Ministry of Economy

National Energy Efficiency Action Plan for Poland 2014

Warsaw, October 2014

INTRODUCTION

The National Energy Efficiency Action Plan, hereinafter referred to as the "National Action Plan" was prepared pursuant to Article 6(1) of the Act of 15 April 2011 on energy efficiency (Journal of Laws No 94, item 551, as amended[1)]). In accordance with Article 24(2) and Annex XIV of Directive 2012/27/EU on energy efficiency (OJ L 315 of 14.11.2012, p. 1), hereinafter referred to as "Directive 2012/27/EU", Member States are required to submit to the European Commission National Action Plans, including information on energy efficiency improvement measures already adopted or to be adopted.

The National Action Plan includes a description of measures intended to improve energy efficiency, focusing on energy end-use efficiency by sectors, and calculations concerning energy end-use savings achieved in 2008-2012 and expected in 2016, as required by Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC (OJ L 114 of 27.04.2006, p. 64). This document was prepared by the Ministry of Economy with the assistance of the Ministry of Infrastructure and Development and of the Central Statistical Office of Poland (GUS) [2)].

The Minister of Infrastructure and Development is in charge of reporting as regards Directive 2010/31/EC on the energy performance of buildings (OJ L 153 of 18.6.2010, p. 13), and, in accordance with Articles 4 and 5 of Directive 2012/27/EU, reporting on buildings' modernisation and an exemplary role of public bodies' buildings.

Calculations concerning energy savings were made on the basis of data transmitted by GUS and Eurostat, and on the basis of data obtained from the "ODYSSEE-MURE 2012" project, prepared under the EU programme "Intelligent Energy - Europe".

[1)] Amendments to this Act were published in the Journal of Laws of 2012, items 951, 1203 and 1397).

[2] 1 Statistical information and data from the Central Statistical Office publication "Efektywność wykorzystania energii w latach 2001-2011" ("Energy efficiency in 2001-2011"), Warsaw 2013 were used in this document.

Contents

1. Introduction

The National Action Plan includes a description of:

- adopted and planned energy efficiency improvement measures in different sectors of the economy, crucial for achieving the national target for efficient use of energy by 2016;
- additional measures to achieve the general energy efficiency objective, understood as arriving at 20 % primary energy use savings in the European Union by 2020.

The First National Energy Efficiency Action Plan was prepared and forwarded to the European Commission in 2007. This document presented a calculation of the national target for efficient use of energy by 2016. This target requires by 2016 a minimum of 9 % of energy end-use savings of the average annual consumption, (i.e. 4.59 Mtoe of energy end-use savings by 2016).

The Second National Energy Efficiency Action Plan for Poland 2011 presents information on the progress in the implementation of the national target for efficient use of energy and on measures taken in order to remove obstacles to the achievement of this target. This document was adopted by the Polish Council of Ministers in April 2012 and forwarded to the European Commission.

The present National Action Plan is the third national plan, and the first plan prepared on the basis of Directive 2012/27/EU on energy efficiency (OJ L 315, 14.11.2012, p. 1). In order to continue measures taken in accordance with Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC (OJ L 114, 27.04.2006, p. 64), hereinafter referred to as "Directive 2012/27/EU", this document uses information and data regarding energy efficiency improvement measures included in previous plans.

The following assumptions were taken into account for the National Action Plan:

- the policy aimed at increasing energy efficiency of the economy will be continued, resulting in reducing energy consumption;
- the envisaged measures will be based as much as possible on market mechanisms, and budget funding will be limited to a minimum;
- the objectives will be achieved following the principle of minimum cost, that is by maximising the use of existing mechanisms and organisational infrastructure;

the national potential for energy efficiency will be availed of.

Energy end-use savings achieved in 2012 and forecast for 2016 in accordance with Directive 2006/32/EC were established in two ways. On the basis of national statistics and evaluation models, total overall energy end-use savings were calculated for the national economy as a whole and for all the end- use sectors. In addition, energy end-use savings were calculated using the bottom-up calculation method for selected measures. This method makes it possible to show a direct connection between the implementation of these measures and the State's energy policy. Measures monitored in accordance with the bottom-up method cover a significant part of the overall energy end-use savings - more than 30 % of the total energy savings which, in accordance with Directive 2006/32/EC should be determined using the bottom-up method. The results obtained are included in Chapter 2.3, in which energy end-use savings are indicated by energy end-use sectors. Energy savings achieved in 2012 and savings to be achieved by 2016 are indicated (top-down and bottom-up).

The national energy efficiency context

Poland actively participates in the creation of the Community energy policy, and in legislative work in the area of energy efficiency, with due regard to national context, protection of consumer interests, its energy resources, and technological conditions of energy production, transmission and distribution..

Poland is making a significant progress in the implementation of the national target for efficient energy management, i.e. towards achieving by 2016 a minimum of 9 % of the final energy savings of the 2001-2005 national average consumption. As a result of GDP growth being higher than the growth rate of energy consumption is a decreasing primary and final energy intensity, with the exception of 2010. In the years 2006 to 2009, the rate of improvement exceeded 5 % in the case of the primary energy consumption and almost 4 % in the case of end-use energy.

The sector of the economy with the highest demand for end-use energy is industry, even though its demand for energy decreased from approximately 32 % in 2000 to 24 % in 2011. Energy-intensive industries (the iron and steel industry, the chemical industry and the mineral industry) account for 60 % of energy consumption in the processing industries. At the same time, there was a significant increase in the demand for energy in the transport sector (from 17 % to 27 %). The share of households in energy consumption fluctuates between 32 % and 30 %, while the share of agriculture decreased from 10 % to 6 %. These changes reflect trends in economic development (e.g. an increase of foreign trade), as well as measures taken in the industrial sector (rationalisation of energy consumption linked with the growing prices of energy carriers). An increase of demand for energy from the transport sector resulted from a substantial increase in

the volume of traffic, both cargo (deriving from an increase of economic activities), and passenger transport (increased level of prosperity of the population, increased saturation of the passenger cars market). The gap between Poland and the European average as regards the main energy efficiency indicators narrowed to around 12 % - 16 %, but the most efficient economies remain well ahead.

Programmes implemented by the National Fund for Environmental Protection and Water Management (NFOŚiGW), support from the funds of the Operational Programme for Infrastructure and Environment (POIiŚ) in the years 2007 to 2013 and in 2014 to2020, as well as preferential loans are very important financial instruments supporting energy-efficient investments. These programmes are described in detail in chapter 3.

"Polish Energy Policy to 2030" is being implemented in Poland since 2010. The objective of this policy, devised on the basis of the Energy Act of 10 April 1997 (Journal of Laws of 2012, item 1059, as amended[3)]) is to meet the most important challenges facing the Polish energy sector, both short-term and up to 2030. As a result of implementation of measures set out in this document, there was a significant improvement of energy efficiency, and consequently an increase in the energy security of the country. Stimulating investments in modern, energy-efficient technologies and products contributes to the increase of innovativeness in the Polish economy. Energy-saving measures significantly contribute to improving the economic effectiveness of the Polish economy and its competitiveness.

[3)] Amendments to the consolidated text of this Act were published in the Journal of Laws of 2013, items 984 and 1238, and of 2014 items 457, 490 and 942.

2. Review of national energy efficiency targets and the level of energy savings

2.1. National energy efficiency targets for 2020

The implementation of Article 3(1) of Directive 2012/27/EU involves devising national energy efficiency targets for 2020. Table No 1 presents the energy efficiency target for Poland devised in accordance with Directive 2012/27/EU. This target implies reducing by 13.6 Mtoe[4] primary energy consumption in the period 2010-2020. Combined with the economic growth, this will also mean an improvement of the energy efficiency of the economy.

The target is also expressed in terms of an absolute level of primary energy consumption and final energy consumption in 2020. The energy efficiency target has been calculated on the basis of data drawn up during the preparation of analyses and forecasts carried out for a government document "Poland's Energy Policy to 2030". These analyses indicate that the reduction of primary energy consumption will be the result of a number of undertakings already implemented, as well as the introduction of ambitious measures included in the country's energy policy to improve energy efficiency.

Table No 1. Summary energy efficiency targets for 2020 devised in accordance with Directive 2012/27/EU.

	Energy efficiency target	Absolute level of energy consumption in 2020	
	Reduction of primary energy consumption in 2010-2020 (Mtoe)	Absolute level of end-use energy consumption (Mtoe)	Absolute level of primary energy consumption (Mtoe)
2020	**13.6**	**71.6**	**96.4**[5]

2.1.1. Energy efficiency obligation scheme (Article 7 of Directive 2012/27/EU)

Article 7 of Directive 2012/27/EU requires Member States to set up an energy efficiency obligation schemes, or to apply alternative solutions to achieve a cumulative end-use energy savings target. Energy savings to be achieved through the national energy efficiency obligation

[4] Mtoe – million tonnes of oil equivalent, 1Mtoe = 11630 GWh

[5]) In accordance with reference values for Poland included in a forecast prepared for the European Commission (PRIMES - Baseline 2007), primary energy consumption is forecast at a level of 110 Mtoe in 202. Therefore, taking into account reduction of energy consumption by 13.6 Mtoe, we obtain: 110 Mtoe – 13.6 Mtoe = 96.4 Mtoe

schemes or through the alternative measures adopted in application of Article 7(9) of Directive 2012/27/EU must be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5 % of the annual energy sales to final customers by energy distributors or retail energy sales companies by volume, averaged over the years 2010 - 2012.

2.1.2. Cumulative target in end-use energy savings, to be achieved in the years 2014-2020, and the method of its calculation, taking into account possible deductions on the basis of Article 7(2) of Directive 2012/27/EU

In the document "Guidance note on Directive 2012/27/EU on energy efficiency - Article 7: Energy efficiency obligation schemes"[6)], hereinafter referred to as "Guidance Note", it was explained how the overall amount of cumulated and new end-use energy savings to be achieved over the 2014–2020 obligation period is to be calculated. The document also specified which statistical datasets are to be used. Moreover, this target may be reduced by Member States even by 25 % by applying any of the four possible deductions provided for in Article 7(2) (a) to (d) of the Directive.

In accordance with the Guidance note, the target in respect of energy savings is to be calculated and reported in the end-use category. Thus, the analysis must also be carried out in this category. In accordance with the Directive, energy consumption in transport cannot be included in the basis for calculating energy savings. The value of the basis from which energy savings will be calculated is presented in Table No 2, in accordance with data provided by Eurostat[7)].

Table No 2. End-use energy consumption in Mtoe in the years 2010-2012, according to Eurostat

Item	INDIC_NRG	No.	2010	2011	2012	average
B_101700	**End-use energy consumption**	**1**	**66.33**	**63.87**	**63.64**	**64.61**
B_101900	**End-use energy consumption - Transport**	**2**	**17.61**	**17.81**	**17.30**	**17.57**
End-use energy consumption (excluding transport)		**3=1-2**	**48.72**	**46.06**	**46.34**	**47.04**

Source: Eurostat 2014

6) Commission Staff Working Document - Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC - Article 7: Energy efficiency obligation schemes, SWD(2013) 451 FINAL

7).http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database (X 2013)

From the base value of 47.04 Mtoe, 25 % of end-use energy consumption may be deducted if this energy is used in the industrial area EU-ETS, defined in Annex I to Directive 2003/87/EC[8].

Directive 2012/27/UE provides two possibilities for calculation of the cumulative target in end-use energy savings, to be achieved in the years 2014 to 2020:

- first - standard energy savings in accordance with Article 7(1) of the Directive - 1.5 % annual savings until 2020, i.e. a total of 10.5 %;
- second - reduced energy savings in accordance with Article 7(2) of the Directive, i.e. a total of 9 %

of the annual energy sales to final customers by volume, averaged over the last three years before 1 January 2013.

At the same time, in accordance with Article 7(2) of Directive 2012/27/EU, each Member State may:

- exclude from the calculation all or part of the sales, by volume, of energy used in industrial activities listed in Annex I to Directive 2003/87/EC (Article 7(2)(b);
- allow energy savings achieved in the energy transformation, distribution and transmission sectors to be counted towards the amount of energy savings (Article 7(2)(c);
- count energy savings resulting from individual actions newly implemented since 31 December 2008 that continue to have an impact in 2020 and that can be measured and verified, towards the amount of energy savings (Article 7(2)(d).

Member States may avail of any of the above-mentioned methods of counting towards the amount of energy savings (i.e. they are free to choose one or more solutions). However, they must take into account Article 7(3) of Directive 2012/27/EU stating that they may not lead to a reduction of more than 25 % of the amount of energy savings.

On the basis analyses, it was decided to adopt a standard programme for implementation, i.e. 1.5 % annually until 2020, i.e. a total of 10.5 % in accordance with Article 7(1) of Article 7(1) of Directive 2012/27/EU, which corresponds to end-use energy savings by 2020 amounting to 3.675 Mtoe.

2.1.3. Energy consumption in the industrial part of the sector EU-ETS (taking into account exclusions on the basis of Article 7(2)(b) of Directive 2012/27/EU)

[8] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275, 21.7.2001, p. 32).

The determination of final energy consumption in the industrial part of the sector EU-ETS is necessary in order to calculate the possible scope of exclusions, i.e. to calculate the ultimate target in energy savings, to be met under the scheme (Article 7(2)(b) of Directive 2012/27/EU). This consumption is presented in Table No 3.

In accordance with the Commission's Guidance note [9)], from this exclusion must be deducted the energy used for the energy activities consisting of fuels combustion (in installations with a rated thermal input exceeding 20 MW), mineral oil refineries; and coke ovens.

Table No 3 Average consumption of final energy in EU-ETS sectors in years 2010-2012

Description		Average final energy consumption in 2010-2012
		Mtoe
1.	Iron and steel production sector	2.26
2.	Cement industry	1.08
3.	Ceramic industry	0.12
4.	Chemical industry	1.1
5.	Timber industry	0.35
6.	Paper industry	0.74
7.	Glass industry	0.82
8.	Lime industry	0.52
9.	Other industries	1.2
10.	**Total: EU ETS excluding the energy sector**	**8.19**

Source: Calculated on the basis of KOBiZE data (database of the National Centre for Emissions Balancing and Management)

In accordance with Table No 3, the consumption of final energy in the industrial part of the EU-ETS sector, i.e. excluding the consumption by the energy sector, amounts to 8.19 Mtoe. In

[9] Guidance note, Section B4, point 18: From this amount must be deducted the energy used for the three 'energy activities' that are listed in Annex I of the ETS Directive: combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations); mineral oil refineries; and coke ovens.

accordance with the Commission's Guidance note[10], this consumption can be deducted from the cumulative final energy consumption in a portion which would not lead to a total reduction of more than 25 % of the amount of cumulative energy savings by 2020. A decision was taken to avail of a possibility provided for in Article 7(2)(b) of the Directive, according to which energy savings which it is possible to achieve depend on energy consumption in the industrial part of the EU -ETS sector. Therefore, in accordance with the adopted standard energy saving scheme (10.5 % according to Article 7(1) of the Directive), the maximum level of deductions is 4.90 Mtoe of final energy.

Table No 4 presents calculations for the programme of standard energy savings - 1.5 % annual increase, resulting in a total of 10.5 % savings of final energy in 2020.

[10])Guidance note, Section B4 points 18 and 19

Table No 4 Calculations of final energy savings for the programme of standard energy savings (total 10.5 % in 2020), taking into account deductions

year	cumulative energy savings	energy savings with no deductions	deductions - maximum 25 % total	energy savings after maximum 25 % deductions	deductions from the industrial part of the EU - ETS	energy savings after EU -ETS deductions
	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe
2014	1.5	0.70	0.175	0.525	**0.123**	**0.58**
2015	3	1.40	0.35	1.05	**0.246**	**1.15**
2016	4.5	2.10	0.525	1.575	**0.369**	**1.73**
2017	6	2.80	0.70	2.10	**0.491**	**2.31**
2018	7.5	3.50	0.875	2.625	**0.614**	**2.89**
2019	9	4.20	1.05	3.15	**0.737**	**3.46**
2020	**10.5**	**4.90**	**1.225**	**3.675**	**0.86**	**4.04**

Source: Calculations on the basis of Directive 2012/27/EU, of the Guidance note, and of Eurostat data

The analysis shows that in the adopted programme of standard energy savings, the deduction of final energy consumption from industrial EU- ETS (3.44 Mtoe) does not result in the 25 % ceilings being exceeded. It also makes it possible to avail of an additional deduction on the basis of Article 7(2)(c) or (d) of Directive 2012/27/EU amounting to 1.46 Mtoe of energy end-use savings.

2.1.4. Methodology used for the calculation of energy savings for Article 7 of Directive 2012/27/EU, Annex V to that Directive, and point 3.2 of Annex XIV to that Directive

In accordance with Article 7(6) of Directive 2012/27/EU, Member States are to ensure that the savings stemming from paragraphs 1and 2 of this Article are calculated in accordance with points (1) and (2) of Annex V to that Directive. EU Member States are to put in place measurement, control and verification systems under which at least a statistically significant proportion and representative sample of the energy efficiency improvement measures operated by the obligated parties is verified. That is conducted independently of the obligated parties.

In accordance with the scheme established on the basis of the Act, entities participating in tendering procedures for investments which are to improve energy efficiency must submit to the

President of the Energy Regulatory Office a correctly completed declaration of interest in the tender, together with an energy efficiency audit prepared for the investment. The detailed scope of the energy efficiency audit and the method and procedures used for its verification are defined in a Regulation of the Minister of Economy of 10 August 2012 on the detailed scope of the energy efficiency audit and the method of its preparation, models of energy efficiency audit sheets, and methods used to calculate energy savings (Journal of Laws item 962). Preparation of the energy efficiency audit for an investment is an obligatory requirement which must be met in order to apply for the white certificate. On the basis of the energy efficiency audit, basic parameters of investments which are to improve energy efficiency are determined. These parameters include annual average final energy savings and annual average primary energy savings. These parameters are recorded on the energy efficiency audit sheet.

The energy efficiency audit prepared before the implementation of an investment aimed at improving energy efficiency, focused on the description of possible types and variations of such investment, together with an assessment of its economic profitability and energy savings which can be achieved, and should cover in particular, in relation to the method of its preparation:

1) an indication of technically feasible and economically justifiable types and variations of investments, taking into account the use of different technologies;
2) a detailed description of improvements planned under different types and variations of investments;
3) an indication of energy savings capable of being achieved, together with an assessment of the economic profitability of every investment which it is possible to implement, and in particular:
   a) assumptions taken and sources of data used for the calculation of energy savings,
   b) procedures applied for data analyses, calculation methods and mathematical models used, as well as detailed description of formulae, indicators and coefficients used in these calculations,
   c) assessment of economic profitability of different types and variations of investments, including in particular: types of investment costs, current and forecast prices of fuels and energy used in the assessment, and anticipated period of return on investment;
   d) results of calculations and conclusions regarding the selection of an optimal variation or type of investment, together with a list of software used to calculate energy savings.

Following the implementation of investments for which energy savings of more than 100 toe[11] annual average were declared, an entity which obtained an energy efficiency certificate is required to prepare an audit confirming energy savings achieved. In all other cases, for energy savings below 100 toe, an entity which obtained the energy efficiency certificate has to enclose a certificate confirming the conformity of the investment with the declaration of interest.

In accordance with Article 23 of the Act, audits confirming energy savings achieved, as well as declarations, are subjected to a verification procedure by the President of the Energy Regulatory Office, or at his request. The Act provides for penalties for energy savings lower than indicated in the declaration of interest if the verification procedure finds that this is the case.

Pursuant to the Act, the President of the Energy Regulatory Office publishes information on energy efficiency certificates issued, together with energy efficiency audit sheets. This ensures compliance with the requirement of Article 7(8) of Directive 2012/27/EU to publish the energy savings achieved under the scheme.

The conversion factors resulting from the efficiency of processes of conversion of primary energy into final energy are determined by the Regulation of the Minister of Economy of 4 September 2012 regarding the method of calculation of the amount of primary energy corresponding to the value of the energy efficiency certificate and the level of unit substitution fee (Journal of Laws item 1039). Values of these factors were determined separately for electric power, heat, and natural gas, assuming that they are equal to the reciprocals of the input of non-renewable primary energy factors, in relation to the fuel or energy source used. They amount to:

1) 0.33 – for electric power supplied from the electricity network;
2) 0.83 – for heat supplied from the heat distribution network;
3) 0.91 - for natural gas.

[11] tonne of oil equivalent (toe) - the equivalent of one tonne of crude oil with heating value equal to 41 868 kJ/kg

2.2. Review of primary energy savings

In the National Action Plan primary energy savings to be achieved by 2016 and by 2020 respectively were estimated. The approach adopted in the calculations was to calculate the size of energy savings in respect of individual measures for improvement of energy efficiency, described in Chapter 3.

The obligation to provide general information in respect of primary energy savings refers to energy efficiency measures which were, or are to be introduced in order to implement Directive 2012/27/EU. In the National Action Plan there is no requirement to indicate energy savings already achieved, as the deadline for the submission of the document precedes the deadline for the implementation of the Directive. At this stage, only primary energy savings planned for 2020 were estimated. A harmonised method for calculating primary energy savings is not available. Detailed data regarding primary and final energy savings planned for 2016 and for 2020 are presented in Table No 5.

Table 5. Review of estimates for primary and final energy savings

	Primary energy savings (Mtoe)	Final energy savings (Mtoe)
2012 - achieved		6.31
2016 - forecast		7.09
2020 - forecast	13.33	8.27

Estimates for primary energy savings were calculated using the bottom-up method presented in point 2.3.2. Primary energy savings were calculated by dividing final energy savings aggregated in Table No 19 in the second part of Annex No 2 to the National Action Plan by conversion efficiencies presented in point 2.3.2. of Table No 8.

2.3. Review of final energy savings

In Table No 6 a review of targets in energy savings calculated in accordance with Directive 2006/32/EC is presented, i.e. 9 % of the annual average of national final energy consumption in the period 2001-2005 and energy savings achieved.

The Table shows that both the amount of achieved and planned final energy savings will exceed the calculated targets.

Table No 6. Review of final energy savings targets

	Target in final energy savings		**Final energy savings achieved in 2010 and to be achieved by 2016**	
	In absolute terms	As a percentage of average consumption in 2001-2005	In absolute terms	As a percentage of average consumption in 2001-2005
2010.	1.02 Mtoe	2 %.	4.73 Mtoe	9.3 %.
2016.	**4.59 Mtoe**	9 %.	7.09 Mtoe	13.9 %.

Table No 7 presents final energy savings achieved by 2012, by energy end-use sectors

Table No 7. Review of final energy savings achieved, by sectors

Sector	**Final energy savings achieved (Mtoe)**		
	2010	2011	2012
Households	1.46	1.19	1.86
Services	0	0	
Industry	1.74	2.17	2.29
Transport	1.53	1.25	2.16
Total:	**4.73**	**4.61**	**6.31**

2.3.1. Final energy savings calculations using the top-down method

Energy savings were calculated using the top-down method, according to the methodology published by the European Commission: "Recommendations on Measurement and Verification Methods in the Framework of Directive 2006/32/EC on Energy end-use Efficiency and Energy Services". The year 2007 is recommended by the European Commission as the base year. Based on the analysis of data availability, the following indicators may be used in reference to the given economy sectors.

	Sector of the economy	Indicator
1.	Households .	P1
2.	Services	M3, M4
3.	Transport	P9
4.	Industry	P14

The description of the indicators and the calculations can be found in Annex 2 to the National Action Plan. On the basis of calculated indicators (as these indicators difference), energy end-use savings in different sectors and sections of the Polish Classification of Activity (PKD) were determined in accordance with the above-mentioned recommendations of the European Commission.

The calculations were made on the basis of data transmitted by GUS and Eurostat, and on the basis of data obtained from the "ODYSSEE-MURE 2012" project, prepared under the EU programme "Intelligent Energy - Europe". For the last few years, GUS and Krajowa Agencja Poszanowania Energii (KAPE) S.A. (the Polish National Energy Conservation Agency) have participated in successive projects aimed at assessing energy efficiency and describing the measures implemented to improve energy efficiency ("Monitoring of European Union and national energy efficiency targets: ODYSSEE - MURE 2010"). Under this project, an ODYSSEE[12)] database and a MURE[13)] database have been developed. These databases contain information concerning energy efficiency indicators and measures to improve energy efficiency.

Annex No 3 to the National Action Plan presents energy savings calculations made on the basis of the ODEX indicator which is the result of work carried out under the ODYSSEE – MURE project and methodology developed under that project. The ODEX energy efficiency indicator is used to measure energy efficiency. It was developed to meet the requirements of energy efficiency monitoring and to obtain an understandable and comparable indicator illustrating energy efficiency progress in European Union Member States. The ODEX indicator is calculated by aggregating changes in unit energy consumption, observed in a particular time at specific levels of end-use consumption. It is calculated for each year as a quotient of real energy consumption in a given year and of theoretical use of energy, not taking into account unit consumption effect, i.e. assuming that energy intensity of production of a given product remains at the existing level. To reduce accidental fluctuations, ODEX is calculated as a 3-year moving average. A drop in the value of the indicator means an increase of energy efficiency. The ODEX indicator does not show the current level of energy intensity, but progress in relation to the base year. It is useful for monitoring the implementation of the indicative target regarding energy savings specified in Directive 2006/32/EC.

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12) www.odyssee-indicators.org

13) http://www.odyssee-mure.eu

2.3.2. Final energy savings calculations using the bottom-up method

A detailed way of calculating final energy savings using the bottom-up method was used for each energy efficiency improvement measure described in Chapter 3. A table presenting algorithms used in the calculations is included in Annex No 2 to the National Action Plan.

In the case of programmes involving several sectors, conversion factors were used which are the weighted average, the weights representing the share of public funds contribution. Efficiency of primary energy conversion into final energy is presented in Table No 8.

Table No 8. Efficiency of primary energy conversion into final energy

	Efficiency of primary energy conversion
Heat distribution networks	0.830[14)]
Electrical energy	0.330[15)]
Transport	0.350[16)]
Economy average	0.620[17)]

[14)] Regulation of the Minister of Economy of 4 September 2012 regarding the method of calculation of the amount of primary energy corresponding to the value of the energy efficiency certificate and the level of unit substitution fee (Journal of Laws item 1039).
[15)] In accordance with the Regulation, see above
[16)] Efficiency of primary energy conversion into final energy (vehicle diesel engine efficiency) is adopted here in accordance with W. Salejda et al., *Termodynamika*, Politechnika Wrocławska, Wrocław 2001.
[17)] Calculations based on a GUS study „Efektywność wykorzystania energii 2001-2011" ("Energy use efficiency 2001-2011", Warsaw 2013.

3. Measures to increase energy efficiency

This part describes the more important measures for improving energy efficiency, already implemented or to be adopted. It also indicates energy savings achieved as a result of implementation of these measures. The bottom-up method (BU) is used for calculating energy savings for measures concerning final energy use. Following an analysis of the already functioning programmes and measures for energy efficiency improvement, priority measures for the National Action Plan were selected, and new measures mere introduced which will ensure that targets regarding energy efficiency for 2020 will be met.

As a result, the following energy efficiency improvement measures were defined:

1. Horizontal measures:

1) Energy efficiency certificates scheme (white certificates);
2) Priority Programme: Smart Grids (ISE);
3) The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iv.); - Development and implementation of intelligent distribution systems for average and low voltage;
4) Information and educational campaigns.

