. When considering the allocation of funds, 61% went to housing, 27% to industrial projects and only 12% to renewable projects.

SlovSEFF I and II jointly achieved annual primary energy savings of 580 000 MWh (compared with a target figure of 504 000 MWh) and result in total annual CO_2 savings of 114 000 t.

7.1.2 Risk-sharing instruments

- ***European Fund for Strategic Investments (EFSI)[22]***

EFSI is an initiative launched by the EIB Group - European Investment Bank and European Investment Fund - and the European Commission to help overcome the current investment gap in the EU by mobilising private financing for strategic investments. EFSI is one of the three pillars of the Investment Plan for Europe that aims to revive investment in strategic projects around Europe to ensure that money reaches the real economy. Its objective is to unlock additional investment of at least EUR 315bn until the end of 2017.

EFSI is a EUR 16 billion guarantee from the EU budget, supplemented by a EUR 5 billion allocation of the EIB's own capital. EFSI has been integrated into the EIB Group and projects supported by EFSI are subject to the normal EIB project cycle and governance.

With EFSI support, the EIB Group provides funding for economically viable projects where it adds value, including projects with a higher risk profile than ordinary EIB activities. It focuses on sectors of key importance where the EIB Group has proven expertise and the capacity to deliver a positive impact on the European economy.

EFSI is demand driven and provides support for projects everywhere in the EU, including cross-border projects. There are no geographic or sector quotas. Projects are considered based on their individual merits.

Energy Efficiency has been an important beneficiary of EFSI during its first year of operation (see chapter 7.2.3), catalysing EUR 2,7 billion investments and accounting for more than 10% of the EFSI guarantee usage[23]. Out of these projects, some are combining ESIF/other public funds and EFSI funds in a way to provide risk sharing and technical assistance.

A good example is the CAP TRI investment fund project in **Nord-Pas-de-Calais** showing how to usefully combine ESIF and EFSI support, in particular as it enabled maximising the private sector participation[24]. The project is a part of a low-carbon economy strategy in the region (Third Industrial Revolution - TRI) intending to make the Region a "zero- emissions" energy model by 2050, while at the same time creating employment, developing the overall economy and combating fuel poverty. CAP TRI a "layered" fund which invests risk capital in enterprises developing TRI projects: the Region

21 SlovSEFF 2015

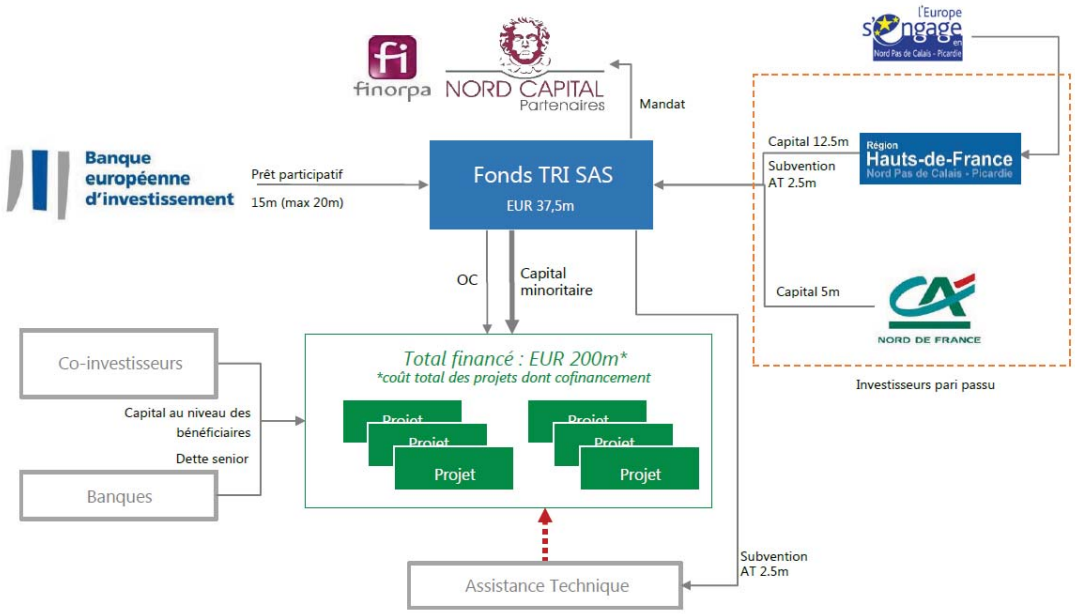
22 http://www.eib.org/efsi/

23 Under the EFSI Infrastructure window.

24 http://europa.eu/rapid/press-release_MEMO-16-1967_en.htm

participates, using European Regional Development Fund (ERDF), providing equity financing alongside public and private investors. The EIB, supported by the EFSI, provides mezzanine debt to the fund and commercial banks provide senior debt at project level. In addition to financing, the Region also offers technical assistance thanks to a grant of up to EUR 2,5 million drawn from ERDF resources. The investment projects eligible to CAP TRI financing are in the field of renewable energies, energy efficiency, energy management and smart grids, smart transport and circular economy.

Figure 60: CAP TRI funding scheme



Source: Diaporama du Fonds CAP TRI, la région Hauts-de-France

Private Finance for Energy Efficiency (PF4EE)[25]

The PF4EE is an **EU** Financial Instrument developed by the European Commission together with the European Investment Bank (EIB) aimed at increasing investments in Energy Efficiency through debt financing (Energy Efficiency loans) provided by private Financial Institutions (FI) to final recipients.

PF4EE has a budget of EUR 80 million for the risk-sharing and expert support facility (from the EU's LIFE+ Programme) for the 2014-2017 period. It is made up of three main elements:

- Energy efficiency loans provided by the EIB to Financial Institutions participating in the PF4EE.
- A risk sharing mechanism providing cash collateral to Financial Institutions to cover up to 80% of their expected losses in dedicated energy efficiency loans portfolios.
- An expert support facility to assist Financial Institutions in setting up a framework to identify, evaluate, and ensure the financing of projects (a maximum amount of 3.2 million euro can be allocated to this expert support facility across the EU).

The PF4EE aims to increase lending activity and to provide better financing conditions for energy efficiency projects (e.g. lower interest rates, longer maturities, reduced collateral). This is achieved mainly through the risk sharing facility, which reduces the credit risk faced by financial institutions when lending to final recipients. One FI can be selected from a given country and no more than 15% of the EU contribution can be allocated to one single country.

25 http://www.eib.org/products/blending/pf4ee/index.htm

Eligibility

- The potential counterparts of the PF4EE are private financial institutions that demonstrate capacity to target final recipients in line with the EE national priorities.
- The investments to be financed by the EE loans should be consistent with the Member State's National Energy Efficiency Action Plan or an energy efficiency national programme or scheme and the resulting energy savings should cover at least 50% of the project cost.
- The EE loans can range from 40 000 Euro up to EUR 5 million26 and any natural person or legal entity undertaking can be a final recipient of this instrument.
- Since its launch at the end of 2014, the PF4EE has signed three operations:
- Lending programme with Komerční Banka, a.s., Czech Republic: this scheme provides targeted energy efficiency loans for businesses and industry. The EIB has committed a loan of EUR 75 million (EUR15 million disbursed so far)[27].
- Spanish lending programme with Banco Santander: addressing energy efficiency in Hotels sector. The EIB has committed EUR 50 million of debt financing (EUR 20 million distributed so far).
- French lending programme for refurbishment of buildings and energy efficiency measures in businesses, with Credit Cooperatif. The EIB has committed a loan of EUR 75 million.

Figure 61: PF4EE scheme

Source: EIB

- ***European Energy Efficiency Fund[28]***

The European Energy Efficiency Fund was created by the European Commission and the EIB to provide specific and tailored financing for energy efficiency projects originated by public sector entities. The Fund was capitalized with EUR 265 million provided by the European Commission, the European Investment Bank, Cassa Depositi e Prestiti and Deutsche Bank, the latter being also the

26 The EE loans can be reduced to accommodate small investments in the residential sector and can go up to 10 million euro in exceptional cases.

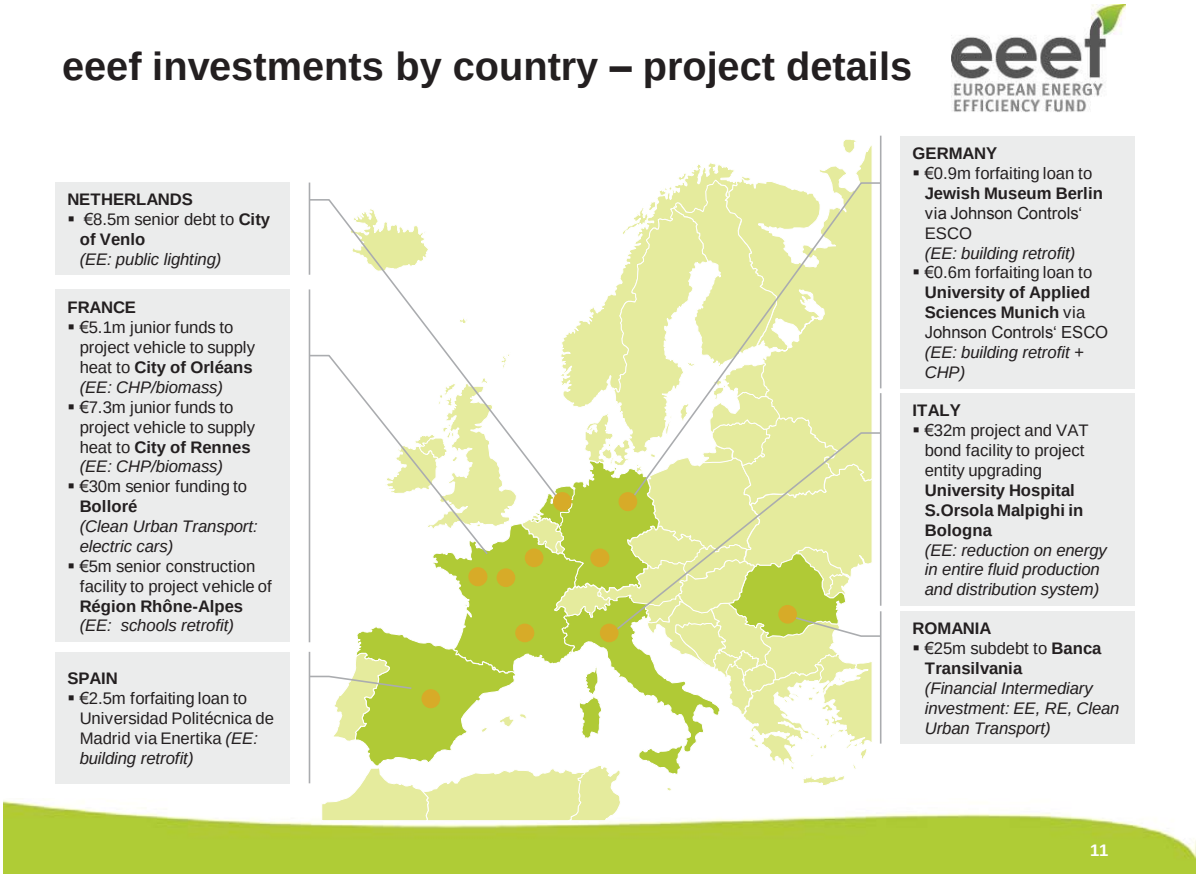
27 i.e. by the end of 2015

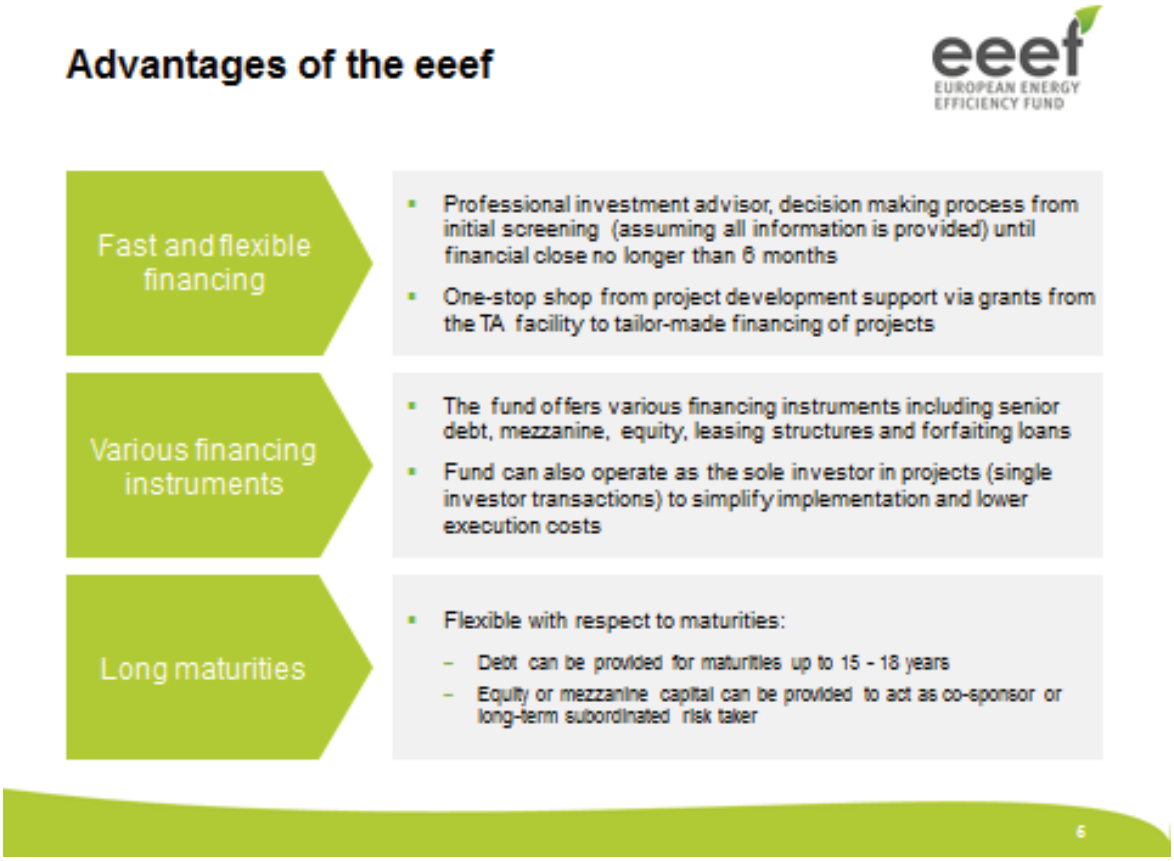
28 http://www.eeef.eu/

Fund manager. As a layered structure, EU public funds were used as a "first-loss" capital tranche, enabling to de-risk the private capital entry into the facility. The Fund aims to attract additional private investors to enlarge the scope of its portfolio.

