Deliverable
D3.3 Report on energy efficiency trends - interim report

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Contents

Reviewing panel	
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1 Introduction

1.1 Context

The main objectives of this document are to determinate final conclusions on energy efficiency trends and provide inputs for the project development.

The procedure followed in this document is: firstly, the global financing and sectorial indicators are appointed with their drivers to know the finality and motive of use; secondly the global trends are selected and divided them into 3 general groups (consumer, policy and financing trends) to summary the important concepts. In the case of consumer trends, the important concepts are the identification of trends including a microeconomic analysis for each type of energy consumer and the impact of actions through analyzing the benefit, drawbacks or barriers generated by the different actions and the expected result of the future trends. In the case of policy trends, they are studied from either European or National framework and their impacts are evaluated. And in the case of financing trends, the public and private implemented mechanisms are studied and their impacts are evaluated; and finally it concludes identifying the key findings on EE trends taking into account the previous division given in this way the main conclusions of EE trends.

1.2 Methodology

The two parallel deliveries on the IN-BEE trends activities (D3.1 - Current trends on energy efficiency report and D3.2 - KPIs of energy efficiency) are the inputs to obtain a final conclusion on EE trends and in the same way, this document is an important input to WP4. It supplies relevant information which allows exploiting the full potential of the analysis.

In addition, the WP5 which treats to develop new EE programmes is fed by this document because in order to develop new EE programmes an analysis of the current trend and their impacts are going to be the starting point of developing.

2 Indicators of Energy efficiency trends

This section has its basis in the D3.2 report which makes an exhaustive explanation of the energy efficiency trends and a complete description of the energy indicators. These indicators are the special tool for analyzing interactions among economic and human activities, energy consumption and carbon dioxide emissions.

Awareness for better use of the world's energy resources is increasing quickly. To understand the impact of energy efficiency, it is necessary to separate the impact of changes in activity, economic structure and other exogenous factors that influence the demand for energy from changes in energy intensities (important parameter to the energy efficient)[1].

In this document, the indicators are going to be divided in 3 general groups: general indicators and energy parameters, financing indicators and indicators by sector and its drivers. In addition, the general classification of the KPIs based on sector is aggregated and disaggregated indicator.

2.1 Global Indicators and energy parameters

These indicators are general concepts and inputs which affect energy efficiency in different aspects. In the following paragraph is shown a simple definition for each parameter and the relationship and evolution during some years.

Table 1. Global indicators and energy parameters.
Source: Own elaboration

Name KPIs	Description	Units
GDP (Gross Domestic Product)	*It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production. Expressing GDP in PPS (purchasing power standards) eliminates differences in price levels between countries, and calculations on a per head basis allows for the comparison of economies significantly different in absolute size*[2]	*Millions €*
Gross Disposable Income	*The sum of the gross disposable incomes of the institutional sectors. Gross Disposable Income indicator is equal to Gross national income (at market prices) plus current transfers receivable by resident units from the rest of the world less current transfers payable to non-resident units from the rest of the world*[34]	*Millions €*

Name KPIs	Description	Units
Disposable income of households	*The sum of household final consumption expenditure and savings, minus the change in net equity of households in pension funds.* *Household gross adjusted disposable income additionally reallocates "income" from government and non-profit institutions serving households (NPISHs) to households to reflect social transfers in kind. These transfers reflect expenditures made by government or NPISHs on individual goods and services, such as health and education, on behalf of an individual household. The indicator includes the disposable income of non-profit institutions serving households. Disposable income, as a concept, is closer to the idea of income as generally understood in economics, than is either national income or gross domestic product (GDP). This indicator is measured in terms of net in annual growth rates and in terms of gross adjusted in USD per capita at current prices and PPPs. Data are under System of National Accounts (SNA 1993) for all countries except for Australia and United States (SNA 2008)*[5]	*Billions €*
GVA	*Gross value added is the value of output less the value of intermediate consumption; it is the source from which the primary incomes of the SNA are generated and is therefore, carried forward into the primary distribution of income account*[6]	*Million €*
Population	*The number of people in a given area to which a specific vital rate applies, that is, the denominator of the crude birth rate or death rate*[7]. *Population growth represents a fundamental indicator for national decision-makers*[8].	*Nº of people*
Energy consumption	*Energy consumption is the key parameter to measure and monitoring in order to assess the energy efficiency of the sector, subsector or activities/ business.*[9]. *Total energy consumption is made up of production plus imports, minus exports, minus international marine bunkers plus/minus stock changes. It is also called Total primary energy supply or Gross inland energy consumption and represents the quantity of all energy necessary to satisfy inland consumption*[10]	*TOE*

Name KPIs	Description	Units
Energy Intensity (Energy consumption/ GDP_{year})	*Energy Intensity is measured by the quantity of energy required per unit output or activity. This is a better measure than per capita energy use because energy use is affected, to a large degree, by per capita income.* *Energy intensity indicators can:* • *show how the intensity of energy use and its components are changing* • *help raise public awareness about how and why energy intensity has changed over the years* • *complement other provided inputs to policy and program analyses, including improved understanding of the impact of program and policy choices on energy intensity* • *Improve understanding of the role of efficiency improvements in changing energy markets*[11]	*Energy consumption /GDP_{year}*
Installed Power	*The installed power is the sum of the nominal powers of all consuming devices in an installation. This is not the power to be actually supplied in practice.*[12]	*Megawatts*
Primary energy consumption	*Total energy consumption or gross inland energy consumption represents the quantity of energy necessary to satisfy the inland consumption of a country*[13]	*Million TOE*
Public thermal power plants	*Output from conventional thermal power stations consists of gross electricity generation and also of any heat sold to third parties (combined heat and power plants) by conventional thermal public utility power stations as well as auto producer thermal power stations. The energy efficiency of conventional thermal electricity production (which includes both public plants and auto producers) is defined as the ratio of electricity and heat production to the energy input as a fuel.*[14] • ***Electricity transformation input****: is the primary energy needed by the thermal power plants to produce electricity*[15] • ***Electricity generation output****: is the electricity generated in the thermal power plants*	*Thousand TOE*

Name KPIs	Description	Units
Combined Heat and Power (CHP)	*Cogeneration is the simultaneous production of electricity and useful heat. In a regular power plant, the heat produced in the generation of electricity is lost. But in a cogeneration plant, it is recovered for use in homes, businesses, and industry.* *The efficiency of electricity and heat production is equal to the sum of electrical output and heat output divided by fuel input*[16]*.* *Two important parameters are studied to measure the efficiency of this kind of plants:* • ***CHP transformation input****: covers quantities of fuels used to produce electricity and heat*[17] • ***CHP transformation output****: is the thermal and electricity generated in the CHP plants*	*Thousand TOE*
Energy Distribution Losses	*Difference between the electricity entering 1the distribution network and that leaving it*[18]	*Thousand TOE*
Total final energy consumption	*Final energy consumption covers all energy supplied to the final consumer for all energy uses. It is disaggregated into the final end-use sectors (following five indicators). Final energy demand is a measure of the energy that is delivered to energy end users in the economy to undertake activities like manufacturing and other day-to-day energy requirements of living.* *This is also known as Total Final Consumption (TFC) which measures the consumption of electricity and heat, fuels for space heating, transport fuels and fuels for industrial processes. It differs from total consumption in that energy transmission and distribution losses have been removed from it. Thus, it represents the final amount of energy left at the disposal of households and other consumers*[19]	*Thousand TOE*
Final energy consumption – Industry	*Final energy consumption in industry which covers the consumption in all industrial sectors with the exception of the 'Energy sector'. The fuel quantities transformed in the electrical power stations of industrial auto producers and the quantities of coke transformed into blast-furnace gas are not part of the overall industrial consumption but of the transformation sector*	*Thousand TOE*
Final energy consumption - Transport	*Final energy consumption in transport which covers the consumption in all types of transportation, i.e., rail, road, air transport and inland navigation*	*Thousand TOE*

Name KPIs	Description	Units
Final energy consumption - Households	*Final energy consumption in households which covers quantities consumed by private households*	*Thousand TOE*
Final energy consumption – Services	*Final energy consumption in services which covers quantities consumed by commerce, public administration and services*	*Thousand TOE*
Final energy consumption - Agriculture	*Final energy consumption in agriculture which covers quantities consumed by agriculture activities*	*Thousand TOE*
Green House Gas Emissions (GHG)	*The greenhouse gas (GHG) emissions indicator reports the trend in human made greenhouse gas emissions at a national provincial/territorial, and sectoral level for six greenhouse gases: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons, and hydrofluorocarbons. When comparing emissions of different gases, these indicators use a concept called "global warming potential" to convert amounts of other gases into carbon dioxide equivalents*[20]	*Mt CO2-eq*
Energy Savings	*Reduction in energy cost, the difference between baseline and reporting period utility bills or metered quantities. This indicator is determined by comparing measured use before and after implementation of a program, making suitable adjustments for possible changes*	%