2. Measures in respect of energy efficiency in the buildings of public institutions

1) Thermomodernisation and Repairs Fund;
2) Green Investments Scheme. Part 1 - Energy management in public utility facilities;
3) The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iii.) - Supporting energy efficiency, intelligent energy management and promotion of renewable energy sources for public infrastructure, including public buildings, and in the housing sector;
4) Improvement of energy efficiency, Part 3 - Subsidised loans for the construction of energy-efficient houses.
5) Operational Programme PL04 - "Energy savings and promotion of renewable energy sources" under the EEA Financial Mechanism in 2009-2014 (c 5 - energy efficiency, and area No 6 - renewable energy);
6) Green Investments Scheme. Part 5 - Energy management in the facilities of selected public finance sector entities;
7) Energy efficiency improvement. Part 2 - LEMUR - Energy Efficient Public Utility Facilities;

8) Operational Programme Infrastructure and Environment (OPIE) 2007-2013 (Measure 9.3) - Thermomodernisation of public utility facilities;
9) Efficient energy use Part 6 - SOWA - Energy-efficient street lighting;
10) Regional operational programmes for 2014-2020.

3. Energy efficiency measures in industry and SMEs:

1) Support for operators as regards low-emissions and resource saving business. Part 1 - Energy/electricity supply audit of an enterprise;
2) Support for operators as regards low-emissions and resource saving business. Part 2 - Increase of energy efficiency;
3) Programme of access to financial instruments for SMEs (PolSEFF);
4) Energy efficiency improvement, Part 4 - Energy-efficient investments in small and medium-sized enterprises;
5) OPIE Programme 2007-2013 (Measure 9.1) - Highly efficient energy generation;
6) OPIE Programme 2007-2013 (Measure 9.2) - Highly efficient energy distribution;
7) The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.ii.) - Promotion of energy efficiency and of the use of renewable energy sources in enterprises;
8) Regional Operational Programmes for 2014-2020.

4. Energy efficiency measures in transport:

1) OPIE Programme 2007-2013 (Measure 7.3) - Urban transport in metropolitan areas and (Measure 8.3) - Development of intelligent transport systems;
2) Green Investments Scheme. Part 7 - GAZELA – Low emission urban transport;
3) The Operational Programme Infrastructure and Environment 2014 -2020
4) Regional Operational Programmes for 2014-2020.

5. Efficiency in energy generation and supplies (Article 14 of the Directive)

1) The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.v.) - Promoting low-emissions strategies for all kinds of territories, in particular for urban areas, including support for sustainable multi-modal urban mobility and adaptive measures with mitigatory influence on climate changes;
2) The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.vii.) - Promoting the use of high-efficiency heat and electric energy cogeneration on the basis of the demand for service heat.

3.1 Horizontal measures

3.1.1 Energy efficiency obligation scheme (white certificates)

The energy efficiency obligation scheme was introduced pursuant to the Act of 15 April 2011 on energy efficiency (Journal of Laws No 94, item 551 and of 2012 items 951, 1203, and 1397), hereinafter referred to as the "Act". In accordance with the Act, this scheme is to operate from 1 January 2013 until 31 December 2016.[18] The Act imposes on energy operators selling electricity, heat, or natural gas to end users an obligation to obtain and present for redemption to the President of the Energy Regulatory Office energy efficiency certificates (white certificates), or to pay a substitution fee.

In accordance with Article 25 of the Act, energy efficiency certificates generate property rights which are considered a commodity within the meaning of the Act of 26 October 2000 on commodity exchange markets (Journal of Laws of 2014, item 197), and as such they are subject to trading on the Commodity Exchange Market. It is assumed that energy efficiency certificates can be obtained primarily for investments which are characterised by the highest economic efficiency. They are selected through tender by the President of the Energy Regulatory Office. A decisive parameter in the selection of tender bids is the value of the energy effect (ω), understood as the ratio between the quantity of energy saved during a year as a result of the implementation of an investment or investments of the same type in order to improve energy efficiency, and the value of the energy efficiency certificate. Winning a tender is connected with a selection of bids for which the parameter (ω) is within a specified range. Certificates are issued in a sequence corresponding to the value of the declared energy effect.

Under the scheme, obligated parties have a specific value of certificates which they must obtain and present for redemption every year starting from 2013. This value and the method of its calculation is defined in the Regulation of the Minister of Economy of 4 September 2012 regarding the method of calculation of the amount of primary energy corresponding to the value of energy efficiency certificates and the level of unit substitution fee (Journal of Laws item 1039).

Up to now, the President of the Energy Regulatory Office has published two tenders for the selection of investments for which it is possible to obtain energy efficiency certificates. The

[18] Following the implementation of Directive 2012/27/EU, a new Energy Efficiency Act is to be introduced. This Act will extend the functioning of the energy efficiency certificates (white certificates) scheme until 2020.

first tender was concluded on 29 August 2013 (the results were published on 13 September 2013), the second tender is underway.

The first tender was published for three areas, so-called investment categories aimed at improving energy efficiency:

1) increase of energy savings by final consumers,
2) increase of energy savings by facilities using energy for own needs,
3) reduction of losses of electricity, heat or natural gas in transmission or distribution.

Category (1) - applying to end users covers all sectors of final energy use. Category (2) - applies only to so-called facilities using energy for own needs, defined as a complex of construction works, or installations, in the meaning of Article 3(10) of the Act of 10 April 1997, Energy Law, using energy in the process of generating electricity or heat. Category (3) - reduction of losses of electricity, heat or natural gas in transmission or distribution - applied to modernisation of networks transporting energy carriers, together with appropriate process-related installations.

According to the information available in the Public Information Bulletin on the Energy Regulatory Office website, 212 bids were submitted in the first tender and 102 of these bids were accepted. More than half of bids submitted were rejected for formal reasons.

A definite majority of entities which submitted bids are companies professionally involved in the production or distribution of heat - approximately 75 % of applications. Other entities included electricity distributors, housing cooperatives, research institutes, etc.

As a result of the first tender, the following values of energy efficiency certificates were awarded[19]:

Category (1) - 42 tenders were successful, for a total value of 13.18 ktoe,

Category (2) - 19 tenders were successful, for a total value of 3.78 ktoe,

Category (3) - 40 tenders were successful, for a total value of 3.56 ktoe.

Energy efficiency certificates for a total value of 20.5 ktoe were awarded. This constitutes less than 4 % of the available pool of 550 ktoe. The following factors probably contributed to such a poor result of the first tender: a short deadline for the submission of tendering documents which was due to the legal regulations in force, and a low quality of documents submitted during the tendering procedures. In the case of enterprises, an audit (at least a preliminary one) is necessary to estimate energy savings. The audit makes it possible to identify areas for improvement of

[19] http://bip.ure.gov.pl/bip/efektywnosc-energetyczn/swiadectwa-efektywnosci/1144,Zagregowane-dane-dotyczace-wydanych-swiadectw-efektywnosci-energetycznej-2014-r.html

energy efficiency. Moreover, a company decision is necessary regarding the need to implement an investment. Such decision guarantees the sources of financing.

Table No 9 presents aggregated data concerning energy efficiency certificates issued and final and primary energy savings achieved.

Table No 9. Aggregated data concerning energy efficiency certificates issued by the end of 2014, and final and primary energy savings achieved

Cumulative data, as at the end of the month	Number of energy efficiency certificates issued (pcs)	Value of energy efficiency certificates issued (toe)	Total final energy savings declared in the period when energy savings were achieved (toe)	Total primary energy savings declared in the period when energy savings were achieved (toe)	Total estimated amount of reduction of CO_2 emissions in the period when energy savings were achieved (tonnes)
January 2014	59	9 898.610	115 528.570	183 863.960	668 018.185
February 2014	90	14 981.730	185 584.620	282 719.760	1 009 366.935
March 2014	94	15,116.730	187 245.120	284 604.860	1 016 081.535
April 2014	100	19 057.730	205 953.820	332 697.860	1 186 722.435
May 2014	101	20 518.730	213 183.820	354 612.860	1 261 602.435

Table No 10. Description of horizontal measures

Name of the measure:	**Energy efficiency certificates scheme (white certificates)**
Category	Obligation imposed on entities selling electric power, heat, and natural gas, to either obtain certificates of energy efficiency (white certificates) and submit them for redemption to the President of the Energy Regulatory Office, or pay a substitution fee.
Objective of the programme	Support mechanism for measures aimed at improving energy efficiency of the economy. Increase of energy savings by end users and by facilities using energy for own needs[20]. Reduction of losses of electricity, heat or natural gas in transmission or distribution.
Programme actions	The white certificate scheme supports energy-efficient investments, such as modernisation of local heating grids and heat sources, buildings, lighting, household appliances, as well as energy recovery and modernisation of industrial devices and installations. The President of the Energy Regulatory Office is entitled to issue and redeem white certificates. Property rights resulting from the certificates are subject to trading, and they are considered a commodity subject to trading on the commodity exchange market or on the regulated market. A detailed list of projects which may be submitted in the tender procedure will be the subject of a notice by the Minister for Economy. The Minister of Economy will have an additional task related to system monitoring: to calculate the achieved energy savings, as well as to prepare reports and submit them to the European Commission.
Status	(2) is underway - the first tender was concluded, the second tender is underway, 101 certificates were issued by the end of May 2014.
Duration	From 1.01.2013 to 31.12.2016
Type of beneficiaries	Energy companies selling electricity, heat, or natural gas to final consumers connected to the grid on the territory of the Republic of Poland, excluding companies selling heat to final consumers if the total amount of power ordered by these consumers does not exceed 5 MW. Entities implementing investments to improve energy efficiency or entities authorised by them to act on their behalf (authorised entities). Final consumers connected to the grid on the territory of the Republic of Poland, who are members of the commodity exchange market[21)], in relation to transactions concluded on their own behalf on the commodity exchange market; Commodity brokerage houses or brokerage houses[22)]
Implementing Body	The President of the Energy Regulatory Office
Managing Authority	The Ministry of Economy
Budget	approximately PLN 0.7 million per year from funds which are at the disposal of the Implementing Body.

3.1.2 Energy audits and energy management systems (Article 8 of Directive 2012/27/EU)

[20] facilities using energy for their own needs - a complex of construction works, or installations, in the meaning of Article 3(10) of the Act of 10 April 1997, Energy Law, used in the process of generating electricity or heat.
[21)] within the meaning of Article 2(5) of the Act of 26 October 2000, on commodity exchange markets (Journal
[22)] Referred to in Article 2(8) and (9) of the Act of 26 October 2000 on commodity exchange markets.

Large enterprises are defined in Article 8(4) of Directive 2012/27/EU as enterprises that are not small and medium-sized enterprises (SMEs). These enterprises are subject to an energy audit.

In accordance with a definition laid down in Article 2(26) of Directive 2012/27/EU "small and medium-sized enterprises" (SMEs) means enterprises as defined in Title I of the Annex to Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. This category is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million EUR, and/or an annual balance sheet total not exceeding EUR 43 million. In accordance with the Act on energy efficiency which is in preparation, entrepreneurs in the meaning of the Act of 2 July 2004 on the Freedom of Economic Activity (Journal of Laws of 2013 item 672, as amended[23)]), with the exception of those running small and medium-sized enterprises in the meaning of Articles 104 to 106 of this Act, will be obliged to carry out, if this is economically justifiable, an energy audit every four years, or to have such an audit performed. Enterprises that are implementing an energy or environmental management system in compliance with the relevant European Standards are exempted from this requirement.

An energy audit is to be carried out by an independent entity which has knowledge and professional experience in performing this type of audits. If the energy audit of an enterprise is carried out by experts from the audited enterprise, they may not be directly involved in auditing the activities of that enterprise. Energy audits of an enterprise are to cover detailed and validated calculations for the proposed measures which are designed to improve energy efficiency, and to provide information on potential energy savings.

An energy audit of an enterprise

1) is to be carried out on the basis of up-to-date, measured, and traceable data on energy consumption and, (for electricity) load profiles;
2) should comprise a detailed review of the energy consumption profile of buildings or groups of buildings, in industrial installations, and in transportation;
3) should be based, whenever possible, on life-cycle cost analysis (LCCA) instead of Simple Payback Periods (SPP) in order to take account of long-term savings, residual values of long-term investments and discount rates;

Operators are to be required to keep the data used in energy audits for a five-year period, for control purposes.

[23)] Amendments to the consolidated text of this Act were published in the Journal of Laws of 2013, items 675, 983, 1036, 1238, 1304 and 1650.

3.1.3 Metering and billing (Articles 9 to 11 of Directive 2012/27/EU)

In order to implement climate policy and increase the efficiency of energy consumption, an introduction is envisaged of tools which would make it possible for the consumer to consciously use this energy, such as smart meters, together with accompanying services[24)]. Providing consumers with a possibility to constantly monitor actual energy consumption and, at the same time, billing the consumer on the basis of actual consumption, encourages in the most direct manner rational and effective utilisation of the State's energy resources. An additional argument in support of the use of smart meters, particularly important in Poland, is lessening of the risk of imbalance in the national electricity system. It is expected that the introduction of intelligent metering systems will contribute to reducing energy consumption, in particular during peak periods. Thus, this issue was introduced already in 2010 in a Government document "Poland's Energy Policy to 2030", with appropriate entries regarding providing consumers with electronic meters, with a possibility to send price signals and proper communication between consumers and suppliers in accordance with standards which are being introduced regarding technical characteristics, installation, and reading of these meters.

The Act of 26 July 2013 amending the Energy Act and certain other Acts (Journal of Laws item 984) introduced rules regarding planning by distributors of projects involving the gathering, transmission and processing of measurements from smart meters. It also contains provisions which make it obligatory for energy companies to guarantee an adequate level of safety of data obtained from smart meters.

Work is being carried out at present to estimate the impact on energy efficiency of changes envisaged following the installation of smart meters.

Promotion and information activities in the area of intelligent energy networks will also be supported from the Cohesion Fund under the Operational Programme Infrastructure and Environment for 2014-2020 Investment Priority (PI) 4iv. - Development and implementation of intelligent distribution systems for low and medium voltage.

Table No 11. Description of horizontal measures

Name of the measure:	**Priority Programme: Intelligent energy networks (IEN);**
Category	Funds

[24)] "The analysis of economic viability of the introduction of intelligent forms of measurement of electricity in Poland", study carried out at the request of the Ministry of Economy, 20 August 2012.

Objective of the programme	The National Fund for Environmental Protection and Water Management will provide financial support for: promotional and educational actions; the implementation (in pilot areas) of smart metering and information transmission networks; efforts in balancing and optimisation of electricity consumption (measuring and feedback); the implementation (in pilot areas) of dispersed renewable energy sources; energy storage facilities and smart lighting networks using energy-efficient lighting; development works; development of IT systems and specification of standards. The implementation of intelligent energy networks in pilot city areas will be conducive to sustainable development of cities.
Programme actions	▪ promotional and educational actions as regards intelligent energy networks, paying particular attention to smart grid, including smart metering; ▪ implementation of smart measuring systems (AMI) in pilot areas, and optimisation of electricity, gas and thermal energy use and service water use; ▪ implementation of distributed renewable and/or alternative energy sources within smart grid projects (in pilot areas), dispersed, renewable, and/or alternative energy sources; ▪ implementation of energy storage devices within smart grid projects (in pilot areas); ▪ implementation of smart lighting networks using energy-efficient lighting in pilot areas; ▪ preparing studies (including IT software) for energy transmission and distribution companies to facilitate the development of peak load times management systems and for integrating energy measurement and distribution with telecommunications systems; ▪ preparing technical feasibility studies for intelligent energy networks projects; ▪ preparing studies concerning specifications and standards for measures related to intelligent energy networks.
Status	(2) is underway - one tender was finalised (the selection of applications from 3.12.2012 to 31.01.2013), no further tenders are planned.
Duration	from 2012 to 2017
Type of beneficiaries	▪ entrepreneurs – operators of electric/gas fuel distribution and transmission systems who balance the system and cooperate with local government and/or housing cooperatives (associations); ▪ local government units which in their area organise pilot IEN areas and develop IEN projects in different layers; ▪ administrators of special economic zones[25)]
Implementing Body/Institution	Minister of the Environment, National Fund for Environmental Protection and Water Management
Managing Authority	Ministry of Economy
Budget/ source of	Funds from the National Fund for Environmental Protection and Water

[25)] Capital companies pursuant to Art.6 of the Act of 20 October 1994 on special economic zones (Journal of Laws of 2007, No 42, item 274, of 2008, No 118, item746, and of 2009 No 18, item 12).

financing	Management PLN 60 million - non-reimbursable forms (grants)

Table No 12. Description of horizontal measures

Name of the measure:	**The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iv.); - Development and implementation of intelligent distribution systems for average and low voltage;**
Category	Funds
Objective of the programme	The objective of the programme will be to intensify the development of renewable energy sources, to increase energy efficiency through optimisation and rationalisation of electric energy consumption, and in consequence the programme will have an impact on meeting the targets of EU climate and energy policy.
Programme actions	Under the Priority *Development and implementation of intelligent distribution systems for average and low voltage,* support is to be provided for the construction of intelligent networks as pilot and demonstration projects. Projects implemented will focus on the modernisation and development of distribution systems for average and low voltage, connected with the implementation of "smart grid" technology in order to enhance, among other things, the possibilities of connection of renewable energy sources (RES) and/or to reduce network losses. Intelligent measuring sets and systems for monitoring and steering intelligent network are among the features of financed projects. Investment projects to be supported are to cover the following elements: ▪ construction of intelligent distribution systems for average and low voltage, dedicated to increased generation of energy from RES, and/or reduced energy consumption, including replacement of transformers, and, as an element constituting an integral part of the project, an intelligent measuring system; ▪ comprehensive pilot and demonstration projects implementing intelligent solutions in a given area, aimed at optimising the use of energy generated from RES and/or rationalisation of energy consumption; ▪ measures involving promotion of know-how regarding intelligent energy transmission and distribution systems, solutions, standards, and best practices related to intelligent networks.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	Energy companies
Implementing Body/Institution	Ministry of Economy
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	EUR 120.05 million, contributions from the EU Cohesion Fund

3.1.4 Consumer information and advisory programme (Articles 12 and 17 of Directive 2012/27/EU)

Information on energy efficiency improvement measures and financial mechanisms are available to all relevant market actors, such as consumers and SMEs.

In the years 1999-2013 Krajowa Agencja Poszanowania Energii S.A. (the Polish National Energy Conservation Agency KAPE S.A.) 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).

The following are some of the actions taken by the National Contact Point of the IEE Programme:

- offering information on the IEE Programme to potential beneficiaries;
- preparation and dissemination of materials on the IEE Programme;
- organisation of National Information Days related to the calls for tenders published by the European Commission;
- organisation of training for institutions interested in participation in the programme;
- participation in training, conferences and workshops organised by other institutions;
- translation of working documents;
- preparation and updating of the www.cip.gov.pl website;
- preparation of reports on the participation of Polish entities in calls for proposals, and reports from entities implementing programmes within the IEE Programme;
- assistance in preparing applications.

There are also many organisations, associations, and institutions whose tasks include providing information and advisory services regarding the promotion of energy conservation issues. They include in particular such organisations as: Narodowa Agencja Poszanowania Energii (National Energy Conservation Agency) – „NAPE", Fundacja na rzecz Efektywnego Wykorzystania Energii (Foundation for Efficient Energy Use) - „FEWE**",** regional energy agencies (e.g. Bałtycka Agencja Poszanowania Energii (Baltic Energy Conservation Agency) – „BAPE", Regionalna Agencja Poszanowania Energii (Regional Energy Conservation Agency) in Toruń – „RAPE", Mazowiecka Agencja Energetyczna (Masovia Energy Agency) – „MAE", Podkarpacka Agencja Energetyczna (Carpatian Energy Agency) – „PAE", Instytut na rzecz Ekorozwoju (Institute for Eco-Development), and other sector-specific organisations.

Information campaigns addressed to the public, whose objective is to shape ecological attitudes and to show how to save energy, also play an important role in creating better energy efficiency.

The Ministry of Economy, in collaboration with the National Fund of Environmental Protection and Water Management envisages the implementation of a nation-wide advisory programme regarding energy efficiency (including RES), also in enterprises. This programme will be implemented in the years 2015-2023. It will constitute a necessary support for the development of a low-emission economy in Poland, linked with so-called low-emission[26] economy plans prepared by municipalities with the help of, among other things, the funds from the OPI&E (2007-2013).

The initiative aimed at developing the advisory system to promote a low-emission economy in the regions will be based on the cohort of advisers providing expertises at a regional and local levels for local government entities, enterprises, natural persons and housing cooperatives.

The objective of the programme is

- to increase public awareness in the area of energy efficiency and RES by making it possible to exchange information at the local and regional levels and to promote good practices in implementation of Directive 2010/31/E and Directive 2012/27/EU (e.g. creation of uniform standards and guidelines);

- to support at a local level the preparation of plans of low-emission economy and the resulting projects regarding energy efficiency and RES;

- to provide incentives for local authorities to create positions of energy advisers to promote energy efficiency;

- to create a training system to enhance the qualifications of municipal advisers.

The nation-wide advisory programme regarding energy efficiency and RES will implement the provisions of Directive 2012/27/EU (Articles 12 and 17) and of Directive 2009/28/EC (Article 14(6)).

The implementation of the programme will be financed from the Cohesion Fund under the Operational Programme Infrastructure and Environment 2014-2020.

Moreover, in the years 2012-2014, the following information and educational campaigns were conducted:

- **Time to save energy**

An information campaign conducted by the Ministry of Economy for the rational use of energy, entitled "Time to save energy". The objective of the campaign is to present issues

[26] The low-emission economy plans cover such issues as combating climate changes, air quality improvement in the areas where air quality standards were not met, energy supply and its use, assurance of security of supply, and promotion of "clean" urban transport, taking into account growing mobility needs of city-dwellers and of inhabitants of the cities functional areas.

connected with the principles and profitability of applying energy-saving solutions and to acquaint the Polish public with issues reflected in the activities of the Minister of Economy, aimed at increasing the energy efficiency of the Polish economy. As part of the campaign the following promotional and educational measures were taken:

1) Publishing:

- information brochures (i.e. a user guide and guides for manufacturers, distributors and sellers of house appliances and radio and TV equipment);
- posters promoting rational energy use;
- an information brochure addressed to pre-school age children and their parents, promoting issues connected with the rational use of energy.

2) Electronic publications:

- two manuals where ways and methods used to improve energy efficiency in the public sector are described.

3) Multimedia campaign:

- TV and radio spots aiming to influence changes in public behaviour in regards to energy savings.

- **We turn off electricity - we turn on saving and Poles save even more heat**

Campaigns were conducted by the Ministry of Environment in 2012 and 2013 devoted to energy savings in households. During campaigns, the largest nationwide Polish TV stations broadcast spots in which well-known personalities encouraged the carrying out of simple everyday actions which contribute to energy savings and make it possible to reduce energy bills.

- **Free your energy and protect the environment**

Advertisements by spots of the Energy Regulatory Office, broadcast during 14 days, were seen by more than 15 million TV viewers. The broadcasts started on 17 June 2012 on TVP and were part of the "Information and educational campaign promoting efficient and cost-effective energy management beneficial for the natural environment and for home budgets". The objective of the campaign was to inform consumers about rights and benefits available to them as well informed and active participants in the energy market. During the campaign, the spot was several times broadcast immediately before the matches during the European Football Cup. 4 million people watched these spots. During that time the number of viewings on the page dedicated to the change of an energy supplier www.maszwybor.ure.gov.pl, increased 10-fold.

Table No 13. Description of horizontal measures

Name of the measure:	**Operational Programme Infrastructure and Environment 2014-2020. Nation-wide advisory programme regarding energy efficiency and RES**
Category	Funds
Objective of the programme	The objective of the programme is: • developing the advisory system to promote low-emission economy in 16 regions of the country, based on the cohort of advisers providing services at regional and local levels for local government entities, the public sector, and housing cooperatives, and enterprises; • increasing public awareness (including among groups to which support under OPI&E and under regional operational programmes is dedicated) in the area of energy efficiency and renewable energy sources; • encouraging local authorities to create dedicated workplaces for energy advisers (by demonstrating the benefits of retaining a post of energy adviser, and to further finance this workplace from local authorities funds, after its financing from the project's funds have finished.
Programme actions	• advisory services; • training; • information activities; • educational visits; in topical areas: preparation and implementation of low-emission plans for municipalities, low-energy construction and thermomodernisation, energy-efficient street lighting, low-emission transport, renewable sources of energy, financing of energy projects, energy efficiency in enterprises, procedures of OPI&E 2014-2020.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	NFEP&WM
Implementing Body	Minister of Economy
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	Cohesion Fund

Table No 14. Description of horizontal measures

Name of the measure:	**Information and educational campaigns.**
Category	Information campaigns dealing with energy efficiency
Objective of the programme	Changes in public behaviour with a view to people becoming more saving-conscious through information and educational campaigns addressed to energy users, including households. Increase in social awareness regarding energy efficiency, funding (and in

	particular through ESCO formula and White Certificates scheme), energy-efficient buildings and other issues relating to energy use and environmental risks.
Programme actions	National campaigns promoting energy efficiency improvement measures, including implementation of innovative technologies by public sector units, promotion of energy-efficient buildings, promotion of ESCO financing. Other measures include information and educational actions and training, and on the websites of relevant Ministries and programme participants publication of handbooks and guidebooks about the available measures to improve energy efficiency and on the rules of using the measures. The campaigns are organised by the Ministry of Economy, the Ministry of Environment, and the Ministry of Infrastructures and Development, and other institutions involved in the programme, including local governments and non-governmental organisations, and energy producers and distributors. They will be implemented by professional companies involved in information campaigns supported by the knowledge of consulting firms. The topics focus on energy use. As far as monitoring of the campaign is concerned, the Minister of Economy is in charge of calculating the energy savings achieved in 2016, preparing reports and submitting them to the European Commission.
Status	(2) under way - in the years 2012-2013 information and educational activities were carried out by the Ministry of Environment, the Ministry of Economy, and the Energy Regulatory Office. Whether these activities will be continued (e.g. in respect of energy-efficient buildings) depends on the availability of funds.
Duration	from 2012 to 2016
Type of beneficiaries	End users of energy, including households, enterprises and public finance sector institutions
Implementing Bodies	Minister of Economy Minister of Environment Ministry of Infrastructure and Development
Managing Authority	Ministry of Economy
Budget	approximately PLN 2 million per year from funds which are at the disposal of the Implementing Bodies

3.1.5 Qualification, accreditation and certification schemes (Article 16 of Directive 2012/27/EU)

In accordance with Article 16 of Directive 2012/27/EU, 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 as defined in Article 2(9) of Directive 2010/31/EU. All information regarding the certification, accreditation, or qualification schemes should be made publicly available. If the level of technical competence, objectivity and reliability of the above-mentioned entities can be recognised as sufficient for the implementation of Directive 2012/27/EU objectives, the introduction of appropriate schemes

should be considered, first of all as regards qualifications, aimed at accelerating the development in the area of energy efficiency and competences of entities operating in this area. Currently, the Polish legislation provides for three basic types of documents aimed at permitting entities interested in the improvement of energy efficiency to assess the level of energy intensity of buildings and installations, and to identify sources of possible energy savings and costs involved in the introduction of pro-efficiency solutions. These solutions include:

- **Energy audits**

In accordance with the Act of 21 November 2008 on the support for thermomodernisation and repairs (Journal of Laws of 2014, item 712), an energy audit means a study defining the scope and technical and economic parameters of thermomodernisation projects. It indicates solutions which are optimal from the point of view of costs of implementation and energy savings. It provides the basis for applying for thermomodernisation work. The objective of thermomodernisation is to reduce energy consumption for heating a building, for preparing warm service water, and to reduce costs involved in ensuring appropriate conditions for comfortable use of premises.