The Fund offers debt, equity and forfaiting finance for mature energy efficiency, renewable energy and clean urban transport projects. As of today, there are 10 projects in its portfolio, presented below. The Fund offers variability and flexibility in its operations, and beneficiaries can use the ELENA Technical Assistance to develop their investment projects, to be potentially funded by the Fund.

Figure 62: EEEF projects map





Source: EEEF (2016)

- ***EERSF loan and guarantee fund for ESCOs (Bulgaria)[29]***

Established in February 2004, the EERSF (Energy Efficiency and Renewable Sources Fund) is a **Bulgarian** public-private for-profit entity, independent from any public or private institution. EERSF has the combined competences of a credit institution, a credit guarantee company and a consulting firm. It provides technical assistance to Bulgarian companies, municipalities and individuals in the development of investment projects in energy efficiency and then accompanies their financing, their co-financing or acts as guarantor to other financial institutions.

EERSF offers three main financial products:

- direct loans to projects,
- partial credit guarantees to ESCOs reducing the credit default risk, and
- portfolio guarantees reducing the risk of payment delays.

The portfolio guarantee for ESCOs is one of the most interesting features of the EERSF. Indeed, ESCOs normally rely heavily on debt to finance their activities, which requires the cash flows from their projects to be precisely coordinated and budgeted. Delays in payment from clients, or customers defaulting, are likely to seriously disrupt the debt service of the ESCO itself. The EERSF provides ESCOs with a guarantee for delays in payments by their clients up to 5% of the total payments. Indeed, statistically customer defects do not exceed 5% of commitments and are more likely to be delayed than not paid at all. This guarantee is not project-based but portfolio-based, which allows levelling the risk premium between all different projects. The EERSF acts as shock absorber and

[29] Quoted from Bullier, A., Milin, C., Alternative financing schemes for energy efficiency in buildings, ECEEE 2013; www.managenergy.net/lib/documents/868/original_3-221-13_Bullier_-_Alternative_financing.pdf

therefore reduces the cost of financing as ESCOs and banks may accept a lower Internal Rate of Return (IRR) due to the lower risk. Besides, such a product provides excellent leverage for the equity of EERSF. For example, a guarantee of BGN 500 000 facilitates an investment portfolio of BGN 10 million, i.e. a leverage ratio of 20.

7.1.3 Grant schemes

- ***Subsidies paid directly to installers.***

The Energy Company Obligation is a **UK** scheme which provides funding for energy efficiency improvements. Unlike most other schemes, payments for improvements go straight to the installers (not the resident), ensuring that funds are actually used to pay for energy efficiency improvements, and making it easier for residents to manage payments in multi occupancy buildings. This system limits consumer choice of installer, but in some situations this drawback is outweighed by the advantage of simplifying the payment process.

- ***Scottish area based programmes for home energy efficiency improvements.***

In **Scotland**, the Home Energy Efficiency Programmes' (HEEPS) Area Based Schemes form a 10 year programme which is funded by the Scottish Government and tops up Energy Company Obligation (ECO) funds. Schemes are delivered through local authorities, who are best placed to understand the nature of local housing provision and co-ordinate a local supply-chain. The programme is focussed on the most deprived areas in the country and hard-to-treat measures, such as external wall insulation (with previous programmes having installed easier low-cost measures).

- ***Sustainable Development Income Tax Credit (France)[30]***

The Sustainable Development Tax Credit (CIDD) in **France** is a tax credit for the purchase of the most efficient materials and equipment in terms of energy consumption and greenhouse gas emissions. Cost of labour is only covered in the special case of the installation of opaque external wall insulation and ground source heat pumps.

This scheme was launched in 2005 and about 8 million households have used the facility. CIDD is available for homeowners and tenants (also occupants who do not pay rent).

Only renovation work in existing buildings is eligible, except in the case of renewable energies, which may be financed for both new and existing buildings. A range of improvements are accepted: insulation of floor, roof, window and front door; insulation of heat or water distribution systems; installation of heating regulation equipment; domestic hot water equipment; energy producing equipment using renewable energy; and connection to a district heating fed by renewables or cogeneration system.

- ***Sustainable Construction Programme in Andalucía (Spain)[31]***

The Sustainable Construction Programme in Andalucía in Spain ('PICSA'), co-financed by EUR 133 million from the ERDF, invested in the energy renovation of buildings and the rehabilitation of urban areas, boosting the competitiveness of the construction sector and the creation of skilled employment. boosting the creation of skilled employment while reducing energy poverty for low income families. The work done to improve energy efficiency in buildings has led to an estimated reduction in CO2 emissions of 62 000 tonnes and energy savings of about 26 000 toe/year. Around 14

30 Source: MURE database

31 http://ec.europa.eu/regional_policy/en/projects/spain/making-andalusias-construction-sector-more-sustainable

000 jobs have been created. Vulnerable groups have benefited greatly, with improved housing quality for more than 7 000 low income families. Moving forward, measures contained in the development plan are expected to generate 80 000 new jobs over the next five years. To help make this happen, EUR 529 million of extra funding has been allocated until 2020.

- ***Energy Performance Certificate requirements for access to public grants (Italy)[32]***

Energy Performance Certificates (EPCs) can be used as an evidence of the quality of energy-related renovation. In the residential sector, EPCs are already being used in many countries as a document necessary to obtain financial support and subsidies for increased energy efficiency. In 2015, EPCs were required in 10 EU Member States to prove eligibility for such schemes, most often both before and after the renovation. In this context, EPC quality assurance plays a key role in a growing number of Member States.

In **Italy**, the tax deductions available in 2014 have been in effect since 1 January 2007 and are designed solely for the energy refurbishment of existing buildings. The deductions are available for homeowners and tenants, and for businesses (deductions limited to buildings used for their activities). To be eligible for tax deductions, any intervention must comply with certain energy performance requirements, which vary according to the type of operation and must be more demanding than the minimum requirements prescribed by law and pursuant to the decree transposing the EPBD. In order to qualify, it is necessary to provide an EPC after the intervention.

Main overall results (2007 – 2012):

- about 1.5 million applications;
- energy savings of more than 9 000 GWh/year;
- environmental benefit in terms of avoided CO_2 emissions more than 1,900,000 ton/year;
- approximately 6,2% of Italian property is involved in energy improvement (partial or total), which has been able to take advantage of tax deductions of 55% or 65%.

The highest number of interventions over the years has been the replacement of lighting fixtures, while the greatest contribution to energy savings achieved can be attributed to the interventions carried out on heating systems. The overall results are summarised in figures below[33].

[33] CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports Available at: https://www.dropbox.com/s/vaq0h8if64ypmlh/CA3-BOOK-2016-web.pdf?dl=0

Figure 63: Number of renovations per type of intervention

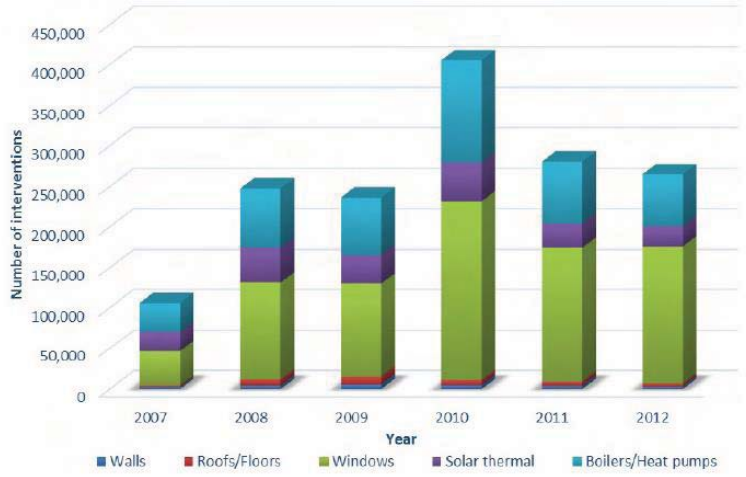
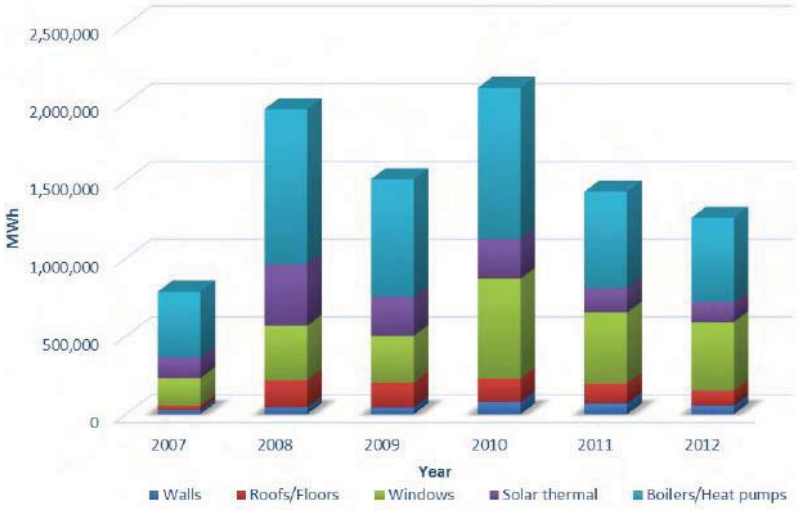


Figure 64: Energy saved per type of renovation



Source: CA EPBD (2016) – Implementing the Energy Performance of Buildings Directive (EPBD)

7.2. Aggregation and assistance

Many **cities, individuals or businesses are not trained**, or experienced **in developing sizeable energy efficiency projects** and they perceive these operations are being unknown, complex and linked to challenging decision-making processes. They lack the necessary technical, organisational, legal or financial capacity to set up, implement and finance such projects. They may lack experts able to perform thorough energy audits, to develop technical specifications for public tenders, to define the most appropriate procurement procedure, or to find the most suitable financing solutions. These skills are often not readily available in-house or are expensive to sub-contract. As a result, a large number of project promoters are not transforming their ideas into concrete investments, and underdeveloped project pipelines become an important bottleneck to the development of the market.

In this context, most project promoters need assistance. This is the purpose of project development

assistance (PDA), which the EEFIG report[34] identified as key to create a large-scale pipeline of bankable projects.

Project Development Assistance can be provided via different instruments such as dedicated PDA facilities, investment platforms[35], local "one-stop-shops" or dedicated services. A large variety of market actors can be involved in PDA activities including local and regional authorities, ESCOs, banks, energy agencies[36] or utilities, usually with a local or regional scope. It can also encompass a wide array of activities including: consumer information, energy audits, proposal for packaged solutions, financing advice, tendering procedures, quality assurance and monitoring.

In addition to triggering action, Project Development Assistance facilities are essential to develop mechanisms **for the aggregation of small scale and fragmented energy efficiency transactions**. This is key to increase the size of energy efficiency investments, generate economies of scale, reduce transaction costs and make projects more appealing to investors.

Public funding can be allocated very effectively to support PDA activities and bridge the capacity gap that inhibits the development of investment-grade projects. At **EU level**, the Intelligent Energy Europe and Horizon 2020 programmes have been funding different Project Development Assistance Facilities, notably the **European Local Energy A**ssistance (**ELENA**) facility and the **PDA call**. These facilities have so far provided about EUR 130 million to about 127 projects, resulting in more than EUR 6 billion of expected investment. The minimum required leverage factor (that is, each EUR provided in assistance is required to trigger at least EUR 15 to 20 in investment) has been overachieved, confirming the positive effects of empowerment of project promoters by knowledge[37]. The ELENA Facility is being reinforced through additional capacity provided under the European Investment Advisory Hub[38], created to provide investment support to project promoters under the Investment plan for Europe. Most of the emerging models to develop and finance energy efficiency investments have been funded under either ELENA or the PDA call of Horizon 2020: *Energies Posit'If*, *Picardie Pass Rénovation*, *Padova FIT!*, *RE:FIT*, as well as a series of projects which aggregate small investments in public buildings and street lighting in order to jointly procure energy performance contracts.

At the **national, regional and local level**, an integrated approach is required to create demand for energy efficiency investments, trust in contactors, and to increase the capacity of those along the value chain. Furthermore, an integrated solution would tie-in various sources of financing, ultimately connecting the attractive supply of finance with demand. Such solutions could include, for instance **One-stop-shop** approaches that cover the whole customer journey from information, technical assistance, structuring and provision of financial support, either through specific public-private vehicles or by the private sector, to the monitoring of savings. To achieve this complete and seamless offer, one-stop-shops have to provide support to both the supply or demand (customer) side and they generally include the following interventions: communication and information campaigns, training and building skills in the supply chain, financing mechanisms, and energy performance tracking (before and after). The figure below explains the main services provided under a one-stop-shop for building renovation:

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34 www.eefig.eu

35 Investment Platforms definition according to the EFSI Regulation: "*special purpose vehicles, managed accounts, contract-based co-financing or risk-sharing arrangements or arrangements established by any other means by which entities channel a financial contribution in order to finance a number of investment projects…*

36 400 local and regional energy agencies exist across the EU, that can provide the needed technical and economic capacity and expertise.