2.2 Financing Energy Efficiency

Table 2. Financing indicators.
Source: Own elaboration

Name KPI	Units
Nº of project per program	Nº $_{projects}$
Financial products supported by 1 EUR of public funds	Nº $_{projects}$/€ $_{funds}$
Actions aimed to energy efficiency improvement per project	Nº $_{actions}$/Nº $_{projects}$
Total amount of additional leverage mobilised at program or strategy level	€ $_{projects}$/€ $_{fund}$
Final energy savings per project	TOE $_{savings}$/Nº $_{project}$
Final energy savings per 1 EUR of public fund	TOE $_{savings}$/€ $_{fund}$

2.3 Indicators by sector and its drivers

Table 3. Aggregated sector indicators and its drivers [1] [21] [22].
Source: Own elaboration

Sector	KPI	Description	Drivers	Unit
Buildings	*Total energy consumption per floor area*	*Amount of total residential energy consumption per floor area*	*Combined with energy consumption per household, provides useful insights*	*TOE/m^2*
Industry	*Total energy consumption by unit of industry value-added*	*Measures how much energy is needed to produce one unit of economic output*	*The relationship of energy consumption to economic development*	*TOE/€*
Transport	*Passenger transport energy consumption per passenger kilometre*	*Amount of total passenger transport energy consumption per passenger kilometre*	The "usage efficiency"	*TOE/km*
	Passenger transport energy consumption per GDP/capita	*Amount of total passenger transport energy consumption per GDP per capita*	*The effect of a countries change in wealth on passenger transport energy consumption*	*TOE/€*
	Freight transport energy consumption per GDP	*Amount of total freight transport energy consumption per GDP*	*Total freight haulage*	*TOE/€*
	Freight transport energy consumption per tonne kilometre	*Amount of total freight transport energy consumption per kilometre*	*The geographical situation, destination, available infrastructure, cost and value of goods*	*TOE/t.km*
Residential	*Residential energy consumption per capita*	*Amount of total residential energy consumption per capita*	*Overall energy efficiency improvements, changes in population, energy mix, urbanization rates, number of occupied dwelling, inhabitants per household, dwelling size, dwelling type, building characteristics and age profile, income level and growth, consumer preferences and behavior, energy availability, climatic conditions, appliances and equipment penetration rate, and standards*	*TOE/population*
	Residential energy consumption per occupied dwelling	*Amount of total residential energy consumption per occupied dwelling*		*TOE/Nº of occupied dwellings*
	Residential energy consumption per floor area	*Amount of total residential energy consumption per floor area*		*KTOE/m^2*
Commercial and public services	*Services energy consumption per services value-added*	*Amount of total services energy consumption per unit of value-added*	*Relationship of energy consumption to economic development*	*TOE/€*
	Services energy consumption by floor area	*Amount of total services energy consumption per floor area*	*The end consumption driving the changes in energy use*	*TOE/m^2*
Agriculture/ forestry	*Total energy consumption by unit of agriculture value-added*	*Amount of total agriculture energy consumption per unit of agriculture value-added*	*Better understanding of the state and evolution of regional farming systems in relation to input use, land use and management practices.*	*TOE/€*
	Total energy consumption per cropland area	*Amount of total agriculture energy consumption per cropland area*		*TOE/ha*
Fishing	*Total energy consumption by unit of fishing value-added*	*Amount of total energy consumption (especially fossil fuels) per unit of fishing value-added*	*Know end-use data concerning activity levels, structural effects and efficiency trends*	*TOE/€*
	Total energy consumption per unit of captured fish	*Amount of total energy consumption (especially fossil fuels) per unit of captured fish*		*TOE/t captured fish*

Table 4. Disaggregated sector indicators and its drivers.
Source: Own elaboration

Sector	KPI	Description	Drivers	Unit
Buildings	Space **heating*** energy consumption per floor area	Amount of energy consumed for space heating per floor area	Indication of the trends in space heating energy consumption	TOE/m^2
	Space **heating*** energy consumption per floor area heated	Amount of energy consumed for space heating per floor area heated	Where only a share of total floor area is heated, indication of the trends in space heating energy consumption	TOE/m^2_{heat}
	Space **cooling*** energy consumption per floor area cooled	Amount of energy consumed for cooling per floor area cooled	Indication of the trends in cooling energy consumption. Indicate the effectiveness of policies	$TOE/ m^2_{cooling}$
	Water heating* energy consumption per occupied building areas	Amount of energy consumed for water heating per occupied building areas	Indication of the trends in water heating energy consumption. Indicate the effectiveness of policies	TOE/ Nº building areas
	Lighting* energy consumption per occupied building areas	Amount of energy consumed for lighting per occupied building areas	Indication of the trends in lighting energy consumption. Indicate the effectiveness of an energy conservation campaign or the impact of efficient lighting regulation	TOE/Nº building areas
	Lighting* energy consumption per floor area	Amount of energy consumed for lighting per occupied floor area		TOE/m^2
Industry	**Industry indicators based on value-added*.** Industry sub-sector's energy consumption by unit of value-added	Measures how much energy is needed to produce one unit of economic output	Indicate the general relationship of energy consumption to economic development	TOE/€
	Industry indicators based on value-added*. Industry sub-sector energy consumption by unit of physical production		Indicate the relationship of energy consumption to physical production. At the disaggregated level, can give a better measure of the energy efficiency of a particular production process	TOE/production unit
	Industry indicators based on value-added*. Total industry energy consumption by energy source	Amount of total energy consumption by energy source	Insights on the effect of the final energy mix on total final energy consumption and on the trends in CO_2 emissions	TOE_{source}
	Industry indicators based on value-added*. Energy consumption by industry sub-sectors and by energy source	Amount of energy consumption by industry subsectors and by energy source	Explain the role energy mix plays in the trend in energy consumption in each industry sub-sector and insights on the trends in CO_2 emissions	$TOE_{subsector\ and\ source}$
	Industry indicators based on value-added*. Share of the composition of industry value-added (in constant currency)	Value-added in constant currency by industry sub-sector	Provides information on the relative importance of each sub-sector	%
Transport	**Passenger transport energy consumption*.** Energy consumption per passenger kilometre by road transport vehicle	For road, amount of energy consumed per passenger-kilometer	Help develop transportation energy policies	TOE/km per passenger
	Passenger transport energy consumption*. Energy consumption by vehicle kilometres	Amount of energy consumed per vehicle-kilometer	Insights on the average fuel economy of the vehicle stock	TOE/km by LDV
	Passenger transport energy consumption*. Passenger travel activity	Amount of kilometers per passenger	The potential evolution of travel	km/passenger

Sector	KPI	Description	Drivers	Unit
Transport	***Passenger transport energy consumption*.*** *Share of passenger kilometres by mode*	*Percentage of passengers by vehicle*	*Qualitative information on how change in activity influences change in energy consumption*	*% of passenger by mode*
	Passenger transport energy consumption*. *Car ownership*	*Amount of car owners*	*The trend in average distance travel*	*Nº owners*
	Passenger transport energy consumption*. *Annual kilometres per vehicle*	*Average distance travelled by vehicle*	*Useful qualitative information on activity trends in the sector*	*km/year*
	Passenger transport energy consumption*. *LDV fuel economy*	*Amount of energy consumed per vehicle-kilometers*	*Assessment of the efficiency of the vehicle stock*	*TOE/km per LDV*
	Freight transport intensity by transport mode*. *Energy consumption per tonne kilometre by transportation mode*	*Amount of total freight transport energy consumption per tons kilometer for each mode of transportation*	*Help develop transportation energy policies*	*TOE $_{transport\ mode}$/tn.km*
	Freight transport intensity by road vehicle type*. *Energy consumption per tonne kilometre by road transport mode*	*Amount of energy consumed per tons-kilometer for each road vehicle type*		*TOE $_{road\ transport\ mode}$/tn.km*
	Freight transport*. *Share of tonne kilometres by mode*	*Percentage tons- kilometer by type of vehicle*	*Qualitative information on how change in activity influences change in energy consumption*	*% of t km mode*
	Freight transport*. *Average load per road freight vehicle*	*Average amount of load per road freight vehicle*	*Strong correlation between changes in load factors and changes in the energy intensity of freight haulage*	*TOE/tn.km*
Residential	*Space **heating*** energy consumption per capita*	*Amount of energy consumed for space heating per capita*	*Indication of the trends in space heating consumption*	*TOE/inhabitant*
	*Space **heating*** energy consumption per occupied dwelling*	*Amount of energy consumed for space heating per occupied dwelling*		*TOE/dwelling*
	*Space **heating*** energy consumption per floor area*	*Amount of energy consumed for space heating per floor area*		*TOE/m^2*
	*Space **heating*** energy consumption per floor area heated*	*Amount of energy consumed for space heating per floor area heated*		*TOE/m^2_{heat}*
	*Space **cooling*** consumption per dwelling with air conditioning*	*Amount of energy consumed for cooling per dwelling with air conditioning*	*Indication of the trends in cooling energy consumption*	*TOE per dwelling*
	*Space **cooling*** energy consumption per floor area cooled*	*Amount of energy consumed for cooling per floor area cooled*	*Indication of the trends in cooling energy consumption. In addition, it can indicate the minimum energy performance, or promotion of high-efficiency air conditioners*	*TOE/$m^2_{cooling}$*
	Water heating* *energy consumption/ capita*	*Amount of energy consumed for water heating per capita*	*Indication of the trends in water heating energy consumption. In addition, it can indicate the minimum energy performance, or promotion of solar water heating*	*TOE/inhabitant*
	Water heating* *energy consumption per occupied dwelling*	*Amount of energy consumed for water heating occupied dwelling*		*TOE/dwelling*