Energy audits include optimalisation variants in respect of: insulation of buildings' envelope, replacement of windows and external doors, replacement or modernisation of the heating system, replacement or modernisation of the system of preparation of hot service water, modernisation and improvement of the ventilation system, and use of energy from renewable sources or high-efficiency cogeneration. The scope of thermomodernisation work which should be taken into account in the energy audit should be as much comprehensive as possible, covering both a reduction of heat losses by building's envelope, and the use of efficient heating and transmission installations which would guarantee maximum efficiency.

- **Energy Efficiency Audit**

In the meaning of the Act, an energy efficiency audit is a study including an analysis of energy consumption and specifying technical conditions of a premises, technical appliances or installations, including a list of projects undertaken/to be undertaken in order to improve energy efficiency of the premises, appliances or installations, as well as an assessment of their economic profitability and energy savings capable of being achieved. An energy efficiency audit is prepared in order to obtain a support in the form of white certificate.

- **Energy performance certificate of a building**

An energy performance certificate of a building, in the meaning of the Act of 7 July 1994, the Construction Law (Journal of Laws of 2013, item 1409 and of 2014 item 40) is a document

which determines the amount of energy (in kWh/m2/year) necessary to meet different needs related to the use of a building, and to indicate construction works, feasible to carry out, which would improve in a profitable way the energy performance of a building.

The above-mentioned documents differ from each other as regards their scope, volume, nature of measures indicated, and the subject of analysis. However, these documents are specific types of energy audits, i.e. documents which indicate the actual energy consumption and measures which make it possible to improve energy efficiency. Naturally, the fact that three types of energy audits are indicated above does not mean that any other audits are not acceptable. The only difference is that they are not regulated on a statutory basis and it is now a general practice by enterprises to commission comprehensive energy audits to reduce energy costs of their business activities. Entities which carry out energy audits, are required to be accredited and certified. This is to guarantee reliability and correctness of audits depending on the type of energy audit required. Currently, additional requirements are only to be met by persons preparing buildings energy performance certificates. In accordance with Article 5(8) of the Act of 7 July 1994, the Construction Law, energy performance certificates for buildings, apartments, or parts of buildings constituting a self-contained technical and functional entity, may be prepared by persons who:

- enjoy full legal capacity;
- within the scope of regulations governing third level education,
  - completed studies awarding a Masters degree, or
  - completed engineering studies in architecture, construction, environment engineering, energy, or similar;
- have no previous convictions for offences against property, offences involving credibility of documents, as well as offences involving business transactions, money and securities markets transactions, or for tax-related offences;
- possess competence in the construction field, are specialised in architecture, building construction or installation, or underwent training and successfully passed required examinations conducted by the Minister competent for construction, local planning and spatial development, and housing.

In addition to the above-mentioned requirements, the Minister competent for construction, local planning and spatial development, and housing, specifies, through a regulation, the manner in which training and examinations are to be conducted, as well as the programme scope. Completion of postgraduate studies of at least one year duration in the fields of architecture, construction, environment engineering, energy, or similar in the area of energy audit for thermal

modernisation and buildings' energy assessment is considered as equivalent to undergoing training and successfully passing examinations. The programme of the above-mentioned postgraduate studies should include the issues covered by the training programme specified, through a regulation of the Minister of Infrastructure of 21 January 2008 on training and examination for persons applying for empowerment to issue energy performance certificates for buildings, apartments, or parts of buildings constituting a self-contained technical and functional entity (Journal of Laws of 2013, item 1210, as amended). The Minister competent for higher education approves the programme of postgraduate studies proposed by relevant faculties of third-level educational establishments, following an assessment of the programme by the Minister competent for construction, local planning and spatial development, and housing.

The Minister competent for construction, local planning and spatial development, and housing keeps, in an electronic format, a register of persons who successfully passed an examination and of persons who completed the above-mentioned postgraduate studies, in accordance with Article 5(14) of the Construction Law.

After the entry into force of the new Act on Energy Performance of Buildings, the catalogue of persons empowered to prepare energy performance certificates will be extended in relation to the current provisions of the Construction Law. It will now be possible for energy performance certificates to be issued by persons who completed any field of third-level studies and obtained a title of engineer, by persons who completed third-level education, regardless the title awarded at the completion, if they also completed appropriate postgraduate studies, as well as by persons with secondary education and a construction licence. Moreover, in order to facilitate access to these licences, examinations which, according to regulations to-date, could only be sat after specialist training courses, are now abolished. In accordance with the provisions of the Act of 29 August 2014 on Energy Performances of Buildings, a separate list of persons qualified to issue buildings performance certificates and of persons qualified to carry out inspection of heating systems and air-conditioning systems, will be created. Information on these lists will be created in a tele-information system and available to the public.

In accordance with the Act on Energy Performances of Buildings, the Minister competent for construction, local planning and spatial development, and housing, will keep, in an electronic format, a central register of energy performances of buildings, where the following information will be found:

- persons qualified to issue energy performance certificates;
- persons qualified to inspect heating systems and air-conditioning systems;
- energy performance certificate issued;

- protocols from inspection of heating systems and air-conditioning systems.

The central register will help potential clients to more efficiently seek licensed specialists and will facilitate an efficient verification of certificates and inspection protocols. It will also be used for reporting tasks connected with the improvement of energy efficiency of the public sector.

On the other hand, no requirements were introduced which would restrict the possibility to issue reports on audits to be used in thermal modernisation, and on the functioning of energy efficiency audits under the white certificates system. It was decided that there is no need for such a strict limitation of access to the preparation of energy efficiency audits, which would consequently reduce the number of such reports. More attention should be paid to checking the correctness of audits than to verifying persons preparing these audits. Energy efficiency audits may be prepared by entities which do not have to confirm their qualifications through administrative procedures. This does not mean that such audits would be prepared by incompetent individuals. To prepare and carry out modernisation of specific categories of appliances, installations, or buildings, it is necessary to obtain independent certificates, specified in other Acts (e.g. in the Construction Law or in the Energy Law). As a result, for the most complicated categories of projects aimed at improving energy efficiency, accreditation and certification systems for individuals who are to carry out such projects are provided for. Duplication of certification systems which would only be used for pro-efficiency investments would only result in additional, unnecessary costs and make the functioning of energy audits more difficult.

Moreover in accordance with the Act of 26 July 2013 amending the Energy Act and certain other Acts, the term micro-installation was introduced to the Polish legal system and a separate support scheme for the developments of renewable micro-energy was introduced, together with a certification system for installers of small- and micro-installations. In accordance with the Act, an installer's certificate confirms competences for installing: boilers and stoves using biomass, photovoltaic systems, solar heating systems, heat pumps, or shallow geothermal systems. Such a certificate is issued by the Chairman of the Technical Supervision Office to persons who meet requirements specified in the Act of 10 April 1997, the Energy Law. To the procedure and requirements for the certification of installers, an extensive regulation is added which determines programme scope of training and examinations for installers, and principles governing the examinations process. It also determines who can assess the examinations, how often the examinations should be held, as well as an appeal procedure in cases where the issue of the certificate is refused. In addition, the Act regulates conditions which must be met by training centres for installers and who and on what basis grants accreditation to such centres. Certificates

are issued to installers for five years. Before the end of the validity period, installers may apply for an extension of certification. In the course of the procedure leading to an extension of certification, in addition to following mandatory complementary training courses installers are required to present a list of at least 5 installations for the carrying out of which he or she was responsible, in order to verify reliability of work and to confirm continuity of work.

The following systems for raising qualifications of auditors are available on the Polish market:

- **Postgraduate studies in the field of energy audits** - Offered by faculties of third level educational institutions, postgraduate studies programmes are approved by the Minister competent for higher education, following an assessment of the programme by the Minister competent for construction, local planning and spatial development, and housing. This is in order to ensure an adequately high level of training. Completion of these studies, provided that additional conditions of lack of criminal record and regarding education have been met, gives the right to issue buildings energy performance certificates[27].

- **Training for energy auditors:**
  - The Polish-Japanese Energy Conservation Technology Centre (PJCEE) operating at the Krajowa Agencja Poszanowanie Energii (KAPE S.A. Polish National Energy Conservation Agency). PJCEE organises, for persons involved in energy management, and for managerial staff of enterprises, cyclical training sessions to increase the competences of persons carrying out energy audits. Training is conducted in the form of lectures, practical workshops in laboratories (work with pumps, ventilators, compressors, fast steam generators, burners, dehumidifiers), and includes tutorials during which examples of energy audits are discussed. Training is organised in an open form (enrolment for training courses is done through a PJCEE website[28)] and is dedicated to specific enterprises which order such service.
  - Training projects are carried out under the Operational Programme Human Capital. By 30 September 2013, 52 training projects were completed. 8334 persons dealing with energy audits and energy efficiency improved their competences as a result. Projects were

[27] A list of third level educational institutions offering postgraduate studies in the area of energy audits can be found at the following address: http://www.mir.gov.pl/Budownictwo/Rynek_budowlany_i_technika/Efektywnosc_energetyczna_budynkow/Nadawanie_uprawnien/Documents/wykaz_studiow_podyplomowych_2013_11_05.pdf

[28)] http://www.pjcee.pl/index_.phtml?item=oferta&item1=oferta_szkolenia

carried out throughout Poland, under four priority themes. Training courses covered energy audits, certification, energy efficiency, and energy-efficient construction. Training courses were organised by third level educational institutions (public and non-public), by research institutions, and by foundations, associations, and private enterprises. The most frequent target of training courses was raising existing competences, or acquiring new ones, by the staff of construction and energy sectors.

3.1.6 Energy services market (Article 18 of Directive 2012/27/EU)

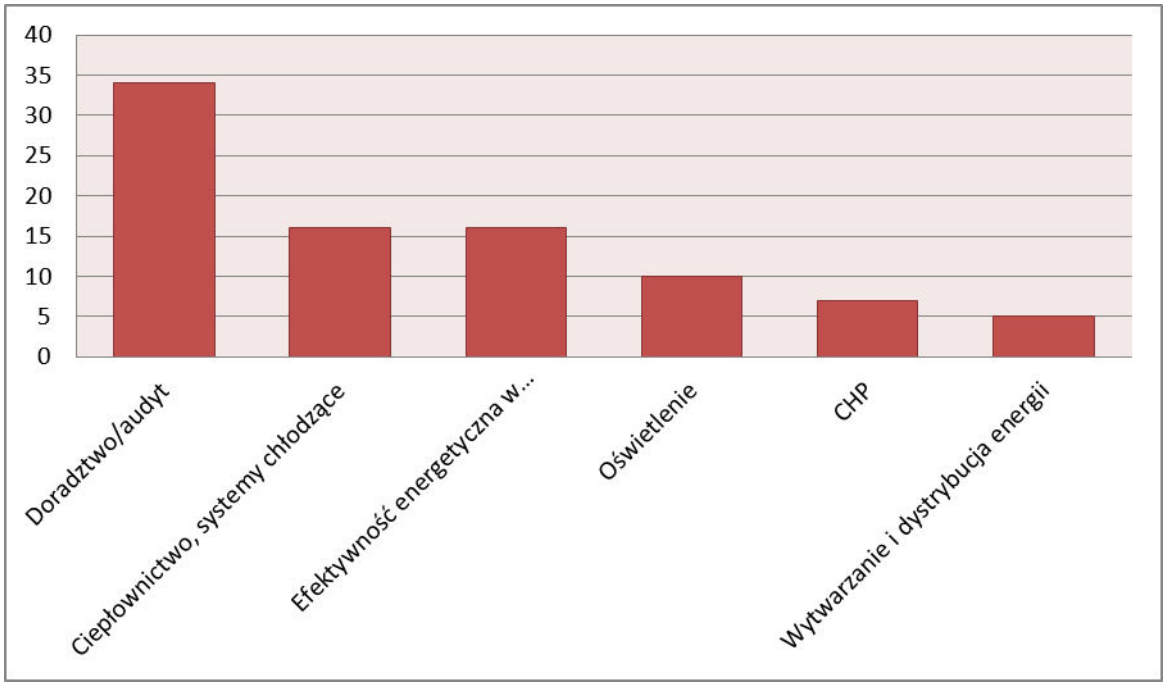
To stimulate the market for companies providing energy services, such as ESCO energy saving companies, the Act introduced provisions under which such entities may enter tenders to obtain energy efficiency certificates (white certificates). ESCO energy saving companies may be beneficiaries of the white certificates scheme due to the possibility provided by the Act to aggregate energy savings and enter tenders on behalf of other entities which will carry out, or have already carried out, energy efficiency improving investments, achieving in total energy savings of at least 10 toe. Moreover, public sector entities, obliged to use energy efficiency improvement measures under the Act, may conclude agreements on the implementation and financing of investments for improving energy efficiency with such entities as ESCO energy saving companies. This contributes to the growth of the market for services of entities which offer various non-budgetary types of financing, such as e.g. third party financing, or an agreement on the improvement of energy efficiency on the basis of which an investment is financed from the funds obtained in connection with the energy saving defined in the agreement. Other measures for developing the market for energy services are also envisaged. The measures focus primarily on facilitating the conclusion of agreements by companies operating in the ESCO formula. The main facilitation when concluding agreements on the improvement of energy efficiency and non-budgetary financing by ESCO-type companies will lie in acquiring financing, considered as own resources in carrying out projects in energy efficiency, from EU funds in the new financial perspective, and from the funds of the National Fund for Environmental Protection and Water Management. This will require, among other things, preparation of a more detailed regulatory environment in that area.

Agreement templates for different categories of services guaranteeing improved energy efficiency are described on the Ministry of Economy website, in the study entitled "Time to save energy. Manual addressed to public sector entities". A list of available suppliers of energy

services is also provided[29]. In view of the absence of GUS data describing in detail the number of these types of enterprises, the list is based on market analyses and on relevant reports published to-date. Companies listed were selected from the point of view of the scope of services provided. Provision of services means direct execution of services by the enterprises concerned.

The figure presents ESCO-type companies divided by services provided. The most popular and the most frequently provided services are advisory services and energy audits. These terms usually describe expertise aimed at identifying potential energy saving areas, and subsequently recommending concrete solutions (technical, organisational), and defining their profitability. The next step is advising on potential investments which may have an impact on a more rational energy management. This is followed by companies which deal with broadly understood heating or refrigerating issues, energy efficiency in buildings, co-generation, as well as generation and distribution of electricity or heat.

Figure. Scope of services provided by companies operating on the basis of ESCO model in Poland



Translation of Figure above: (left to right)

Consulting/audit

Heating, cooling systems

Energy efficiency in…

[29] www.mg.gov.pl/files/upload/10722/Podrecznik-Sektor_publiczny_OSTATECZNY.pdf

Lighting

CHP

Generation and distribution of energy

Currently, there is no system which would make it possible to carry out permanent monitoring and to obtain precise statistical data regarding the ESCO market in Poland. It is very likely that such monitoring is carried out by leading companies which are present on the Polish market and provide such services. According to estimates quoted by the Environmental Economy Institute, in 2011 the lower boundary value of turnover on that market in Poland was PLN 40 million, while the upper boundary value was PLN 100 million. ESCO companies operate in different sectors for different clients. ESCO clients may include the public sector, the commercial sector, the energy sector, industry, small and medium-sized enterprises, and even households which taken together constitute a significant potential for reducing energy consumption[30]. There are significant opportunities for the development of the ESCO model in the public administration sector. Even though in the recent years the volume of projects for the public administration sector decreased, this sector remains one of the more important segments of ESCO market in Poland.

In the recent years in Poland, both in industry and in households, expenditures for purchasing energy were more important than outlays for increasing energy efficiency. However, a reversal in this trend can be observed. The current economic situation, in the EU and worldwide, has forced companies to reduce costs. One of the simplest and fastest ways to achieve costs reduction is cooperation with companies operating the ESCO formula. A growing popularity and interest in this model of investment can be observed. It does not require financial outlays by companies, it offers real savings, and also introduces innovative solutions to enterprises.

We present below some examples of good practices as regards energy services in Poland. They include a project involving modernisation of lighting in Jaworzno and a project of complex thermal modernisation of buildings housing educational institutions in the Radzionków municipality. In the first project the ecological effect factor plays a very important role, in addition to economic benefits achieved. In that particular case approximately 60 % savings were achieved. Moreover it should be noted that a 50 % reduction of power provides huge savings connected with reduction of emissions, reduction of fuel consumption, and, above all, reduction of costs[31].

[30] Report ESCO market in Poland, March 2013, Environmental Economy Institute
[31] Prepared on the basis of: http://www.mg.gov.pl/files/upload/19288/9_POE_ESCP_pol_ang.pdf

Modernisation project for lighting in Jaworzno		
Main objectives	**Scope of modernisation**	**Results**
▪ Increased road safety for vehicles and more safety for pedestrians ▪ Measurable financial savings by reducing installed capacity of lighting appliances ▪ Reduction of energy intensity of the entire street lighting of the town ▪ Improved quality and standards ▪ Improved external image of town	▪ Replacement of lighting points - total number 7531 ▪ Replacement of lighting points - total number 1326	▪ Installed capacity after modernisation: 819.54 kW ▪ Savings: 60.0 % / 3752 MWh

On the other hand, the thermal modernisation investment in Radzionków municipality is a good example of a public-private partnership, where the role of the private partner was to prepare, finance, and provide heat energy management services. The private partner also gave a full guarantee that the anticipated economic and saving effect would be achieved. The agreement covers a period of 10 years: 2010-2020. The estimated amount of savings achieved as a result of modernisation is approximately PLN 3.4 million[32].

Comprehensive thermal modernisation project for educational buildings in Radzionków municipality		
Main objectives	**Scope of modernisation**	**Results**
▪ **savings obtained in spending for heat and electric energy** ▪ **maintenance of premises for a period of 10 years: 2010-2020** ▪ **reduction of CO2 emissions to atmosphere** ▪ **raising standards of facilities used**	▪ thermal modernisation of central heating installations and heat sources ▪ modernisation of lighting installations and sources ▪ implementation of a management system for heating and lighting	▪ replacement of 762 windows ▪ modernisation of 3 boiler rooms ▪ replacement of 1 179 light fittings ▪ improvement of town's aesthetic appearance ▪ positive impact on natural environment: anticipated reduction of CO2 emissions by 2010: 4 550 tonnes ▪ heat energy savings: 54 % ▪ electric energy savings: 40 %

[32] http://www.ppportal.pl/artykuly-polskie/kompleksowa-termomodernizacja-budynkow-oswiatowych-gminy-radzionkow-studium-przypadku

3.2. Measures in respect of energy efficiency of buildings

3.2.1. Building renovation strategy (Article 4 of Directive 2012/27/EU)

A building renovation strategy entitled "Supporting Investments in Building Renovation", developed by the Ministry of Infrastructure and Development on the basis of Article 4 of Directive 2012/27/EU, is presented in Annex No 4 to the National Action Plan.

3.2.2. Additional measures related to energy efficiency of buildings

Support for investment projects involving improved energy efficiency of existing buildings is provided, among other things, on the basis of the Act of 21 November 2008 on supporting thermomodernisation and repairs. The programme of support for thermomodernisation projects and related repair projects, implemented in existing, multi-apartment buildings, is financed by the Thermomodernisation and Repairs Fund, funded from the State budget. In its present form, this programme has functioned since 2009. Funds from the Thermomodernisation and Repairs Fund are designated for refinancing part of the costs of thermomodernisation and repair projects, to improve the technical conditions of existing housing resources, while at the same time reducing demand for heating. This refinancing takes in particular the form of a so-called thermomodernisation grant and repairs grant. In 2012 the following support was granted from the Thermomodernisation and Repairs Fund: PLN 139.42 million for the implementation of 2859 thermomodernisation projects with a total value of PLN 1 018.8 million; and PLN 31.79 million for the implementation of 658 repair projects with a total value of PLN 226.2 million.

To improve energy efficiency of buildings, measures were taken consisting, among other things, of introducing stricter technical and construction provisions concerning minimum requirements for energy savings and heat insulation, together with an access path to the level which should be reached by 2021, in accordance with Article 9 of Directive 2010/31/EU on the energy performance of buildings, by which time newly constructed buildings should be near-zero energy buildings. These provisions are brought into force by a Regulation of the Minister of Transport, Construction and the Marine Economy of 5 July 2013 amending the Regulation regarding technical conditions which should be met by buildings and their locations (Journal of Laws item 926).

The Ministry of Infrastructure and Development is preparing a National Plan aimed at increasing the number of buildings with low energy consumption. This applies mainly to newly constructed buildings and is the implementation of Article 9 of Directive 2010/31/EU on the energy performance of buildings. The Plan will include the level of requirements appropriate for buildings with low energy consumption and information regarding available measures of support

for improvement of energy efficiency. Moreover, activities of the National Fund for Environmental Protection and Water Management include the continuation of implementation of a group of priority programmes: "Green Investment Scheme – energy management in public utility facilities" and "Energy efficiency", focused on the following parts: "LEMUR, Energy Efficient Public Utility Facilities" and "Subsidised loans for the construction of energy-efficient houses".

Table No 15 Description of measures in respect of energy efficiency of buildings

Name of the measure:	**1. Thermomodernisation and Repairs Fund;**
Category	Funds
Objective of the programme	The objective of the programme is financial aid for investors who implement projects involving thermomodernisation, repairs, and renovation of individual houses, using credits obtained in commercial banks. The objectives of thermomodernisation projects include ▪ reducing the consumption of energy for heating and service water heating purposes in housing units, multi-apartment units, and facilities owned by local government units and used by them for public tasks; ▪ reducing the cost of acquiring heat delivered to the buildings – as a result of building a technical connection to a centralised heating source due to the liquidation of a local heating source; ▪ reducing primary energy losses in local heating grids and local heat sources; ▪ a complete or partial change of energy sources to renewable sources, or using high-efficiency cogeneration.
Programme actions	The programme covers actions aimed at: ▪ improvements which result in a reduction in demand for energy delivered for heating and service water heating purposes; ▪ improvements which result in reducing primary energy losses in local heating grids and local heat sources; ▪ building a technical connection to a centralised heating source due to the liquidation of a local heating source, which results in a reduction of cost of acquiring heat; ▪ a complete or partial change of energy sources to renewable sources, or using high-efficiency cogeneration. To obtain a thermomodernisation bonus the investor must take a loan in a commercial bank for the investment. The amount of the thermomodernisation bonus constitutes 20 % of the amount of loan for the investment, but no more than: ▪ 16 % of expenses incurred for the thermomodernisation investment, and ▪ twice the amount of expected annual energy savings, assessed on the basis of an energy audit.
Status	(2) under way - in the years 2007 to 2013 more than 20 000

	thermomodernisation bonuses were granted, for a total amount of PLN 1 billion.
Duration	From 2007. This is a systemic measure and the provisions in force do not provide for a definite time framework for the programme.
Type of beneficiaries	Owners and administrators of ▪ residential buildings; ▪ multi-apartment units; ▪ public utilities owned by local government authorities and used by them for public tasks; ▪ local heat distribution networks; ▪ local heating sources. All investors, regardless their legal status, may avail of the bonuses. They may include, for example, legal persons (e.g. housing cooperatives and corporations), local government entities, associations of owners of apartments, and natural persons, including owners of individual residential buildings. State-owned entities and plants financed from the State budget are not eligible for the bonus.
Implementing Body	Bank Gospodarstwa Krajowego
Managing Authority	Ministry of Infrastructure and Development
Budget/ Source of financing	1) funds transferred from the State budget. The amount is determined annually in the Budget Act; 2) interest on the Fund's bank deposits; 3) income from investments of the Fund's monies in securities; 4) donations and legacies; 5) other income.

Table No 16 Description of measures in respect of energy efficiency of buildings

Name of the measure:	**2. Green Investment Scheme (Part 1) - Energy management in public utility facilities**
Category	Funds
Objective of the programme	Reduction or elimination of carbon dioxide emissions through co-financing of projects improving the efficiency of energy use in public utility facilities.
Programme actions	Co-financing may be granted for investments in public utility buildings, i.e. buildings assigned to be used for the following purposes: to house local administration; to house fire protection services (Voluntary Fire Services); to be used by cultural institutions, by religious associations, by educational institutions, by scientific and research institutions, by the health service, and by social welfare and social assistance organisations. Co-financing may also be granted for investments in multi-apartment buildings intended to temporarily house people outside their permanent residence (in particular boarding schools, and student houses), and for investments in buildings intended to permanently house a significant number of people (in particular retirement homes, orphanages, nursing homes, monasteries, and convents); Thermomodernisation of public utility facilities, including equipping facilities with appliances of the highest, economically justified energy

	efficiency standards, directly related to the thermomodernisation of the facilities, in particular: ▪ insulation of a building; ▪ replacement of windows; ▪ replacement of external doors; ▪ alterations in the heating system (including changing the source of heat); ▪ replacement of ventilation and air conditioning systems; ▪ preparation of technical documentation for the investment; ▪ the use of energy management systems in buildings; ▪ the use of technologies of renewable energy sources; ▪ replacement of internal lighting by an energy-efficient one (as additional work performed together with thermomodernisation).
Status	(2) under way - since 2010, 5 tenders were organised as a result of which more than 250 applications were approved for co-financing.
Duration	from 2010 to 2017
Type of beneficiaries	▪ local government units and associations thereof; ▪ entities which are not entrepreneurs and which provide public services as part of local government own tasks; ▪ Voluntary Fire Services; ▪ universities, within the meaning of the Act on university education, and research institutes; ▪ independent public healthcare centres and healthcare establishments operating as enterprises (within the meaning of Article 55[1] of the Civil Code) providing healthcare services; ▪ non-governmental organisations, churches, other religious associations, church legal persons; ▪ entities or units defined in points 1 to 6, which are parties to a loan agreement in a collective project.
Implementing Body	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget[33]/ source of financing	Funds from AAU trade transactions[34)] or from other funds of the National Fund for Environmental Protection and Water Management: PLN 515 million - non-reimbursable forms (grants) PLN 511 million - reimbursable forms (loans).