37 PDA evaluation report

38 http://www.eib.org/eiah/about/index.htm

Figure 65: One Stop Shop for building renovation

Source: REQUEST project[39]

The experiences presented below represent different concepts which can be adapted and replicated in many regions of Europe.

Last, but not least, there is still a major lack of skills across the value chain which needs to be addressed through flanking measures such as capacity building and stakeholder dialogue.

7.2.1 Assistance to facilitate the use of Energy Performance Contracts

An Energy Performance Contract (EnPC) is a contractual arrangement between a host beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.

EnPC are interesting contractual arrangements as they allow facility owners and managers to upgrade ageing and inefficient assets while recovering the necessary capital directly from the energy savings guaranteed by the EnPC providers. However, these projects are often complex to set up and project promoters often lack the necessary expertise to go through that process.

39 http://building-request.eu/sites/building-request.eu/files/REQUEST%20Project%20Summary%20Report_FINAL.pdf

Different experiences have shown that a local EnPC market can be developed with the support of a 'market facilitator', i.e. an entity which not only helps clients to prepare, procure and manage an EnPC, but also structures the market by training ESCOs, providing template contracts, and informing all market actors[40]. Based on the successful example of Berlin's Energy Savings Partnership, several regions in Europe have implemented market facilitation services with success, often in the framework of EU-funded projects.

- ***EESI2020, market facilitators to assist the development of the EnPC market***

The EESI 2020 project[41] supported the development of the EnPC market by providing direct training to 800 potential facilitators, and by establishing a guide on the typical tasks and responsibilities of EPC project facilitators. In addition, it demonstrated the importance of this local assistance by implementing 27 EnPC pilot projects which triggered almost EUR 27 million of total investments in energy efficiency, e.g.:

- In the **Czech Republic**, the offices and the beautiful concert hall of the Czech Philharmonic Orchestra with a net floor area of 16 957 m2 was renovated under a 9 year contract. The cooling and air conditioning systems were renewed, a heating control system was introduced and efficient lighting was installed. The total investment was EUR 900 000, with guaranteed energy savings of 35%.

- In **Karlovac County** in **Croatia**, the Eugen Kvaternik primary school was renovated under a 12 year contract. Overall, EUR 309 000 was invested to switch the heating system from oil to biomass, insulate the building envelope and modernise the lighting system. Not only did these measures achieve guaranteed savings of 53%, but also the indoor climate has improved significantly making it more convenient for teachers and pupils to be in school.

- In **Germany**, Postbank retrofitted various large-scale administrative properties ranging from 26 000 m² to 125 000 m² and located throughout the country. The objective was to achieve a holistic energetic renewal of the office buildings with limited internal investments. This was achieved with 8 year EnPC that included the exchange of existing luminaires with LED modules and the retrofitting of the buildings. Depending on the initial state of the buildings, guaranteed savings of 35-70% could be achieved with a total investment of EUR 1,9 million.

The EESI 2020 project also developed a database of EnPC good practices targeted both at facilitators (consultants, energy agencies etc.) and final customers (i. e. predominantly decision makers and officials of public administrations/city governments). It provides a single point of access to high quality EnPC references, training material to implement an energy performance contract, template contracts, and marketing information.

- ***Supporting the development of EnPC for street lighting***

The region of Upper **Austria** has implemented a plan of lighting refurbishment for public lighting in order to lower its CO_2 emissions and reach its goal, which is to supply 100 % of space heat and electricity with renewable energy sources by 2030. The region is supported by an Intelligent Energy Europe financed project, *STREETLIGHT EnPC*[42], which creates demand and supply for Energy Performance Contracting projects not only in Upper Austria but in 8 other European regions by providing regional EnPC facilitation services. These services support municipalities and (potential) ESCOs in developing projects with this innovative financing mechanism.

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40 The facilitator concept is detailed at length in Bleyl et al., IEA DSM Task XVI, 'ESCo market development: A role for Facilitators to play', ECEEE 2013

41 http://eesi2020.eu

42 http://www.streetlight-epc.eu/

Thanks to the *STREETLIGHT EnPC*, nine projects were implemented so far. They were realised by 6 different ESCOs, including 3 new ESCOs that were supported by the facilitation service in developing this new business field. Of the 9 projects, 6 were street lighting projects, 3 were indoor lighting of halls. Together, these 9 projects achieve an annual reduction of electricity consumption of 700 000 kWh and reduce electricity and maintenance costs by about EUR 170 000 per year. The total investment made in the context of these projects was EUR 2,3 million of which EUR 900 000 was financed through the electricity and maintenance cost savings (regional and national funding programmes as well as building owners' own capital made up the rest). Modernising public lighting with EnPC contributes to climate protection, saves public budgets and improves public infrastructure while increaseing safety and well-being of citizens.

- ***EnPC Plus: assistance to help SMEs develop new business models***

The *EnPC PLUS* project[43] aims to develop and promote new business models for the implementation of energy efficiency services through cooperation between SMEs, by setting-up SME Partnerships for Innovative Energy Services (SPINs) in 11 countries. This aims to reduce transaction costs of energy service packages so that smaller investments and projects in SMEs become possible for companies offering energy services. 3 types of SPINs have been defined: simple, complex and complicated, depending on the strength of the relationships between the key actors (coordinator and partners) and the maturity of the market. The project includes the definition of highly standardised energy service packages that can be easily implemented by the SPINs. At least one pilot project will be implemented in each partner country. An EU Energy efficiency network[44] has been set-up, seen as an international "market place" where the members can safely exchange valuable know-how and develop EnPC-models and SPIN-concepts.

7.2.2 Key role of project development assistance for aggregation of small scale projects into investible packages.

Project Development Assistance has been proven useful in aggregating small projects at a city or regional level. This aggregation has promoted the use of EnPC by reducing transaction costs and by making the contracts less risky for EnPC providers: a failure by a project may be balanced by better results on the other buildings, so that the overall contractual targets are respected.

An ESCO is indeed in a better position to finance investments on a pool of projects. It can create a special purpose vehicle (SPV) which will be based on the project's cash flows; this SPV can attract equity from the ESCO and institutional investors, while borrowing a large part of the investment from banks. Banks will be more inclined to lend to such a contract, because the risk is better mitigated and the legal structure is more clearly identified. This type of financial structure can only be implemented above a certain threshold, and may reduce the cost of an EnPC by diminishing transaction costs, providing more affordable financing, and reducing the risk margins which the ESCO needs to take[45].

- The **province of Teramo** (Italy) has mobilised 32 municipalities in order to procure jointly energy performance contracts (EnPC) on their street lighting facilities, thanks to support from ELENA. The municipalities get lower bills with a guaranteed level of savings, and retrofitted street lights. Street lighting management contracts are currently being awarded in 3 lots, representing a total of around EUR 150 million over up to 24 years, of which EUR 20 million will be invested in energy efficiency and renewables.

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43 http://epcplus.org/

44 http://www.energyefficiencynetwork.eu/

45 Adapted from Bullier, A., Milin, C., Alternative financing schemes for energy efficiency in buildings, ECEEE 2013; www.managenergy.net/lib/documents/868/original_3-221-13_Bullier_-_Alternative_financing.pdf

- The municipality of **Bratislava** has received an ELENA contribution to develop and implement an ambitious energy efficiency programme which aims at improving the energy efficiency of their public buildings and lighting systems using an Energy Performance Contracting (EnPC) approach. ESCO companies will therefore carry out the renovation work, provide the bulk of project financing, maintain the facilities and guarantee the contractually agreed level of savings over the duration of the contract. The programme is ambitious in terms of scale and level of expected energy performance. The ELENA assistance will contribute substantially to the implementation of this investment programme by bringing in missing resources and expertise and by strengthening the city capacities in the area of utilisation of ESCO services and EnPC. Overall, the project should trigger EUR 66 million of investments, 34 GWh/y of energy savings and 5 GW/y of RES production with an ELENA funding of less than EUR 1,4 million.

- The city of **Paris** received in December 2010 a grant of EUR 1.3 million from the ELENA programme to help them prepare and implement the refurbishment of 300 schools. This project was implemented within the framework of the Climate Action Plan for the City of Paris, through which the city has committed itself to reduce by 30 % the level of energy consumption and CO_2 emissions of its public buildings (including 600 schools) by 2020. The EU grant for project development assistance was intended to cover all the activities necessary for the preparation and implementation of the investment programme including the preparation of energy performance contracts, the preparation of energy base lines, the development of tendering procedures or the monitoring of the signed contracts. As a result, EUR 73 million of sustainable energy investments have been triggered, 45 schools were renovated in 2012 and 55 in 2013. In addition, tendering procedures for the renovation of 140 additional schools have been launched in 2015.

- The City of **Ljubljana** received an ELENA contribution in 2013 to develop and implement an ambitious energy efficiency programme which aims at improving the energy efficiency of their public buildings using an Energy Performance Contracting (EnPC) approach. In this model, ESCO companies implement the energy efficiency measures and provide third party financing. Thanks to the ELENA contribution, a special project implementation unit has been formed which is working on e.g. simplified energy audits, energy baseline checks, preparation of tender documentation, EnPC contracts, legal and financial advice. The programme is ambitious in terms of scale and level of expected energy performance. As such, it has a high market replication potential and it will contribute to the development of the EnPC market in Slovenia. Overall, the project is expected to trigger up to EUR 50 million of investments, 79 GWh/y of energy savings and CO_2 reduction of 24 500 tonnes per year, with an ELENA funding of EUR 1,3 million.

- Within the IEE Mobilising Local Energy Investment programme[46] **Cambridgeshire County** Council successfully overcame a wide spread barrier amongst public authorities which is the inability to borrow money for energy efficiency investments - even if payback times are short and the investment would generate significant cost reductions on the public purse over the long-term. The county council developed an innovative Managed Service Arrangement to provide Energy Performance Contracting (EnPC) services for schools as an off-balance sheet solution. This works through Cambridgeshire County Council contracting directly with the energy services company, then offering a Managed Service Arrangement ('back-to-back contract') with the school. More than 20 schools have signed up to the scheme leading to an investment of EUR 20 million into energy efficiency and renewable energy measures installed and reducing energy consumption by 3 828 MWh per year.

[46] www.cambridgeshire.gov.uk/MLEI

In addition, Cambridgeshire County Council set up a long-term structure to boost financing for sustainable energy projects in the county. The county council established an Energy Investment Unit (EIU) that identified and built a project pipeline, whilst at the same time securing political commitment for setting up a local authority fund of EUR 28 million. As a result, the council succeeded in signing a construction contract of the value of EUR 13 million for a 12MW solar farm to service nearly 3 000 homes with electricity and generate significant revenue for the council and it continues to build the project pipeline for the EnPC services to schools.

The **City of Padova** comprises a large number of condominiums (private multifamily buildings). In order to address this large energy savings potential, the municipality and its partner have engaged with many condominiums in order to mobilise a critical mass of demand for energy efficiency investments under the PADOV FIT! project[47]. The municipality has then procured a private ESCO whose role will be to sign energy performance contracts with the condominiums. The ESCO was selected to finance and deliver at least EUR 15 million of energy efficiency investments, thus allowing households to improve comfort and save on their energy bills.

- **A framework contract** to simplify EnPC procurement: **the London RE:FIT programme**[48]**.**

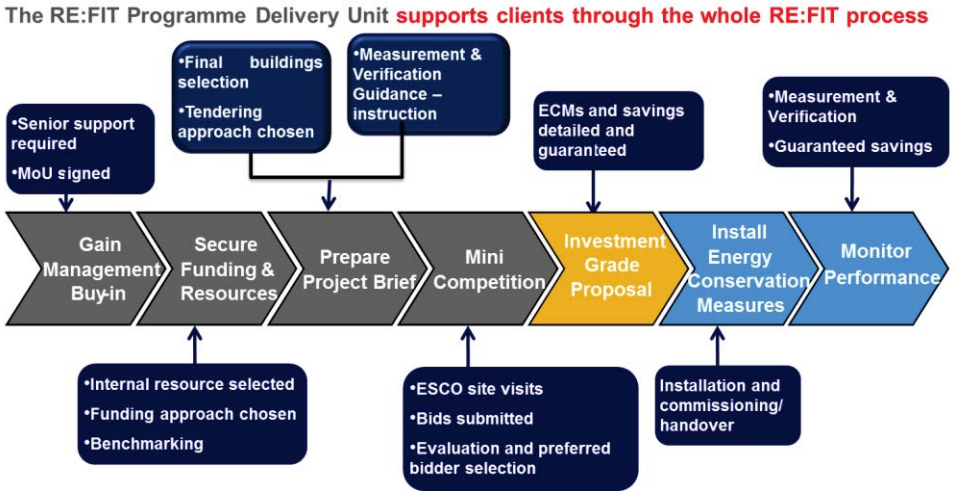
  RE:FIT is one of the pillars of the Mayor of **London**'s strategic approach to climate mitigation. It is designed to help public sector and charitable organisations achieve substantial financial savings, improve the energy performance of their buildings and reduce their CO_2 footprint based on the principle of Energy Performance Contracting (EnPC).

  Supported under the ELENA programme, this initiative has succeeded to streamline the procurement process for EnPC by providing pre-negotiated, EU-regulation-compliant contracts that can be used with a group of pre-qualified ESCOs for the design and implementation of energy conservation measures.

47 http://www.padovafit.it

48 This section is mostly adapted from: Lieven Vanstraelen, Jean-Francois Marchand and Miguel Casas, "Increasing capacities in Cities for innovating financing in energy efficiency. A review of local authority innovative large scale retrofit financing and operational models, 2015; www.citynvest.eu/content/review-local-authority-innovative-large-scale-retrofit-financing-and-operational-models

Figure 66: key steps in the RE:FIT process[49]



Source : RE:FIT

The *RE:FIT London* programme has already achieved significant results: 619 buildings have been refurbished representing a total investment value of GBP 93 million, GBP 6,9 million of cost savings (each year from lower fuel bills) and 119 kt of CO_2 saved.