Sector	KPI	Description	Drivers	Unit
Residential	***Lighting**** *energy consumption per capita*	*Amount of energy consumed for lighting per capita*	*Indication of the trends in lighting energy consumption. In addition, it can indicate the effectiveness of an energy conservation campaign or the impact of efficient lighting regulation*	*TOE/inhabitant*
	Lighting* *energy consumption per occupied dwelling*	*Amount of energy consumed for lighting per occupied dwelling*		*TOE/dwelling*
	Lighting* *energy consumption per floor area*	*Amount of energy consumed for lighting per floor area*		*TOE/m2*
	Cooking* *energy consumption per capita*	*Amount of energy consumed for cooking per capita*	*Indication of the trends in cooking energy consumption. It may indicate the effectiveness of policies*	*TOE/inhabitant*
	Cooking* *energy consumption per occupied dwelling*	*Amount of energy consumed for cooking per occupied dwelling*		*TOE/dwelling*
	Appliances* *energy consumption per capita*	*Amount of energy consumed for appliances per capita*	*Insights of the change in its importance in the residential sector.*	*TOE/inhabitant*
	Appliances* *energy consumption per occupied dwelling*	*Amount of energy consumed for appliances per occupied dwelling*		*TOE/dwelling*
Commercial and public services	*Space* ***heating**** *energy consumption per value-added*	*Amount of energy consumed for space heating per value-added*	*Indication of the trends in space heating energy intensity*	*TOE/€*
	Space ***heating**** *energy consumption per floor area*	*Amount of energy consumed for space heating per floor area*		*TOE/m^2*
	Space ***heating**** *energy consumption per floor area heated*	*Amount of energy consumed for space heating per floor area heated*		*TOE/m^2_{heat}*
	Space ***cooling**** *energy consumption per value-added*	*Amount of energy consumed for cooling per value-added*	*General indication of the trends in cooling use*	*TOE/€*
	Space ***cooling**** *energy consumption per cooled floor area (or total floor area)*	*Amount of energy consumed for cooling per cooled floor area*		*TOE/$m^2_{cooling}$*
	Water heating* *energy consumption per value-added*	*Amount of energy consumed for water heating per value-added*	*Indication of the trends in lighting energy intensity*	*TOE/€*
	Lighting* *energy consumption per value-added*	*Amount of energy consumed for lighting per value-added*		*TOE/€*
	Lighting* *energy consumption per floor area*	*Amount of energy consumed for lighting per floor area*	*Indication of the trends in lighting energy intensity. In addition, indicate the effectiveness of an energy conservation campaign or the impact of efficient lighting regulation*	*TOE/m^2*
	Other equipment* *energy consumption per value-added*	*Amount of energy consumed for equipment per value-added*	*Indication of the trends in other equipment intensity. When total energy is compared with other end uses, provides insights of the change in its importance in the residential sector*	*TOE/€*
	Other equipment* *energy consumption per floor area*	*Amount of energy consumed for equipment per floor area*		*TOE/m^2*

Sector	KPI	Description	Drivers	Unit
Agriculture/ forestry	**Irrigation/ pumping*.** *Energy consumption in propulsion per value added*	*Amount of energy consumed for pumping per value-added*	*Provide relevant information for analysis of the sector and supporting the development of energy efficiency policies. The most important parameter in this sector is the population growth*	*TOE/€*
	Irrigation/ pumping*. *Energy consumption per cropland irrigated area*	*Amount of energy consumed for pumping per cropland irrigated area*		*TOE/ha*
	Irrigation/ pumping*. *Energy consumption per unit of production*	*Amount of energy consumed for pumping per unit of production*		*TOE/t_{prod}*
	Farm equipment*. *Fuel consumption per cropland area*	*Amount of fuel consumption for farm equipment per cropland area*		*TOE/€*
	Farm equipment*. *Fuel consumption per unit of production*	*Amount of fuel consumption for farm equipment per unit of production*		*TOE/t_{prod}*
	Farm equipment*. *Fuel consumption per unit cropland area*	*Amount of fuel consumption for farm equipment per unit of cropland area*		*TOE/ha*
	***Fertilisers** consumption per value added*	*Amount of fertilisers consumption per value added*		*$t_{fertilizers}$/€*
	***Fertilisers** consumption per unit of production*	*Amount of fertilisers consumption per unit of production*		*$t_{fertilizers}$ /t_{prod}*
	***Fertilisers** consumption per unit cropland area*	*Amount of fertilisers consumption per unit cropland area*		*TOE/ha*
Fishing	*Energy consumption in **propulsion** per value added*	*Amount of energy consumption for propulsion per value added*	*Provide relevant information for analysis of the sector and supporting the development of energy efficiency policies. The amount of energy used to fishing depends on many factors but the major cause is the fuel inefficiency*	*TOE/€*
	*Energy consumption **propulsion** per unit of fishing capture*	*Amount of energy consumption for propulsion per unit of fishing capture*		*TOE/$t_{captured\ fish}$*
	*Energy consumption in **fish processing** per unit of fishing added value*	*Amount of energy consumption for propulsion per unit of fishing added value*		*TOE/€*
	***Fish processing**. Fuel consumption per unit of production*	*Amount of fuel consumption for fish processing per unit of production*		*TOE/$t_{processed\ fish}$*

**** Used to indicate the end use level in the disaggregated indicators.***

3 Energy efficiency trends

Best practices & recommendations guidelines on energy efficiency trends based on tasks T3.1-T32 and the case studies with relation.

3.1 Energy efficiency consumers trends

T3.2 – Energy efficiency consumers trends (Leader: SEC; Contributing: UPO, IEN)
There are several barriers toward a wide implementation of the current EU and national energy policies. One of these barriers is the lack of understanding from consumers of the principles of EE as a whole. Very good practices are not appreciated by consumers, because of their different expectations and misunderstanding of the purpose of these practices. On the other hand, in many cases the policies are oriented only to energy savings without taking into consideration the needs and behaviour of consumers. This task is devoted to the analysis of the relation between consumer trends and the successful implementation of energy saving measures, and the level of acceptance of these measures. Based on the information obtained in T3.1, some previous actions of energy efficiency for consumers will be compared to local and regional economic statistics in order to establish correlations among different actions and the direct effects occurred. The analysis will be based on data collected under different EU and national projects for EE in buildings.
The expected results of the assessment will be microeconomic analyses for different types of energy consumers and the direct benefits of the implementation of energy efficiency actions as well as future trends. The results of this task will be part of the report on EE trends.

3.1.1 Classification and analysis of energy consumers

Identify main types on energy consumers. Develop a microeconomic analysis for each type of energy consumer

3.1.2 Impact of past actions

Analyse the benefits, drawbacks or barriers generated by the different actions already implemented (extract more relevant actions for the customer perspective from deliverable D3.1) for the different types of users defined in 3.1.1. Evaluate local and regional economic statistics, to infer the direct effects occurred as a consequence of the actions.

3.1.3 Expected impact of future trends

Based on the evaluated impacts obtained in section 3.1.2, try to predict which will be the impacts that future trends will have on the different types of energy consumers. Analyse those impacts and look for possible actions or tools that could be applied to future trends in order to modify them to improve expected positive impacts.