Table No 17 Measures in respect of energy efficiency of residential buildings

Name of the measure:	**3. The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iii.) - Supporting energy efficiency, intelligent energy management and promotion of renewable energy sources for public infrastructure, including**

[33] Report on the activities of the National Fund for Environmental Protection and Water Management in 2012 (http://www.mos.gov.pl/g2/big/2013_08/1ef1588e0cc4a3ec5d4c0885a32ec17c.pdf)

[34] AAU (Assigned Amount Units) – a unit of assigned greenhouse gas emissions, equal to one metric tonne of carbon dioxide equivalent. The units were used in the Kyoto Protocol to define the amounts of emissions allowed to states-signatories over the 2008-2012 commitment period. Assigned Amount Units are subject to international trading, and the funds obtained by Poland through selling the Units are spent on the Green Investment Scheme.

	public buildings, and in the housing sector;
Category	Funds
Objective of the programme	The objective of the intervention will be to improve the quality of the environment on a local scale by reducing the emission of pollutants particularly harmful for people's quality of life. At the same time, measures to be taken provide a real support for the implementation of objectives connected with the improvement of air quality, included in the air protection programmes.
Programme actions	The support will be aimed at a so-called deep, comprehensive energy modernisation of multi-apartment residential buildings. As a result, energy efficiency will increase as well as the use of RES (if this transpires from an energy audit prepared prior to modernisation). The projects must be based on low-emission economy plans. In view of the above, measures connected with energy modernisation of buildings will promote its comprehensive dimension (a so-called deep comprehensive modernisation based on monitoring and energy management systems). The mandatory condition preceding the implementation of such projects is energy audits on the basis of which it will be possible to verify the actual energy savings. Therefore, plans must be prepared on the basis of needs assessments, covering lists of all buildings owned by the applicant and energy costs associated with these buildings. In these plans priority must be given to buildings with the greatest potential regarding energy savings. The support for investment projects involving deep comprehensive energy modernisation of multi-apartment residential buildings, covers such elements as: ▪ insulation of a building, replacement of windows, external doors, and replacing lighting with energy-efficient one; ▪ alterations in the heating system (including changing the source of heat and replacing it with a more energy efficient and eco-friendly one); ▪ installation of cooling systems, also including the use of RES; ▪ modernisation of ventilation and air conditioning systems; ▪ application of weather-sensitive automatic temperature regulation; ▪ the use of energy management systems in buildings; ▪ construction or modernisation of internal receiving installations, together with liquidation of existing heat sources; ▪ installation of micro-cogeneration or micro-trigeneration for own needs; ▪ installation of RES in energy-modernised buildings, or if this is supported by an energy audit, in buildings meeting the standards defined in the amended Regulation of the Minister of Infrastructure of 12 April 2002 regarding technical conditions which should be met by buildings and their locations; ▪ preparation of energy modernisation projects which constitute parts of investment projects; ▪ installation of individual meters for heating, cooling, and service water; ▪ installation of central heating valves and thermostats;

	▪ creation of green roofs and "living green walls"; ▪ carrying out of energy audits as part of investment projects.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	▪ housing cooperatives; ▪ associations of owners of apartments; ▪ entities which are suppliers of energy services within the meaning of Directive 2012/27/EU.
Implementing Bodies	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Planned **B**udget/ source of financing	EUR 271.02 million, contributions from the EU Cohesion Fund

Table No 18 Description of measures in respect of energy efficiency of buildings

Name of the measure:	**4. Improvement of energy efficiency, Part 3 - Subsidised loans for the construction of energy-efficient houses**
Category	Funds
Objective of the programme	Energy savings and reduction or avoiding CO_2 emissions through co-financing projects which improve the efficiency of energy use in newly constructed residential buildings.
Programme actions	Co-financing may be granted for the implementation of investments consisting of: • construction of individual houses; • purchase of new individual houses; • purchase of an apartment in a new multi-apartment residential building. The investment must meet energy standards defined in the guidelines to the programme. The amount of co-financing depends on the indicator of annual unitary demand for energy delivered for heating and ventilation, calculated taking into account guidelines to the programme and other conditions (including efficiency of installation for heating and for preparation of service water) which must be met as listed in the guidelines.
Status	(2) under way - the selection of banks granting loans under the first tranche amounting to PLN 100 million is completed.
Duration	from 2013 to 2022
Type of beneficiaries	Natural persons
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM) Non-reimbursable forms (grant for a partial repayment of the bank loan capital) - PLN 300 million.

3.3 Energy efficiency measures in public institutions

3.3.1 Buildings housing public bodies (Article 5 of Directive 2012/27/EU)

In accordance with Article(5)(1) of Directive 2012/27/EU Member States are to ensure that, as from 1 January 2014, 3 % of the total floor area of heated and/or cooled buildings owned and occupied by their central government bodies is renovated each year to meet at least the minimum energy performance requirements that they have set in application of Article 4 of Directive 2010/31/EU on the energy performance of buildings. As Article 5(6) of Directive 2012/27/EU allows for an alternative solution to the implementation of Article 5, paragraphs 1 to 5 of this Directive, we present below characteristics of the solution adopted in Poland.

1. Calculation of the target value of energy savings

In calculating the target value of energy savings, the following assumptions were taken:

- On the basis of a definition of central government in Directive 2012/27/EU and in the Guidance note[35], in order to specify institutions bound by an obligation to meet the requirements indicated in Article 5(1) of Directive 2012/27/EU, a list of central government bodies was used, as included in Annex IV of Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts (OJ L of 30.4.2004, as amended), with the exception of regional authorities, independent public healthcare establishments, and courts of general jurisdiction (regional, district and appellate) in view of the fact that their competence does not extend over the whole territory of Poland.
- Institutions obliged to meet the requirements of Article (5)(1) of Directive 2012/27/EU submitted information on useful floor area of their buildings, on values of the heat penetration coefficients for building envelope, on the value of non-renewable primary energy factor PE, on the basis of energy performance certificates, and on the value of energy consumption for heating the building, and for preparing warm service water if an energy performance certificate was not available.
- In cases of lack of an energy performance certificate for a building, the value of the PE factor for the building was assessed.

[35] Commission Staff Working Document: Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC - Article 5: Exemplary role of public bodies' buildings

- In accordance with Article 4 of Directive 2010/31/EU, minimum energy performance requirements were adopted for buildings both new or under construction, and for existing buildings subject to major renovation. These requirements are set in a Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, which entered into force on 1 January 2014 and which amends an earlier Regulation regarding technical conditions which should be met by buildings and their locations. This Regulation laid down new requirements regarding heat protection and energy efficiency of buildings and of technical systems using energy in buildings. An "access path" to meeting requirements set for 2021 was also indicated, with a view to arriving at near-zero energy buildings. For new buildings requirements were laid down regarding the maximum value of the non-renewable primary energy factor, maximum values of the heat penetration coefficients, as well as requirements concerning heating, ventilation, preparing warm service water, and cooling installations.

  For existing buildings subject to major renovation, i.e. construction works which result in a change of functional or technical parameters of existing buildings, with the exception of such parameters as air space, floor area, height, length, width, or the number of floors, requirements were set regarding building envelope's thermal insulation (maximum values of the heat penetration coefficients), as well as requirements concerning heating, ventilation, preparing warm service water, and cooling installations. The list includes buildings which by 1 January 2014 did not meet the requirements regarding heat penetration coefficient for building envelopes).
- In accordance with the Guidance Note, in the alternative approach potential energy savings should be estimated, expressed in GWh/year, for buildings which are not meeting the requirements set in the a Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, amending a Regulation regarding technical conditions which should be met by buildings and their locations. These energy savings are calculated as the difference between the non-renewable primary energy factor "EP" for a building after thermomodernisation, and the non-renewable primary energy factor "EP" for the existing building, multiplied by the surface of the building. However, in view of the fact that in the above-mentioned Regulation requirements for existing buildings depend on the values of heat penetration coefficients rather than on the non-renewable primary energy factor "EP", an assumption was used that following a major renovation in the existing buildings, the value of the "EP" factor will be equal

to the value of the "EP" factor of a newly constructed building defined in that Regulation.

We present below a list of buildings with a useful floor area of more than 500 sq. metres, belonging to central government institutions and occupied by them, which do not meet minimum energy performance requirements set in accordance with Article 4 of Directive 2010/31/EU regarding energy performances of buildings for 2014.

Energy savings for buildings with a useful floor area of more than 500 sq. metres, belonging to central government institutions and occupied by them, which do not meet minimum energy performance requirements set in accordance with Article 4 of Directive 2010/31/EU regarding energy performances of buildings (buildings do not comply with acceptable maximum values of the heat penetration coefficient, and with the acceptable non-renewable primary energy factor "EP" which determines annual demand for non-renewable primary energy per unit of floor area) for 2014.

intended use of the buildings	number of buildings	usable floor area	value of non-renewable primary energy factor "EP"		energy saving
			weighted average	based on the regulations *)	
-	pcs	m^2	kWh/(m^2·year)	kWh/(m^2·year)	MWh/year
lodgings	7	19416.20	437.93	220.00	4231.47
	9	30409.69	290.72	195.00	2910.76
multi-apartment residential building	4	3271.15	148.41	115.00	109.30
	11	12030.62	167.96	105.00	757.43
public utility facilities	77	543825.34	260.35	190.00	38256.87
	51	227066.21	263.48	165.00	22361.09
warehousing, industrial, utility	1	874.40	517.46	235.00	246.98
	12	18743.85	309.48	210.00	1864.55
TOTAL	**172**	**855637.46**			**70738.45**

*) Value of the "EP" factor which determines annual demand for non-renewable primary energy per unit of floor surface is set in the Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, amending a Regulation regarding technical conditions which should be met by buildings and their locations. This requirement was specified in accordance with Article 4 of Directive 2010/31/EU regarding energy performances of buildings.

Moreover, in view of the absence of information on energy standard for 32 buildings with a total useful floor area of 143418.66 m^2, it was not possible to define energy savings for these buildings. On the basis of calculations carried out, the target value of annual energy savings was estimated at 3 % x 70738.45 = 2122 MWh.

2. Description of an alternative solution (Article 5(6) of Directive 2012/27/EU)

In accordance with Article 5(6) of Directive 2012/27/EU, the following alternative measures were adopted to ensure the implementation of Article 5, paragraphs 1 to 5 of this Directive.

- Meeting minimum energy performance requirements included in the Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, amending a Regulation regarding technical conditions which should be met by buildings and their locations.

According to the Assessment of the Consequences of the Regulations, prepared in respect of the above-mentioned Regulation, annual savings resulting from its entry into force will amount to 513 GWh. However it should be noted that these savings refer to all newly constructed public utility facilities, not only buildings which are the property of central government institutions. No separate calculations were made for central government institutions' buildings or for existing buildings.

- Under the envisaged Operational Programme Infrastructure and Environment, Investment Priority 4 iii was created for the period 2014-2020. The name of the Priority was "Supporting energy efficiency, and use of renewable energy sources for the public sector and for the housing sector". This programme will contribute to meeting targets regarding the increase of energy efficiency, increase of production, and greater use of renewable energy sources, as well as to CO_2 emission reduction. It is anticipated that the support under this priority will be mainly focused on a comprehensive, deep, energy modernisation of public utility buildings and residential buildings, together with a replacement of these facilities' equipment by more modern equipment. It is estimated that as a result of this co-financing energy savings will amount to 300 MWh/year. However, it should be noted that this programme applies both to buildings from the public finance sector and to multi-apartment residential buildings. Public buildings meeting the criteria listed below will be supported:
  1) buildings of the central Government bodies' whose competence extends over the whole territory of Poland (see Article 2(9) of Directive 2012/27/EU);
  2) buildings with a useful floor area of more than 500 sq. metres, belonging to central government institutions and occupied by them, which at 1 January of each year do not meet minimum energy performance requirements set in accordance with Article 4 of Directive 2010/31/EU (in accordance with Article 5(1)(2)).
  3) The above does not apply to historical buildings (buildings meeting the criteria of Article (4)(2)(a) of Directive 2010/31/UE and of Article 5(2)(2) of Directive 2012/27/EU.
- Programmes implemented by the National Fund for Environmental Protection and Water Management regarding energy savings for buildings owned by the public finance sector, including:
  - Operational Programme (PL04) "Energy savings and promotion of renewable energy sources" ,

- Energy efficiency improvement. Part 2 - LEMUR - Energy Efficient Public Utility Facilities;
- Priority Programme "GIS – Green Investment Scheme, Part 5). Energy management in the facilities of selected public finance sector entities*";*
- Priority Programme Ecological Education for 2014.

These programmes focus on the promotion of energy savings through the implementation of thermomodernisation projects, raising ecological awareness and shaping public ecological attitudes by promoting sustainable development principles. The objective of the programmes is the reduction or elimination of carbon dioxide emissions by co-financing projects improving the efficiency of energy use in selected public utility facilities.

- The use of renewable energy sources in buildings used by the public finance sector. In accordance with Article 5(2a) of the Act of 7 July 1994 the Construction Law, buildings of the public finance sector, when constructing buildings or planning major renovation or planning investment which is to improve energy efficiency, are encouraged to consider the use of renewable energy sources.
- Preparation is planned of a guide regarding the use of energy efficiency improvement measures in residential housing (both individual housing and multi-apartment buildings) and in public utility buildings. This guide will be available to the public on the website dedicated to be used by the Minister competent for construction, local planning and spatial development, and housing. It will include a description of investments which will have impact on the improvement of energy efficiency of buildings, guidance regarding changes in behaviour leading to an improvement of energy efficiency, and a description of existing support schemes for improvement of the energy efficiency of buildings.

Taking the above into consideration, it is estimated that as a result of the alternative approaches mentioned, the objective of annual energy savings of 2122 MWh/year will be achieved.

Table No 19 Description of energy efficiency measures in public institutions

Name of the measure:	**1. Operational Programme PL04 - "Energy savings and promotion of renewable energy sources" under the EEA Financial Mechanism in 2009-2014 (c 5 - energy efficiency, and area No 6 - renewable energy);**
Category	Funds
Objective of the programme	The objective of the programme is to reduce the emissions of greenhouse gases and air pollution, and to increase the share of energy originating from renewable sources in the total balance of energy use.

Programme actions	Thermomodernisation of public utility buildings. Work necessary to achieve a lower consumption level for electricity necessary to use the buildings. Modernisation or replacement of existing energy sources (together with replacement or renovation of outdated local networks); supplying public utility buildings with modern, energy-efficient and ecological sources of heat or electricity with a nominal rating up to 5 MW, including: those originating from renewable energy sources or from heat and electricity sources generated in a combined manner (co-generation/three-generation). Installation, modernisation, or replacement of district heating with a total nominal rating of up to 3 MW, supplying public utility buildings.
Status	(2) under way - the first tender was organised in 2013, a complementary call for tenders is carried out (up to 15.09.2014)
Duration	from 2013 to 2016
Type of beneficiaries	Public finance sector entities or non-public entities carrying out public tasks.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ Source of financing	EUR 55.9 million (PLN 232 million) – area No 5 EUR 11.5 million (PLN 47.7 million) – area No 6 Financial Mechanism of EEA in the years 2009-2014.

Table No 20 Description of energy efficiency measures in public institutions

Name of the measure:	**2. Green Investments Scheme. Part 5 - Energy management in the facilities of selected public finance sector entities;**
Category	Funds
Objective of the programme	Reduction or elimination of carbon dioxide emissions by co-financing projects improving the efficiency of energy use in selected public utility facilities.
Programme actions	Thermomodernisation of buildings, including equipping facilities with appliances of the highest, economically justified energy efficiency standards, directly related to the thermomodernisation of the facilities, in particular: ▪ insulation of a building; ▪ replacement of windows; ▪ replacement of external doors; ▪ alterations of the heating system (including changing of the heat source); ▪ replacement of ventilation and air conditioning systems; ▪ preparation of technical documentation for the investment; ▪ the use of energy management systems in buildings; ▪ the use of technologies of renewable energy sources; ▪ replacement of internal lighting by an energy-efficient one (as additional work performed together with facility thermomodernisation).
Status	(2) under way - since 2010, two tenders were organised in respect of Part A, and one tender in Part B. Projects are being implemented under

	the agreements signed.
Duration	from 2010 to 2015
Type of beneficiaries	Part A ▪ the Polish Academy of Sciences and research institutes created by the Academy; ▪ State cultural institutions; ▪ self-governed cultural institutions operating on the basis of the Act on the organisation and management of cultural activities; ▪ budgetary institutions; ▪ district and municipal State Fire Service Headquarters. Part B State budgetary institutions.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from AAU trade transactions or from other funds of the National Fund for Environmental Protection and Water Management: PLN 605 million - non-reimbursable forms (grants)

Table No 21 Description of energy efficiency measures in public institutions

Name of the measure:	**3. Operational Programme Infrastructure and Environment 2007-2013 (Measure 9.3) - Thermomodernisation of public utility facilities**
Category	Funds
Objective of the programme	The objective of the programme is to reduce energy consumption in the public sector. In addition, the preparation of low-emission economy plans will contribute to meeting air quality as stipulated in the Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (CAFE).
Programme actions	Examples of types of projects Thermomodernisation of public utility facilities together with the replacement of equipment of the facilities by energy- efficient ones, including: ▪ heat-insulation of buildings; ▪ replacement of windows, external doors, and lighting with energy-saving ones; ▪ alterations of the heating system (including the replacement of the heat source), ventilation and air-conditioning systems. Preparation of technical documentation for projects, including investment documentation for the systemic project of thermomodernisation for public art buildings. Preparation/updating of low-emission economy plans in municipalities. Under the support of low-emission economy plans, municipalities are to obtain support for obligatory measures, i.e.: ▪ preparation or updating of the plan; ▪ creation, within the municipality, of a database containing selected and organised information which would make it possible to assess energy management within the municipality and in its different

	sectors and facilities, and to record greenhouse gas emissions ▪ training for the staff of municipalities on issues related to the creation of low-emission economy plans; ▪ information and publicity regarding the contribution of co-financing from the OPI&E in the creation of low-emission economy plans and on availability of information concerning the preparation of these plans. In addition, it is possible to receive support for optional measures, i.e.: ▪ preparation of elements used in plans which are being developed or updated (or assumptions for these plans) concerning heat, electricity, or gas supplies; ▪ strategic environmental impact assessment.
Status	(1) completed
Duration	from 2007 to 2014
Type of beneficiaries	Entities of the public finance sector, i.e.: - local government units and groups: unions and associations thereof; - State budgetary institutions; - entities which are not entrepreneurs and which provide public services as part of local government own duties; - official authority bodies, including government administration units, state inspection bodies, law enforcement bodies, courts and tribunals; - police bodies, fire services (including Voluntary Fire Services), and municipal police bodies; - state universities; - independent public healthcare centres. Non-governmental organisations, churches, church legal persons and associations thereof, and other religious associations.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	EUR 128.72 million, including: EUR 109.41 million contributions from the EU Cohesion Fund EUR 19.31 million national public contributions[36]

3.3.2 Buildings housing public bodies (Article 5(7) of Directive 2012/27/EU)

Public administration plays an exemplary role on the basis of the Act, which determines, amongst other things, the tasks of public sector bodies regarding energy efficiency. In accordance with Article 10 of the Act, a public sector body, carrying out its tasks, should apply at least two out of five energy efficiency improvement measures listed. These measures include thermomodernisation investments, according to the provisions of the Act of 21 November 2008 on supporting thermomodernisation and renovation works. The implementation of

[36] Data regarding OPI&E 2007-2013: http://www.pois.gov.pl/Dokumenty/Strony/Dokumenty.aspx

thermomodernisation investments indicated in the energy audit is recommended on the basis of their economic profitability. These investments can be financed from the funds of the National Fund for Environmental Protection and Water Management.

Public administration bodies play an exemplary role also by promoting buildings with low energy consumption. Co-financing from EU funds for public utility buildings, i.e. construction of schools, hospitals, etc. should be granted primarily, and after 2015 exclusively, for buildings with increased energy efficiency, including, first of all, those with low energy consumption. The promotion of show and pilot projects regarding the construction of public utility buildings with low energy consumption is also envisaged. Taking into account the pilot nature of such activities, the grant component should be higher than in the case of conventional measures connected with thermomodernisation of public utility buildings.

Table No 22 Description of energy efficiency measures in public institutions

Name of the measure:	**4. Energy efficiency improvement. Part 2 - LEMUR - Energy Efficient Public Utility Facilities**
Category	Funds
Objective of the programme	The objective of the programme is to avoid CO_2 emissions in connection with designing and constructing new energy-saving public utility buildings and lodgings.
Programme actions	Investments consisting of designing and construction, or construction only, of new public utility buildings and lodgings.
Status	(2) Under way. The first tender has been published, the call for tenders is carried out continuously until 31.12.2014.
Duration	from 2014 to 2023
Type of beneficiaries	▪ entities of the public finances sector, excluding State budget entities; ▪ legal persons of the local self-government, corporations in which local self-government entities have 100 % shares and which are assigned to carry out municipalities' own statutory tasks; ▪ non-governmental organisations, including foundations and associations, churches, other religious associations entered into a register of churches and of churches, other religious associations, church legal persons which carry out public duties on the basis of separate provisions.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM): PLN 30 million - non-reimbursable form (grants) PLN 270 million - reimbursable form (loans).

Table No 23 Description of energy efficiency measures in public institutions

Name of the measure:	**5. Efficient energy use Part 6 - SOWA - Energy-efficient street lighting**
Category	Funds
Objective of the programme	The objective of the measure is to reduce carbon dioxide emissions by co-financing projects improving energy efficiency of street lighting systems.
Programme actions	Co-financing can be granted for the implementation of projects consisting of: ▪ modernisation of street lighting (among other things replacement of light sources, fittings, firing plugs, feeders, poles, installation of new lighting points as part of modernised lighting installations, if this is necessary to meet PN EN 13201 standard); ▪ installation of devices for intelligent lighting controls; ▪ installation of control systems for power reduction and for stabilisation of supply current.
Status	(2) Under way. Since 2013, one tender was organised. Its results were published in October 2013.
Duration	from 2013 to 2017
Type of beneficiaries	Local self-government entities with the right to decide on street lighting infrastructure in respect of project implementation.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	EUR 347.2 million, including: PLN 151.2 million - non-reimbursable form (grants) PLN 196 million - reimbursable form (loans). Funds from AAU trade transactions or from other funds of the National Fund for Environmental Protection and Water Management:

3.3.3 The Operational Programme Infrastructure and Environment 2014 -2020

Measures in the area of energy efficiency in the public sector, financed under the Investment Priority 4.iii, will be implemented under the Operational Programme Infrastructure and Environment 2014-2020, funded from the Cohesion Fund. - Supporting energy efficiency, intelligent energy management and promotion of renewable energy sources for public infrastructure, including public buildings, and in the housing sector. Projects involving public administration buildings will be supported as a priority, pursuant to a document "Supporting Investments in Building Modernisation", prepared on the basis of Article 4 of Directive 2012/27/EU, and of the National Plan aimed at increasing the number of buildings with low energy consumption, prepared on the basis of Article 9 of Directive 2010/31/EU.

Projects regarding energy modernisation of buildings will have to be in compliance with the Regulation of the Minister of Infrastructure of 12 April 2002, regarding technical conditions

which should be met by buildings and their locations whose amendment providing for stricter requirements regarding energy efficiency, which entered into force on 1 January 2014. These projects will also have to comply with the Regulation of the Minister of Infrastructure and Development of 3 June 2014 on methodology for the calculation of energy performance for buildings, apartments, or parts of buildings constituting a self-contained technical and functional entity, and the method of preparation of energy performance certificates, including templates of these certificates.

Table No 24 Description of energy efficiency measures in public institutions

Name of the measure:	**6. The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iii.) - Supporting energy efficiency, intelligent energy management and promotion of renewable energy sources for public infrastructure, including public buildings, and in the housing sector.**
Category	Funds
Objective of the programme	The objective of the intervention will be to improve the quality of the environment on the local scale by reducing the emission of pollutants particularly harmful for people's quality of life. At the same time, measures to be taken will provide a real support for the implementation of objectives connected with the improvement of the air quality, included in the air protection programmes.
Programme actions	The support is to be focused on a so-called deep comprehensive energy modernisation of public utility buildings (including public utility buildings which are under obligation to carry out energy modernisation pursuant to Article 5(1) of Directive 2012/27/EU on energy efficiency). Projects which are to be granted co-financing must be in compliance with low-emission economy plans. In view of the above, measures connected with energy modernisation of public utility buildings will promote its comprehensive dimension (a so-called deep comprehensive modernisation based on monitoring and energy management systems). Taking into consideration synergy effect and increased energy efficiency, as well as ambient air protection, projects involving energy modernisation of buildings should be implemented together with construction/modernisation of heat or cooling distribution networks and highly efficient heat sources. Co-financing will be granted for investment projects involving comprehensive, cost-effective energy modernisation of buildings. Cooling installations may constitute an element of a project if their purchase and assembly is based on an energy audit for the facility and will not have an impact on the facility's increased demand for energy. The support for investment projects involving deep comprehensive energy modernisation of public utility buildings, covering such elements as: • insulation of a building, replacement of windows, external doors, and replacing the lighting with energy-efficient one; • alterations of the heating system (including changing of the heat source and replacing it with a more energy-efficient end eco-friendly

	one); • installation of cooling systems, also including the use of RES; • modernisation of ventilation and air conditioning systems; • application of weather-sensitive automatic temperature regulation; • the use of energy management systems in buildings; • construction or modernisation of internal receiving installations, and removal of existing heat sources; • installation of micro-cogeneration or micro-trigeneration for own needs; • installation of RES in energy-modernised buildings, or if it is supported by an energy audit, in buildings meeting the standards defined in the amended Regulation of the Minister of Infrastructure of 12 April 2002 regarding technical conditions which should be met by buildings and their locations; • preparation of energy modernisation projects which constitute parts of investment projects; • installation of individual meters for heating, cooling, and service water; • installation of central heating valves and thermostats; • creation of green roofs and "living green walls"; • carrying out energy audits as part of investment projects.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	• State budgetary institutions; • entities which are suppliers of energy services within the meaning of Directive 2012/27/EU.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	EUR 180.70 million, contributions from the EU Cohesion Fund

Regional Operational Programmes for 2014-2020.

Support for energy efficiency, smart energy management and the use of renewable energy sources in public infrastructure, including public buildings, and in residential sector, will also be implemented at the level of Regional Operational Programmes, financed from the European Regional Development Fund (ERDF). A division of interventions between the OPI&E and ROPs is to be regulated by a demarcation line. The intervention area covers a broad catalogue of measures which contribute to a comprehensive energy modernisation of public utility buildings and residential buildings, as well as energy audits for these investments. Detailed information regarding, among other things, examples of investment types and of potential beneficiaries will be presented in an implementing document for ROPs, e.g. in a Detailed Description of Investment Priorities.

3.4. Energy efficiency measures in industry and SMEs:

Article 24(2) of Directive 2012/27/EU includes a requirement to provide detailed information regarding any energy efficiency improvement measures which help to implement main elements of the Directive. In this part we present information on energy efficiency measures relating to industry, including those which are used to support an increase of energy efficiency in small, medium-sized (SMEs) and large enterprises.

Activities in the area improvement of energy efficiency in the industrial sectors will be supported, inter alia from the Cohesion Fund under the Operational Programme Infrastructure and Environment for 2014-2020 (Investment Priority 4ii. - Promotion of energy efficiency and of the use of renewable energy sources in enterprises.