In the summer of 2013 the Greater London Authority launched a specific *RE:FIT* School programme targeted to address energy efficiency in schools. The programme is supported by the Salix energy efficiency loan scheme, which provides 100% interest-free capital for the public sector to reduce their energy costs by enabling the installation of modern, energy efficient technologies and replacing dated, inefficient technologies.

Since 2016 the RE:FIT programme has been extended to other parts of **the UK** such as **Wales**.

7.2.3 Innovative financing schemes for energy efficiency

- The *Citynvest*[50] project has analysed 24 case studies across Europe where local authorities have developed a specific set of arrangements to deliver investments in building renovation, usually financed through private investors. A report provides detailed information on each scheme and a cross-cutting analysis of all schemes.

[49] Source: Camilla Allwood, Tristan Oliver, Brussels 28 April 2015 http://www.managenergy.net/lib/documents/1378/original_REFIT_-_T._Oliver_and_C._Allwood.pdf?1431080314

[50] Lieven Vanstraelen, Jean-Francois Marchand and Miguel Casas, "Increasing capacities in Cities for innovating financing in energy efficiency. A review of local authority innovative large scale retrofit financing and operational models, 2015; www.citynvest.eu/content/review-local-authority-innovative-large-scale-retrofit-financing-and-operational-models

Figure 67: overview of different models to deliver energy efficiency investments

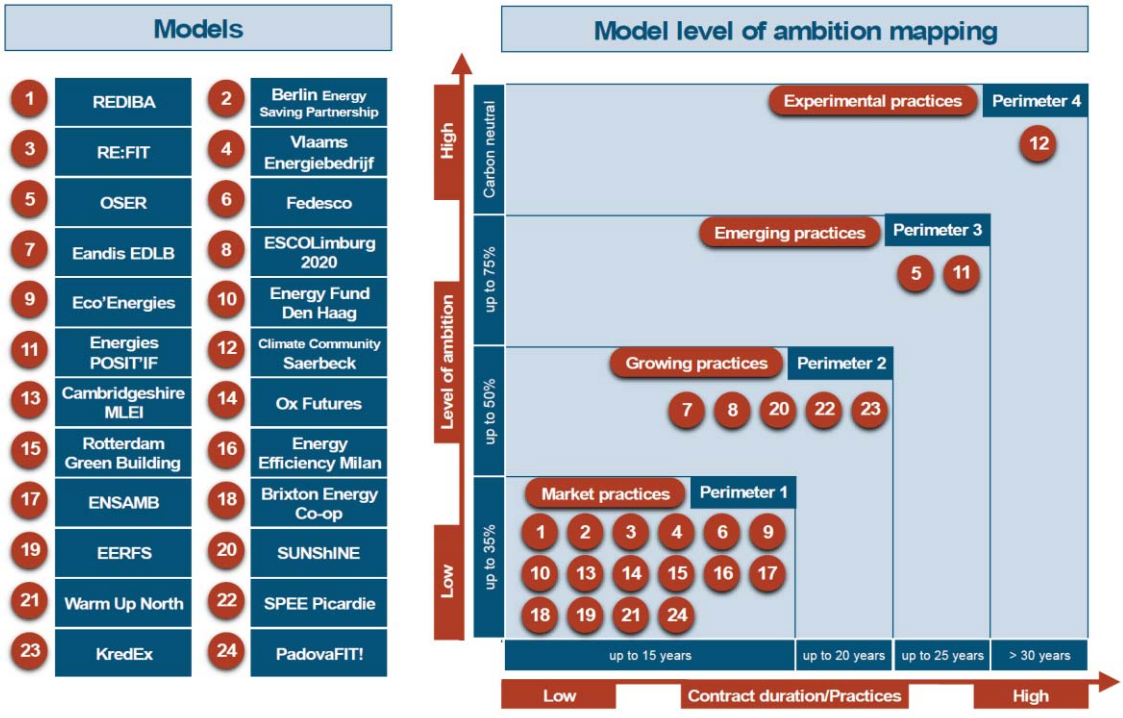
Model positioning synthesis

	Facilitation model		Integration model		Financing only model
	Without aggregation	With aggregation	Without aggregation	With aggregation	
FI financing (*)	REDIBA Eco'Energies EERFS	Berlin ESP RE:FIT Vlaams energiebedrijf ENSAMB Energie POSIT'IF	Warm Up North	-	N/A
ESCO financing	REDIBA Eco'Energies EERFS	Berlin ESP RE:FIT Vlaams energiebedrijf Rotterdam GB EE Milan PadovaFIT!	-	-	N/A
PDU financing (**)	OSER	Fedesco Ox Futures	OSER	Fedesco Energie POSIT'IF Eandis EDLB EscoLimburg 2020 SPEE Picardie	N/A
Investment fund	EERFS SUNSHINE	-	-	EscoLimburg 2020 Cambridgeshire MLEI	Energy Fund Den Haag KredEx
Citizens financing	-	OxFutures Brixton Energy Co-op	-	-	Saerbeck

(*) FI financing = Financial Institutions financing
(**) PDU financing = Program Delivery Unit (PDU) financing

Source: Citynvest

Figure 68: An overview of the schemes and the level of energy savings they aim to deliver.



Source: Cityinvest

- *'One-stop shop' approach for home renovation (Denmark)*

Better Home is a new scheme started in 2014 by the **Danish** Energy Agency. Its aim is to facilitate energetic renovation for homeowners. **Denmark** wants to create a "one stop shop" for energy renovation for private home owners, where the owner only has to contact one certified building contractor to get counselling on energy renovation of the entire building. The Agency educates/trains and approves professionals such as architects, engineers, craftsmen, energy consultants and building designers and advisors on energy renovation in private homes. A Better Home advisor can manage the process and can follow the project all the way from plan to completed renovation. The advisors can give homeowners the reassurance they lack today to engage in a major renovation project. There are educated Better Home advisers all over the country, but not yet in every municipality.

The purpose of the Better Home programme is to ensure that homeowners get the most out of their investments. The energy savings can help pay for the home improvements. This requires that the homeowner gets an overview of the entire house, i.e., climate shield as the roof and exterior walls as well as installations, such as heat pumps.

- *Energie Posit'If (France)*

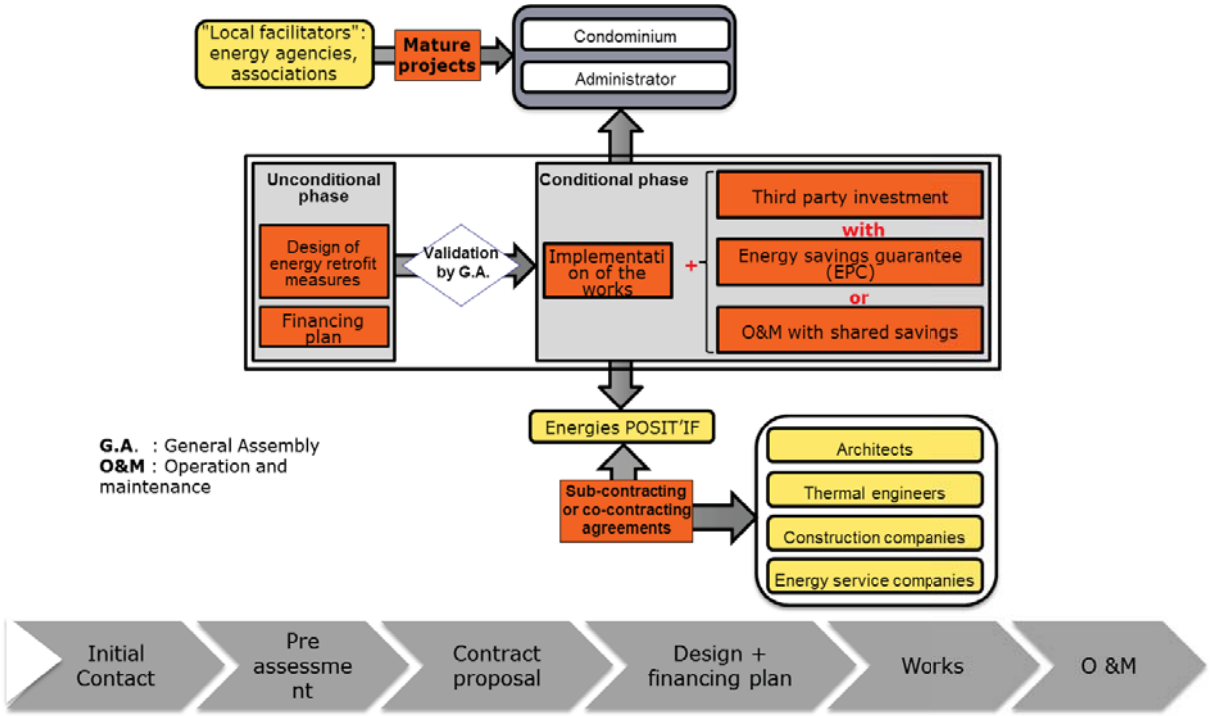
Île-de-France, the region around **Paris**, has set itself an ambitious target of reducing energy consumption in buildings by 38% in 2020. Residential buildings represent the lion's share of the savings potential, in particular the 1 million private apartments in multifamily buildings, which are lagging behind in terms of energy efficiency. Energy retrofits are very difficult to implement due to a number of factors such as the lack of capacity among homeowner associations, the lengthy and difficult collective decision-making procedures; and the high level of indebtedness of many homeowners, due to the increase of housing prices over the past 20 years[51], which often prevents taking additional loans.

The **Ile de France** Region therefore created its own ESCO called *Energies POSIT'IF*[52], which aims to develop, implement, monitor and finance deep renovations in large condominiums. It operates as a semi-public company under market rules. *Energies POSIT'IF* assists homeowner associations in the definition of the deep renovation measures and the financing plan for each homeowner. If this is validated, *Energies POSIT'IF* provides a comprehensive service offer which includes the delivery of the works, guaranteed energy savings, and the provision of finance for homeowners who need it. *Energies POSIT'IF* subcontracts the design, works and operation and maintenance activities and acts as an assembler.

51 The average price for homes was multiplied by 2.5 between 1996 and 2016 (source: INSEE)

52 http://www.energiespositif.fr ; the development of the project pipeline is co-funded by the Intelligent Energy Europe (IEE) programme under the MLEI PDA initiative.

Figure 69: Energies Posit'If



Source: José Lopez, Energies POSIT'IF

The provision of finance is a cornerstone of the *Energies POSIT'IF* concept, but it faced major legal obstacles. For instance, according to the previous French law, Energies Posit'If had to comply to the full prudential rules imposed on banks as they are making credit operations. Finally, the French Energy Transition law adopted in summer 2015 provides an exceptional regime for public third party financing companies, and enables *Energies POSIT'IF* to provide finance to homeowners with a specific status.

Besides, *Energies POSIT'IF* faced a major challenge in access finance at affordable cost as they didn't have any track record, and they were considered as a risky client by banks. The shareholders (Region or local authorities) were also not allowed to provide a guarantee in case of default, as that would be considered an unjustified State aid under EU regulations. The solution finally came in December from the European Fund for Strategic Investments (EFSI), which gave a guarantee for a credit line of EUR 100 million with the European Investment Bank (EIB). ***Energies POSIT'IF* was thus one of the first projects validated under EFSI**, along with **Picardie** *Pass Renovation*.

Four years after *Energies POSIT'IF* was created, renovation work is ongoing in four condominiums made up of 1 500 apartments and an investment value of EUR 20 million, which so far is only financed through grants and bank loans. Another 60 contracts are already in the pipeline.

- ***Picardie Pass Rénovation (France) - deep renovation of detached houses (France)***

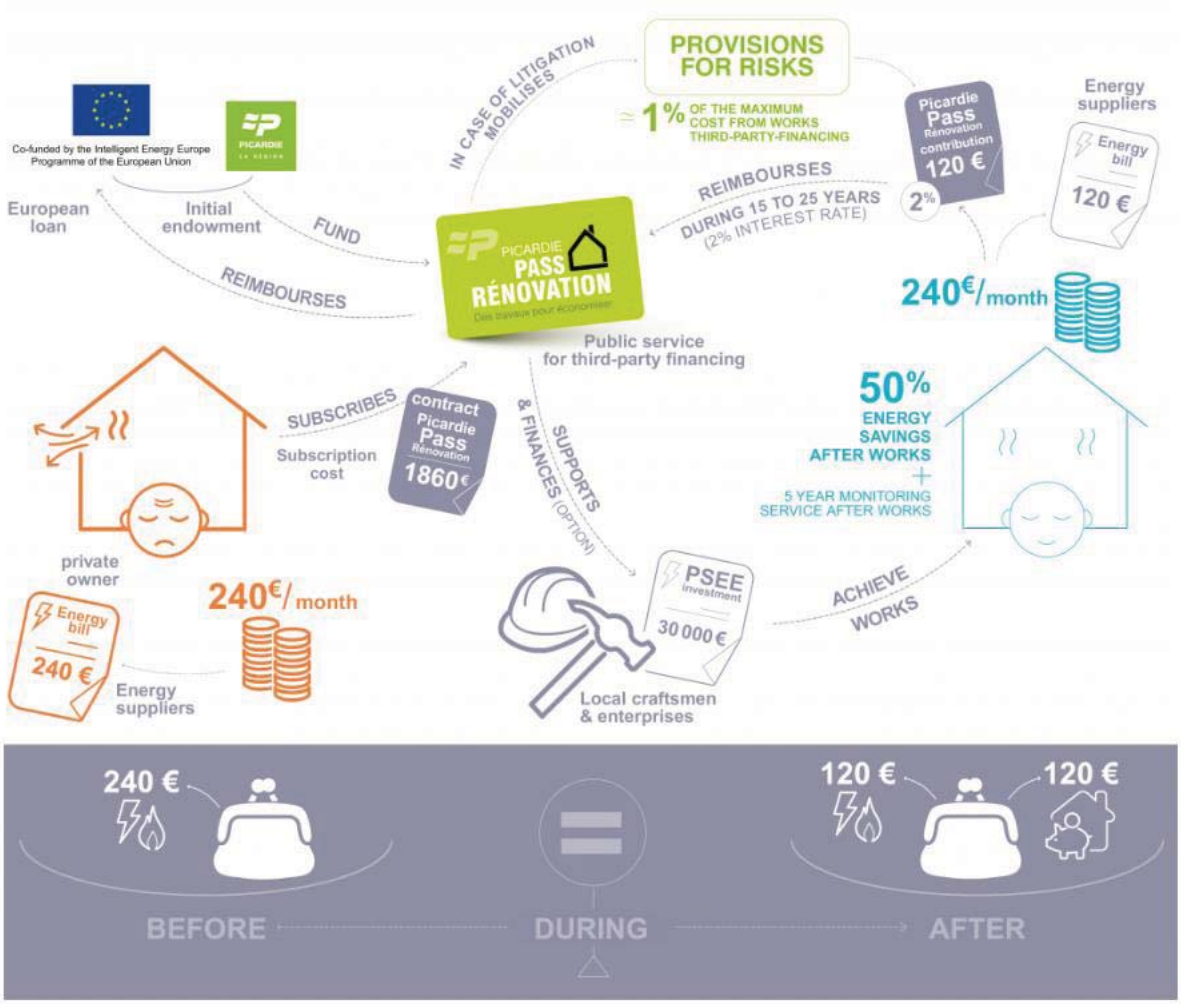
The **Picardie region** (France) has launched a **Public Service for Energy Efficiency (PSEE)** called 'Picardie Pass Rénovation' programme, which aims to implement large-scale deep renovation of detached housing, the predominant building type in the region.

