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**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 $CO_2$e 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

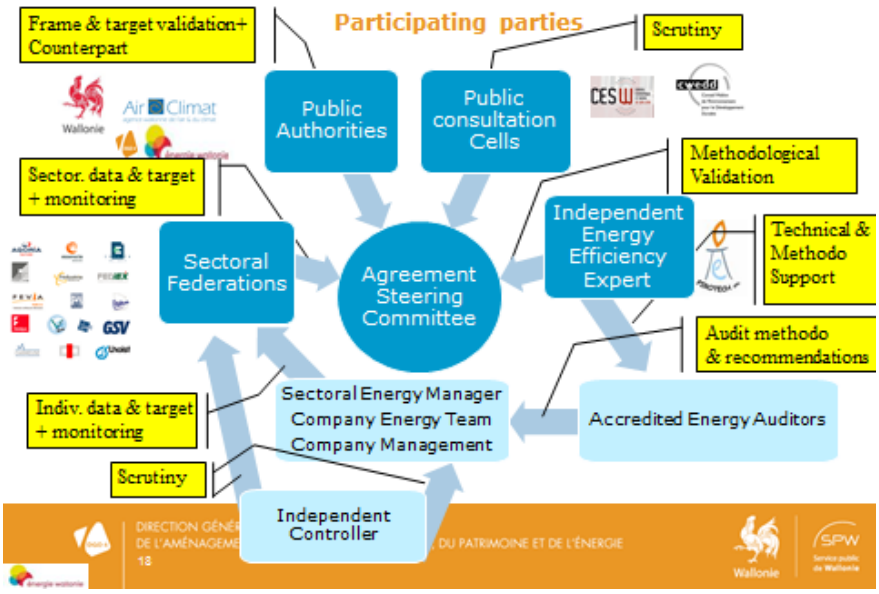
other members of the network have achieved energy savings[19].

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.

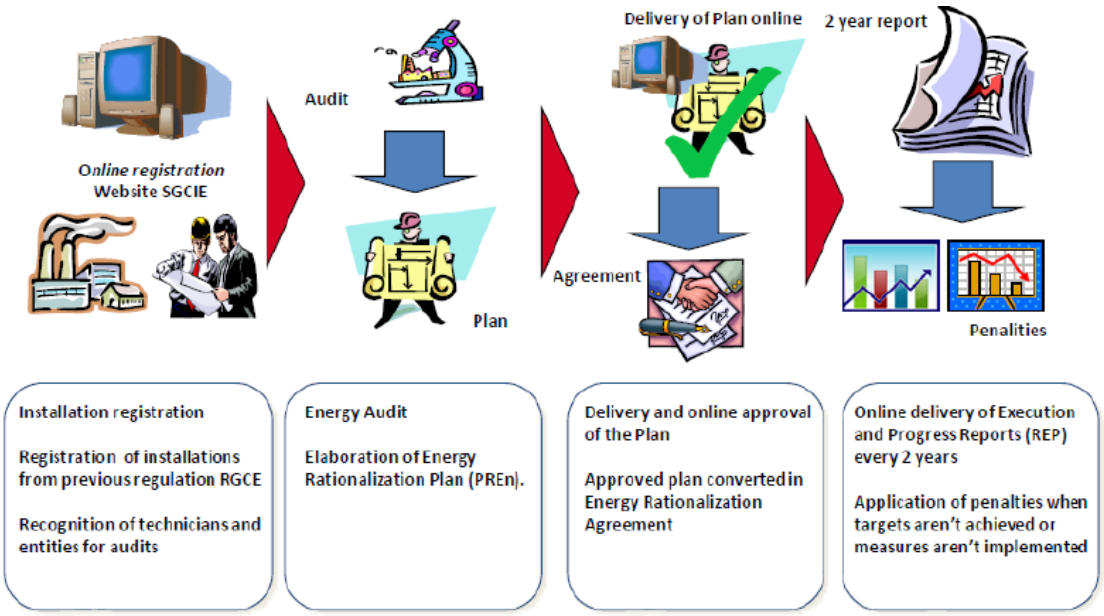
In **Portugal** the Intensive Energy Consumption Management System has specific provisions for energy-intensive companies. This system promotes increases in energy efficiency through changes in production processes, technologies, and behaviour. It applies to all companies that have an annual consumption 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 $CO_2$e/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:

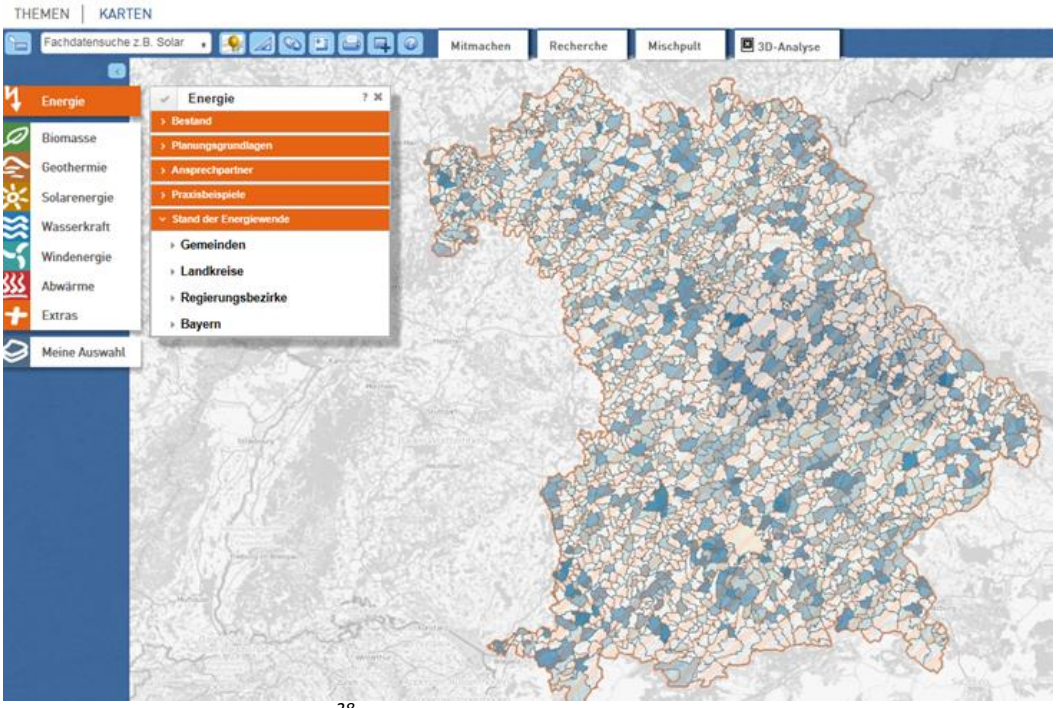
- The **German** federal state of **Bavaria** launched 'Energie-Atlas'[26]**,** a web platform supporting citizens, municipalities and companies with information on how to realise energy savings and increase energy efficiency, and on the use of renewable energy technologies. The core content is an interactive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

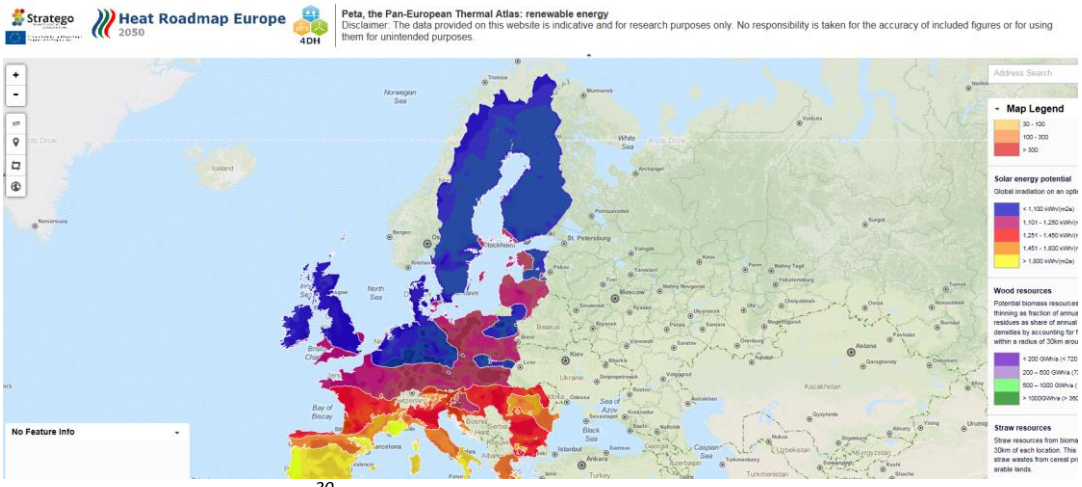
- The *STRATEGO*[29] project aims at supporting national authorities in the preparation of National Heating and Cooling Plans. For this purpose a thermal atlas of the 28 EU Member States including demand and supply sources for heating and cooling will be produced. At national level, an in-depth assessment 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].