Table No 25 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**1. Support for operators as regards low-emissions and resource saving business. Part 1 - Energy/electricity supply audit of an enterprise**
Category	Funds Obligation to prepare energy audit for large enterprises
Objective of the programme	The aim of the programme is to launch investment actions which increase energy efficiency of the economy, including the support mechanism and leading to measurable energy savings and reduction of energy consumption by final recipients
Programme actions	Supplementary financing will be offered for energy audits of technological processes, electrical energy audits of buildings and internal industrial grids, energy audits of sources of electricity, heating, and cooling, energy audits of external heating networks and buildings.
Status	(2) Under way. 16 tenders completed, co-financing (on the basis of agreements signed) was granted for 188 energy audits.
Duration	from 2011 to 2017
Type of beneficiaries	industrial sector, meaning entrepreneurs whose total energy consumption (electric and thermal) exceeds 20 GWh/year.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM): PLN 40 million - non-reimbursable forms (grants)

Table No 26 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**2. Support for operators as regards low-emissions and resource saving business. Part 2 - Increase of energy efficiency**
Category	Funds

Objective of the programme	The objective of the programme is to increase energy efficiency of enterprises. It will consist of investment measures, covering the support mechanism and leading to an efficient use of energy, or to measurable energy savings. Investment measures availing of co-financing must be based on the recommendations of an energy audit, where energy effect may not be lower than 7 %.
Programme actions	In particular, the material scope of investments will include: Implementation of energy management systems and quality management systems and implementation of management of electrical energy grids in business facilities. Technologies providing rationalisation of the use of electricity by means of: ▪ energy efficient drive systems; ▪ drive control systems e.g. by gentle start-up installations; ▪ energy efficient engines; ▪ inverters for pumps and fans; ▪ energy-efficient compressors and compressor control systems; ▪ internal energy transmission grids, including limiting passive power flows; ▪ energy efficient lighting systems; ▪ network drive rectifiers; ▪ higher efficiency transformers in local electric energy systems and internal distribution networks. Technologies providing rationalisation of the use of heat by means of: ▪ insulation and dewatering of steam systems; ▪ renewable energy sources, including geothermal systems, solar collectors, heat pumps; ▪ thermomodernisation of industrial and office buildings; ▪ recuperation and heat recovery from processes and devices; ▪ modernisation of internal heating networks; ▪ using energy from waste generated in industrial processes; ▪ construction/modernisation of own (internal) energy sources, including cogeneration. Modernisation of industrial processes in respect of energy efficiency.
Status	(2) ongoing project. Since 2013 13 tenders were organised, 27 applications were submitted by enterprises from the chemical, mineral, metallurgical and transport sectors. Another tender notice is envisaged for publication in 2015.
Duration	from 2013 to 2017
Type of beneficiaries	industrial sector, meaning entrepreneurs whose total energy consumption (electric and thermal) exceeds 20 GWh/year.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM): PLN 780 million - reimbursable forms (loans).

Table No 27 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**3. Programme of access to financial instruments for SMEs (PolSEFF);**
Category	Funds
Objective of the programme	PolSEFF stands for the Polish Sustainable Energy Financing Facility with a EUR 150 million credit line. PolSEFF's offer is addressed to small and medium sized businesses (SMEs) interested in investing in new, sustainable energy technologies and equipment which reduce energy consumption or produce energy from renewable resources.
Programme actions	Financing may be obtained as a loan or lease in the amount of up to EUR 1 million with the help of financial institutions participating in the Programme (banks and leasing institutions). ▪ Investments permitting achievement of at least 20 % savings in energy consumption. ▪ Investments increasing efficient energy use in buildings, permitting achievement of energy consumption cuts in commercial and administrative buildings of SMEs by 30 %. ▪ Investments in renewable energy sources. ▪ Investments including selected technologies – investments in undertakings and equipment selected from a prepared technology list.
Status	(1) completed
Duration	from 2011 to 2014
Type of beneficiaries	Small and medium-sized enterprises
Implementing Body	European Bank for Reconstruction and Development (EBRD)
Managing Authority	EBRD/Minister of Economy
Budget/ source of financing	EBRD funds EUR 180 million.

Table No 28 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**4. Operational Programme Infrastructure and Environment 2007-2013 (Measure 9.1) - Highly efficient energy generation**
Category	Funds
Objective of the programme	Increasing the efficiency of electricity and heat generation. Under this measure, support is provided for investments in alterations and construction of units for combined heat and electricity generation which meet the requirements of high-efficiency cogeneration. Promoting high-efficiency cogeneration on the basis of demand for useful heat is one of the EU priorities, having regard to the efficient use of primary energy, avoiding network losses, and reducing emissions of harmful substances.

Programme actions	Construction and alterations of units for combined heat and electricity generation which meet the requirements of high-efficiency cogeneration, as defined in Directive 2004/8/EC. Construction or alteration of heat generation units, as a result of which the units will be replaced with combined energy generation units that meet the requirements of high-efficiency cogeneration set forth in Directive 2004/8/EC.
Status	(1) completed
Duration	from 2007 to 2014
Type of beneficiaries	▪ Entrepreneurs. ▪ Local government units and groups: unions, and associations thereof. ▪ Entities which provide public services as part of local government own tasks.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	EUR 46.66 million contributions from the EU Cohesion Fund[37] EUR 8.81 million national public contributions [38]

Table No 29 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**5. Operational Programme Infrastructure and Environment 2007-2013 (Measure 9.2) - Efficient energy distribution**
Category	Funds
Objective of the programme	Reducing energy losses in energy and heat distribution.
Programme actions	The following projects are developed under the measure: comprehensive projects in construction (replacing the existing system) or alterations of high, medium and low voltage electric energy grids aimed at cutting down grid losses (replacement of low energy-efficiency transformers, shortening of very long distance lines, changing cross-sections of wires to adjust them to current grid temperatures, and other types of projects equivalent in terms of their results). Under this measure it is also intended to support investments in alterations and construction (replacing existing systems) of heat distribution grids with the greatest potential for reducing energy losses. Only projects for electric energy grids which will demonstrate cuts in energy losses by at least 30 % will be eligible for funding.
Status	(1) completed
Duration	from 2007 to 2014
Type of beneficiaries	▪ Entrepreneurs.

[37] Data regarding OPI&E 2007-2013: http://www.pois.gov.pl/Dokumenty/Strony/Dokumenty.aspx
[38] National public contribution depends on the availability of funds

	▪ Local government units and groups: unions and associations thereof. ▪ Entities which provide public services as part of local government own tasks.
Implementing Body	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Budget/ source of financing	EUR 214.37 million contributions from the EU Cohesion Fund[39] EUR 6.24 million national public contributions[40]

Table No 30 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	6. **Operational Programme PL04 - "Energy savings and promotion of renewable energy sources" under the Norwegian Financial Mechanism in 2009-2014 (area: Reduction of waste production and of emissions of pollutants into the air, water, and soil)**
Category	Funds
Objective of the programme	The objective of the programme is to reduce emissions of greenhouse gases and air pollution, and to increase the share of energy originating from renewable sources in the total balance of energy use.
Programme actions	Modernisation or replacement of existing heat sources together with modernisation of the combustion process or use of another energy carrier (e.g. combustion of gas, oil, or biomass through elimination of coal combustion).
Status	(2) ongoing process - one tender is being implemented, selection of applications completed on 7.4.2014, no other tenders are planned.
Duration	From 2014 to 30.4.2016 (predefined projects) and 30.4.2017 (public call projects).
Type of beneficiaries	Small, medium-sized, and large enterprises, excluding enterprises to which Council Regulation (EC) No 1198/2006 of 27 July 2006 on the European Fisheries Fund applies, as well as enterprises to which Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) applies.
Body/Implementing Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	PLN 229.87 million (predefined projects) PLN 63.16 million (open tender) Norwegian Financial Mechanism in the years 2009-2014

Table No 31 Description of energy efficiency measures in industry and in SMEs

[39] Data regarding OPI&E 2007-2013: http://www.pois.gov.pl/Dokumenty/Strony/Dokumenty.aspx
[40] National public contribution depends on the availability of funds

Name of the measure:	**7. Energy efficiency improvement, Part 4 - Energy-efficient investments in small and medium-sized enterprises;**
Category	Funds
Objective of the programme	The objective of the programme is to reduce energy consumption as a result of implementation of investment regarding energy efficiency and the use of renewable energy sources in the SME sector. As a result of implementation of the programme, CO_2 emissions will decrease.

Programme actions	Co-financing can be granted for the implementation of projects in the areas of:
	• LEME investments - projects covering investment activities in respect of:
	  • improvement of energy efficiency and/or use of renewable energy sources;
	  • thermomodernisation of buildings and/or use of renewable energy sources
	implemented through the purchase of materials/appliances/technologies included on the LEME list (List of qualified materials and appliances, published on the website of the National Fund for Environmental Protection and Water Management).
	• Supported Investments - investment activities which do not qualify as LEME Investments, in the area of:
	  • improvement of energy efficiency and/or use of renewable energy sources as a result of which 20 % energy savings will be achieved;
	  • thermomodernisation of buildings and/or renewable energy sources, as a result of which a minimum of 30 % energy savings will be achieved.

Status	(2) ongoing project - the programme is in the initial stage of implementation. The selection of banks granting loans is completed, and the call for applications to be selected by banks is planned for the fourth quarter of 2014.
Duration	from 2014 to 2016
Type of beneficiaries	Private legal entities (enterprises) established on the basis of Polish legislation and operating in Poland. Beneficiaries must comply with a definition of micro-enterprises and small and medium-sized enterprises contained in Commission recommendation of 6 May 2003 on definition of micro-enterprises, and of small and medium-sized enterprises (OJ L 124, 9.8.2008, p. 36).
Body/Implementing Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM): PLN 60 million - non-reimbursable forms (grants)

Table No 32 Description of energy efficiency measures in industry and in SMEs

Name of the measure:	**8. The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.ii.) - Promotion of energy efficiency and of the use of renewable energy sources in enterprises.**
Category	Funds
Objective of the programme	The objective of the measure is to increase energy efficiency of enterprises. This will have an impact on the creation of a more effective production system in enterprises.
Programme actions	Investments aimed at efficient use of energy from RES in enterprises will be supported. Intervention will be addressed to large enterprises, focussed on the use of solutions contributing to optimisation of energy management and increase of energy efficiency, including the use of renewable energy sources. Support for cost-effective investment projects is expected, which would include the following elements, based on the enterprises' energy audit: ▪ modernisation and extension of production lines, rendering them more energy efficient; ▪ deep, comprehensive energy modernisation of buildings in enterprises; ▪ use of energy efficient technologies in enterprises; ▪ replacement or modernisation of local heating sources, including the replacement of a heating source with RES (if this is suggested by an energy audit); ▪ use of energy recovery technology together with the waste heat energy utilisation system within the enterprise; introduction of an energy management system.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	Large enterprises
Implementing Body	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Planned budget/ Source of financing	EUR 150.32 million, contributions from the EU (Cohesion Fund)

Regional Operational Programmes for 2014-2020.

Promotion of energy efficiency and use of renewable energy sources in enterprises will be also undertaken at the level of Regional Operational Programmes funded from the European Regional Development Fund (ERDF) (most of ROPs provide for supporting enterprises in respect of energy efficiency). In the case of absence of measures under a particular ROP, to assist enterprises in pursuing energy-efficient measures, intervention will be possible

under the national programme. Division of interventions between the OPI&E and ROPs is regulated by a demarcation line. Intervention area covers extensive measures contributing to an increase of energy efficiency in small and medium-sized enterprises, and detailed information concerning, among other things, examples of types of investments and potential beneficiaries will be presented in implementing documents of ROP, e.g. in a Detailed Description of Investment Priorities.

3.5. Energy efficiency measures in transport

This part presents information on measures aimed at improving energy efficiency in transport of persons and transport of goods and in use of more sustainable means of transport. Projects are implemented under the Operational Programme Infrastructure and Environment for 2007-2013 (Measure 7.3) - Urban transport in metropolitan areas, and (Measure 8.3) - Development of intelligent transport systems. In addition, a programme of the National Fund for Environmental Protection and Water Management is implemented under the Green Investment Scheme, Part 7, GAZELA, low-emission urban transport, whose objective is to reduce or avoid carbon dioxide emissions by co-financing projects consisting of lowering the use of energy and fuels in urban transport. This programme covers activities consisting of: the purchase of new hybrid buses powered by CNG gas; training of drivers of urban transport vehicles on operating low-emission vehicles; training regarding infrastructure and management consisting of modernisation or construction of service stations dedicated to fuelling collective transport vehicles through adaptation of these stations to provide for the requirements of hybrid buses fuelled with CNG gas; modernisation or construction of bicycle paths; modernisation or construction of bus lanes; modernisation or construction of "Park& Ride" parking lots; implementation of urban transport management systems; implementation of urban bike system.

Support for public transport will also be part of the implementation of measures under Investment Priority 4.v. of the Operational Programme Infrastructure and Environment 2014-2020, resulting from low-emissions economy plans prepared by local governments, whose scope covers issues connected with sustainable urban mobility. Investments will be of an infrastructural nature, but also include acquisition of new vehicles. They will be comprehensive, including two types of projects. Preferred projects will involve rail transport and bus vehicles powered by fuel which is an alternative to combustion engines. Projects implemented will also include other elements complementary to basic linear infrastructure (investments), including ITS (Intelligent Transport Systems), making the functioning of the entire transport system more efficient. As a result of introduction of these elements, there will be an infrastructural integration of existing means of transport and adaptation of the transport system to serving persons with limited mobility. The support provided from EU funds for low-emission public transport in cities will also be provided for in the continuation for the years 2014-2020 of the Operational Programme Eastern Poland (Operational Programme Development of Eastern Poland in the years 2007-2013) and in Regional Operational Programmes for 2014 – 2020.

Table No 33 Description of energy efficiency measures in transport

Name of the measure:	**1. Operational Programme Infrastructure and Environment for 2007-2013 (Measure 7.3) - Urban transport in metropolitan areas and (Measure 8.3) - Development of intelligent transport systems**
Category	Funds
Objective of the programme	The objective of the programme is to make the traffic management system more efficient by applying Intelligent Transport Systems in road, maritime, inland water and urban transport, to improve inter-modal system and logistics, 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.
Programme actions	Adaptation, construction, transformation, and development of railways (fast city trains, tramways, and metro), and trolleybuses: ▪ construction, transformation, and development of rail systems on routes, and of loops, stabling, and depots, together with the purchase of vehicles; ▪ adaptation of railway network to the needs of urban public transport; ▪ construction, reconstruction, and development of a metro line, together with a purchase of rolling stock; ▪ construction, reconstruction, and development of energy network and tramway and trolleybus traction sub-stations; ▪ equipment of roads, streets, and tracks with engineering structures and necessary road facilities providing traffic safety for public transport vehicles; ▪ provision of roads and streets with infrastructure servicing public infrastructure (e.g. lay-byes, ramps, exit roads) and passengers (e.g. stops, islands); ▪ modernisation of rolling-stock and trolleybus fleet; ▪ purchase of rolling-stock and trolleybus fleet, together with necessary infrastructure for their maintenance; ▪ purchase of diesel multiple units (DMUs). Actions aimed at increasing the use of rail transport. ▪ Construction, reconstruction, development of stops, stations and hubs, integrated with other transport systems, including: - parking systems for cars "Park & Ride" and for bicycles "Bike & Ride" at service termini and hubs of public transport, together with accompanying infrastructure to be used to provide services for passengers. ▪ Telematic projects improving the functioning of public transport: - acoustic signalling systems; - light signalling systems, activated by buses, trolleybuses, trams (accommodation signalling); - tickets distribution and identification systems; - satellite navigation systems for improved traffic efficiency and increased safety of public transport; - information systems for travellers - electronic bulletin boards, including on-line systems; - security monitoring systems, installed at stops, platforms, stations, hubs, parking lots, and on-board carriages or vehicles.

	▪ Preparatory work for projects under the measure. Establishment of zones with limited or regulated access for transport users. Modernisation of means of transport (purchase of more fuel-efficient vehicles by transport companies). Introduction to eco-driving for users of vehicles.
Status	(1) completed
Duration	from 2007 to 2014
Type of beneficiaries	▪ Municipalities and towns with district rights situated in 9 metropolitan areas, or organisational entities operating on their behalf; ▪ Unions and associations of local government units; ▪ Transport operators providing services in the area of passenger transport on the basis of relevant agreements; ▪ Road managers; ▪ Managers of communications infrastructure; ▪ Managers of railway infrastructure; Regional self-governments or organisational entities appointed to carry out tasks which are within competences of regional self-governments.
Implementing Body	The Centre for European Union Transport Projects (CUPT):
Managing Authority	Ministry of Infrastructure and Development
Budget/ Source of financing	EUR 2 890.84 million contributions from the EU Cohesion Fund EUR 524 60 million national public contributions (own funds of municipalities and towns)

Table No 34 Description of energy efficiency measures in transport

Name of the measure:	**2. Green Investment Scheme, Part 7, GAZELA, the low-emission urban transport**
Category	Funds
Objective of the programme	To reduce or avoid carbon dioxide emissions by co-financing projects consisting of lowering the use of energy and fuels in urban transport.
Programme actions	Co-financing may be granted for carrying out projects aimed at lowering energy and fuels consumption in urban transport. The programme covers the following measures: 1) regarding fleet, mainly city buses, consisting of: ▪ purchase of new hybrid buses, fuelled by CNG gas, ▪ training drivers of vehicles used in public transport in operating low-emission vehicles; 2) regarding infrastructure and management, consisting of: ▪ modernisation or construction of service stations for refuelling public transport vehicles in order to adapt them for the requirements of hybrid buses, fuelled by CNG gas; ▪ modernisation or construction of cycling trails; ▪ modernisation or construction of bus-lanes; ▪ modernisation or construction of parking lots; ▪ implementation of urban transport management systems;

	▪ implementation of city bike system.
Status	(2) Ongoing programme. Since 2013, one tender was organised. The projects are to be carried out in the years 2014-2015.
Duration	from 2013 to 2015
Type of beneficiaries	▪ urban municipalities; ▪ municipal companies carrying out the tasks of urban municipalities related to local public transport; ▪ other entities providing services in the area of local urban transport on the basis of agreements concluded with urban municipalities.
Implementing Body/Institution	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of the Environment
Budget/ source of financing	Funds from the National Fund for Environmental Protection and Water Management (NFEP&WM): PLN 124.8 million - non-reimbursable forms (grants)

Table No 35 Description of energy efficiency measures in transport

Name of the measure:	**The Operational Programme Infrastructure and Environment 2014-2020**
Category	Funds
Objective of the programme	The objective of interventions in the operational programme will be the development and greater use of low-emission urban transport, servicing the inhabitants of cities' functional areas.
Programme actions	▪ Infrastructural investments: adaptation, construction, reconstruction, development of the urban transport network (linear infrastructure), including rail system, road system, energy network and tramway and trolleybus traction sub-stations, construction, reconstruction, and development of hubs. ▪ Investments concerning rolling-stock: purchase, modernisation of rolling stock (trams), trolleybus and bus fleet (EURO 6), [41] together with necessary infrastructure for its maintenance (e.g. technical support for servicing and maintenance of the bus fleet, places and facilities for refuelling with alternative fuel). ▪ Comprehensive investments covering infrastructural elements and bus fleet. ▪ Arrangements in the area of ITS, improving the functioning of

[41] Exhaust emission standard, in force since 2014. In addition, preference for vehicles operating on alternative fuels.

	public transport, as elements of an infrastructural, fleet-related, comprehensive project, including: light signalling systems, activated by buses, trolleybuses, trams (accommodation signalling), tickets distribution and identification systems, satellite navigation systems for improved traffic efficiency and increased safety of public transport, information systems for travellers - electronic bulletin boards, including on-line systems, security monitoring systems, installed at stops, platforms, stations, hubs, parking lots, and on-board carriages or vehicles. ▪ Preparatory work for investments under the measure. Possibility to implement projects integrating the above-mentioned types of projects.
Status	(3) planned; launching depends on the approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	▪ territorial self-government units, including their unions and associations; ▪ managers of infrastructure used by urban transport; ▪ operators of public mass transport; ▪ organisers of public mass transport operating on behalf of local government entities, organisational entities, and special purpose companies.
Implementing Body	The Centre for European Union Transport Projects (CUPT):
Managing Authority	Ministry of Infrastructure and Development
Budget/ Source of financing	Cohesion Fund

3.6. Efficiency in energy generation and supplies (Article 14 of the Directive)

3.6.1 Comprehensive potential assessment

In the implementation of Article 14(1) of Directive 2012/27/EU the Minister competent for the economy is statutorily required to prepare a comprehensive assessment of the potential for generation of electricity in highly-efficient cogeneration and for energy-efficient heating or cooling systems.

In accordance with a definition laid down in Article 2(41) of Directive 2012/27/EU, "energy-efficient heating or cooling system" means a district heating or cooling system using at least 50 % renewable energy, 50 % waste heat, 50 % cogenerated heat, or 50 % of a combination of such energy and heat.

In order to prepare an assessment of the potential, the Minister competent for the economy is to carry out an analysis concerning the introduction of specific variants of generation of electricity in highly-efficient cogeneration and for energy-efficient heating or cooling systems, including technical possibilities and economic profitability of the introduction of different variants.

On the basis of guidelines included in the last paragraph of Part 1 of Annex IX to the Directive, it was also decided that relevant local authorities, i.e. municipalities, should be assigned own tasks consisting of the preparation of economic and financial analyses to assess the potential in respect of the territory of their municipality. The assessment of potential is also required as an obligatory element of draft assumptions governing plans pertaining to municipalities regarding heat, electricity and gas fuels supplies.

Moreover, in accordance with the draft regulation implementing Article 14(3) of Directive 2012/27/EU, a costs and benefits analysis covering the entire territory of the country is to be carried out. Energy undertakings involved in the generation, transmission and distribution of electricity or heat and undertakings envisaging construction or modernisation of a generating facility will be under an obligation to prepare a costs and benefits analysis regarding construction or modernisation of the generating facility. The objective of this analysis will be to identify the most resource-and cost-efficient solutions to meeting heating and cooling requirements. The analysis will be prepared on the basis of a description of the envisaged construction or modernisation of a generating facility, taking account of: installed electricity or installed heat, type of fuel used for generating electricity or heat, anticipated useful life of the generating

facility, planned number of hours of work of the generating facility in a year, location of the generating facility, and demand for electricity or heat.

3.6.2 Energy efficiency measures regarding generation and supply of energy

Article 24(2) of Directive 2012/27/EU, and Part 2.2 of Annex XIV thereto, include a requirement to provide detailed information regarding any energy efficiency improvement measures which help to implement main elements of the Directive. This section presents information regarding energy efficiency measures in respect of supply of electricity and heat.

The support system in force in Poland in the years 2007-2012 was addressed to electric power producers in high-efficiency cogeneration (PES>10 %). In 2014 this system was reactivated and will remain in force until the end of 2018. Electric power producers in high-efficiency cogeneration will receive certificates of origin (certificates). Subsequently they can dispose of property rights deriving from these certificates either at a stock exchange or through bilateral contracts. In the Energy Law entities are indicated which are under an obligation to redeem certificates acquired at a stock exchange or through bilateral contracts. The annual level of these obligations was also specified for each year.

In addition, there are other legal instruments regarding support for electric power producers in high-efficiency cogeneration:

- an electricity system operator, in his area of activity, is required to ensure that priority in providing services of transmission and distribution of electrical energy is given to entities dealing with electricity generated in high-efficiency cogeneration, while maintaining the reliability and safety of the national electricity system;
- an electricity system operator, in his area of activity, is required to receive electricity generated in a high-efficiency cogeneration, in sources located in Poland, directly connected to that operator's grid;
- a new requirement was introduced to connect to an existing heat distribution network, or to equip the facility with an individual renewable heat source, heat source from cogeneration, or waste heat source in cases where the anticipated "heat peak power" of installation of appliances for heating that facility is not less than 50 kW. This requirements does not apply when the price of grid heat is equal to or higher than the average price of heat generated in a source which is not a cogeneration unit, taking into account the same type of fuel.

In addition to legal instruments, there are investment support programmes regarding the construction of new high-efficiency cogeneration units and construction of electric energy and heating networks which are granted on an individual basis following submission of an appropriate application and after requirements included in the programme description

have been met. Such programmes function in Poland, among other things under the Operational Programme Infrastructure and Environment 2007-2013, and are funded by the National Fund for Environmental Protection and Water Management. These programmes were described in detail in Chapter 3.4.

On the other hand, in the period 2014-2020 the support for heating networks will be directed to areas (mainly urban ones) which already have low-emissions economy plans prepared in advance. Such documents may take the form of any local; strategy referring to issues connected with providing local energy safety, and contributing to meeting the objectives of the energy climate package 3x20.

Taking into consideration increased energy efficiency and restriction in the carbon dioxide emissions in urban areas, it is recommended to improve efficiency of distribution of heat to customers (in particular through modernisation and development of heating networks), and to improve the efficiency of heat generation by changing the heat sources into highly efficient cogeneration units.

Table No 36 Efficiency of generating and transmitting energy

Name of the measure:	**The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.v.) Promoting low-emissions strategies for all kinds of territories, in particular for urban areas, including support for sustainable multi-modal urban mobility and adaptive measures with mitigatory influence on climate changes;**
Category	Funds
Objective of the programme	Reduction of losses in the heat/cold distribution process in order to ensure an "efficient heating and cooling system".
Programme actions	• construction, development, or reconstruction of heating and cooling networks which, following the implementation of the project will meet the requirements of an "efficient heating and cooling system", in order to connect new customers to the network; • modernisation of heating/cooling networks to reduce energy losses in the heat distribution process, also through the implementation of heat and cold management systems, together with the supporting infrastructure.
Status	(3) planned; launching depends on approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	▪ entrepreneurs; ▪ local government entities and organisational entities operating on their behalf; ▪ entities which are not entrepreneurs and which provide public services as part of local government own tasks; ▪ official authority bodies, including government administration units, subordinated bodies, and organisational entities.

Implementing Body	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Planned budget/ Source of financing	EUR 224.10 million, contributions from the EU (Cohesion Fund)

Table No 37 Efficiency of generation and transmission of energy

Name of the measure:	**The Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.vii.) - Promoting the use of high-efficiency heat and electric energy cogeneration on the basis of the demand for useful heat.**
Category	Funds
Objective of the programme	The effect of the measures will be benefits connected with savings of primary energy. These measures will make it possible to substantially reduce carbon dioxide emissions and emissions of other greenhouse gases. As a result, the environment quality at local level will improve due to a reduction of emissions of pollutants particularly harmful for people's quality of life. Support is planned for construction, development or adaptation resulting in an increase of capacities of entities generating electricity and heat through the highly efficient cogeneration system, and development/adaptation of entities generating heat and/or electricity, as a result of which these entities will be replaced by entities generating energy through the highly efficient cogeneration system. Projects involving generation of energy through the highly efficient cogeneration system, using RES, will also receive support.
Programme actions	Support is to be provided in particular in the following areas: ▪ construction, development, or adaptation of entities generating electricity and heat through the highly efficient cogeneration systems; ▪ construction, development, or adaptation of entities generating electricity and heat through the highly efficient cogeneration systems, using RES; ▪ construction, development, or adaptation of entities generating heat and/or electricity, as a result of which these entities will be replaced by entities generating energy through the highly efficient cogeneration system; ▪ construction, development, or adaptation of entities generating heat and/or electricity, as a result of which they will be replaced by entities generating energy in a highly efficient cogeneration system, using RES; ▪ construction of connections to heating networks to use useful heat produced in entities generating electricity and heat through the highly efficient cogeneration systems, and construction of connections taking out electricity and feeding it to the national electricity system which constitutes an integral part of a project dealing with energy-generating sources owned by the applicant.