3.2 Energy efficiency policy trends – EU approach

Many countries have established the energy efficiency policy as priority. Energy efficiency policy is known as the mean to address numerous energy-related issues. These issues include energy security, the social and economic impacts of high energy prices, and concerns about climate change[23].

Energy efficiency policies at EU level are well-defined under the Directive 2012/27/EU and the subsequent communications and guidance notes. The transposition of this regulation to the EU Member states has to be done through different actions. One of them is the implementation of the NEEAP (National Energy Efficiency Action Plans) by 30th of April of 2014.

3.2.1 Overview of EU policies in Energy Efficiency

By using energy more efficiently, Europeans can lower their energy bills, reduce their reliance on external suppliers of oil and gas and help to protect the environment.

Energy efficiency has to be increased at all stages of the energy chain from generation to final consumption. At the same time, the benefits of energy efficiency must outweigh the costs, for instance those involved in renovations. EU measures therefore focus on sectors where the potential for savings is greatest such as buildings.

Policies to reach the energy efficiency targets for 2020

1. Energy efficient products (Labelling and Eco-design)

In the European Union, most household products, such as washing machines, refrigerators and cooking appliances, carry energy labels and have been designed to meet minimum energy efficiency standards. This label makes easier to costumers buy and identify a proper product to help in the energy efficiency project.

EU foresees an energy saving of around 166 Mtoe (equivalent to the annual primary energy consumption of Italy) by 2020 as result of these labels and standards. For consumers, this means a saving of €465 per year on household energy bills. Moreover, energy efficiency measures will create €55 billion in extra revenue for European companies.

EU's Energy Labelling Directive was designed in order to stablish a template and some requirements for each group of products. The most important Labelling's Directives are:

- **Directive 92/75/EC**: this Directive established the first energy consumption labelling framework for the harmonization of national measures on end-user information on the consumption of energy. 92/75/EC shall apply to every product which has a significant impact (directly or indirectly) on the consumption of energy although shall not apply to products such as second-hand products, means of transport, etc. The directive was implemented by several other directives thus most white goods, light bulb packaging and cars must have an EU Energy Label clearly displayed when offered for sale or rent. The information should also be given in catalogues and included by internet retailers on their websites.
- **Directive 2010/30/EU**: the Directive replaced the Directive 92/75/EC in May 2010. This extends the scope of the directive from energy using products to include energy related products and also extends from domestic products to products from services and industrial sector. The updated Energy Labelling Directive introduces new energy

efficiency classes (A+, A++ and A+++), in addition to A-D ratings. The new type of label makes use of pictograms rather than words. They use a seven color scale, with dark green representing the highest energy efficiency class and red representing the lowest.

Regarding the eco-design requirements was created the EU's Eco-design Directive for individual product groups. As an alternative, industry sectors may also sign voluntary agreements to reduce the energy consumption of their products. In addition, this standard makes it easier for manufacturers to launch product on the market, they do not have to perform multiple national regulations over their products. The most important Eco-design's Directives are:

- **Directive 2005/32/EC:** sets a framework for establishing the eco-design requirements of energy-using products with the intention of free movement of those products within the internal market. The directive put forward the requirements which the energy-using products covered by the implementing measures have to fulfill in order to be placed on the market and/or put into service which in turn contributes to sustainable development by enhancing energy efficiency and the level of protection of environment while simultaneously increasing the security of energy supply. An exception are the means of transport, they are not taking into account of this directive.
- **Directive 2009/125/EC*:*** The directive establishing a framework for the setting of eco-design requirements for energy- related products (recast) creates a framework for the constitution of requirements to an ecologic design of products that are related to energy. It replaces the directive 2005/32/EC from 6 July 2005. The "Directive for Energy-using Products" which had to be transformed into national law by the member states until 11 August 2007 was related to energy efficiency and environmental compatibility of electronic devices only. The subsequent directive, "Energy-related Products", includes besides products that actively need electricity those which are relevant for energy consumption and influence energy efficiency such as insulating materials. It had to be translated into national law until 20 November 2010.

2. Buildings

Buildings consume around the 40% of total energy and generate up to 36% of CO_2 emission in the EU. So, improving the energy efficiency of buildings the consumption could be reduce by 6% and the CO_2 emission could be lower up to 5%[24]. For this reason, two Directives were established by EU: the 2010 Energy Performance of Buildings Directive and the 2012 Energy Efficiency Directive.

- **Energy Performance of Buildings Directive:** This directive establishes some rules on buildings and in this way Member State shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units. New buildings have to ensure the technical, environmental and economic feasibility of high-efficiency alternative systems such as energy supply from renewable sources; district or block heating or cooling from renewable sources; cogeneration and heat pumps. Existing buildings have to ensure that when buildings undergo major renovation, the energy performance of the building or the renovated part thereof is upgraded in order to meet minimum energy performance requirements. In addition, for the sale or rental of all of

both type of buildings an energy performance certificate has to be include in advertisements.

The main goals of Member States are:

- Draw up lists of national financial measures to improve the energy efficiency of buildings.
- Ensure that all new buildings are nearly zero energy buildings by 31 December 2020 (public buildings by 31 December 2018)[25].

- **Energy Efficiency Directive:** This directive repeals the Cogeneration Directive and the energy End-use efficiency and energy Services Directive, which sets overarching objectives and targets to be achieved by a coherent and mutually reinforcing set of measures covering virtually all aspects of the energy system from supply to consumption. The main goals of the Member States are:
  - EU countries make energy efficient renovations to at least 3% of buildings owned and occupied by central government.
  - EU governments should only purchase buildings which are highly energy efficient.
  - EU countries must draw-up long-term national building renovation strategies which can be included in their National Energy Efficiency Action Plans[24].

3. Cogeneration

Energy efficiency and cogeneration are recognized in the opening paragraphs of the European Union's Cogeneration Directive 2004/08/EC. This directive intends to support cogeneration and establish a method for calculating cogeneration abilities per country. The development of cogeneration has been very uneven over the years and has been dominated throughout the last decades by national circumstances.

The Energy Efficiency Directive requires each EU country to carry out a comprehensive assessment of the national potential of cogeneration and district heating and cooling (a main user of cogeneration) by December 2015, in its article 14.

4. Energy end-use efficiency and energy services Directive 2006/32/EC

There is a need for improved energy end-use efficiency. Improved energy end-use efficiency will also contribute to the reduction of primary energy consumption, to the mitigation of CO_2 and other greenhouse gas emissions and thereby to the prevention of dangerous climate change. Then, the purpose of the Directive is to make the end use of energy more economic and efficient by:

- Establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end use of energy.

- Creating the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency.

As result, the Directive's provisions are:

- Regarding energy savings targets:
    - General targets. They can be resumed in 7 points:
        - Achieve an overall national indicative energy savings target of 9 % for the ninth year of application.
        - Take cost-effective, practicable and reasonable measures.
        - Establish an intermediate national indicative energy savings target for the third year of application.
        - Provide an overview of its strategy for the achievement of the intermediate and overall targets.
        - Draw up programmes and measures to improve energy efficiency.
        - Assign to one or more new or existing authorities or agencies the overall control and responsibility for overseeing the framework set up.
        - Examine whether it is appropriate to come forward with a proposal for a directive to further develop the market approach in energy efficiency improvement by means of white certificates
    - Energy end-use efficiency in the public sector.
- Regarding promotion of energy end-use efficiency and energy services:
    - Energy distributors, distribution system operators and retail energy sales companies.
    - Availability of information.
    - Availability of qualification, accreditation and certification schemes.
    - Financial instruments for energy savings.
    - Energy efficient tariffs and other regulations for net-bound energy.
    - Funds and funding mechanisms.
    - Energy audits.
    - Metering and informative billing of energy consumption.

5. Energy efficiency Directive (2012/27/EU)

Energy efficiency Directive (EED) establishes a framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. The Directive lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020. The requirements laid down in the Directive are minimum requirements and do not prevent any Member State from maintaining or introducing more stringent measures.

The main goals of this directive are:

- Each Member State plans how they intent to meet their energy efficiency targets. This goal is performed by generating NEEAPs and Annual Reports.
- Realize obligation schemes and alternative measures to reduce energy consumption by final costumers.
- Each Member State improves energy efficiency in public buildings.

As result, the Directive's provisions are:

- Regarding efficiency in energy use
    - Energy efficiency targets.
    - Building renovation.
    - The exemplary role of public buildings.
    - Energy efficiency obligation schemes.
    - Energy audits and energy management systems.
    - Metering and Billing information and access to these.
    - Consumer information and empowerment.
- Regarding efficiency in energy supply
    - Promotion of efficiency in heating and cooling.
    - Energy transformation, transmission and distribution.
- Regarding horizontal provision
    - Availability of qualification, accreditation and certification schemes.
    - Information and training.
    - Energy services.