Supported under the EU funded ELENA programme, this regional entity assists homeowners in the implementation of energy efficiency measures by acting as a one-stop-shop from the start with initial advice, further on an energy audit, defining the optimal set of energy efficiency measures, contracting and overseeing the works, providing long term funding and monitoring the results of the project during five years.

The project is based on a multi-stakeholders partnership approach, which involves local governments and construction companies. The proposed third-party funding mechanism provides an alternative to the traditional banking system. The programme can lend money to the homeowner based on the future energy cost savings, which banks normally refuse to take as a collateral.

Their main objective is to renovate 2 000 private housing units in the test phase and 10 000 per year as of mid-2018. The average loan includes 30 000 EUR for energy efficiency measures and the average monthly reimbursement for householders is around 150 EUR/month during 25 years. In order to generate mass demand for energy renovation in individual housing in Picardie and take up one of the challenges in climate change, the Picardie Pass renovation received a framework loan amounting to EUR 23.5 million from the European Fund for Strategic Investment, which should mobilised EUR 58 million.

Figure 70: Picardie Pass' Rénovation



Source: http://www.pass-renovation.picardie.fr/project-funded-by-europe/

A similar programme is being developed in the **Alsace region** ('Oktave') with support from the Intelligent Energy Europe programme.

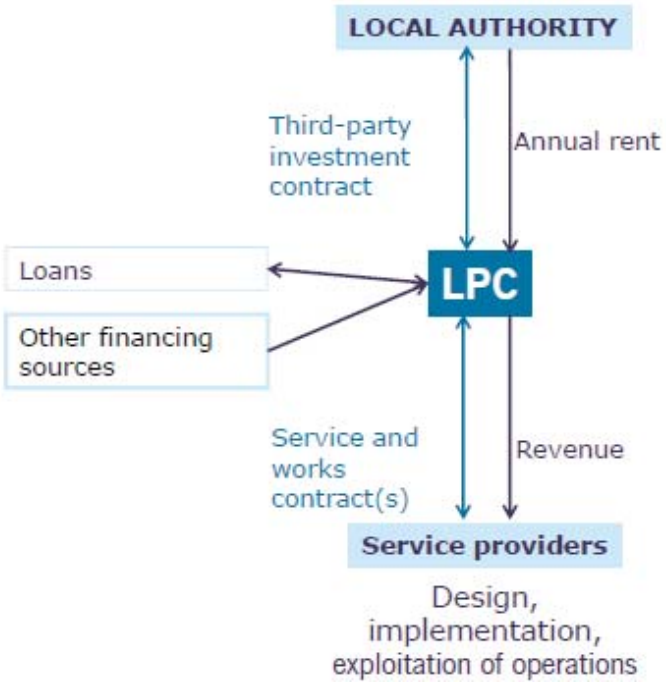
- ***OSER, a public ESCO for deep renovation of public buildings (France)***

The **Rhône-Alpes region** has set itself a goal to reduce the energy consumption of public buildings by 40 to 75%. However, small municipalities lack the capacity to develop these projects and need to be assisted. Energy performance contracting (EnPC) is a powerful mechanism to deliver projects, but

ESCOs are not willing to finance the investments required for deep renovation, due to the amounts involved and the long tenor of the debt. There is a clear market failure when it comes to financing deep renovation EnPC. The Region therefore created its own public ESCO, called OSER[53], together with 10 municipalities. OSER is an in-house ESCO acting for its member public authorities.

OSER assists public authorities in designing energy performance contracts for deep renovation. OSER takes care of the initial audits and specifications of the works (including non energy related works). It then procures an ESCO which will design and implement the works and guarantee the savings over the lifetime of the contract (usually 20 years). OSER signs an EnPC with the public building owner, and signs a back-to-back contract with the ESCO, so that all obligations are passed on.

Figure 71: The OSER scheme[54] (LPC refers to OSER)



OSER takes care of financing the investments upfront, thanks to a construction finance loan issues by the European Energy Efficiency Fund. Once the works are delivered, OSER sells the future receivables of the contract to financial institutions; a practice which is very common to finance public authority contracts ('cession Dailly') and not based on the future energy savings. The investments are therefore fully consolidated in the debt of public authorities.

OSER is currently working on 9 public building renovation projects, and plans on investments between EUR 15 and 20 million per year.

7.2.4 Capacity building and stakeholder dialogue

In addition to the development of projects and financing schemes, an essential component to increase energy efficiency investment is to build the capacity of stakeholders across the value chain on energy efficiency finance. Energy efficiency experts, policy makers, building owners, financiers,

53 http://spl-oser.fr

54 Regis Pouyet, Rhône Alpes region, 8 October 2014, http://managenergy.net/lib/documents/1218/original_Pr%C3%A9sentation_Bruxelles_081014_VA_OSER.pdf?1412843690

and consumers do not speak the same language when it comes to financing a project or a programme. An increasing number of initiatives are taking place across Europe to build capacity.

- In the **Infinite Solutions** project[55], 9 cities across Europe are creating home renovation loans and intracting[56] schemes based on the successful examples of Delft and Stuttgart, who are delivering training to those cities. A complete set of training materials is developed and the project will be training future trainers in 2016, in order to roll-out the results of the project across Europe. Similarly, the *Citynvest* project[57] is delivering 9 workshops across Europe to present the different types of programmes that local and regional authorities can develop to foster energy efficiency investments in buildings. The *ManagEnergy* initiative delivered 45 regional workshops across the EU between 2012 and 2015, many of which focused on financing energy efficiency and energy performance contracting. Despite these initiatives, capacity still needs to be increased.

- Other initiatives focus on organising dialogue between stakeholders, such as the **Energy Efficiency Financial Institutions Group[58] (EEFIG)**, which was initiated in 2013 by the European Commission and the UNEP Finance Initiative as a discussion platform. The EEFIG report published in 2015 provides useful input to EU policies, and the 120 participants of the group have considerably increased their mutual understanding.

  The EEFIG approach attracted a lot of interest and is currently being replicated at a global level by the G20's Energy Efficiency Finance Task Force. At the national level, also supported by the European Climate Foundation, **similar working groups were initiated so far in Germany, France and Bulgaria** delivering analyses and recommendations specific to their national context. Over the period 2016-2019, the European Commission will be implementing events in 15 Member States aiming to kick-start national discussion platforms on sustainable energy finance on the one hand, and to build capacity of national stakeholders in terms of project / programme development[59].

- The **Sustainable Energy Financing Platform for Austria (SEFIPA)** kicked-off in 2016 and aims to organize dialogue with the national stakeholders in order to develop new financing solutions for energy efficiency and renewable energy; it will also develop a crowdfunding platform for renewable energy projects.

- In **Spain**, the *ENERINVEST* project started in 2016 and will be promoting all information available on successful innovative financing models for energy efficiency, engaging in a dialogue with all stakeholders in order to improve legislative frameworks, and create an electronic platform which will allow the assessment the market potential for a specific financing scheme.

7.3. De-risking energy efficiency – creating the market

Project promoters and financiers often see energy efficiency investments as risky, because their results, risks and benefits are not fully known. Projects are technically very diverse and financial institutions do not have the technical expertise to process them in accordance with their normal due diligence requirements, in particular for smaller investments. Another key issue is the lack of a track record accepted by the financial community, which would provide statistical data regarding the

55 http://www.energy-cities.eu/spip.php?page=infinitesolutions_en

56 "Intracting" is like an internal EnPC, where all operations are done with the city administration and with operational accounts.

57 http://www.citynvest.eu

58 www.eefig.eu

59 Sustainable Energy Investment Forums initiative, starting in September 2016.

certainty of energy savings actually taking place and predictable default rates; this could in turn allow financiers to count those savings as revenue and ease access to finance for projects.

De-risking energy efficiency means developing standardised and commonly accepted frameworks which would give the financial sector and investors enough confidence in the quality of projects and their financial performance. In other words, energy efficiency investment cycle needs to be standardised so that both supply and demand side of finance know what to expect, based on hard data.

Finally, it is necessary to create benchmarks and indicators for institutional investors which will allow them to prioritise assets with higher sustainability (low-carbon) scoring derived from energy efficiency and renewable energy investments.

7.3.1 Standardisation of energy efficiency increases investors' confidence

Standardisation is needed to simplify the due diligence processes of financial institutions, asset managers and investors, which is essential to ensure that they manage properly the money or assets entrusted to them. Due diligence is an investigation of a potential investment, which serves to confirm all material facts in regards to a contract. In the absence of standards, project developers provide very different types of information, which financiers are not able to analyse quickly in a uniform manner. The same project can be presented in very different ways depending on the technical standards which were used; this creates confusion for financiers and a lack of trust on the expected outcomes of the investment, i.e. a steady cash flow in the form of energy savings.

- ***Trust EnPC South***

The Trust EnPC South project[60] aims to increase the confidence of the finance sector in energy performance contracts by developing a certification for energy performance contracting projects for private tertiary buildings in Southern Europe. The certification to be developed will be an extension of the existing Green Rating methodology, developed by Bureau Veritas for existing commercial buildings. Green rating scores the environmental performance of a building and the improvement potential on energy, carbon, waste, water, health and transportation. The “Trust ENPC” label will be a proof of quality of the ESCO's project, certified by a recognised organisation such as Bureau Veritas. It will give financial institutions confidence that the energy savings forecast by the ESCO are realistic and can be delivered without risk; this will allow financial institutions to reduce the effort required to understand and evaluate the risk of a project, which in turn should allow better access to and cheaper financing.

- ***Investor Confidence Project Europe***

In collaboration with industry stakeholders and with support from Horizon 2020, the *Investor Confidence Project Europe*[61] has developed its ICP Europe Protocols to define European best practices for predicting energy savings, optimising performance, and monitoring the results of energy efficiency investments. The protocols don't create new standards but list the technical standards which need to be applied to ensure that a project is of good quality. The concept of ICP was initially developed in the USA, where it is progressively becoming a reference for investors and a series of State or regional programmes are adopting it. The ICP protocols enable the acceleration of energy efficiency investments and the emergence of a robust and thriving commercial renovation sector by increasing confidence in the engineering fundamentals and financial returns of projects.

ICP Europe’s Investor Network was developed to help address the needs of investors looking for

60 http://www.trustepc.eu/en

61 http://europe.eeperformance.org

standardised projects that reduce the time, risk, and costs involved in funding energy efficiency building retrofits. At its launch in 2016, it brings together investors with over EUR 1 billion available for energy efficiency retrofit projects, and comprises a wide range of energy efficiency financiers who recognise the value of standardised, investor-ready projects to increase deal flow and drive demand in the marketplace. As a result, some of the members offer developers incentives such as accelerated underwriting, reduced transaction fees, and preferable terms for certified projects.

- ***Simplifying the assessment of small-scale projects***

The *SEAF project*[62] ("Sustainable Energy Asset Evaluation and Optimisation Framework") intends to enhance investors' confidence in sustainable energy and, in particular, energy efficiency projects and thus to facilitate access to finance. It develops an IT-based platform to standardise the valuation and benchmarking of small-sized sustainable energy projects (energy efficiency, demand response, distributed renewable energy generation, electricity storage).

Joule Assets, the project promoter, has developed and applies sustainable energy asset valuation tools and procedures, which are being refined and complemented by two other tools:

- standardised energy performance protocols based on the Investor Confidence Project, available for each country in the EU, which will be used to simplify due diligence processes;

- a risk assessment and optimization component: insurer HSB fine-tunes and integrates its risk assessment tool in the project context and offers corresponding insurance solutions, thereby enhancing the risk profile for investors.

Overall, SEAF streamlines the communication and valuation process, overcomes/reduces (perceived) market complexity (e.g. by providing a "one-stop-shop" solution) and, thereby, increases investor's trust and confidence in sustainable energy investments.

- ***Green mortgages by ASN Bank (Netherlands)***

ASN Bank introduced in 2002 the first green mortgage product in the Netherlands[63]. It included an Energy Performance Assessment, paid for by the ASN Bank, worth 200 Euro, and a 0,2% reduction in interest rate after implementation of one single energy audit recommended measure (0,3% reduction interest fee after implementation of all recommended measures).