Status	(3) planned; launching depends on approval of the Operational Programme by the European Commission
Duration	from 2015 to 31.12.2023
Type of beneficiaries	▪ entrepreneurs; ▪ local government entities and organisational entities operating on their behalf; ▪ unions, associations and JST agreements; ▪ entities which are not entrepreneurs and which provide public services as part of local government own tasks;
Implementing Body	National Fund for Environmental Protection and Water Management (NFEP&WM)
Managing Authority	Ministry of Infrastructure and Development
Planned budget/ Source of financing	EUR 300.23 million, contributions from the EU (Cohesion Fund)

I APPROVE

Prepared
in the Energy Department
of the Ministry of Economy

Annex No. 1

Annual report regarding energy consumption in 2012, in accordance with Part I of Annex XIV to Directive 2012/27/EU

The table below presents data concerning energy consumption in 2011 and 2012, within a scope conforming to Part 1 of Annex XIV to Directive 2012/27/EU.

Table Data concerning energy consumption in 2011 and 2012, within a scope conform to Part 1 of Annex XIV to Directive 2012/27/EU.

Information	Unit:	year 2011	year 2012
(i) primary energy consumption	ktoe	97122	94145
(ii) total final energy consumption (includes non-energy use)	ktoe	68451	68285
(iii) final energy consumption by sector			
– Industry	ktoe	15235	15006
– Transport (passenger and freight transport together)	ktoe	17367	16832
– Households	ktoe	19016	19599
– Services	ktoe	8372	8568
(iv) gross value added by sector[42]: – Industry	PLN million, constant prices with 2005 being the reference year	414305.3	420508.7
– Services		684618.6	703173.1
(v) disposable income of households (net)	PLN million, current prices	914086	948511
(vi) gross domestic product (GDP)	PLN million, constant prices with 2005 being a reference year	1293822.6	1218905.4
(vii) electricity generation from thermal power generation	GWh	157581.555	154925.986
(viii) electricity generation from combined heat and power[43]			

[42]) For the industrial sector it is a sum of value added from industry and construction, and for the services sector it is a sum of value added from the G-T section

[43]) Separating on the list the group of thermal power generation is not in compliance with the Act of 29 June 1995 on public statistics (there are only two entities in this group). Data aggregated in the same way are sent to IEA - Eurostat, using the form "Annual Questionnaire Electricity and Heat"

(ix) heat generation from thermal power generation	TJ	206637.615	208174.779
(x) heat generation from combined heat and power plants, including industrial waste heat[44]			
(xi) fuel input for thermal power generation[45]	ktoe	39354	38501
(xii) passenger kilometres (pkm)[46]	Mpkm	50073	49884
(xiii) tonne kilometres (tkm)	Mtkm	318474	325775
(xv) population	000	38525.7	38533.8

It should be noted that as a result of corrections, there was a change of data for 2011, as regards Part 1 of Annex XIV to Directive 2012/27/EU, transmitted to the European Commission in 2013. In view of the fact that indicators listed in Part 1 of Annex XIV to Directive 2012/27/EU are not determined in a clear way, additional details were provided for the data, on the basis of experience gained under ODYSSEE – MURE projects, aimed at monitoring energy efficiency.

[44]) Separating on the list the group of thermal power generation is not in compliance with the Act of 29 June 1995 on public statistics (there are only two entities in this group). Data aggregated in the same way are sent to IEA - Eurostat, using the form "Annual Questionnaire Electricity and Heat"

[45] includes also combined heat and power

[46] without transport by passenger cars and by public transport

Annex No. 2

I. Final energy savings calculations using top-down method

The document "RECOMMENDATIONS ON MEASUREMENT AND VERIFICATION METHODS IN THE FRAMEWORK OF DIRECTIVE 2006/32/EC ON ENERGY END-USE EFFICIENCY AND ENERGY SERVICES" recommends a methodology for energy savings calculations in respect of Article 4 of Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services, and repealing Council Directive 93/76/EEC (OJ L 114 of 27.04.2006, p. 64). The European Commission developed this methodology with the support and active participation of EU Member States. Methods recommended in the document present harmonised principles governing calculation of end-use energy savings in respect of ESD. The procedures indicated cover: recommended "*top-down*" method formulae (from general concept to details) to calculate energy efficiency indicators, and a "*bottom-up*" method (from details to general concept) to calculate energy savings. The document also covers recommended periods for taking measures to improve energy efficiency to be used in the "*bottom-up*" method.

- In the "*top-down*" method (from general concept to details) aggregated data are used. For this reason the method is called "energy efficiency indicators". Using this method, it is possible to determine correct indicators for the development of the situation, however these are only indicators. It does not give precise energy savings calculations at detailed level. Usually, the subject of calculations by this method is, e.g. types of means of transport, industrial sectors, etc. Calculated values of energy consumption or energy intensity are subject to corrections, taking into account external factors, such as the number of degree-days in the heating season, structural changes, production profiles, etc.
- The "*bottom-up*" (from details to general concept) method is a more precise way to calculate energy saving resulting from the increase of energy efficiency. First, energy consumption is calculated for an individual end-user, e.g. a passenger car, in a specified period of time prior to the implementation of a measure aimed at increasing energy efficiency, thereby obtaining the "reference values". Then, the level of consumption obtained in that manner is compared with the actual energy consumption (noted in the same timeframe, but after the implementation of measures increasing energy efficiency).

The difference between the two results constitutes the measure of increase of energy efficiency. If such calculations are made for all energy consumers, and the results are added, a reasonably precise measure of improved energy efficiency is obtained. In doing the calculations, one should bear in mind the need to take into account corrections in respect of, e.g. climate conditions, and other factors.

This Annex presents calculations of end-use energy savings using the "*top-down*" method (from general concept to details). In this respect, the European Commission's guidelines define two types of indicators to be used to calculate energy saving: preferred indicators (identified by letter P) and minimum indices (identified by letter M).

End-use energy savings achieved in the years 2008-2012 are presented in respect of different sectors of Polish economy. The following is presented in respect of each sector: a definition of indicators, the methodology used in calculating energy saving, necessary statistical data, and the results of calculations.

Households sector

P1 Indicator

The P1 Indicator represents the unit energy consumption of households for heating of premises in [toe/m^2] (tonnes of oil equivalent/m^2 of floor area) adjusted for climatic conditions. The formula for the P1 Indicator is:

$$\mathrm{P1} = \frac{E^{H_{SH}}}{F} \cdot \frac{MDD_{25}^{heating}}{ADD^{heating}}.$$

Energy savings achieved in year t in relation to the recommended base year 2007 are calculated according to the formula:

$$\left[\left(\frac{E_{2007}^{H_{SH}}}{F_{2007}} \cdot \frac{MDD_{25}^{heating}}{ADD_{2007}^{heating}}\right) - \left(\frac{E_t^{H_{SH}}}{F_t} \cdot \frac{MDD_{25}^{heating}}{ADD_t^{heating}}\right)\right] \cdot F_t$$

where the different symbols mean:

$E_{2007}^{H_{SH}}, E_t^{H_{SH}}$ - consumption of energy for heating in the housing sector, in 2007 and in year "t", respectively;

$MDD_{25}^{heating}$ - average multi-annual size of degree-days for the previous 25 years;

$ADD_{2007}^{heating}$, - the size of degree-days in 2007;
$ADD_{t}^{heating}$ sizes of degree-days in the calculation year t;

F_{2007}, F_t - total size of apartments [in m^2] in 2007 and, respectively, in the calculation year t;

The P1 indicator (a quotient of energy consumption by the households sector, adjusted for climatic conditions and the total area of apartments permanently lived-in) is the most important energy efficiency index in the households sector.

The following data are necessary to calculate the P1 indicator:

- number of apartments permanently lived-in;
- average floor area of apartments (m^2);
- energy consumption for heating the area, adjusted for climatic conditions.

In order to calculate energy consumption for heating the floor area of apartments, taking into account climatic correction, the following data are required

- energy consumption for heating the floor area of apartments;
- number of degree-days;
- average number of degree-days.

There are also other statistical methods in respect of housing resources. The most popular ones refer to the number of apartments lived-in on a permanent basis. Data used for energy consumption analyses and the number of apartments permanently lived in are published by GUS.

Climatic correction is based on a relationship between energy consumption and external temperature. A direct ratio between energy consumption for heating and the number of degree-days (Sd) is assumed.

The number of degree-days is the product of the number of heating days and the difference between the average temperature of the heated space and average external temperature. According to Eurostat methodology, the number of degree-days in a year is calculated as follows:

$$Sd = \sum_{n=1}^{N} \begin{cases} 18^{o}\mathrm{C} - t_{śr}(n) & dla \quad t_{śr}(n) \le 15^{o}\mathrm{C} \\ 0 & dla \quad t_{śr}(n) > 15^{o}\mathrm{C} \end{cases}, \text{[day/year]}$$

where:

$t_{śr}(n) = \frac{t_{\min}(n) + t_{maks}(n)}{2}$ - average external air temperature on the n-th day of the year [^{o}C];

$t_{\min}(n),\ t_{maks}(n)$ - minimum and maximum air temperature on day n of the year, [°C].

According to the formula, and following the assumption adopted by Eurostat, heating days are those days when the average daily external temperature is below 15°C. For Poland, the average multi-annual size of degree-days (for the years 1980-2004) was 3615.77.

Below are the calculations of energy savings in the years 2008 - 2012 in relation to the base year 2007. Data used in calculations and results of calculations of energy saving are presented in tables below:

Table No 1. Data used in calculations of energy efficiency indices in the households sector in the years 2008 – 2012

Value	Source:	Unit:	2007	2008	2009	2010	2011	2012
Number of apartments	Main Statistical Office (GUS)	k*	12994	13150	13302	13470	13587	13723
average floor area of apartments	Main Statistical Office (GUS)	m^2	70	70	71	72	73	73
number of degree-days	Eurostat	degree-days	3222	3164	3439	3881	3317	3552
average number of degree-days.	Eurostat	degree-days	3616	3616	3616	3616	3616	3616
Energy consumption excluding electric energy (adjusted for climatic conditions)	Main Statistical Office (GUS)	ktoe	18143	18648	17384	17404	18081	17475
Energy consumption for heating, (adjusted for climatic conditions)	Calculation	ktoe	14170	14629	13610	13757	14215	13745

*) k ≡ 1000

Table No 2. P1 indicator for households sector in the years 2008 – 2012

Energy Efficiency Indicator		Unit:	2008	2009	2010	2011	2012
P1	he unit energy consumption of households for space heating per floor area in m^2 (adjusted for climatic conditions)	ktoe/m2	15.85	14.51	14.13	14.41	13.76

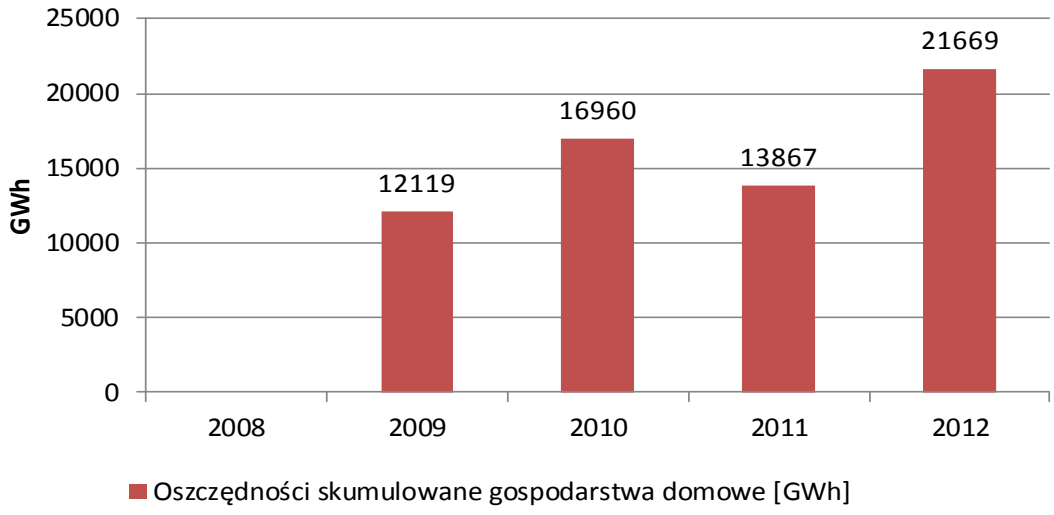
Table No 3. Energy savings for households sector in the years 2008 – 2012

On the basis of an indicator.	Energy savings	Unit:	2008	2009	2010	2011	2012
P1	Space heating	ktoe	-207	1042	1458	1192	1863
Total savings calculated on the basis of preferred indicators		**ktoe**	**0**	**1042**	**1458**	**1192**	**1863**
		GWh	**0**	**12119**	**16960**	**13867**	**21669**

Final energy savings in the household sector calculated on the basis of the preferred P1 indicator are as follows:

Table No 4. Household sector's energy consumption

Year	**2008**	**2009**	**2010**	**2011**	**2012**
ktoe	0	1042	1458	1192	1863
GWh	**0**	**12119**	**16960**	**13867**	**21669**



Translation of Figure above:

Cumulated savings in the households (GWh)

Figure Energy savings in the household sector calculated on the basis of the preferred P1 indicator

Energy savings in the households sector are subject to some fluctuations. The far from perfect climate adjustment factor has a significant impact on these fluctuations, but there are also other factors such as changes in consumers' behaviour). There is a general trend indicating a reduction in unitary energy consumption. This is due to the installation of more efficient appliances, which in turn is linked to a significant impact of thermomodernisation and increasingly restrictive standards for buildings' thermal protection.

Service sector

M3 Indicator

The M3 Indicator defines unitary energy consumption, excluding electricity, expressed in [toe/worker] (tonne of diesel oil/full-time worker), taking into account climate adjustment. The M3 indicator is defined by the following formula:

$$\mathrm{M3} = \frac{E^{S_{NON-EL}}}{em^{S^{fte}}} \cdot \frac{MDD_{25}^{heating}}{ADD^{heating}}.$$

Energy savings achieved in year t in relation to the recommended base year 2007 are calculated according to the formula:

$$\left[\left(\frac{E_{2007}^{S_{NON-EL}}}{em_{2007}^{S^{fte}}} \cdot \frac{MDD_{25}^{heating}}{ADD_{2007}^{heating}}\right) - \left(\frac{E_t^{S_{NON-EL}}}{em_t^{S^{fte}}} \cdot \frac{MDD_{25}^{heating}}{ADD_t^{heating}}\right)\right] \cdot em_t^{S^{fte}},$$

where the different symbols mean:

$E_{2007}^{S_{NON-EL}}$, $E_t^{S_{NON-EL}}$ - energy consumption, excluding electricity in the services sector, in 2007 and, respectively, in the calculation year "t";

$em_{2007}^{S^{fte}}$, $em_t^{S^{fte}}$ - total number of workers (employed on a full-time basis) in 2007 and, respectively, in the calculation year "t";

MDD_{25} - average multi-annual size of degree-days for the previous 25 years;

$ADD_{2007}^{heating}$, $ADD_t^{heating}$ - **the size of degree-days in 2007; sizes of degree-days in the calculation year t;**

M4 Indicator

The M4 Indicator defines unitary electricity consumption, expressed in [kWh/worker] (kilowatt-hours/full-time worker).

The M4 indicator is calculated on the basis of a formula:

$$M4 = \frac{E^{S_{EL}}}{em^{S^{fte}}},$$

Energy savings achieved in year t in relation to the recommended base year 2007 are calculated according to the formula:

$$\left(\frac{E_{2007}^{S_{EL}}}{em_{2007}^{S^{fte}}} - \frac{E_t^{E_{EL}}}{em_t^{S^{fte}}} \right) \cdot em_t^{S^{fte}}$$

where the different symbols mean:

$E_{2007}^{S_{EL}}, E_t^{E_{EL}}$ - total electricity consumption in the services sector, in 2007 and, respectively, in the calculation year "t";

$em_{2007}^{S^{fte}}, em_t^{S^{fte}}$ - total number of workers (employed on a full-time basis) in 2007 and, respectively, in the calculation year "t".

The following table presents data used for calculation of energy efficiency indicators M3 and M4.

Table No 5. Data used for calculation of energy efficiency indicators M3 and M4 in the years 2008 – 2012

Value	Sources	Unit:	2007	2008	2009	2010	2011	2012
number of degree-days	Eurostat	degree-days	3222	3164	3439	3881	3317	3552
average number of reference degree-days.	Eurostat	degree-days	3616	3616	3616	3616	3616	3616
Final energy consumption in the services sector	EUROSTAT	ktoe	6786	7358	7621	8488	8081	8190
Final use of electricity	EUROSTAT	ktoe	3197	3532	3480	3755	3809	3870
Number of persons working in the services sector	Main Statistical Office (GUS)	k	7698	7952	7883	7956	8031	8059

*) k ≡ 1000

We present below calculations of energy savings in the service sector made on the basis of minimum indicators M3 and M4.

Table No 6. M3 and M4 indicators for the service sector in the years 2008 - 2012

On the basis of an indicator.	Energy Efficiency Indicator	Unit:	2008	2009	2010	2011	2012
M3	Energy consumption (excluding electric energy) per worker (adjusted for climatic conditions)	toe/worker	0.52	0.55	0.55	0.55	0.58
M4	Total unitary energy consumption per worker	kWh/worker	4829	5165	5134	5488	5895

Table No 7. Energy savings for the services sector in the years 2008 – 2012

On the basis of an indicator.	Energy savings	Unit:	2008	2009	2010	2011	2012
M3	Excluding electricity	ktoe	-211	-229	-247	-456	-403
M4	Electric	ktoe	-230	-207	-451	-473	-700
Total sum calculated on the basis of minimum indicators		ktoe	-441	-436	-698	-929	-1003

Energy savings in the service sector are calculated on the basis of minimum indicators M3 and M4. No energy savings were recorded in the transport sector, on the basis of methodology used, in the years 2008-2012.

Transport Sector

P9 Indicator

The P9 Indicator defines energy use in the road transport of goods, expressed in [goe/tkm] (grammes of equivalent oil/tonne-kilometres). The P9 Indicator is calculated on the basis of a formula:

$$\mathrm{P9} = \frac{E^{TLV}}{T^{TLV}}$$

Energy savings achieved in year "t" in relation to the recommended base year 2007 are calculated according to the formula:

$$\left(\frac{E_{2007}^{TLV}}{T_{2007}^{TLV}} - \frac{E_t^{TLV}}{T_t^{TLV}} \right) \cdot T_t^{TLV}$$

where the different symbols mean:

$E_{2007}^{TLV}, E_t^{TLV}$ - energy consumption, excluding electricity in the services sector, in 2007 and, respectively, in the calculation year "t";

$T_{2007}^{TLV}, T_t^{TLV}$ - total transport of goods in lorries, in tonne-kilometres in 2007 and, respectively, in the calculation year "t".

The following table presents data used for calculation of energy efficiency indicator P9. The data sources include EUROSTAT and GUS (including EDYSSEE-MURE).

Table No 8. Data used in calculations of energy efficiency indices in the transport sector in the years 2008, 2009, and 2010, referred to the year 2007.

Values	Source:	Unit:	2007	2008	2009	2010	2011	2012
Total energy consumption by heavy and light lorries	Main Statistical Office (GUS)	ktoe	6465	6730	6930	7516	7624	7293
Road transport of goods	Main Statistical Office (GUS)	Mtkm	159527	174223	191484	233170	218888	233310

Energy efficiency indicator P9 for transport, and energy savings laid down for transport and energy savings calculated on the basis of this indicator are presented in tables below.

Table No 9. Energy efficiency indicator P9 in the years 2008-2012

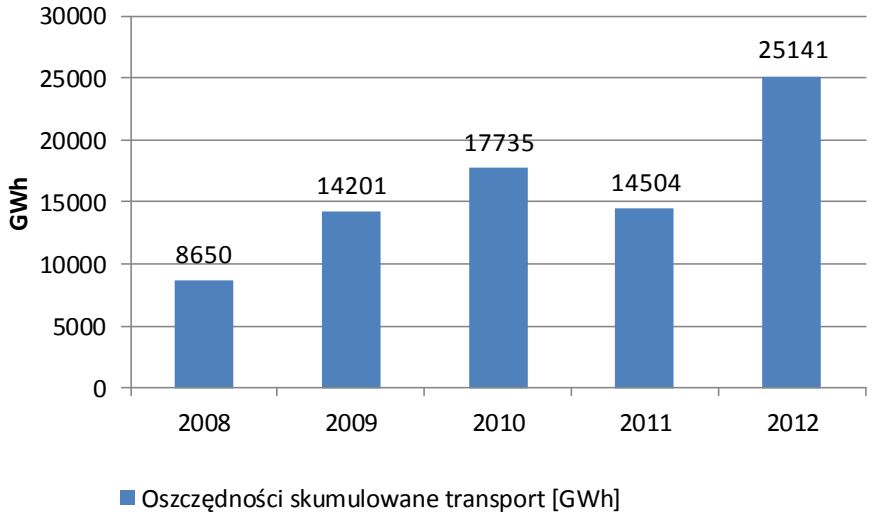
Indicator	Title	Unit:	2008	2009	2010	2011	2012
P9	Use of energy in goods transport by road	goe/tk m	39	36	32	35	31

Table No 10. Energy savings for the transport sector in the years 2008 – -2012

On the basis of an indicator.	Energy saving	Unit:	2008	2009	2010	2011	2012
P9	Heavy goods vehicles and light-duty vehicles	ktoe	330	830	1165	1247	2162
Total savings calculated on the basis of priority indicators		**ktoe**	**744**	**1221**	**1525**	**1247**	**2162**
		GWh	**8649**	**14201**	**17735**	**14504**	**25141**

Table No 11. Cumulated savings in the transport sector

Year	**2008**	**2009**	**2010**	**2011**	**2012**
ktoe	744	1221	1525	1247	2162
GWh	**8650**	**14201**	**17732**	**14504**	**25141**



Translation of Figure above:
Cumulated savings, transport [GWh]

Figure Energy savings in the transport sector calculated on the basis of the P9 indicator

Almost 95 % of energy used by transport in Poland is used in road transport, and over 2 % is used in rail transport. In addition, almost 3 % of energy is used in air transport and small quantities are used by inland waterway vessels and by coasters.

Industrial Sector

P14 Indicator

The P14 Indicator is defined as unitary energy consumption of the industrial sector for its volume of production. To calculate the indicator in accordance with recommendations of the European Commission, it is necessary to know the share of ETS in energy consumption by different industry subsections. P14 Indicators recommended by the Commission cover the following industry subsections (according to NACE REV 1 classification):

- Mining and quarrying, except of energy producing materials (NACE 13-14);
- Food (NACE 15-16);
- Textiles (NACE 17-19);
- Wood (NACE 20);
- Paper (NACE 21-22);
- Chemicals (NACE 24);
- Mineral products (NACE 26), including cement (NACE 26.51);
- Manufacture of basic iron and steel and of ferro-alloys (NACE 27.1);
- Manufacture of basic non-ferrous metals (NACE 27.2);
- Machinery (NACE 28-32);
- Transport equipment (NACE 34-35);
- Other (NACE 25, 33, 36-37);
- Construction (NACE 45).

The P14 Indicator defines energy consumption in the industrial sector related to the production index. This indicator is calculated based on the following formula:

$$\mathrm{P14} = \frac{E^{I^X}}{IPI^{I^X}}.$$

Energy savings achieved in year "t" in relation to the recommended base year 2007 are calculated according to the formula:

$$\left(\frac{E_{2007}^{I^X}}{IPI_{2007}^{I^X}} - \frac{E_t^{I^X}}{IPI_t^{I^X}} \right) \cdot IPI_t^{I^X} \cdot K_{2007}^{I^X},$$

where the different symbols mean:

$E_{2007}^{I^X}, E_t^{I^X}$ - total energy consumption in the industrial sector, in 2007 and in the calculation year "t";

$IPI_{2007}^{I^X}, IPI_t^{I^X}$ - production index for the industrial sector, in 2007 and in the calculation year "t";

$K_{2007}^{I^X}$ - share of energy consumption in subsections, in accordance with Directive 2006/32/EC.

Energy efficiency indicators for the industrial sector cover final energy consumption in the sector's different subsections, in accordance with Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services, and repealing Council Directive 93/76/EEC. In their reports for the European Commission, EU Member States should present the methodology used to account for energy savings achieved by enterprises which are covered by Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275 of 30.4.2004, p. 32; (OJ Polish Special Edition, Chapter 15, Volume 7, p. 631). The proposed method aims at making amendments in the presentation of energy savings by taking into account the emission allowance trading system and its exclusion from energy savings achieved in accordance with the methodology compliant with the Commission's recommendations (K ratio in the P14 indicator).

The P14 indicator characterises energy consumption by individual subsections of industry. Energy consumption per unit of industrial production in a subsections of industry is defined and a ratio between energy consumption by a given subsection and the production index

Data necessary to calculate the P14 indicator:

- energy consumption by a subsection;
- production index of an industry subsection;
- share of energy consumption by a subsection which is within the scope of Directive 2006/32/EC.

The index of the industrial production in subsections is the most frequently used indicator to characterise industrial production, which is calculated in relation to the base year. Indices are determined by EUROSTAT and GUS.

The share of energy consumption in industry subsections covered by the scope of Directive 2006/32/EC corresponds to the usage which is not taken into account in the system of trade in emissions rights. This share may be based on data prepared by the National Allocation Plans and remain at the same level (in the years 2008 – 2016).

Energy savings are calculated on the basis of energy consumption in relation to the production index. These calculations may also take into account the share of non-structural changes in the structure of production, in particular in the chemical industry - the effect of transferring the production from heavy to light chemical substances (e.g. cosmetics, pharmaceutical products).
Energy savings in the industrial sector were calculated on the basis of preferred P14 indicators for the following subsections of industrial manufacturing (PKD - SECTION C) and construction (PKD SECTION F):

Manufacturing	Subsection PKD 2004	Subsection PKD 2007
Chemical	24	20-21
Metal	27	24
Mineral	26	23
Wood	20	16
Paper	21-22	17-18
Food	15-16	10-12
Textiles	17-19	13-15
Machinery	28-32	25-28
Means of transport	34-35	29-30
Other	25, 33, 36 -37	22, 31-32

The following table presents data used for calculation of energy efficiency indicators. Data sources are EUROSTAT and GUS.

Table No 12. Data used in calculations of energy efficiency indices and energy savings in the industrial sector in the years 2008 – 2012

Data	Unit	2008	2009	2010	2011	2012
Energy consumption in the chemical industry	ktoe	3478	3677	3593	3725	3804
Energy consumption in the metal industry	ktoe	2804	2080	2216	2417	2478
Energy consumption in the minerals industry	ktoe	2769	2653	2801	3105	2782
Energy consumption in the wood industry	ktoe	690	688	758	773	791
Energy consumption in the paper industry	ktoe	1167	1211	1257	1235	1276
Energy consumption in the food	ktoe	1925	1785	1801	1801	1890

industry						
Energy consumption in the textile industry	ktoe	171	132	131	108	105
Energy consumption in the machinery industry	ktoe	737	636	702	706	683
Energy consumption in the means of transport industry	ktoe	452	337	357	355	353
Energy consumption in other subsections of manufacturing industry	ktoe	548	452	506	593	545
Energy consumption in construction	ktoe	217	264	240	229	216
Production index for chemical industry	year 2000 =100 %	166 %.	167 %.	196 %.	190 %.	199 %.
Production index for metal industry	year 2000 =100 %	113 %.	84 %.	98 %.	114 %.	111 %.
Production index for mineral industry	year 2000 =100 %	170 %.	160 %.	187 %.	217 %.	203 %.
Production index for wood industry	year 2000 =100 %	142 %.	141 %.	155 %.	160 %.	167 %.
Production index for paper industry	year 2000 =100 %	155 %.	164 %.	188 %.	205 %.	217 %.
Production index for food industry	year 2000 =100 %	141 %.	147 %.	152 %.	159 %.	167 %.
Production index for textile industry	year 2000 =100 %	94 %.	84 %.	89 %.	99 %.	103 %.
Production index for machinery industry	year 2000 =100 %	258 %.	256 %.	308 %.	320 %.	344 %.
Production index for means of transport industry	year 2000 =100 %	210 %.	186 %.	206 %.	241 %.	253 %.
Production index for other subsections of manufacturing industry	year 2000 =100 %	228 %.	225 %.	244 %.	282 %.	275 %.
Production index for construction	year 2000 =100 %	118 %.	123 %.	128 %.	148 %.	125 %.