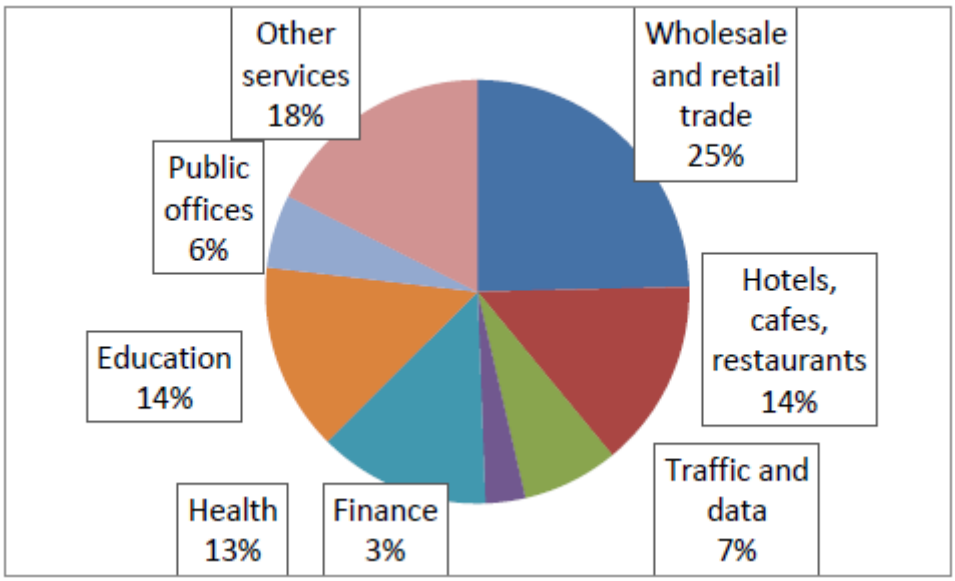
Many measures described in other parts of this document will also apply to the service sector. The measures are quite mixed, including building codes, renovation plans for the public sector, mandatory audits, third party financing, and rules for outdoor lighting. They are complemented by eco-design and 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

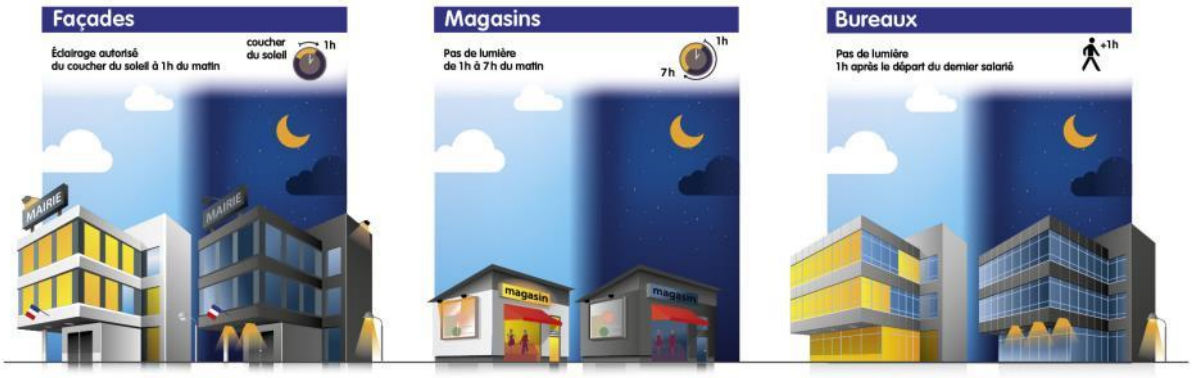
39 SWD(2016) 24 final

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](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:*

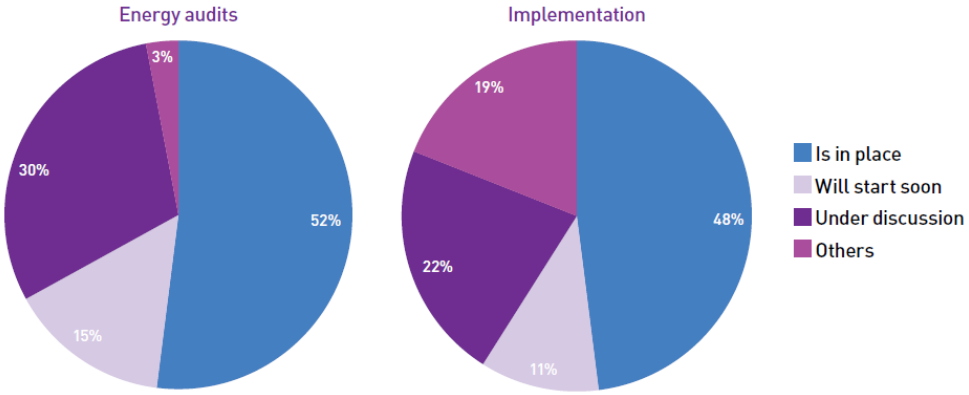
Majority of the measures related to SMEs fall into this category. It includes measures dealing with funds, loans, subsidies, financial support schemes, consultations, financial incentives, and aid for SMEs.

*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.