- Other measures to promote energy efficiency.
- Energy Efficiency National Fund, Financing and Technical Support.

3.2.2 Comparative of measures included in the NEEAPs

In the different NEEAPs, policy measures have been established to keep a standard procedure of measures in the field of energy efficiency. The following list shows the standard list of measures:

- **Horizontal measures[26]. These measures are applied in every sector in a transversal way.** Good practices include awareness raising and training, energy performance contracting and other innovative financing schemes, metering and billing provisions, and involvement of energy market actors in delivering energy efficiency. Other measures that can be implemented either on a sectoral or a cross-sectoral level – such as subsidies, fiscal measures, voluntary agreements and energy audits.
- **Energy efficiency measures in building construction**. This measures the extent to which the energy consumption per square meter of floor area of the building measures up to established energy consumption benchmarks for that particular type of building under defined climatic conditions[27]. These measures take into account 3 different concepts:
  - Addressing the requirements of the recast EPBD (2010/31/EU).
  - Building renovation strategy.
  - Additional measures addressing energy efficiency in buildings and appliances.
- **Energy efficiency in the public sector** is synonymous with good public management, when energy is saved, the public funds used to pay for it are also saved. These measures are divided into 3 specific groups:
  - Central government buildings.
  - Buildings of other public bodies.
  - Purchasing by public bodies.
- **Energy efficiency measures in industry** is the key tool for the reduction of industrial CO_2 emissions from the industry activity. For all measures addressing energy efficiency in the industrial sector is recommended to provide a breakdown of savings achieved by measures or groups of measures up to 2012 and savings expected up to 2020.
- **Energy efficiency measures in Transport** effort and measures to mitigate rising energy consumption and GHG emissions from the transport activity. This measure requires special attention due to the rapidly increasing number of vehicles.

- **Promotion of efficient heating and cooling** is the technique used in the application of high-efficiency cogeneration and efficient district heating and cooling . Three main points are distinguished:
    - Comprehensive assessment.
    - Cost of installation for the user.
    - Individual installation.
- **Energy transformation, transmission, distribution and demand response.** Provide system services to end-users which enable them to implement energy-efficiency improvement measures by introducing smart grids, taking into account the costs and benefits associated with each measure and making sure that the security of the system is ensured. The following points are highlighted:
    - Energy efficiency criteria in network tariffs and regulations.
    - Facilitate and promote demand response.
    - Energy efficiency in network design and operation[28].

3.2.3 Impact of the main measures of the NEEAPs

Energy Efficiency Directive (EED) is a pillar of the 20-20-20 strategy and article 7 of the Directive is the key of its contribution to the 20% energy consumption reduction target. From them, different NEEAPs are created in each nation for the purpose of obtaining the proper measures to achieve the strategy and they are updated in periods of 3 years. In the following image, the evolution of the energy efficiency Directive and NEEAPs is shown:

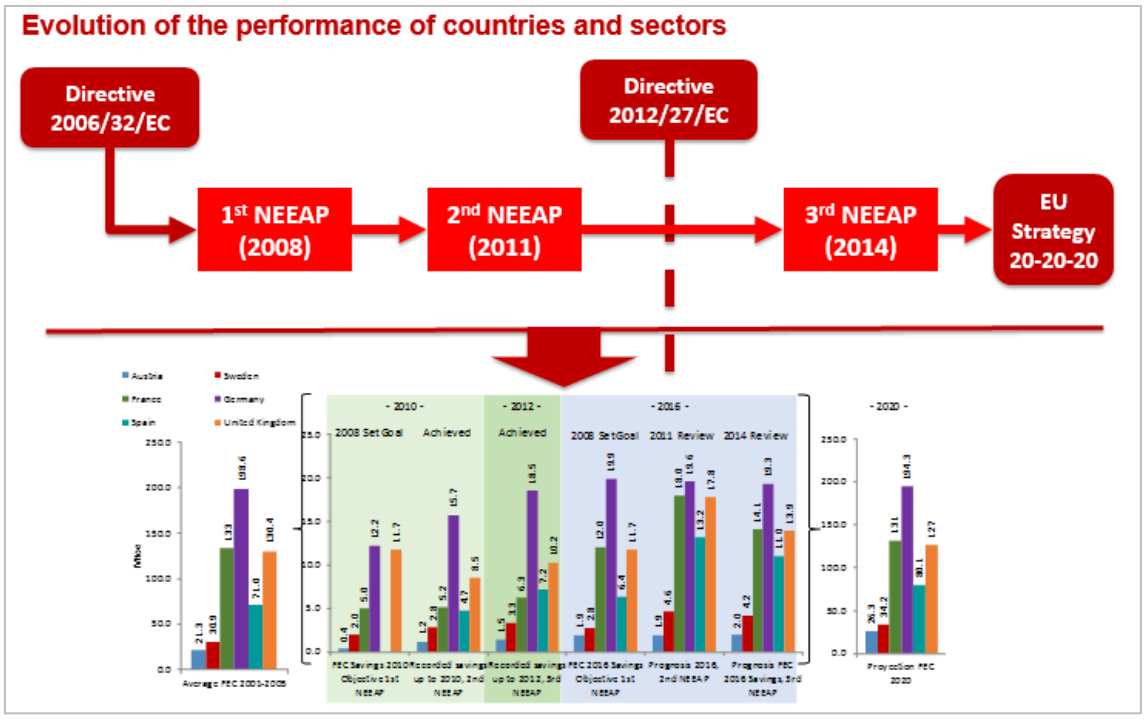

Figure 1. Evolution of the frame 20-20-20
Source: Deloitte.

As the document D3.2 indicates, in accordance with European Commission recommendations (Requirements of Directive 2006/32/EC), the savings are calculated on the basis of the cumulative annual energy savings achieved during the overall period of application.

For verification of the indicative energy savings target the Member States must use a harmonized calculation model with a combination of top-down and bottom-up calculation methods. Both approaches are necessary for monitoring and evaluating energy efficiency policy (different aspects can be examined).

Objectives:

- 2020 target: intensity reduction of 20%,
- The energy saving path from 2015 to 2020 has been built according to the real experience of the most advanced EU Economies.
- The roadmap for the period 2024 – 2030: target of 27% energy intensity reduction by 2030, according to the Climate Change police of EU.
- The reduction in energy intensity target for the period 2031–2050 will be 50%: according to the most advanced EU economies.

MEASURES OF THE NEEAPs[29]

To achieve the NEEAP's objectives, the measures indicated in the previous section have to be performed. Here, a segmentation of these measures is given to understand the procedure.

1. Horizontal measures

Central to the Energy Efficiency Directive is the requirement in the article 7 to achieve final energy consumption target. This target is equivalent to achieve new energy savings each year from January 1, 2014 to December of 2020 of 1.5 % of annual energy sales to final consumers.

- To determine the savings target in accordance with Article 7, consumption in the transport sector was subtracted from the final energy consumption in accordance with the energy balance.
- Since, pursuant to the EED, the target is based on the volume of energy sold to final customers by energy distributors or retail energy sales companies, further reductions can be made. The availability of reliable data is an important criterion in the identification of possible deductions.