Data used for calculations according to KASHUE are presented in Table No 13

Table No 13. Data used for calculations according to KASHUE

Subsections of industrial manufacturing	$1-K_{2007}^{t^x}$
Chemicals (PKD 24);	0.39
Metallurgical (PKD 27)	0.20

Mineral (PKD 26)	0.70
Wood (PKD 20);	0.47
Paper (PKD 21-22);	0.59
Food (PKD13-14)	0.39
Textiles (PKD 17-19);	0.11
Machinery (PKD 28-32);	0.11
Means of transport (PKD 34-35);	0.07
Other	0.22

Values of the energy efficiency indicator P14 for industrial subsections, and energy savings are presented in Tables Nos 14 and 15.

Table No 14. Values of energy efficiency indicator P14 for industrial subsections in the years 2008 to 2012

Indicator	Insustrial subsection	Unit	2008	2009	2010	2011	2012
P14	Chemical	Mtoe/index	2.10	2.20	1.83	1.96	1.92
P14	Metal	Mtoe/index	2.49	2.46	2.27	2.12	2.26
P14	Mineral	Mtoe/index	1.63	1.66	1.50	1.43	1.37
P14	Wood	Mtoe/index	0.48	0.49	0.49	0.48	0.48
P14	Paper	Mtoe/index	0.75	0.74	0.67	0.60	0.59
P14	Food	Mtoe/index	1.36	1.21	1.19	1.14	1.13
P14	Textile	Mtoe/index	0.18	0.16	0.15	0.11	0.10
P14	Machinery	Mtoe/index	0.28	0.25	0.23	0.23	0.20
P14	Means of transport	Mtoe/index	0.18	0.21	0.19	0.15	0.14
P14	Other	Mtoe/index	0.24	0.20	0.21	0.21	0.20
P14	Construction	Mtoe/index	0.18	0.21	0.19	0.16	0.17

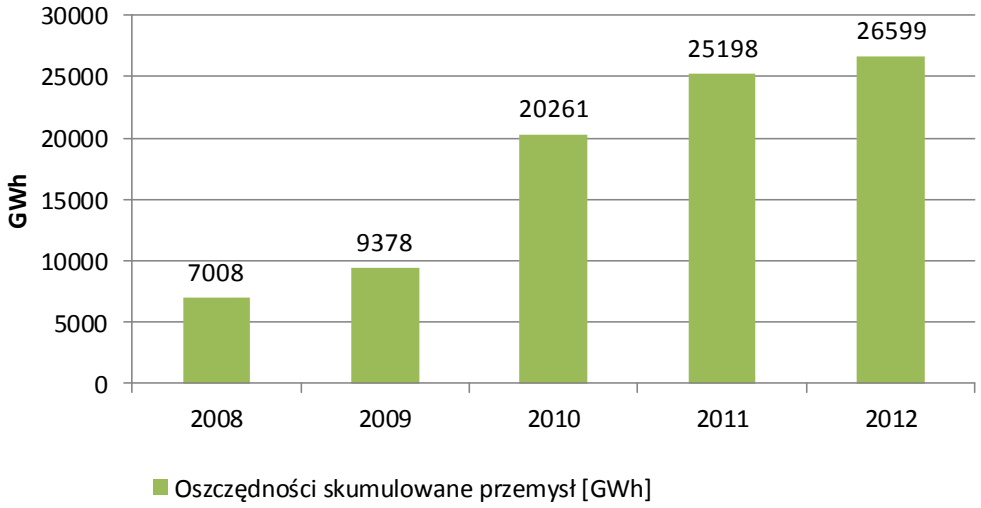
Table No 15. Energy savings for the services sector in the years 2008 – 2012

On the basis of an indicator.	Industrial subsection	Unit	2008	2009	2010	2011	2012
P14	Chemical	ktoe	85	-12	421	264	326
P14	Metal	ktoe	227	189	376	584	439
P14	Mineral	ktoe	74	53	154	218	245
P14	Wood	ktoe	-53	-55	-61	-58	-54

P14	Paper	ktoe	6	16	72	135	156
P14	Food	ktoe	26	162	190	251	271
P14	Textile	ktoe	18	36	46	84	93
P14	Machinery	ktoe	86	168	258	271	380
P14	Means of transport	ktoe	19	75	98	174	200
P14	Other	ktoe	38	107	104	113	136
P14	Construction	ktoe	23	-11	22	72	41
Total		**ktoe**	**603**	**806**	**1742**	**2167**	**2287**
		GWh	7008	9378	20261	25198	26599

Table No 16. Cumulated energy savings in the industrial sector

Year	2008	2009	2010	2011	2012
ktoe	**603**	**806**	**1742**	**2167**	**2287**
GWh	7008	9378	20261	25198	26599



Translation of figure above:

Cumulated energy savings, industry [GWh]

Figure Energy savings (GWh) calculated on the basis of P14 indicator for industry subsections

For many years the industrial sector has demonstrated an improvement in energy efficiency, and energy saving were achieved primarily in its most energy intensive subsections. This trend could also be observed in the calculations for the period 2008-2012.

List of energy savings achieved

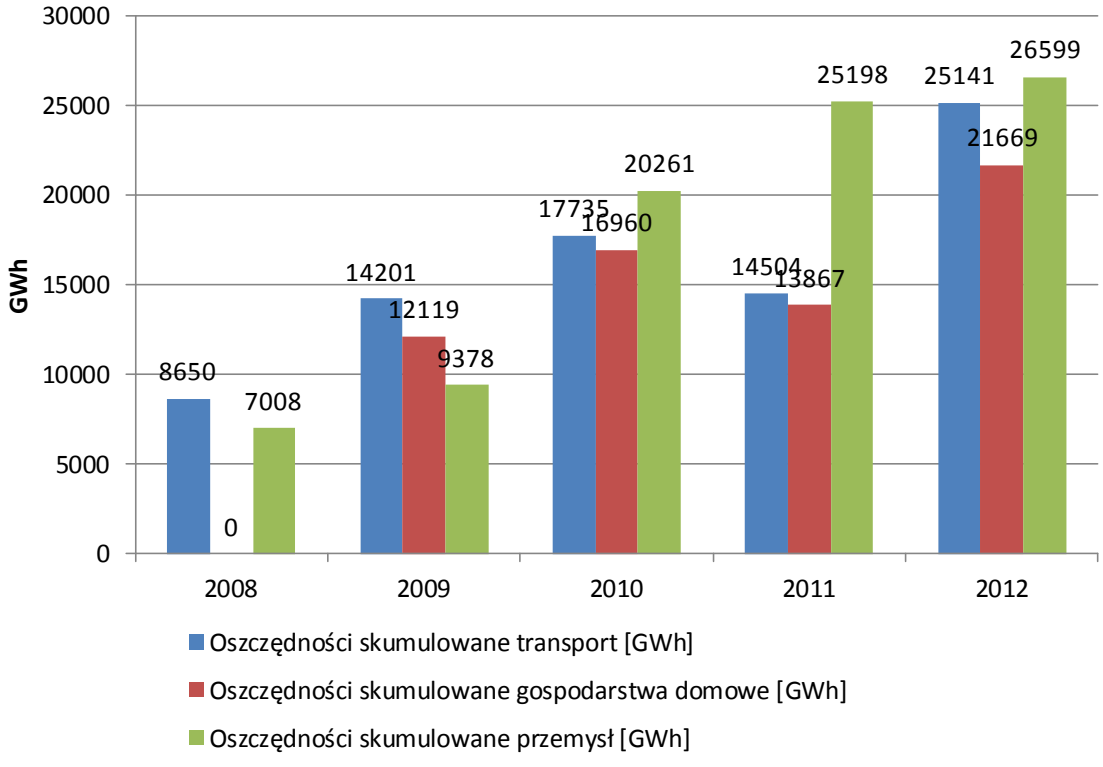
Energy savings were calculated according to the methodology published by the European Commission in a document "Recommendations on Measurement and Verification Methods in the Framework of Directive 2006/32/EC on Energy end-use Efficiency and Energy Services".

Tables 17 and 18 present calculated energy efficiency indicators and energy savings achieved in the years 2008 – 2012.

Table No 17. List of energy savings in the industrial sector

Sector of the economy	Indicator	Unit	2008	2009	2010	2011	2012
Households	P1	ktoe	0	1042	1458	1192	1863
		GWh	0	12119	16960	13867	21669
Services	M3, M4	ktoe	0	0	0	0	0
		GWh	0	0	0	0	0
Transport	P9	ktoe	744	1221	1525	1247	2162
		GWh	8650	14201	17735	14504	25141
Industry	P14	ktoe	603	806	1742	2167	2287
		GWh	7008	9378	20261	25198	26599
Savings calculated on the basis of indicators		**ktoe**	**1346**	**3069**	**4725**	**4606**	**6312**
		GWh	15658	35697	54957	53568	73409

Table No 17 and the Figure below present energy savings achieved in the years 2008 to 2012 in economic sectors and total energy savings on the basis of energy efficiency indicators.



Translation of figure above:

Cumulated savings transport [GWh]

Cumulated savings households [GWh]

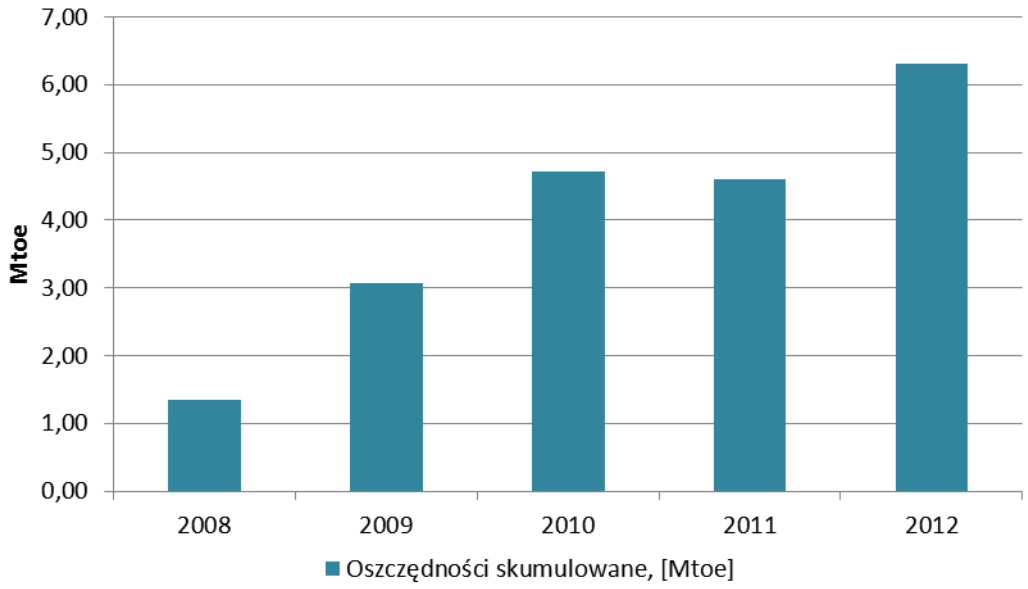
Cumulated savings industry [GWh]

Figure Energy savings in different sectors on the basis of preferred indicators P

Table No 18. Cumulated energy savings in all economic sector, in relation to the base year 2007

Unit	2008	2009	2010	2011	2012
Mtoe	**1.35**	**3.07**	**4.73**	**4.61**	**6.31**
GWh	15658	35697	54947	53568	73409

Energy savings in 2012 in relation to 2007 constitute total energy savings achieved in the transport sector, in households and in the industrial sector, amounting to 2.16, 1.86, and 2.29 Mtoe respectively, which constitutes 6.31 Mtoe.



Translation of figure above:

Cumulated savings [Mtoe]

Figure Total energy savings (GWh) achieved in all economic sectors, calculated on the basis of priority P indicators

Energy savings values have grown regularly since 2007. 2007 is the year adopted as a base years (in accordance with the European Commission's recommendations and savings are calculated starting from that year (in 2007 the savings were calculated (they amount to 0 in 2007). Certain fluctuations from one year to another in the values of savings calculated are due to the methodology based on proposed indicators which are simplified in relation to economic processes, inhabitants' behavioural patterns, or climate conditions. A strongly growing trend in energy savings indicates that the process of reducing energy intensity of the economy is a permanent one.

The top-down method (from general to detailed) showed that the indicative target of Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC, was met already in 2006. The method "from general to detailed" is a method based on estimates, but it certainly illustrates an improvement in energy efficiency of the economy in the years under investigation. Calculations of energy savings undertaken following the recommendations of the European Commission are a comparative tool, both in relation to a particular economy, the years covered by calculations, and also between different countries. It should be noted that indicators are devised on the basis of physical quantities, in the realisation that statistical errors may occur. In the case of Poland, it is also important that public statistics make it possible to calculate savings using priority indicators.

II. Final energy savings calculations using the bottom-up method

Table No 19 Algorithms for final energy savings calculations used in respect of different energy efficiency improvement measures

	Names of measures to increase energy efficiency	The algorithm used in the calculations of energy savings	Sources of information on input data	Adopted period of durability of energy savings	Achieved and planned final energy savings (ktoe)
	Thermomodernisation and Repairs Fund	$O_{FTiR} = \sum_{i=1}^{n} o_i$ o_i – final energy savings achieved/expected as a result of different investments co-financed by the Thermomodernisation and Repairs Fund	BGK	30 years - in accordance with the recommendations of the European Commission	2012 -412 2016 -557 2020-736
	Country-wide information and educational campaigns	$O_{kamp} = \frac{L_{odb} * Ods_{skł} * Ods_{dz} * Z_{energ-mieszkanie} * Ods_{zm-beh}}{L_{mieszk}}$ L_{odb} – number of recipients of the most popular campaigns in a given year $Ods_{skł}$ – percentage of people inclined to save energy Ods_{dz} – percentage of persons whose declarations of being inclined to save energy translate into concrete actions reducing energy consumption Z_{mieszk} – final energy consumption per capita Ods_{zm-beh} – percentage of energy used in an apartment which can be reduced through behavioural changes L_{mieszk} – average number of persons living in one apartment in Poland	GUS, MG, MŚ, Garrison Institute, RWE Polska, TVP SA	2 years - in accordance with the Recommendations of the European Commission	PLN 2012 – 15. PLN 2016 – 30. PLN 2020 – 30.
	Green Investments Scheme. (Part 1 - Energy management in public utility facilities)	$O_{GIS1} = \frac{B_{GIS1}}{B_{GIS1-zob}} * (O_{GIS1_1} + O_{GIS1_2-5}) =$ $= \frac{B_{GIS1}}{B_{GIS1-zob}} * \varphi * \left(\sum_{i=1}^{n} \frac{k_{i-GIS1-1}}{w_T} + \sum_{j=1}^{m} e_{j-GIS1_2-5} \frac{w_T}{w_{T-CO2}}\right)$ O_{GIS1_1} – final energy savings achieved/expected as a result of thermomodernisation measures implemented by public institutions under GIS 1 in the first tender O_{GIS1_2-5} – final energy savings achieved/expected as a result of thermomodernisation measures implemented by public institutions under GIS 1 in tenders 2 to 5 $B_{B_{GIS1}}$ – GIS 1 programme budget $B_{GIS1-zob}$ – Commitments under GIS 1 φ – index of primary energy conversion into final energy $k_{i-GIS1-1}$ – investment inputs for projects	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	30 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 192 2020 – 268

		implemented under GIS 1 tender 1 w_T – average investment inputs per primary energy saving unit in thermomodernisation projects e_{j-GIS1_2-5} – CO_2 emissions avoided as a result of GIS 1 in tenders 2 to 5, as declared by beneficiaries w_{T-CO2} – average investment inputs per CO2 emissions unit avoided in thermomodernisation projects			
	Green Investments Scheme. Part 5 - Energy management in the facilities of selected public finance sector entities;	$O_{GIS5} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{i-GIS5}}{w_T} \right)$ O_{GIS5} – final energy savings achieved/expected as a result of thermomodernisation measures implemented by public institutions under GIS 5 φ – index of primary energy conversion into final energy k_{i-GIS5} – investment inputs for projects implemented under GIS 5 w_T – average investment inputs per primary energy saving unit in thermomodernisation projects	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	30 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. PLN 2016 – 8.5. PLN 2020 – 13.8.
	Operational Programme Infrastructure and Environment (OP IE 2007-2013) Measure 9.3 Thermomodernisation of public utility facilities	$O_{POIŚ9.3} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{POIŚ9.3}}{w_T} \right)$ $O_{POIŚ\ 9.3}$ – final energy savings achieved/expected as a result of thermomodernisation measures implemented by public institutions under GIS 9.3 φ – index of primary energy conversion into final energy $k_{POIŚ9.3}$ – investment inputs for projects implemented under OP IE 9.3 w_T – average investment inputs per primary energy saving unit in thermomodernisation projects	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	30 years - in accordance with the recommendations of the European Commission	PLN 2012 – 3.1. PLN 2016 – 15.7. PLN 2020 – 15.7.
	Operational Programme PL04 "Energy saving and promotion of renewable energy sources (programming area No 5, energy efficiency)	$O_{PL04} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{PL04}}{w_T} \right)$ O_{PL04} – final energy savings expected as a result of thermomodernisation measures implemented by public institutions under PL04 φ – index of primary energy conversion into final energy k_{PL04} – investment inputs for projects implemented under PL04 w_T – average investment inputs per primary energy saving unit in thermomodernisation projects	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	30 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 15.5 2020 – 15.5

	Energy efficiency improvement. Part 2 LEMUR Energy Efficient Public Utility Facilities	$O_{EWE4} = \varphi * \left(\sum_{i=1}^{n} e_{EWE4} \frac{w_T}{w_{T-CO2}} \right)$ O_{EWE4} - final energy savings expected as a result of thermomodernisation measures implemented by public institutions under EWE4 w_T – average investment inputs per primary energy saving unit in thermomodernisation projects e_{EWE4} – avoided CO2-emissions declared by beneficiaries w_{T-CO2} – average investment inputs per CO2 emissions unit avoided in thermomodernisation projects	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	30 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 6.2 2020 – 12.4
	Green Investments Scheme. Part 6 SOWA Energy Efficient Street lighting	$O_{GIS6} = \varepsilon * e_{GIS6}$ ε – Reference emissions indicator for electric energy production (average for years 2008-2010) e_{GIS6} – CO_2 emissions avoided as a result of GIS 6, as declared by beneficiaries	National Fund for Environmental Protection and Water Management (NFEP&WM) KOBIZE	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. PLN 2016 – 3. PLN 2020 – 3.
	White certificates	$O_{cert} = \sum_{i=1}^{n} o_{i-cert}$ O_{cert} – final energy savings achieved/expected as a result of measures availing of the support under the white certificates scheme o_{i-cert} – final energy savings achieved/expected in the project availing of the support under the white certificates scheme	URE	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 1364 2020 – 3675
	Efficient energy use Part 2 Support for operators as regards low-emissions economy - increased energy efficiency	$O_{EWE2} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{i-EWE2}}{w_{EWE2}} \right)$ O_{EWE2} – final energy savings achieved/expected as a result of measures implemented under the EWE2 programme φ – index of primary energy conversion int final energy k_{EWE2} – Amount of subsidies for projects implemented under the EWE2 programme w_{EWE2} – Average amount of subsidies per unit o saved primary energy	National Fund for Environmental Protection and Water Management (NFEP&WM)	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 104.9 2020 – 113.7
	Programme of access to financial instruments for SMEs (PolSEFF);	$O_{PolSEFF} = \sum_{i=1}^{n} o_{PolSEFF} * m_i$ $O_{PolSEFF}$ – final energy savings achieved/expected as a result of measures implemented under the PolSEFF programme	EBOR	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 11.5 2020 – 11.5

		$o_{PolSEFF}$ – Average final energy savings achieved under the PolSEFF programme m_i – Number of projects implemented in year i			
	Priority Programme: Intelligent energy networks (IEN);	$O_{ISE} = \left(\sum_{i=1}^{n} e_{ISE} * \varepsilon\right)$ O_{ISE} - final energy savings expected as a resu of measures implemented under the ISI programme e_{ISE} – Avoided CO2-emissions to be achieved in year "i" ε – reference emissions indicator for electricity production	National Fund for Environmental Protection and Water Management (NFEP&WM) KOBIZE	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. PLN 2016 – 0.5. PLN 2020 – 8.5.
	Operational Programme Infrastructure and Environment (OP IE) Measure 9.2 Efficient energy distribution	$O_{POI\$9.2} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{POI\$9.2}}{w_{9.2}}\right)$ $O_{POI\$ 9.2}$ – final energy savings achieved/expected as a result of measures implemented under the OP IE 9.2 programme φ – index of primary energy conversion int final energy $k_{POI\$9.2}$ – investment inputs for projects implemented under OP IE 9.2 $w_{9.2}$ – average investment inputs per primary energy saving unit in projects implemented under OP IE 9.2 programme	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	15 years - in accordance with the recommendations of the European Commission	PLN 2012 – 0. 2016 – 22.9 2020 – 22.9
	Operational Programme Infrastructure and Environment (OP IE) Measure 9.1 Efficient energy generation	$O_{POI\$9.1} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{POI\$9.1}}{w_{9.1}}\right)$ $O_{POI\$ 9.1}$ – final energy savings achieved/expected as a result of measures implemented under the OP IE 9.1 programme φ – index of primary energy conversion int final energy $k_{POI\$9.1}$ – investment inputs for projects implemented under OP IE 9.1 $w_{9.1}$ – average investment inputs per primary energy saving unit in projects implemented under OP IE 9.1 programme	National Fund for Environmental Protection and Water Management (NFEP&WM) Report "Impact assessment of investments under measures 9.1, 9.2 and 9.3	15 years - in accordance with the recommendations of the European Commission	2012 – 5.7, 2016 – 7.9 i 2020 – 7.9.
	Operational Programme Infrastructure and Environment (OP IE) Measure 9.4 |Generation of energy from renewable sources [in respect of high-	$O_{POI\$9.4} = \varphi * \left(\sum_{i=1}^{n} \frac{k_{POI\$9.4}}{w_{9.4}}\right)$ $O_{POI\$ 9.4}$ – final energy savings achieved/expected as a result of measures implemented under the OP IE 9.4 programme φ – index of primary energy conversion int final energy $k_{POI\$9.4}$ – investment inputs for projects implemented under OP IE 9.4	"Assessment of possibility to ensure comparability of projects involving the use of different renewable energy sources using measure 9.4 as an example"	15 years - in accordance with the recommendations of the European Commission	2012 – 1.1 2016 – 2 PLN 2020 – 2.

	efficiency cogeneration].	$w_{9.4}$ – average investment inputs per primary energy saving unit in projects implemented under OP IE 9.4 programme			
	Operational Programme Infrastructure and Environment (OP IE) Measure 8.3 Development of smart transport systems	$O_{ITS} = \sum_{i=1}^{m}(2+\rho_i)\sum_{j=1}^{n}\varphi * w_{ITS} * k_{j_{ITS}}$ φ – index of primary energy conversion into final energy w_{ITS} – unitary primary energy savings in relation to investment inputs $k_{j_{ITS}}$ – investment inputs into projects in the area of traffic management systems and optimisation of freight transport ρ_i – coefficient of variation in the programme allocations for the year 2014-2020 as compared to the 2007-2013 programme	EUROSTAT Evaluation of the TRAVOLU-TION project under the FuE programme "Information and communications technique@ of the Free State of Bavaria PKN Orlen Ministry of Regional Development, Partnership Agreement (draft, July 2013)	15 years, own assumptions (there are no European Commission's recommendations regarding traffic optimisation)	PLN 2012 – 0.5. 2016 – 43.5 2020 – 57
	Operational Programme Infrastructure and Environment (OP IE) Measure 7.3 Urban transport in metropolitan areas	$O_{FLOTA} = \sum_{i=1}^{m}(2+\rho_i)\sum_{j=1}^{n}\varphi * w_{FLOTA} * k_{FLOTA}$ φ – index of primary energy conversion into final energy w_{FLOTA} – unitary primary energy savings in relation to investment inputs k_{FLOTA} – investment inputs in vehicles replacement programmes in urban transport companies and promotion of eco-driving ρ_i – coefficient of variation in the programme allocations for the year 2014-2020 as compared to the 2007-2013 programme	Data regarding urban transport systems in the cities of Lubin and Wałbrzych; P.Rosik et al. "Commuting to work to Warsaw and Białystok; alternative methodological approaches", 2010 Studia Regionalne i Lokalne, Uniwersytet Warszawski (Regional and Local Studies, Warsaw University)	15 years, own assumptions (there are no European Commission's recommendations regarding traffic optimisation)	2012 – 38 2016 – -1080 PLN 2020 – 2016.

Annex No. 3

Final energy savings on the basis of the ODEX indicator

This Annex presents values of the ODEX indicator and energy savings calculated on the basis of this indicator for three sectors of the economy, households, transport, and industry. In accordance with Directive 2006/32/EC, the year 2007 was adopted as the base year. The ODEX indicator and energy savings were calculated accordingly (ODEX for 2007 equals 100 and energy savings for that year are zero).