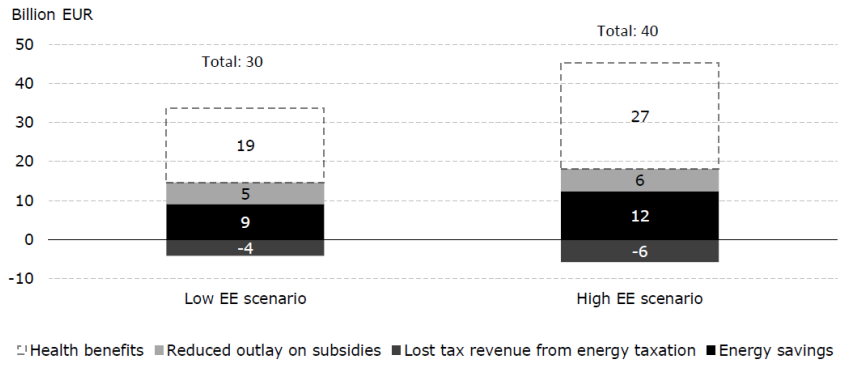
134 IEA (2014): Capturing the Multiple Benefits of Energy Efficiency. Available at: http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf

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]




Note: The improvement of public finances is a subset of the overall benefits to society
The rebound effect has been taken into account

*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/

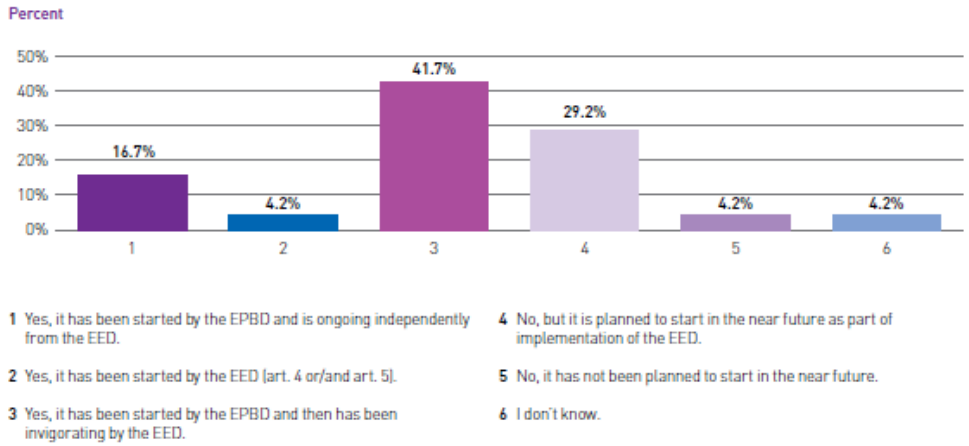
150 PWC, London Economics, Ecorys (2011): Public procurement in Europe: Cost and Effectiveness; Dimitri N et al. (2006): Handbook of procurement. Cambridge University Press, Cambridge.

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).

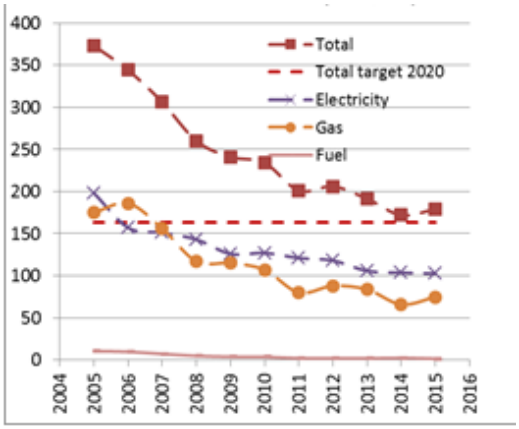
**Figure 51: Evolution of total annual energy consumption indicators for Brussels EMAS area offices (kWh/m2)**

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

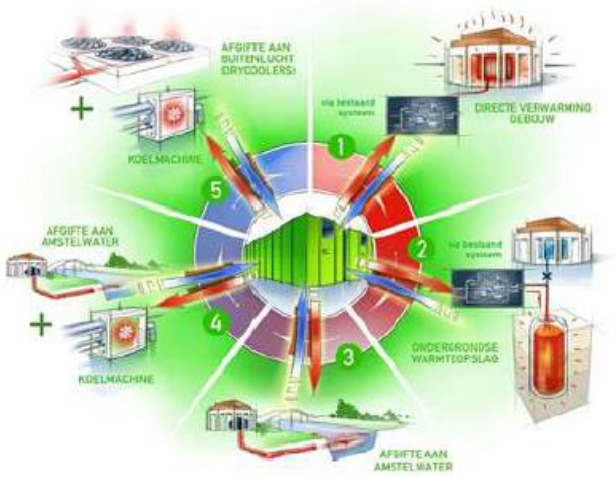
165 http://www.ceppi.eu/home/

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.).