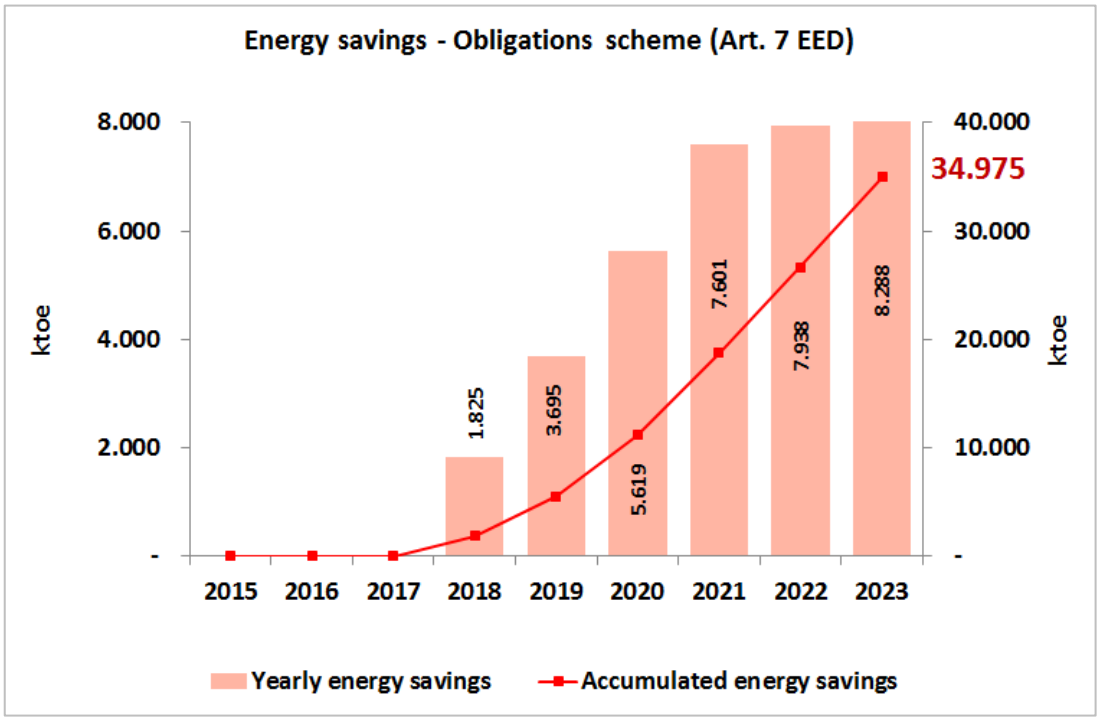

Figure 2. Energy savings scheme.
Source: Deloitte

Energy Efficiency obligation Scheme

The overall amount of energy savings over the obligation period from 1 January 2014 to 31 December 2020. Energy saved shall be certified based on the evaluation of the project proposed under the Voluntary Agreement scheme for utilities. Estonia is selected in order to have an example of energy efficiency scheme with some numeric references,

Estonia represents a total of 9,468 GWh during this period from 1 January 2014 to 31 December 2020. Estonia plans to make use of the possibilities listed in Articles 7(2) and (3) within the ranges prescribed in the Directive. The following are options for meeting the overall energy efficiency obligation:

- Article 7(2)(a). By applying this relaxation measure, overall energy savings in the obligation period could be reduced by 1,972 GWh.
- Article 7(2)(b). Nine industrial installations in Estonia are part of the European Union's Emissions Trading System, and their gross energy consumption in 2012 was 2,294 GWh.
- Article 7(2)(c). Based on the results of the research, the potential energy savings from the complete renovation of the heating pipelines would amount to as much as 542 GWh.
- Article 7(2)(d). Estonia plans to submit updated information concerning the possibility of counting newly implemented actions in the communication to be submitted under Article 7(3) of the Directive.
- Article 7(3).Taking into account the restriction in this article, the overall energy efficiency obligation may not be reduced by more than 2367 GWh.

Energy audits and energy management systems

Energy audits will be compulsory for the companies for a range of sectors and identified energy saving measures for a determined amount (in Italy this amount is set to 260 Ktoe) and buildings with an area bigger than determined dimensions used for commercial or service purposes (In Italy covered 500 small and medium-sized enterprises). As example of saving, the overall Italy's project, which incurred a cost of EUR 8.5 million, produced energy efficiency actions which led to savings of some 4,000 toe.

In addition, all enterprises are obliged to establish an energy management system and nominate an energy manager in the industry and services sector.

Smart Meters

Currently a target for smart meter penetration has not been established. If the electronic meters are installed at the supply points to consumers, it is possible to add functions that can help distributors and sellers improve the services such as billing the consumer on the basis of actual consumption. The target set by the European Commission is to cover at least 80% of European consumers by 2020.

This target has already completed in Italy, Finland and Sweden. Italy was originally driven by significant operating savings (EUR 500,000,000 per year for some 30 million meters).

Recover Costumer information and training programmes

The instruments adopted to encourage final customers to change their habits have been: incentives, grants or subsidies, the provision of information, flagship/exemplary projects, workplace activities and energy saving education.

For example, in the years 1999-2013 Krajowa Agencja Poszanowania Energii S.A. (Poland) played the role of a National Contact Point, initially for EU SAVE and ALTENER programmes, and subsequently for the beneficiaries of an EU programme "Intelligent Energy - Europe" (IEE). Some of the actions, among others, are:

- organization of training for institutions interested in participation in the programme;
- offering information on the IEE Programme to potential beneficiaries;
- participation in training, conferences and workshops organised by other institutions;
- translation of working documents;
- etc.

Availability of qualification, accreditation and certification schemes

Article 16 of Directive 2012/27/EU defines that if the "national level of technical competence, objectivity and reliability is insufficient", certification or accreditation schemes should be established, including training programmes for providers of energy services, energy auditors, energy managers and installers of energy-related building elements. This information should be public.

In the particular case of Poland provides for three types of documents. They are: energy audits, energy efficiency audits and energy performance certificate of a building

Energy services market

Transpose the requirements laid down in Article 18 of the Directive, and continue to develop the provision of project-based energy services and increase the reliability of energy services from the point of view of consumers.

A study was performed in Estonia and the following points determine the main areas which provide energy services participating in achieving energy savings:

- Lighting. Perform projects to replace lamps by more effective lamps and lamps that are better suited to various environments, as well as using programmable lamps and sensor-equipped lamps.
- Heating, ventilation and air conditioning systems (HVAC). Projects involve optimizing HVAC systems, using heat pumps, waste heat recovery, etc.
- Insulating buildings. Projects involve minimizing buildings' energy costs, by using comprehensive renovation.

- Automation and control systems. Projects involve optimizing the control systems of buildings and processes, consuming energy at times when it is less expensive, introducing sensor solutions, etc.

However, some important barriers were identified:

- Regulative/administrative problems:
    - the capacity to make public sector investments,
    - No experience in the sector.
- Technical problems:
    - clients lack technical knowledge and understanding,
    - clients' uncertainty about the future,
    - the technical nuances of energy service contracts.
- Financial problems:
    - overall awareness in the area of energy saving is low,
    - energy service enterprises' capacity to finance projects,
    - for Estonian banks and financial institutions, the system of energy services is novel,
    - clients' distrust of energy services.

2. Energy efficiency measures in building construction.

Building renovation strategy

MS shall establish a long-term strategy for investing in the renovation of national stock of residential and commercial buildings, based on Article 4 of Directive 2012/27/EU.

At 2013 In Italy, for example the residential buildings were 11.7 million and comprised more than 29 million dwellings. More than 60% of this building stock is over 45 years old and more than 25% of total buildings are in the consumption band between 160 kWh/(m^2*year) and over 220 kWh/(m^2*year). To solve it, the energy saving assessment concerned the existing buildings stock built in the period of 1946-2005 including complete and partial renovations. Potential consumption reduction was estimated taking into account performance standards in force, the applicability of energy efficiency schemes, the cost-benefit ratio and the feasibility of some work such as thermal insulation and replacement of windows and doors amount others.

Creation of additional measures to improve energy efficiency of buildings

The Member States' governments can establish economic aids to make improvements in buildings like subsidy for lighting renewal, subsidies to improve building isolation or to install boilers and air conditioning and other technologies.

3. Energy efficiency in the public sector

Central government buildings

MS shall ensure the renovation of 3% of the total floor area of heated and cooled buildings owned by central governments. This requirement is contained in the Article 5 of EED.

For example, Italy's actions to follow the EU requirements are set out:

- the methodology used to establish the stock of buildings concerned,
- the methodology used to establish their energy performance,
- an estimate of the energy saving target,
- the instruments put in place to achieve such target.

Buildings of other public bodies

This is the mean used to improve the energy and environmental performance of urban centers through new technology solutions for sustainable development. In the case of Turin (Italy) the city is making efforts to improve it by joining the "Smart Cities & Communities" initiative".

Purchasing by public bodies

Article 6 indicates MS shall provide steps taken or planned to ensure that central government purchases products, services and buildings with high-energy efficiency performance and on measures undertaken or planned to encourage other public bodies to do likewise.

Italy introduces an Action Plan for environmental sustainability and reducing energy consumption by public authorities adopted by Interministerial Decree of 11 April. This plan tries that public bodies carry out green procurement practices delivering reduced environmental impact (consumption of natural resources, dangerous substances content, emission of pollutants and waste production, and also taking into account economic aspects and social impacts of the goods, services and works over their entire lifecycle).

4. Energy efficiency measures in industry

Fund for energy-efficiency measures in the industrial sector to improve the competitiveness

The fund will promote energy efficiency measures in the industrial sector because the industry is a complex sector which comprises large energy intensive industrial consumers. This fund is focused in:

- Improving the energy efficiency of electrically operated, heating, cooling, lighting systems,
- Replacing outdated productive equipment,
- Modernizing production installations,
- Improving energy management at the level of industrial platforms.