The results were very convincing: 100% of new ASN Bank mortgage clients accepted the Energy Performance Assessment and implemented at least one recommended measure. The costs for the bank were minimal (0,2% was calculated in the pricing model) and the impact was very large, as many clients implemented more than one recommended measure. In the present circumstances, with extremely low interest rates, this product might be less successful. In order to keep administration costs low, the evidence required was minimal: no check on invoices, the rule is to trust as long as no evidence of fraud occurs.

7.3.2 Making energy efficiency attractive for institutional investors

A secondary (re-financing) market for energy efficiency investments needs to be created in order to allow investors/lenders to refinance their assets and invest their money into new projects. This is especially important in the period post-COP 21, where large institutional investors are keen to re-allocate their asset holdings in areas such as renewable energy sources or energy efficiency.

There is an increasing appetite of the financial community for investing in energy efficiency, which

62 https://www.seaf-h2020.eu/about-us/

63 http://www.duurzaam-beleggen.nl/2002/10/16/titel-117

can be seen in the different investor statements which were published in the run-up to the COP21 in December 2015. The G20 Energy Efficiency Investor Statement was signed and endorsed by 39 investors managing close to USD 4 trillion, while the Statement by Financial Institutions on Energy Efficiency was endorsed by over 100 banks and leasing companies from 42 countries[64].

Appetite for 'green' investments is growing in the finance sector, as policies are being put in place that will progressively disincentivise investments which do not contribute to the fight against climate change. The ability to finance green investments is limited by the ability for investors to identify what a green investment is, and which investments are greener than others. To this end, more clear guidelines on what is 'green' are essential for investors and for the market that recommend transparency and disclosure to promote integrity in the development of the green investment market.

In the case of energy efficiency, this is more difficult as dedicated financial products are rather marginal and energy efficiency is usually integrated in larger investments. The green bond market has been growing tremendously over the past years, but its energy efficiency content is still very slim and mostly focused on new buildings. When it comes to equity investments in companies, there is no clear data that would allow investors to modify their asset allocation towards energy efficiency.

- ***Sustainable Energy Investment Metrics for financial markets***

The *SEI Metrics* project (funded under Horizon 2020) is developing a framework to assess the climate performance of institutional investors' portfolios, i.e. their alignment with the investments that are required to keep global warming under 2°C. This will allow investors to benchmark themselves, and to set targets for the reallocation of assets to low(er) carbon investments. The first version of this benchmarking framework[65] was released in November 2015. Demand from the financial sector is proving much higher than expected, which reflects the dynamics launched around COP 21 in the financial sector. *SEI Metrics* now has 70 investors testing the 2°C portfolio methodology and is in discussion with index providers to include it in the selection of projects.

- ***Incorporating energy transition in mainstream risk models***

In complement to *SEI Metrics*, the *ET RISK* project (funded under Horizon 2020) is developing a methodology to assess the risks and opportunities associated to an Energy Transition scenario for institutional investors in the bond and equity markets. This methodology should contribute to the reallocation of assets as energy efficiency and renewables present a lower energy transition risk. The project will then develop equity valuation models and credit risk models, which will be integrated into the products of mainstream service providers such as Standard & Poor's. This answers a clear need of financial regulators, as the European Systemic Risk Board published in February 2016 a report calling for climatic stress tests on financial firms[66].

At the international level, *SEI Metrics* and *ET RISK* come at a very timely moment. In January 2016, the G20's Financial Stability Board nominated a Task Force on Climate-related Financial Disclosures, led by Michael Bloomberg. This task force is expected to give guidelines for the implementation of the new **French** law on the disclosure of climate impact of institutional investors, and how to integrate climate risk in asset valuation. The research on climate metrics and their integration into policies is providing input for the drafting of new policies.

64 http://www.unepfi.org/fileadmin/documents/EnergyEfficiencyFinanceStatement.pdf

65 http://2degrees-investing.org/IMG/pdf/2dportfolio_v0_small.pdf

66 https://www.esrb.europa.eu/pub/pdf/asc/Reports_ASC_6_1602.pdf

7.3.4 Refinancing energy efficiency assets

Refinancing is a key mechanism in the financial sector; it allows a financial institution to transfer to another entity the claim they have on a client or on a project, in order to free their balance sheet and be able to finance further projects. Refinancing consists of assigning a contract or a claim against a cash payment representing the future cash flows. The most common procedure for energy efficiency projects is 'forfeiting' on energy performance contracts, whereby the future energy savings are assigned by the ESCO to a financial institutions, as developed below.

However, due diligence costs for such operations are rather high and not adapted for small investments, which need to be aggregated and sold in the form of a security. Such securities can be sold over the counter (i.e. on a bilateral basis without publicity) or through a public operation, the most popular of which is the issuance of a bond. A bond allows reaching directly the debt capital markets, and avoiding the constraints imposed by financial regulations.

- ***Refinancing ESCOs for public building renovation (Bulgaria)[67]***

The investment capacity of ESCOs is limited because banks do not allow them to go beyond certain debt ratios, even with the help of guarantee funds. That is why ESCOs need to refinance their debt, i.e. to sell the claims they have over the future receivables of their contracts (energy savings). As already stated, the risk of underperformance from an EnPC more likely to occur at the beginning of the contract and becomes very low once the first years of monitoring and verification have proven the energy savings. Such contracts then become a safe revenue stream which can easily be assigned (transferred) to a bank or another institutional investor. In Berlin, this is done through forfeiting by the banks, but this may be more complicated in markets where banks are less confident in ESCOs and energy efficiency investments.

Still in **Bulgaria**, the Energetics and Energy Savings Fund (EESF) buys from ESCOs the future receivables of EnPCs (the energy savings). Thanks to loans from the EBRD (EUR 7 million initial loan followed by EUR 10 million loan in 2012), EESF can release the ESCOs from the burden of debt and enables them to develop more projects. This is typically what *Energies POSIT'IF* or the City of **Newcastle** will need once they have a sufficient pipeline of projects.
Another solution consists of the emission of specific bonds based on the securitisation of the future energy savings. This could be implemented through the creation of a specific vehicle combining private and public equity, with a public guarantee on the first losses. The fund would buy future receivables from EnPCs (guaranteed cash flows), like the EESF in **Bulgaria**, and then refinance itself through the emission of long-term bonds on the capital market. Bond emission would enable to raise funds at lower cost than through a usual loan, and thus offer ESCOs better refinancing conditions. However, the emission of bonds requires a critical size and homogeneity of assets which can only be reached in a mature market.

- ***Forfeiting fund in Latvia***

In **Latvia**, the *SUNSHINE* project[68] is currently exploring options to create a similar forfeiting fund which would refinance ESCOs working on multifamily buildings. As an illustrative example, RenEsco[69] has implemented energy performance contracts on approximately 15 buildings in Latvia, with energy savings of 50 to 60% guaranteed for 20 years. The savings have been achieved and the ESCO now has a good track record, but it has mobilised all its equity (along with bank loans) and cannot finance any

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67 Quoted from Bullier, A., Milin, C., Alternative financing schemes for energy efficiency in buildings, ECEEE 2013; www.managenergy.net/lib/documents/868/original_3-221-13_Bullier_-_Alternative_financing.pdf

68 http://www.sharex.lv/en/project-overview

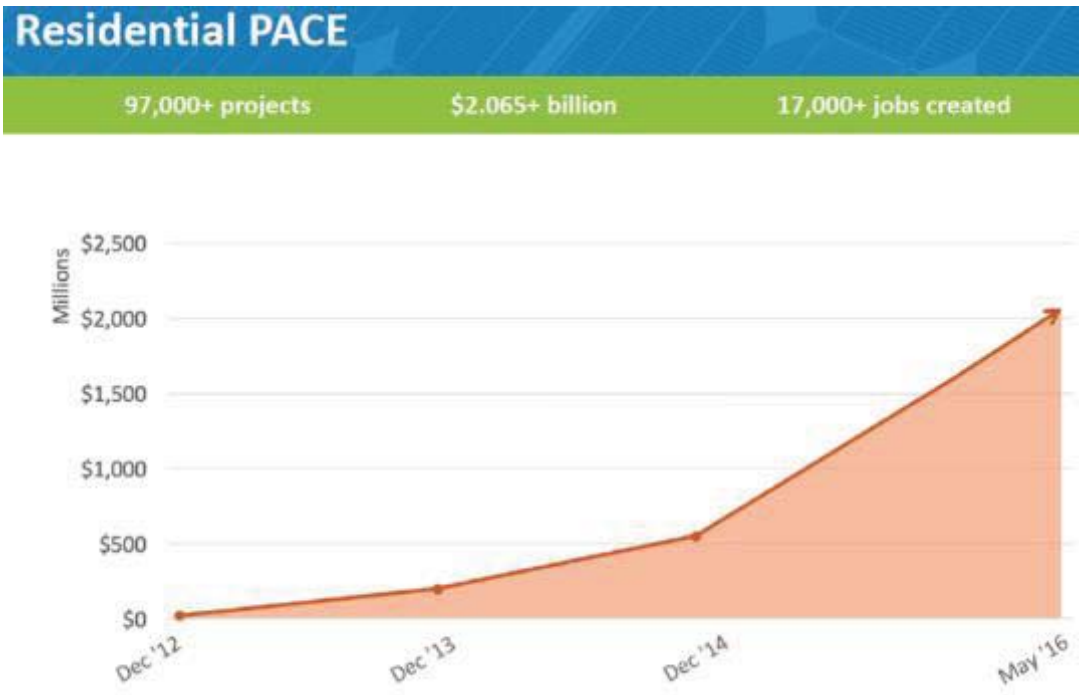
69 www.renesco.lv; RenEsco won the European Energy Services Award in 2012 for developing EnPC for deep renovation on multifamily buildings

additional projects. A forfeiting fund would thus allow RenEsco to off-load its balance sheet and invest equity in new projects; it would also allow new ESCOs to develop, by providing them with a medium-term financing solution.

- ***PACE bonds: securitisation of home renovation loans (USA)***

Property Assessed Clean Energy (PACE) is a system which allows attaching a debt to a property so that the debt service is collected through the property tax bill. PACE was created in 2008 in Berkeley, California, and has since spread over the US, first on commercial and more recently on residential buildings. In the commercial sector, over USD 250 million have been invested so far on more than 750 large buildings. In the residential sector[70], over USD 2 billion have been financed on more than 97 000 homes, with an exponential uptake since 2015 when USD 1 billion was issued in loans.

Figure 72: Uptake of PACE investments in the residential sector



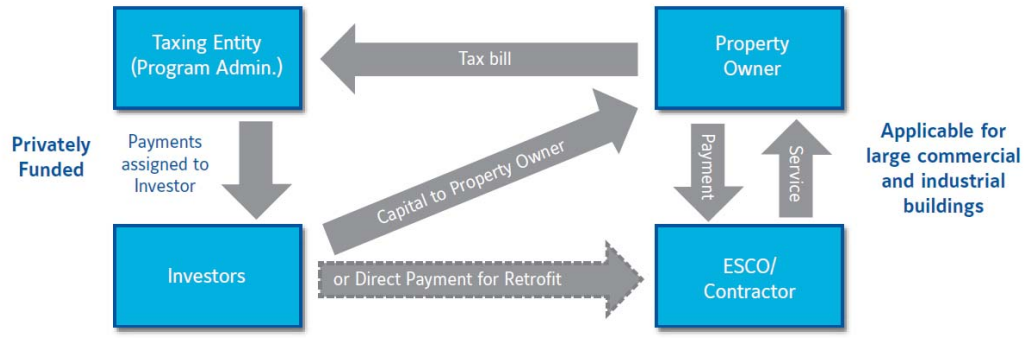
Source: PACE Nation

A PACE programme can be put in place by passing PACE-enabling legislation at State and/or county level. A PACE administrator is hired to manage the programme, in which 1 or several investors propose funding to building owners for a list of investments which have been identified as eligible (mostly energy efficiency, renewable energy, and to some extent water saving devices).

Usually, contractors are the entry point to sell new equipment: they are trained to propose PACE finance when the client needs to repair or change equipment. If the client agrees, the loan is registered with the local authority and a regular fee is attached to the property ('property assessment'). The building owner then repays it through the property tax over the lifetime of the loan. Most contracts are financed through private capital, although sometimes public money is used to kick-start PACE (e.g. through Green Banks or municipal bonds).

[70] Residential PACE was slowed down by a 2010 decision of the Federal Housing Finance Agency requiring that mortgages holders approve PACE loans before they are contracted, arguing that PACE loans are based on collateral (i.e. the value of the home) rather than ability to pay (energy savings). However, residential PACE continued to develop and the issue is now being overcome.

Figure 73: Principles of a PACE programme



Source: Katrina Managan, Kristina Klimovitch, 'Setting the PACE: Financing Commercial Retrofits', Institute for Building Efficiency, 2013.

PACE has many advantages compared to traditional finance. As in an EnPC, the lack of upfront costs makes it an attractive solution for building owners. Contrary to EnPC, PACE does not guarantee the level of savings, which reduces the transaction costs related to the establishment of a baseline, contract establishment, monitoring and verification, etc. It is a purely financial contract, which is easy to establish even for small transactions in individual homes. Attaching the debt to the tax bill makes it a very secure asset, because taxes are the most senior debt (i.e. anyone has to pay their taxes before they reimburse their other debts, even if they are bankrupt). It also allows passing on the debt in case the building is sold.

Finally, successful PACE programmes deliver a large number of investments which are all based on the same contracts and same underlying assets, in particular the same low risk of payment default. It is therefore rather easy to securitise PACE loans and sell them to institutional investors. The first PACE bond was issued in 2013 and since then, the number and size of PACE bonds has been increasing steadily. On 6 June 2016, Renovate America issued their 7th PACE bond[71], which is the biggest to date at USD 300 million. Coupons were sold at 7,96%, based on 3,432 PACE assessments of 15 years with an average loan USD 24 000. Whereas 7,96% remains a high interest rate, this is due to the fact that PACE bonds are still not considered as a liquid asset with a secondary market where investor can sell the bonds when they need. However, the growth of the market should result in the development of a secondary market in the coming years, thus driving down the cost of finance for energy efficiency.