5. Energy efficiency measures in Transport

This sector is a key in energy efficiency. A quite number of energy efficiency measures can generate significant energy savings from the point of view of end-use. Depending on the trends in each country, each NEEAP establishes different main measures. This section takes into account some of the measures establish by United Kingdom, Poland, France and Spain.

Eco-driving (UK)

The main objective is teaching driving the skills in a fuel-efficient way supplied by the Driver and Vehicle Standards Agency (DVSA) for driving cars and vans. In addition, the government is also working to ensure that there is available information on the potential financial and environmental benefits of eco-driving.

Public Transport (UK)

The Green Bus Fund objective is switching to the greener and quieter buses. 1,250 new low carbon buses and each bus emits at least 30% fewer emissions. Then, 28,000 tonnes of CO_2 per year will be saved. In addition, the Government is committed to electrification of large parts of the existing network infrastructure and set out plans for further electrification.

Development of intelligent transport systems (Poland)

The purpose is to apply Intelligent Transport Systems in road, maritime, inland water and urban transport, to improve inter-modal system, to purchase new vehicles, mainly city buses, and to promote eco-driving among the users of vehicles, contributing to reduction of energy use for transport purposes. The employed measures among others are: adaptation, construction, transformation and development of railways.

Low-emission urban transport (Poland)

The aim is to reduce CO_2 emissions. To achieve it, projects are designed to reduce the use of energy and fuels in urban transport. The employed measures among others are:

- Purchase hybrid buses,
- transfer knowledge about operating low-emission vehicles to drivers of vehicles used in public transport,
- upgrade and create cycling trails, bus-lanes and service stations for refueling public transport vehicles (hybrid buses).

Waterway and maritime transport (France)

- Support the use of new fuels. Due to difficulties with marine gas oil, the government is considering the development of alternative solutions like Liquefied Natural Gas.
- Support to the work of the International Maritime Organization. Regulation of the limitation and control of ship emissions

Actions intended to promote mode change in the mobility of people and freight towards more energy-efficient modes (Spain)

Spain has a markedly urban population. Spanish Sustainable Mobility Strategy (EEMS) is the national framework used to promote sustainable mobility plans. This strategy integrates principles and tools to guide and give consistency to sector policies which facilitate sustainable, low-carbon mobility. This mobility plan has been implemented in 50,000 inhabitants as part of the 2008-2012 EEAP. After that, Law 22/2013 on General State Budgets of 23 December 2013 includes the application of a mechanism for evaluation energy efficiency criteria in the concession of state aid to public transport systems. The goals in order to continue improving the energy efficiency in this sector are to continue working on urban mobility, promoting mobility plans to achieve important changes in transport modality with more efficient modes detriment to the use of private, low-occupation vehicles and to continue encouraging the use of modes which do not consume fossil fuels, such as walking and cycling.

6. Promotion of efficient heating and cooling

Elaborate a National Comprehensive Assessment of CHP and District Heating-Cooling System

This strategic measure involves two important processes: identification of the technical and economic potential.

Identification of the technical potential

This identification is classified in three phases due to the complexity of the process. Firstly, the identification of the overall heating and cooling demand is performed and it will be identified by integrating and analytical approach which is based on the characterisation of clusters of users and on the application of KPIs. Secondly, the identification of the supply from efficient systems that supply information about the geographical distribution of the efficient systems. And finally, the identification of technical potential which is identified by comparing the previous two phases.

Identification of the economic potential

This strategic carries out the economically sustainable share of the identified technical potential.

7. Energy transformation, transmission, distribution and demand response

Establish an efficiency criteria in grid tariff and in the electricity sector regulation

Among others the incentive schemes could be focused on the following topics:

- Removal of tariff elements discouraging energy efficiency
- Signals in grip tariffs to improve energy efficiency
- Tariffs stimulating demand response

Facilitate and promote demand management

Focus on the following activities:

- Remove demand discrimination in energy and services markets,
- participation of aggregators in the services market.

Improve grid design and regulation

Among others the incentive schemes could be focused on the following topics:

- Introduce flexible services into the electric system to permit to users implement energy efficiency improvement measures,
- encourage grid operators to improve infrastructure efficiency,
- priority of dispatch classification and publication.

3.3 Energy efficiency financing trends

The EU will need invest €100 billion per year[30] in order to meet the EU´s 2020 energy efficiency target. It exists the need of private energy efficiency investments through a targeted use of public fund, then the EU has increased the amount of public funds available.

The main funding schemes promoted by the EU are:

- Horizon 2020.
- IEE programme.
- European Energy Efficiency Fund (EEEF).
- Project Development Assistance.
- European Structural & Investment Funds (ESIF).

Some mechanisms used in order to manage these funds are:

- Tax incentives.
- Subsidies.

3.3.1 Public energy efficiency financing mechanisms

Most important public funds in the EU

Most of the funds mentioned are public funds. Here, there is an explanation of each one and some projects which use them.

Horizon 2020

Horizon 2020[31] is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract.

The Programme reflects the politic priorities in order to reach the goals the Europe 2020 strategy. This challenge approach resources and knowledge from different fields, areas, technologies and disciplines.

This programme will invest founds on challenges like Health, demographic change and wellbeing, food security, clean an efficient energy…

IEE programme

Intelligent Energy – Europe (IEE[32]) is now closed. This program offered a helping hand to organizations willing to improve energy sustainability. Launched in 2003 by the European Commission, the programme was part of a broad push to create an energy-intelligent future for us all. It supported EU energy efficiency and renewable energy policies, with a view to

reaching the EU 2020 targets (20% cut in greenhouse gas emissions, 20% improvement in energy efficiency and 20% of renewables in EU energy consumption).

The different areas supporting by this programme were[32]:

- Energy efficiency and the rational use of energy (SAVE)
- New and renewable resources (ALTENER)
- Energy in transport (STEER)
- Integrated initiatives.

Project Development Assistance (PDA)

The European Commission has set up different PDA[33] facilities to support the development and launch of ambitious and replicable energy efficiency projects:

Table 5. Programmes of the fund called PDA

Programme	Manager	Objective
PDA	Agency for Competitiveness and Innovation (EACI)	Provides grants to help local and regional authorities develop and launch large-scale sustainable energy investments.
ELENA	European Investment Bank (EIB)	Develop sustainable energy investment projects.

European Energy Efficiency Fund (EEEF)

The European Energy Efficiency Fund[34] was initiated by the European Commission in cooperation with the European Investment Bank. After the initial capitalization the sponsors European Investment Bank, Cassa Depositi e Prestiti as well as the Investment manager Deutsche Bank were added.

EEEF aims to support the goals of the European Union to promote a sustainable energy market and clime protection. EU is still raising climate change mitigation by improving energy efficiency to reduce greenhouse gas emission. The main objectives of EEEF are:

- Contribute to the mitigation of clime change. Investments should contribute significantly towards energy savings and the reduction of greenhouse gas emissions to promote the environmentally friendly use of energy. For this reason, EEEF treats to invest in public sectors because it offers an enormous potential.
- Achieve economic sustainability of the fund. The fund observes the principles of sustainability and viability, combining environmental considerations and market orientation.
- Attract private and public capital into clime financing in order to achieve the first two objectives.

Private Financing for Energy Efficiency instrument (PF4EE)

PF4EE[35] is managed by the EIB and funded by the Programme for the Environment and Climate Action (LIFE programme).

The PF4EE instrument provides:

- A portfolio-based credit risk protection provided by means of cash-collateral.
- Long-term financing from the EIB.
- Expert support services for the Financial Intermediaries.

European Structural & Investment Funds (ESIF)

Under ESIF[36], more than €27 billion is ring-fenced to support the shift towards a low-carbon economy. Funds work together to support economic development across all EU countries, in line with the objectives of the Europe 2020 strategy. The EU's 5 structural and investment funds are:

- European Regional Development Fund (ERDF)
- European Social Fund (ESF)
- Cohesion Fund (CF)
- European Agricultural Fund for Rural Development (EAFRD).
- European Maritime & Fisheries Fund (EMFF).

Financial mechanism for energy efficiency projects

Tax incentives

An offer to pay less tax, given to people who do something that the government is trying to encourage.

The following example was implemented in Italy[37]:

Italy has been offering tax incentives for energy efficiency improvements to existing buildings since 2007. The program provides tax credits to households and companies for single retrofit measures such as thermal insulation, installation of solar panels, and replacement of heating and air-conditioning systems, or for comprehensive retrofit work.

Tax credit can cover 55% of the energy-related cost, but cannot exceed a maximum value that is determined by the type of measure taken (see table 1). Tax credits are reimbursed over 10 years, beginning with the completion of work.