Although implemented in the specific context of the USA, PACE has been a very successful model which would deserve replication[72].

- ***Green bonds: ABN Amro's example***

In the **Netherlands**, in 2015 ABN Amro issued a covered bond to finance EUR 10 billion worth of investments in its real estate portfolio, enabling its clients to invest for energy efficiency upgrades. The financing offered covers 100% of the building's upgrade. ABM Amro is also leading by example, by investing into renovation of own buildings and has received 2016 BREAM Award for its headquarters' buildings.

The green bond policy of ABN Amro focuses on new and upgraded sustainable real estate. For the second green bond, energy efficient renovations and transformations of existing commercial real

71 www.prnewswire.com/news-releases/largest-pace-bond-securitization-completed-300280343.html

72 In France, the Picardie and Alsace regions are trying to attach debt to the property, but face complex legal obstacles

estate were included. Proceeds will be used to (re)finance loans to green real estate including recently built buildings and energy efficient upgrades. Four assets categories are eligible for the green bond:

- Mortgage loans for recently built energy efficient residential houses;
- Green loans for financing energy efficiency improvements and renewable energy measures on residential property;
- Recent commercial real estate loans for energy efficient buildings;
- Energy efficiency upgrades, renovations and/or transformations of (former) commercial real estate.

All projects have to meet clearly predefined sustainability criteria, which are verifiable by quantitative indicators. The fund flow management and the impacts are regularly monitored and reported on, as well as independently evaluated/audited.

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PART 4/4

COMMISSION STAFF WORKING DOCUMENT

Good practice in energy efficiency

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency

{COM(2016) 761 final}

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Annex I: National policies and measures identified as successful policies in the ODYSEE-MURE project

Selected Member States

Code	Most successful energy efficiency measures in France	Avg Score	Measure Type 1)	Starting Year
HOU-FRA7	Sustainable Development Tax Credit	4.1	Fis/Tar	1995
HOU-FRA16	Local energy information centres (EIE)	4.0	Inf/Edu	2001
HOU-FRA31	Zero-rated eco-loan	3.5	Fin	2009
TER-FRA1	Audits subsidies in buildings	3.8	Fin	2000
TER-FRA8	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance diagnosis	3.2	Leg/Inf	2006
IND-FRA15	Loans for small and medium sized enterprises	3.6	Fin	2010
TRA-FRA22	Voluntary commitments to reduce CO_2 emissions	3.9	Co-op	2008
TRA-FRA19	Automobile bonus malus	3.6	Fis	2007
GEN-FRA1	Energy Savings Certificates (ESC)	4.2	NMB	2006
GEN-FRA2	Information and advertising campaign: why wait?	3.6	Inf/Edu	2008
GEN-FRA18	Heat Fund	3.6	EE/CC/RES	2008

Code	Most successful energy efficiency measures in Germany	Avg Score	Measure Type 1)	Starting Year
HOU-GER33	KfW Programme "Energy-efficient refurbishment" (former CO_2 Building Rehabilitation Programme)	3.9	Fin	2009
HOU-GER8	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Energiebetriebene-Produkte-Gesetz - EBPG	3.7	Leg/Nor	2005
HOU-GER6	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Savings Ordinance (Energieeinsparverordnung - EnEV)	3.5	Leg/Inf, Leg/Nor	2002
TER-GER35	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Eco-Design of Energy-using products (Energiebetriebene-Produkte-Gesetz - EBPG)	3.8	Leg/Nor	2011
TER-GER29	Special fund for energy efficiency in SME's	3.6	Fin	2008
TER-GER32	Smart Metering	3.5	Leg/Inf	2010
IND-GER36	Special fund for energy efficiency in SME´s	3.7	Fin	2008
IND-GER18	Voluntary agreement with German industry II	3.5	Co-op	2000
TRA-GER39	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) - Accelerating technical development / CO2 strategy for passenger cars	3.9	Leg/Nor	2009
TRA-GER32	Improving the infrastructure for using bicycles	3.8	Fin	2002
TRA-GER2	Heavy goods vehicle toll charges	3.3	Fin	2005
GEN-GER29	National Climate Initiative (NKI)	3.7	EE/CC/RES, NMB	2008
GEN-GER19	National Energy Efficiency Action Plan (NEEAP) of the Federal Republic of Germany	3.6	EE/CC/RES	2008

Code	Most successful energy efficiency measures in Greece	Avg Score	Measure Type 1)	Starting Year
HOU-GRE16	"Energy Savings in households" Program	4.3	Fin, Leg/Nor	2010
HOU-GRE15	Energy Performance of residential Buildings	4.0	Leg/Inf, Leg/Nor	2009
HOU-GRE20	Installation of electronic and intelligent metering of electricity and natural gas residential consumers	3.7	Co-op, Fin, Inf/Edu	2010
TER-GRE13	Energy upgrading of existing buildings through third-party financing arrangements (TPF), energy performance contracting and public and private joint ventures (PPJV)-Tertiary Sector	4.3	Co-op, Fin, Leg/Inf	2012
TER-GRE9	Energy savings in Local Self-Governments. - "Economize" program	4.1	Fin, Inf/Edu/Tr	2010
TER-GRE10	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance of Buildings of Tertiary sector	4.0	Leg/Nor	2010
IND-GRE6	Incentives for obligatory implementation of Energy Management Systems	3.6	Fin, Leg/Inf	2008
IND-GRE10	Promotion of Combined heat and power (CHP) and district heating systems- Industry Sector	3.5	Fin	2009
IND-GRE7	GRE7-Promotion of voluntary agreements in industrial sector	3.4	Inf/Edu/Tr, Leg/Inf, Leg/Nor	2010
TRA-GRE3	Improvements in Public Transport Networks	4.0	Infr	1998
TRA-GRE13	Taxation of new cars according CO_2 emission	3.9	Fis	2010
TRA-GRE10	Incentives for replacement private vehicles	3.8	Fin	2008
GEN-GRE9	Program for Fin support of technological investments in energy efficiency	4.2	EE/CC/RES, Leg/Nor, NMB	2008
GEN-GRE10	Farther penetration of Natural Gas and LPG in Greek market	3.8	EE/CC/RES, Leg/Nor, NMB	2008
GEN-GRE11	Target campaigns for Tr, informing and awarding of best practice activities	3.7	EE/CC/RES, Leg/Nor	2008

Code	Most successful energy efficiency measures in Sweden	Avg Score	Measure Type 1)	Starting Year
HOU-SWE23	Technology procurement groups	4.3	Co-op	1989
HOU-SWE4	Energy and carbon dioxide tax in the household sector	3.9	Fis	1991
IND-SWE17	Energy efficiency networks for the industry	3.7	Co-op, Inf/Edu/Tr	2009
IND-SWE3	The Programme for Energy Efficiency in Industry	3.2	Co-op	2005
TRA-SWE24	Energy efficiency measures in transport Infrastructure	4.2	Infr	2011
TRA-SWE13	Value of fringe benefits for company cars	3.6	Fis	1997
TRA-SWE12	Vehicle taxation according to CO_2 emissions	3.4	Fis	2006
GEN-SWE12	Energy and carbon dioxide taxes)	3.8	EE/CC/RES	1995
GEN-SWE8	Local Energy/Climate Counsellors	3.5	EE/CC/RES	1998

1) Co-op = co-operative measures, Leg/Nor = Legislative/Normative measures, Leg/Infor = Legislative/Informative measures, Fis/Tar = Fiscal/Tariffs, Fin = Financial measures, Fis/Tar = Fiscal/Tariff-based measures, Inf/Edu/Tr = Information/Education/Training measures, NMB = New Market-based instruments, Infra = Infrastructure measures, EE/CC/RES = General Energy Efficiency / Climate Change / Renewable Programmes,

Source : MURE database, September 2015 (the measure codes refer to the MURE database)

Overall scoring (most successful energy efficiency measures with the two highest average scores per EU Member State)

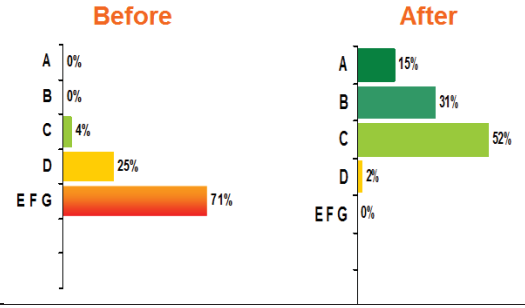
Country	Code	Measure Title	Avg. Score	Measure Type 1)	Starting Year
AU	GEN-AU2	"klima:aktiv" National programme for climate protection	4.2	EE/CC/RES	2005
AU	HOU-AU13	Residential building subsidy	3.8	Fin	1989
BEL	IND-BEL4	Flanders - Energy efficiency criteria in environmental permits	3.7	Leg/Inf	2004
BEL	HOU-BEL30	Wallonia - Financial incentives for RUE investments in buildings	3.5	Fin	2005
BG	HOU-BG19	Extension of the administrative, functional and financial capacity of Bulgarian Energy Efficiency and RES Fund with authorizing it for financing projects with renewable energy sources	3.8	Fin	2011
BG	TER-BG15	Financing of energy efficiency projects in municipal buildings by Operational Program Regional Development	3.8	Fin	2010
CR	TRA-CR18	Eco-driving training for drivers of road vehicles	4.3	Inf/Edu/Tr	2011
CR	HOU-CR9	Building regulations and enforcement	4.2	Leg/Nor	2006
CY	HOU-CY11	Net metering scheme was introduced for the promotion of small residential photovoltaic systems	3.9	Fin	2013
CY	IND-CY3	EU-related: Amended EU Emission Trading Scheme (Directive 2009/29/EC) - Governmental grants/subsidies scheme for the promotion of RES, energy saving technologies and the creation of a special fund for financing or subsidising	3.9	Fin, Inf/Edu/Tr	2003
CZ	HOU-CZ17	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy labelling of household appliances – support of implementation	3.6	Leg/Nor	2004
CZ	HOU-CZ19	Green Savings Programme	3.4	Fin	2009
DK	GEN-DK6	The Energy Companies' saving effort	4.3	Co-op	2006
DK	GEN-DK10	Danish Energy Agreement 2012	4	EE/CC/RES	2012
FIN	IND-FIN14	Energy Efficiency Agreement of Industry 2008-2016	4.5	Co-op	2008
FIN	TER-FIN3	Energy Auditing Programme in the Service Sector	4.4	Fin, Inf/Edu/Tr	1994
FRA	GEN-FRA1	Energy Savings Certificates (ESC)	4.2	NMB	2006
FRA	HOU-FRA7	Sustainable Development Tax Credit	4.1	Fis/Tar	1995
GER	HOU-GER33	KfW Programme "Energy-efficient refurbishment" (former CO2 Building Rehabilitation Programme)	3.9	Fin	2009
GER	TRA-GER39	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) - Accelerating technical development / CO2 strategy for passenger cars	3.9	Leg/Nor	2009

Source: ODYSEE-MURE (2015): Synthesis: Energy Efficiency Trends and Policies in the EU

Annex II: Overview of good practices per Member States as identified by the CA EED

Country	Title	Theme	Outcome
Austria	Measuring Impacts - Energy Counselling - Austria	Public Sector (CT2)	At the moment, the calculation method is used for reporting for the Energy Services Directive (ESD) only.
Austria	Consumer Information - Information campaign on energy management systems for SMEs - Austria	Consumer Information (CT6)	Guidebook, distribution of guidebook via Austrian Ministry of Economy, Family and Youth, the Austrian Energy Institute for Business, Austrian Chamber of Commerce and the Federation of Austrian Industries
Belgium	Article 4 building renovation strategy - Brussels Capital Region	NEEAPs (CT1)	n/a
Bulgaria	Energy Efficiency for Competitive Industry Financing Facility - Bulgaria	Financing (CT4)	Still the project is at an early phase of implementation and no results are available. It is expected that the programme will lead to high absorption rates of the SCF for energy efficiency in SMEs.
Croatia	Consumer Information - Energy efficiency information campaign - Croatia	Consumer Information (CT6)	The interest in energy efficiency has significantly increased as well as implementation of EE measures by citizens. Public opinion surveys have revealed the following: • number of citizens familiar with energy efficient products available on the market has increased from 33,4% to 43,9% • number of citizens using CFLs increased from 48% to 67,4% • number of citizens using A+ appliances increased from 22% to 30,8% • number of citizens using low-e windows increased from 14,8% to 23,4% In addition, the number of requests for subsidies from the Fund has increased significantly since the start of the campaign.
Croatia	IPMVP obligation for public energy performance contracts - Croatia	Energy Services (CT5)	**On-going** It is expected that Measurement & Verification based on IPMVP in the public sector will enable better evaluation of expected and achieved savings and eventually increase the trust in energy services, which could become the solution for large-scale refurbishment of the public buildings in stock
Czech Republic	Energy audits - Czech Republic	Energy Services	There are more than 350 energy auditors and more than 1 500 energy audits are prepared

Country	Title	Theme	Outcome
		(CT5)	annually.
Cyprus	n/a	n/a	n/a
Denmark	n/a	n/a	n/a
Estonia	n/a	n/a	n/a
Finland	EcoStart – Specialist Product Service for SMEs - Finland	Financing (CT4)	The impact assessment on the outcomes and benefits will be carried out in 2013.
Finland	Energy Services - Finland	Energy Services (CT5)	The outcomes have been: • ESCO seminars for ESCOs and potential clients (approximately every second year) • ESCO project register • ESCO guidelines and brochures • Articles about ESCO service • Information dissemination by phone etc. • Separate studies about ESCO service
Finland	Public Sector - Towards smarter green public procurement processes - Finland	Public Sector (CT2)	The key achievement will be the database, a sustainable public procurement excellence network and a smoothly running Help Desk.
Finland	Study of Cost Effectiveness of Individual Heat Meters and Heat Cost Allocators in Apartment Buildings - Finland	Metering and Billing (CT3)	The most important outcome about the project was to get reliable facts and results about the cost effectiveness of heat meters or heat cost allocators in apartments in Finland. The topic i.e. heat metering in apartments, is not new in Finland but it has been under discussion and judgment for decades. The heat meters or cost allocators have faced mistrust and critics for many reasons (listed e.g. in the statement of Technical Board of Helsinki City 1.4.2008) though cost effectiveness have not been lately studied in deep details like in this study. Now the study, that was focusing clearly to the direct costs, shows the heat meters and cost allocators in apartments not to be cost effective in the Finnish circumstances (taking into account the state of energy efficiency, typical HVAC solutions in apartment buildings and

Country	Title	Theme	Outcome
			the climate in Finland). So the result of the study confirms the previous views and positions of the issue. The study will give a clear indication to the authorities when formulating the energy efficiency law for implementing EED.
France	Writing the French 2014 NEEAP - France	NEEAPs (CT1)	• The key achievement is the NEEAP itself, and the comprehensive overview it gives about our energy efficiency policies. The evaluations in the NEEAP (especially TD calculations using EC recommended methods) are also very helpful to identify sectors generating most energy savings, and sectors where more efforts are needed. • The NEEAP is a very useful communication tool for us. After its publication in spring 2014, we will update a synthesis brochure, with the communication team of the ministry, like we did after our 2nd NEEAP.
France	The use of ERDF funds in France for EE in social housing - France	Financing (CT4)	**At the national level, by the end of 2011:** • **67 000 households** with low incomes benefitting from energy savings (~2 200 dwellings refurbished per month) • **15 000 local jobs** created or maintained • ERDF Average funding: **EUR 2 886** per dwelling, representing **14%** of the investment • Global investment: **EUR 1.1 billion** • Estimation of energy savings per year per households: - A 40% reduction in energy consumption - EUR 360-1000 saved per year **Energy consumption of dwellings before and after refurbishment:** 

Country	Title	Theme	Outcome
			(source USH) For the first call for proposals, projects have been completed recently: the follow up is going on.
France	Financing - Energy Performance Contracting for Public Buildings - France	Financing (CT4)	Main outcomes : • Connection of 69 buildings to a centralized management system ; • Installation of condensation boilers in 17 buildings ; • Connection of 2 buildings to a heat network • Installation of wood-fired boilers in 2 schools • Installation of 38sqm of solar thermal panel for hot water production at the central kitchen • Installation of heat pumps in 13 buildings • Replacement of all 284 doorframe of the Frédéric Mistral school Expected benefits : **17% reduction in primary energy consumption and EUR** 177 000 savings for the city
France	Financing - Energy Performance Contracting for Schools- France	Financing (CT4)	Some results of the project: - the building of 6 biomass boiler rooms, - the installation of PV panels on 12 schools. - the connecting of one school to a low carbon heat network, - the improvement /optimization of lighting and heating management in all schools. The Koeberlé de Sélestat school benefited from a 4,3 M€ investment to build a wood-fired boiler room and isolate the
France	Financing - Technical Assistance - France	Financing (CT4)	**Project is on-going** The expected benefits of the project are delivery of important energy savings and emissions reductions for 1/6 of Paris' schools and creation of a new culture for energy efficiency for all the pupils, teachers and parents involved in these schools
Germany	Approach for the chapter on the market for energy services in the next NEEAP - Germany	NEEAPs (CT1)	Information basis for the assessment of the market for energy services and therefore also a basis for the detection of challenges and a further development of the market for energy services.

Country	Title	Theme	Outcome
Germany	Energy-Atlas Bavaria (Energie-Atlas Bayern) - Germany	Energy Services (CT5)	Project is on-going
Germany	Financing - KfW Energy Efficient Construction and Refurbishment - Germany	Financing (CT4)	Positive Promotional Effects in 2012: • 360 000 housing units reached with promotion • 370 000 jobs created or secured (estimation) • energy savings of 2 200 GW • CO_2 savings of 770 000 t/a • positive effect for public budget due to tax income and social security contributions: investment activities and job creation result in a high degree of self-financing of the promotional programs due to backflow of funds to the public budget
Greece	Saving Energy at Home - Greece	NEEAPs (CT1)	• Contribution to the country's energy security supply • Increase employment • 1700 employers • 500 engineers (4 000 engineers are involved as energy inspectors, consultants, sub-contractors, etc) • 300 bank employers • Until now: more than EUR 600 million have been distributed • Increase population awareness regarding energy saving issues • Reduce energy poverty, Improve thermal comfort and quality of life • The average energy consumption decrease is about 43% (164 kWh/m2) • Energy savings accounts approximately to 1.200 euro / year • Total annual energy saving is estimated at 712 GWh based on the 42 780 applications completed so far
Hungary	n/a	n/a	n/a
Ireland	The Green Plan - Ireland	NEEAPs (CT1)	**Kilbarrack Fire Station: Worlds first Carbon Neutral Fire Station** • 92% Water reduction • 97% Gas reduction • 80% Electrical reduction • 100% Organic waste reduction • 60% Domestic waste reduction

Country	Title	Theme	Outcome
			• 5 working Bee Hives and an allotment • Sick Building Syndrome eradicated • Better place to work – Fire Crews as Stakeholders • Link with Retired members restored **Dublin Fire Brigade** • 44% Energy reduction across estate • €11M tax payer money saved • €3.6M investment from ring fenced fund • Sustainability Report signed into Dublin Law • First Commemorative Garden for Deceased Members created
Ireland	Optimising Power at Work - Ireland	NEEAPs (CT1)	• Over 270 large Central Government buildings actively participating in the campaign. • Average annual energy savings of 20.4% currently being achieved (Sept 2015). • Approximate annual cost savings of EUR 4.9 million • Programme now being expanded into the wider public sector.

<table>
<tr><th>Country</th><th>Title</th><th>Theme</th><th>Outcome</th></tr>
<tr><td>Ireland</td><td>Good Practice Energy Case Studies in Dublin City - Ireland</td><td></td><td>
<table>
<tr><th>Organisation</th><th>Projects</th><th>Energy Reduction kWh CO_2</th><th>Savings T/YR</th></tr>
<tr><td>PwC</td><td>HVAC and BEMS upgrade</td><td>35%</td><td>35%</td></tr>
<tr><td>Citi Bank</td><td>Energy Management, CHP and DH – EPC</td><td>4 GWh</td><td>35%</td></tr>
<tr><td>Charlotte Quay Apartments</td><td>CHP and district heating</td><td>120 000</td><td>30</td></tr>
<tr><td>Westcourt Management Services</td><td>BEMS & Lighting Retrofit</td><td>40 000</td><td>20</td></tr>
<tr><td>Royal Victoria Eye & Ear Hospital</td><td>CHP and energy efficient upgrade – ESCO</td><td>120 000</td><td>71</td></tr>
<tr><td>Dublin Port Company</td><td>Boiler House Refurbishment & Ventilation Controls Retrofit</td><td>N/A</td><td>134</td></tr>
<tr><td>An Post, Delivery Service Unity Cardiff Lane</td><td>Lighting – High Bay</td><td>442 250</td><td>237</td></tr>
<tr><td>The Mansion House</td><td>Solar PV Thermal</td><td>108 000</td><td>28</td></tr>
<tr><td>Brasserie 7</td><td>Energy efficient lighting (LED), Building Management System upgrade, Energy bureau</td><td>100 000</td><td>50</td></tr>
<tr><td>Dublin Bus</td><td>Staff awareness and Energy Efficient Lighting</td><td>110 000</td><td>50</td></tr>
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Country	Title	Theme	Outcome
Ireland	Energy Services - Small Medium Enterprise (SME) Business Programme - Ireland	Energy Services (CT5)	On average, businesses make an 11% energy savings through this programme and the benefit is straight to the bottom line. To date businesses participating in the programme have shared savings in excess of EUR 50 million The key opportunities for energy savings among many participants are in the following areas. Many of these can be implemented at relatively low cost: • Energy management practices – becoming more organised about understanding & monitoring energy performance and taking action to exploit opportunities for savings. • Lighting – switching off, changing to more efficient fittings, daylight & occupancy sensors, e.g. 16% electricity saving (EUR 4,700 saving per annum) in a school by replacing light fittings; • Refrigeration, heating, ventilation & air conditioning – designing, procuring, operating, maintaining & controlling these systems more efficiently, e.g. refrigeration can account for up to 65% of consumption in the retail sector. Range of Savings Although the average annual energy saving attributable to participation in the programme is over 11%, the range of savings enjoyed by specific participants varies significantly: • 82% of participants save at least 5%; • Over half make at least 10% savings; • Nearly a third saves more than 15%.
Italy	Renewable Technology for Improving Energy Efficiency in Greenhouses - Italy	NEEAPs (CT1)	n/a
Italy	TREND (Technology and Innovation for energy saving and efficiency in SMEs) - Italy	Energy Services (CT5)	Almost 90 works for improving energy efficiency of SMEs. 4 000 toe saved Successful promotion of a new professional skill (expert in energy management)
Latvia	n/a	n/a	n/a
Lithuania	n/a	n/a	n/a

Country	Title	Theme	Outcome
Luxembourg	Smart Metering Project - Luxembourg	Metering and Billing (CT3)	n/a
Malta	n/a	n/a	n/a
Netherlands	Customer-friendly Individual Heat Metering - Netherlands	Metering and Billing (CT3)	n/a
Netherlands	Financing - Green Fund Scheme - Netherlands	Financing (CT4)	n/a
Netherlands	Friendly energy audit in the framework of Voluntary Agreement - Netherlands	Energy Services (CT5)	n/a
Poland	n/a	n/a	n/a
Portugal	Energy Audits - Portugal	Energy Services (CT5)	• By the end of February 2013, DGEG (Directorate General of Energy and Geology) had approved 649 PREn (Energy Consumption Realisation Plan) which became ARCEs (Realisation Agreement for Energy Consumption). • The implementation of these ARCEs will lead to a reduction of 80 769 toe in energy consumption and 291 903 t CO_2 of GHG. • Excise duties exemption (ISP) amounts to around 5,9 M Euro/year. • Facilities that are in compliance of SGCIE are equivalent to 1,389 Mtoe and represent 24% of final energy consumption in the sectors of Agriculture and Fisheries, Mining, Manufacturing and Construction and Public Works.
Portugal	Qualification System of Energy Services Companies - Portugal	Energy Services (CT5)	The Program aims to achieve a 30% improvement in energy efficiency in public services and bodies of Public Administration by 2020.
Romania	n/a	n/a	n/a
Slovakia	Measuring Impacts - Energy Saving Caluation from Highways - Slovakia	Public Sector (CT2)	We know how much energy is used in highways and that, even though energy savings are not the top priority for highway planning, there are some measurable savings which can be achieved.

Country	Title	Theme	Outcome
Slovenia	n/a	n/a	n/a
Spain	Article 4 renovtion strategy - Spain	NEEAPs (CT1)	• Detailed and comprehensive overview of national building stock. Segmentation of the housing stock in building clusters according to building characteristics, which allows the definition of targeted renovation measures. Consideration of climatic zones. Clear identification of the different set of upgrading measures for the different building clusters (insulation, window replacement, heating/cooling system, etc.). • Ambitious concept of "deep renovation": expected saving from 70-90%. • Clear description of current (2014) policies and programmes to support building renovation. Nearly parallel definition of policy measures (8/2013 Law, 2013 State Plan) and the process of drafting the Renovation Strategy. • Identification of bottlenecks and precise definition of required measures for the future, in order to achieve the Strategy Objectives. • Clear picture of the different scenarios for renovation, including total funding (private and public) required and the evaluation of impact in employment, CO_2 emissions, energy savings, etc.
Spain	Energy Services - Spain	Energy Services (CT5)	Project currently under development, so far no outcome yet.
Sweden	Consumer Information - Local energy advice - Sweden	Consumer Information (CT6)	The municipal energy and climate advisors are increasingly known and used by the target groups. Citizens are more active in making contact with them than SME's. The local advisors are, together with the regional agencies and supported with national training programmes, developing strategies and schemes to actively reach SME's. Recently, a survey has been conducted, where individuals who were given energy advice via telephone during 2008 and 2009 were interviewed twice, one and two years respectively after the advice was given. The survey showed that 78% of the interviewees had taken action to save energy (behaviour change and investment). 39% of these had made a change of their heating system, among other actions. The single most important source of information for these people in influencing their decisions was the municipal energy and climate advisor (26%).

Country	Title	Theme	Outcome
Sweden	Technology procurement for the building sector - Sweden	NEEAPs (CT1)	n/a
UK	Article 4 renovation strategy - UK	NEEAPs (CT1)	Building regulations have achieved ongoing replacement of inefficient boilers that have contributed to a significant reduction in domestic energy use. All of the supplier obligation targets met and exceeded as part of phases 1,2 and 3 of the Energy Company Obligation Implementation of the Minimum Energy Efficiency Standard Regulations for the Private Rented Sector (April 2016) Provision of the Energy Saving Advice Service – a telephone advice line providing independent advice on energy efficiency refurbishment – receives on average more than 20 000 calls a month. Step by step energy efficiency scheme "Warmer Homes Scotland" launched covering advice to installation Funding for household energy efficiency targeted at the worst performing homes through the Nest scheme in Wales.
UK	Energy Services - Green Deal - UK	Energy Services (CT5)	**Project is on-going**
UK	Financing - EU Structural Funds and Technical Assistance - UK	Financing (CT4)	**Project is on-going**
UK	Use of ERDF funds in England for energy efficiency in social housing and supply chain development - UK	Financing (CT4)	Delivery of project outputs, including • 410 business assists, • installation of 787 measures on social housing, • reduction of 1114 tonnes of CO_2, • creating or safeguarding 360 jobs and GBP 20m GVA.

Source: CA EED (2015) and country good practice factsheets. Available at: http://www.ca-eed.eu/country-information