The program boosted retrofit investment in the residential sector between 2007 and 2009. In 2009, building owners submitted 240,000 tax credit claims. Table 2 summarizes the main performance indicators of the Italian tax incentives program in 2009. There are no estimates

on the free rider rates, which were likely high for replacement of windows.

A survey of a similar tax credit program in France reported a high share (51%) of households who stated that availability of tax credits did not influence their retrofitting decisions (MURE 2010). In 2009, total investment in buildings retrofit provided by the program constituted more than $3.6 billion, primarily in households (96%).

Table 6. Measures Supported and Level of Tax Credits in Italy[38]

Type of measure	Performance required	Tax credit	Max value
Comprehensive retrofit measures	Reduction of primary energy demand for heating to levels at least 20% lower than the current building code	55%	$139,430
Thermal insulation a) Walls b) Roofs c) Basements d) Windows	For climate zone of > 3000 HDDs: a) 0,26 W/m2 K b) 0,23 W/m2 K c) 0,28 W/m2 K d) 1,30 W/m2 K	55%	$83,658
Thermal solar installations	Panels (components) with 5-year guarantees and quality certification	55%	$83,658
Replacement of heating / air conditioning systems	Certified equipment from manufacturer for small installations, detailed criteria for larger installations	55%	$41,829

Table 7. Claims and Investment Supported by the Italian Tax Incentives in 2009[39]

Type of measure	Number of claims accepted	Average energy savings per measure (kWh/a)	Average cost per energy unit saved ($/kWh/a)	Average cost per measure ($)	Total investment ($ millions)
Comprehensive retrofit	5,622	21,528	0.04	18,915	106
Thermal insulation					
a) Walls	5,377	8,025	0.14	23,261	125
b) Floors and roofs	9,838	16,115	0.15	36,617	360
c) Windows	114,806	2,626	0.25	13,205	1,516
Thermal solar installations	35,248	6,960	0.07	9,619	339
Replacement of heating / air conditioning systems	68,056	9,164	0.15	17,212	1,171

Comprehensive retrofit projects delivered the highest average savings and were significantly

more cost-effective than other measures. The average savings for comprehensive retrofits was $0.04 per kilowatt-hour, compared to window replacement, which was six times less cost effective.

The distribution of investments across different measures is not uniform. Despite higher energy saving potentials and absolute support values, the share of comprehensive retrofits was only 3% of total investment and 2% of total claims in 2009. The low demand for comprehensive retrofit can be partially explained by the greater complexity of such measures, a lack of information and certified advisors, as well as by insufficient incentives. Because relative support for comprehensive or single measures is the same, there is no additional financial incentive to pursue higher levels of efficiency.

At the same time, performance criteria for comprehensive retrofit are more stringent than for single measures. As a result, it is unlikely that these tax incentives in their current form have led to a significant increase in the comprehensive thermal retrofit rate. The fact that the tax credit scheme in Italy has multiple objectives should be taken into consideration, however.

In addition to improving the energy performance of buildings, it also aims to stimulate growth in the construction and solar thermal panels markets, as well as creating an incentive for households to receive installation services from legal sources, since income from such sources, e.g. window replacement, is often unreported.

Subsidies

A benefit given by the government to groups or individuals usually in the form of a cash payment or tax reduction. The subsidy is usually given to remove some type of burden and is often considered to be in the interest of the public.

Politics play an important part in subsidization. In general, the left is more in favor of having subsidized industries, while the right feels that industry should stand on its own without public funds.

These subsidies can be obtained for the buy of different objects like:

Refrigerators

In France, the subsidy policy has a welfare cost of about €6.4 million. The subsidy generates a bigger saving in CO_2 than the energy tax, almost six times greater. In terms of the welfare costs per ton of CO_2, the subsidy has a cost of €60/ton.

In Denmark, the subsidy policy has a small welfare benefit of about €15,900. In terms of CO_2 savings the subsidy option reduces emissions by 38,000 ton. In terms of the welfare costs per ton of CO_2, the subsidy option has a benefit of €0.4/ton.

3.3.2 Private energy efficiency financing mechanisms

Most important private funds in the EU

Two of the main funds explained in the previous sector are public-private. For this reason, these funds are taken into account hear. They are PF4EE and EEEF and some projects have been developed.

Private Financing for Energy Efficiency instrument (PF4EE)

Example project highlights[40]:

SANTANDER ENERGY EFFICIENCY FL.

Framework loan dedicated to finance energy-efficiency schemes in hotels in Spain. The objectives are the financing of energy efficiency and small renewable energy investments mainly in existing hotels and, to a lesser extent, in other buildings for tourist accommodation, all located in Spain. The investments involve a variety of measures such as improvements to the building envelope, heating and cooling systems, energy-efficient lighting, energy-management systems, solar heaters, etc.

The promoters of the underlying sub-projects are private companies not operating in the utilities sector and not having the status of a contracting entity, and thus are not subject to EU rules on public procurement. However, if after the project appraisal, the EIB were to conclude that a sub-scheme is after all subject to EU public procurement legislation (i.e. Directive 2004/17/EC), then the Bank would require the financial intermediary to ensure that contracts for the implementation of the sub-project have been/will be tendered in accordance with the relevant applicable EU procurement legislation (Directive 2004/17/EC and Directive 92/13/EEC), with publication of tender notices in the EU Official Journal, as and where required.

European Energy Efficiency Fund (EEEF)

Example projects highlight[41]:

The University of Applied Sciences Munich and the Energy Service Company (ESCO) of Johnson Controls entered into an energy performance contract (EPC) for both buildings of the university's campus in Munich-Pasing with a total EPC volume of € 1.1 m. The ESCO and the university agreed on energy efficiency measures comprising the optimization of heating, lighting, metering, building management and pumping as well as the acquisition of a 49.5 kW combined heat and power (CHP) plant. The implementation of all measures achieved primary energy savings of 1,275 MWh and 9 tonnes of CO_2 emissions in 2013.

Although it is a smaller project, it proves the concept of combating climate change through a smarter use of energy which also benefits the public budget. It even includes a small component of decentralized energy production for the university's own use. This project can serve as a role model for further energy efficiency investments in educational facilities such as universities, schools and kindergartens.

City of Orleans

This CHP plant, with an installed capacity of 7.5 MW in electricity and 17 MW in thermal heat, will supply heat to the city of Orléans and sell the electricity via a Power Purchase Agreement (PPA) to Electricité de France (EDF) at a negotiated tariff set over 20 years. During the first partial year of operation, the CHP plant achieved primary energy savings of 2,470 MWh and 23,361 tonnes of CO2.

The project enables decentralized energy supply for the city of Orleans using an existing district heating network. The plant will allow 15,000 households in the city to achieve annual savings of € 200 with the new energy source and increase environmental sustainability especially of private households. The supply of biomass can be ensured within a 100 km radius, which is pretty comfortable. Also by signing a long term PPA with EDF, the off-take of the project risk is minimized.

Financial mechanism for energy efficiency projects

Performance contracting

Legal agreement in which one organization agrees to pay another when they successfully finish the project or task they were to do[42]. Project example:

Energy savings performance contracting, Bremer Bäder project (Germany).

EUROCONTRACT is a platform for the promotion of Energy Performance Contracting in Europe. The project called "Bremer Bäder", treats to replace of the water installations for a modernization. The goals of this project are: electricity savings of 3.6%, heating savings of 12% and water savings of 12%. The CO_2 reductions are also estimated at 5% [43].

Carbon financing

General term applied to resources provided to a project to acquire appropriately certified greenhouse gas (GHG) emission reductions ("carbon" for short). The purchaser can then use these reductions to meet, for example, obligations to reduce carbon emissions which may have been incurred under EU or national legislation. Commitments of finance for the purchase of carbon have grown rapidly since the first carbon purchases began in 1996. Carbon funds are financial entities which facilitate the operation of carbon finance[44].

Project example:

GEF Small Grants Programme: Climate Change

This program is part of the AFOLU projects. The goal of this programme is the removal of barriers to energy efficiency and energy conservation; promoting the adoption of renewable energy by removing barriers and reducing implementation costs; conservation and restoration of arid and semi-arid areas; efficient stoves and biogas to reduce forest loss; integrated watershed management; soil conservation; afforestation; prevention of forest

fires; and organic farming. The maximum financing support project is US$50,000, but averages around US$20,000. Grants are channeled directly to CBOs and NGOs[45].

3.3.3 Evaluation of the impact of energy efficiency mechanisms

To do in Deliverable 3.4.

4 Key findings on energy efficiency trends

To do in Deliverable 3.4.

4.1 Consumer trends

4.2 Policy trends

4.3 Financing trends

4.4 Main conclusions

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