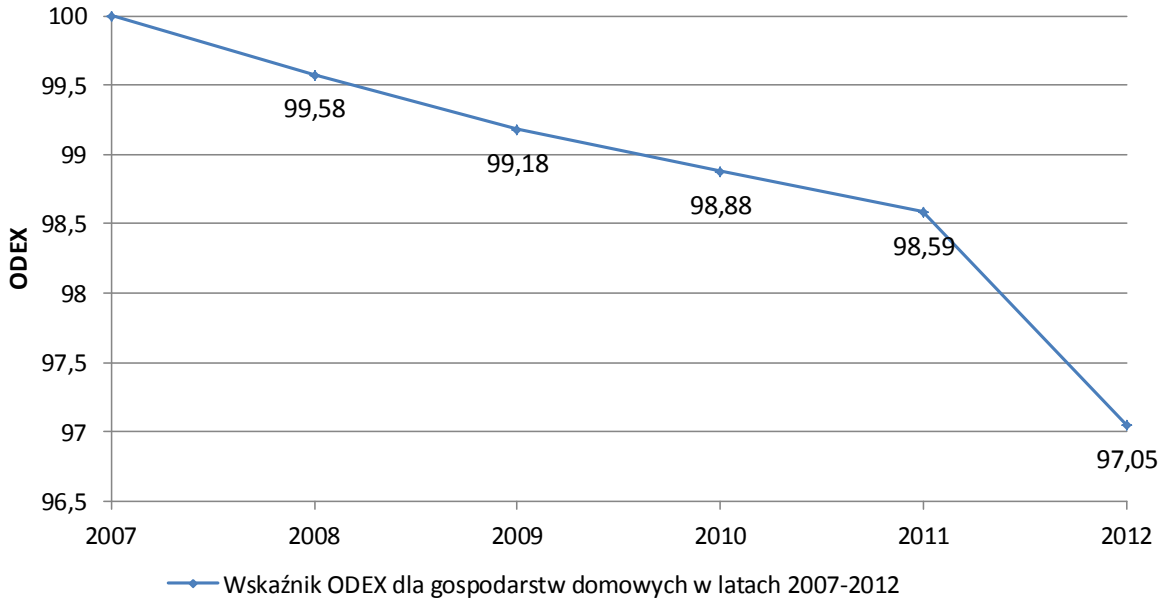
1. ENERGY SAVINGS ON THE BASIS OF THE ODEX INDICATOR IN THE HOUSEHOLDS SECTOR

Since 2007 there was stable progress in the households sector regarding the improved energy efficiency. The same applies to the cumulated amount of energy savings. This is presented respectively in Table No 1 and Figure 1.

Table No 1 ODEX indicator in the households sector in relation to the year 2007

Year	2007	2008	2009	2010	2011	2012
ODEX	100	99.6	99.2	98.9	98.6	97.1

Figure No 1 Changes in the ODEX indicator in the households sector in relation to the year 2007



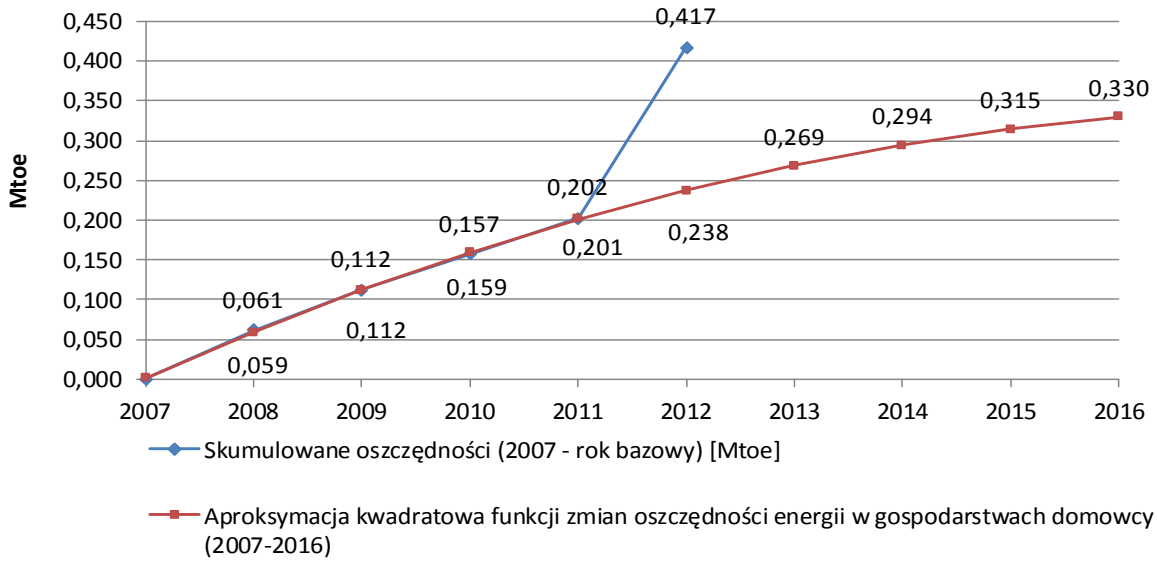
Translation of the figure above:

ODEX indicator in the households sector in the years 2007-2012

Energy savings in the households sector calculated on the basis of the ODEX indicator in consecutive years 2008-2012, in relation to the base year 2007 [Mtoe], and their approximation by square root function in the years 2007-2016, are presented respectively in Table No 2 and Figure 2.

Table No 2 Cumulated energy savings in the households sector in the years 2008-2012, and their approximation by square root function in the years 2007-2016

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Savings	0.00	0.061	0.112	0.157	0.202	0.417				
Approximation	0.001	0.059	0.112	0.159	0.201	0.238	0.269	0.294	0.315	0.330



Translation of figure above:
Cumulated savings (2007 – the base year) [Mtoe]
Square function approximation of changes in energy savings in households (2007-2016)

Table No 2 Cumulated energy savings in the households sector[Mtoe] and their approximation by square root function in the years 2007-2016

In the years 2007-2012, the ODEX indicator for households fell from 100 to 97 points. Average rate of improvement of energy efficiency was 0.60 %/year.

Cumulated energy savings since 2007, indicating how much higher energy consumption would be if no improvements were achieved regarding energy efficiency after 2007, amounted to 0.417 Mtoe in 2012. In the approximation of changes in cumulated energy savings, the year 2012

was not taken into account in view of a very significant change in the trend (increased improvement) in relation to previous years. Thus, forecasts for savings in 2016 will be more cautious. They amount to 0.330 Mtoe.

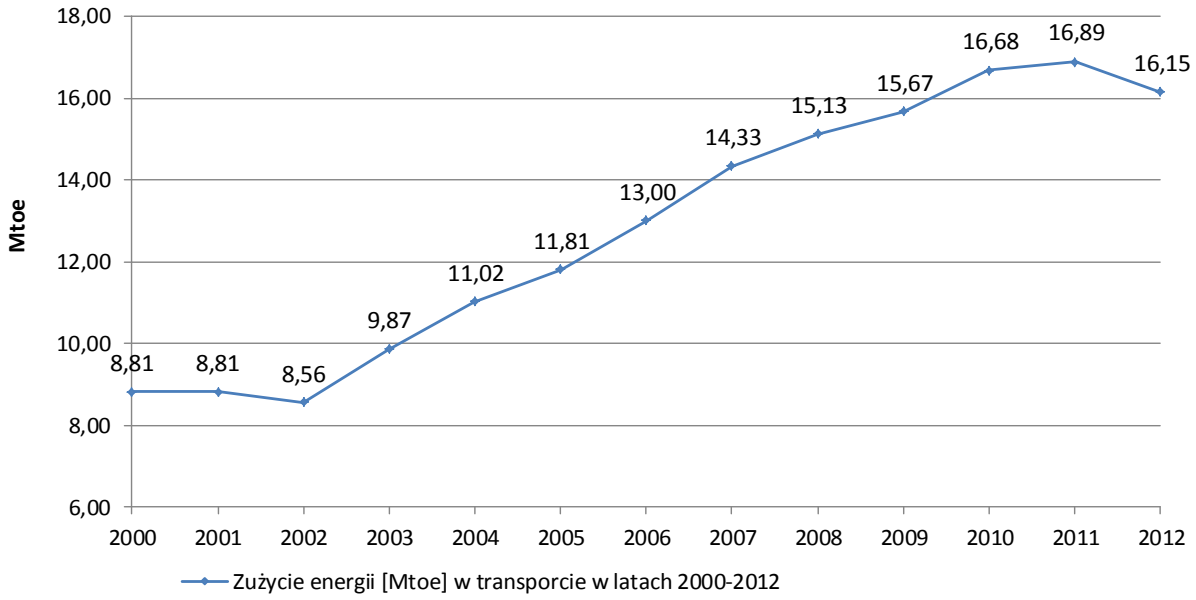
Trends of a systematic improvement of energy efficiency in the households sector will certainly be maintained. New regulations regarding stricter standards for buildings' thermal protection (Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, amending a Regulation regarding technical conditions which should be met by buildings and their locations), a number of aid programmes in the years 2014-2020, several promotional campaigns, as well as the dwellers' efforts to reduce costs of energy provide a guarantee that the minimum targets set for energy savings in 2016 will be achieved.

2. ENERGY SAVINGS IN THE TRANSPORT SECTOR ON THE BASIS OF THE ODEX INDICATOR

Energy consumption in the transport sector presented in Table No 3 and in Figure 3 is characterised by a steady growth from 2002 to 2011. However, a drop in consumption was noted in 2012.

Table No 3 Energy consumption in the transport sector [Mtoe] in the years 2000-2012

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Mtoe	8.81	8.81	8.56	9.87	11.02	11.81	13.00	14.33	15.13	15.67	16.68	16.89	16.15



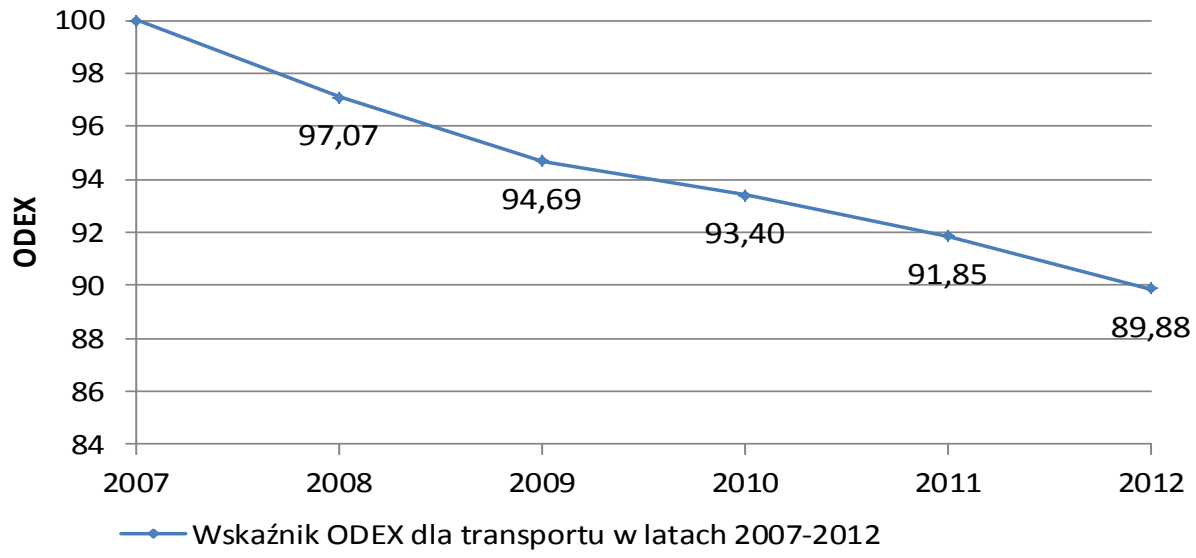
The text under Figure 3 is identical as the title

Figure No 3 Energy consumption [Mtoe] in the transport sector in the years 2000-2012

Table No 4 and Figure 4 present changes in the ODEX indicator in the years 2007-2012, i.e. progress in energy efficiency since the year 2007 (the base year).

Table No 4. Changes in the ODEX indicator in the transport sector in relation to the year 2007

Year	2007	2008	2009	2010	2011	2012
ODEX	100	97.07	94.69	93.40	91.85	89.88



Translation of Figure 4:

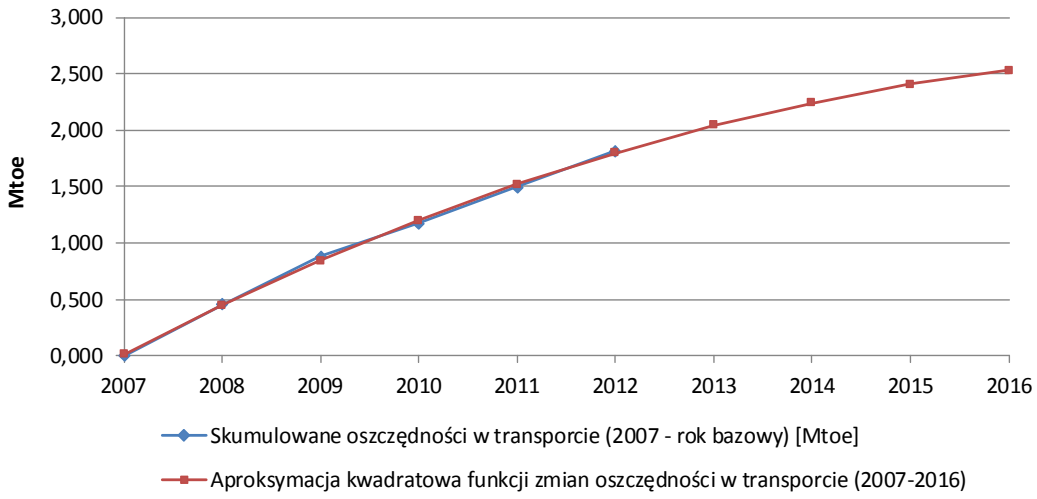
ODEX indicator for transport in the years 2007-2012

Figure 4 Changes in the ODEX indicator in the transport sector in relation to the year 2007

Energy savings in transport in the years 2008-2012 calculated on the basis of the ODEX indicator, referred to the base year 2007 [Mtoe], and their approximations using the square function in the years 2007-2016 are presented respectively in Table No 5 and Figure 5.

Table 5 Energy savings in transport sector [Mtoe] and square approximation in the years 2007-2016

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Savings	0	0.457	0.878	1.178	1.498	1.818				
Approximation	0	0.488	0.844	1.202	1.521	1.801	2.042	2.244	2.407	2.532



Translation of figure 5:
Cumulated savings in transport (2007 – the base year) [Mtoe]
Square function approximation of changes in energy savings in transport (2007-2016)

Figure 5 Table 5 Energy savings in transport sector [Mtoe] and square approximation in the years 2007-2016

In the years 2007-2012 the ODEX indicator dropped from 100 points to 90 points. The average rate of improvement of energy efficiency was 2.11 %/year.

In 2012, cumulated energy savings since 2007, showing how much higher energy consumption would have been in a given year without the introduction of improvements regarding energy efficiency, amounted to 1 818 Mtoe for the transport sector. After the

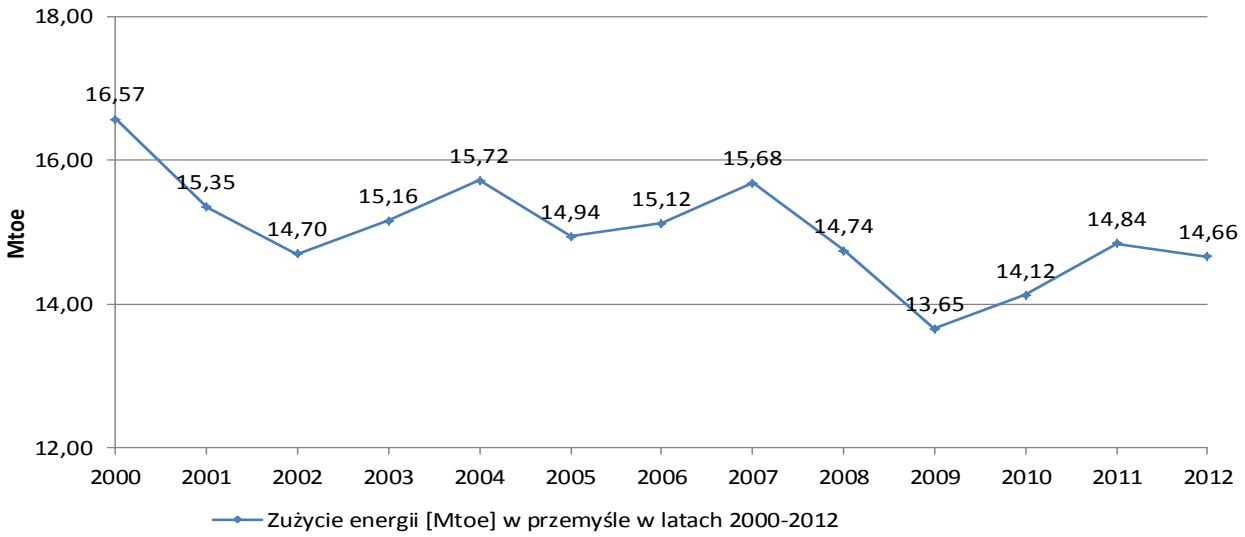
approximation of changes in energy savings in the period 2007-2012, using the square function, energy savings in 2016 are forecast to be 2 532 Mtoe.

3. ENERGY SAVINGS IN THE MANUFACTURING INDUSTRY SECTOR ON THE BASIS OF THE ODEX INDICATOR

Energy consumption in the manufacturing industry sector presented in Table 6 and in Figure 6. is characterised by strong fluctuations, generated, to a large extent, by changes in economic activities.

Table No 6 Energy consumption [Mtoe] in the manufacturing industry sector in the years 2000-2012

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Mtoe	16.57	15.35	14.70	15.16	15.72	14.94	15.12	15.68	14.74	13.65	14.12	14.84	14.66



Translation of Figure 6:

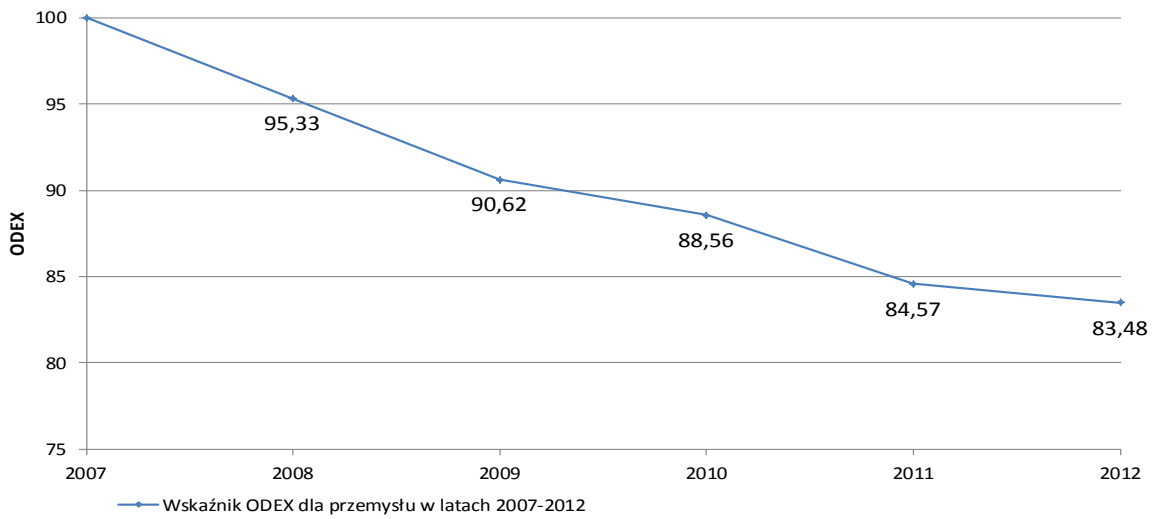
Energy consumption [Mtoe] in industry in the years 2000-2012

Figure 6 Energy consumption [Mtoe] in the manufacturing industry sector in the years 2000-2012

Table No 7 and Figure 7 present changes in the ODEX indicator in the manufacturing industry sector in the years 2007-2012, i.e. progress in energy efficiency since the year 2007 (the base year).

Table No 7 Changes in the ODEX indicator in the manufacturing industry sector in relation to the year 2007

Year	2007	2008	2009	2010	2011	2012
ODEX	100	95.33	90.62	88.56	84.57	83.48



Translation of Figure 7:

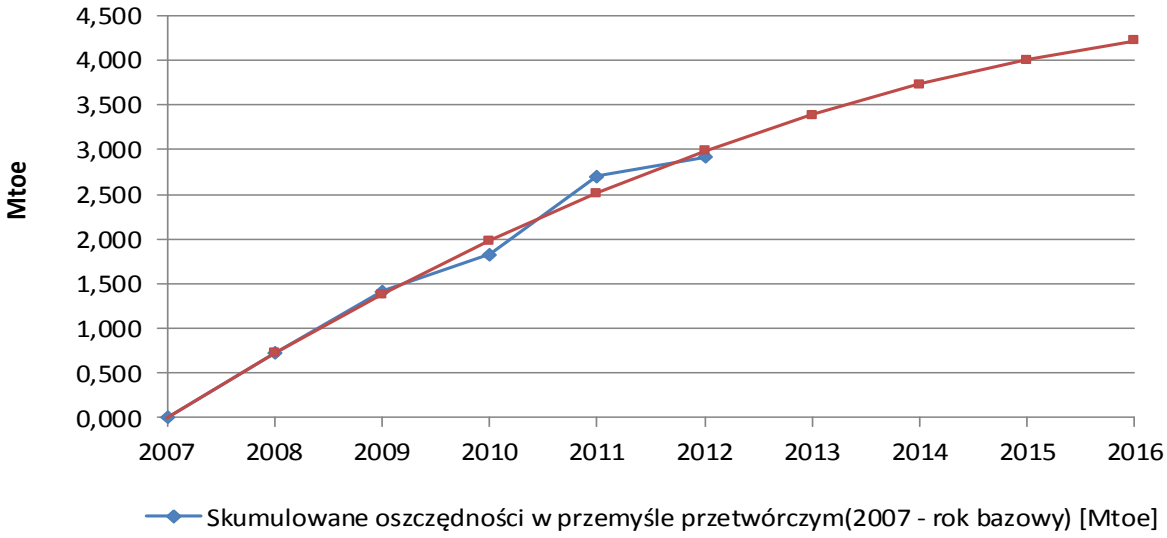
ODEX indicator for industry in the years 2007-2012

Figure 7 ODEX indicator in the manufacturing industry sector in relation to the year 2007

Energy savings calculated on the basis of the ODEX indicator in the manufacturing industry sector in the years 2008-2012, referred to the base year 2007 [Mtoe], and their approximations using the square root function in the years 2007-2016 are presented respectively in Table No 8 and Figure 8.

Table 8 Cumulated energy savings in the manufacturing industry sector [Mtoe] and square approximation in the years 2007-2016

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Savings	0	0.722	1.413	1.825	2.701	2.916				
Approximation	0	0.721	1.384	1.982	2.516	2.986	3.392	3.734	4.011	4.224



Translation of Figure 8:

Cumulated savings in the processing industry (2007 – the base year) [Mto]

Figure 8 Energy savings in the manufacturing industry sector [Mtoe] and square approximation in the years 2007-2016

In the years 2007-2012 the ODEX indicator dropped from 100 points to 83.5 points (the most significant reduction in all economic sectors). The average rate of improvement of energy efficiency for manufacturing industry was 3.55 %/year.

In 2012, cumulated energy savings since 2007, showing how much higher energy consumption would have been in a given year without the introduction of improvements regarding energy efficiency, amounted to 2 916 Mtoe for the manufacturing industry sector. It should be noted that enterprises to which the ETS system applies are not excluded from energy savings calculated on the basis of ODEX indicators.

After the approximation of changes in energy savings in the period 2007-2012, using the square function, forecast energy savings in 2016 are 4 224 Mtoe.

4. TOTAL ENERGY SAVINGS IN SECTORS AND ESTIMATED ENERGY SAVINGS IN 2016

The trend presented shows a steady improvement of energy efficiency of individual sectors: households, transport, and industry. It has been observed and documented since 2000, and it did have a place also in previous years. It is justified to assume that the trend will continue in the coming years, in particular until 2016. The rate of improvement slows down only slightly, as it becomes increasingly difficult to achieve. Technological developments and non-technical factors ensure that trends observed will be maintained. Thus, it is justified, but also safe to adopt square approximations (slowing in the rate of increase of energy savings in the years 2012-2016.

In Table No 9 and in Figure 9, energy savings achieved in the years 2007-2012 are added together for the three above-mentioned sectors. The savings were calculated on the basis of ODEX indicators and focerast until 2016.

Table No 9 Energy savings and square approximation in the years 2007-2016 for households, transport, and industry sectors [Mtoe]

Energy savings (Mtoe)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Achieved	0	1.240	2.404	3.159	4.407	5.152				
Approximated	0	1.228	2.340	3.343	4.238	5.025	5.702	6.272	6.733	7.085

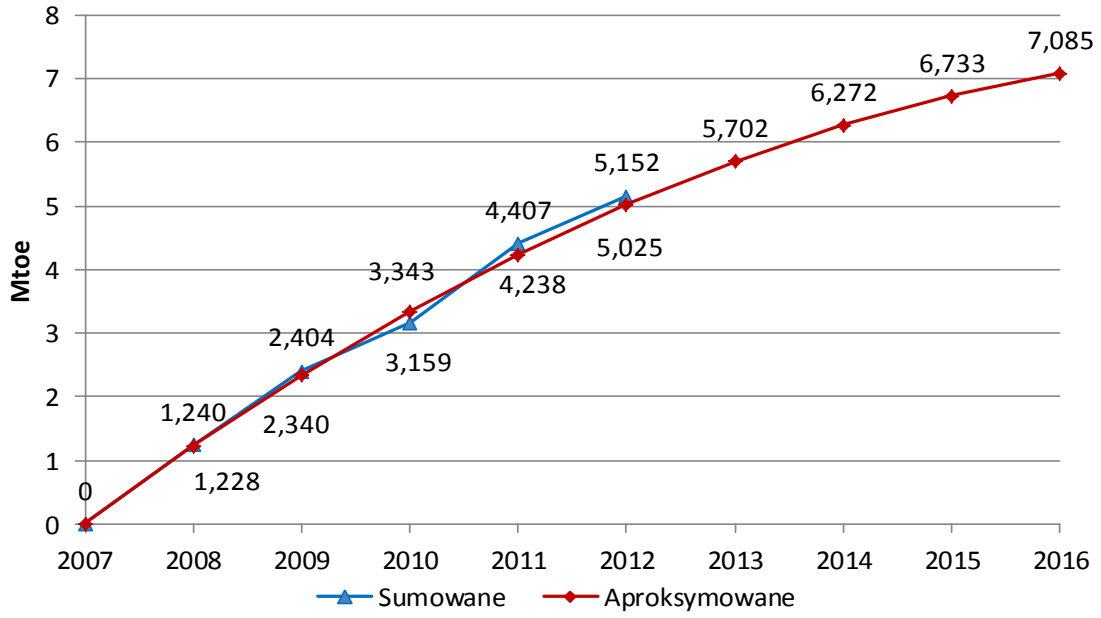


Figure 9 Total Energy savings and square approximation in the years 2007-2016 for the three sectors[Mtoe]

For the three sectors together (without the services sector) cumulated energy savings forecast for 2016, on the basis of ODEX indicators, amount to approximately **7 09 Mtoe**. Energy savings in the years 2008-2012, calculated on the basis of energy efficiency indicators in accordance with the European Commission recommendations, are not significantly different from those calculated on the basis of ODEX indicators which are more precise in determination of their values. The nature of changes in the values of energy savings obtained (in accordance with ODEX) in the years 2007-2012, as well as their values (even when including also enterprises to which ETS applies), point to the potential which makes it possible to achieve an indicative target regarding final energy consumption, set out in Directive 2006/32/EC.

Annex No. 4

Supporting Investments for Buildings Modernisation

Supporting investments in the modernisation of the national stock of residential and public utility buildings, private ones, and those owned by the State Treasury and by local self-government, is the implementation of the requirements of Article 4 of Directive. In accordance with that Article, Member States are to establish "a long-term strategy for mobilising investment in the renovation of the national stock of residential
and commercial buildings, both public and private", hereinafter referred to as "a long-term strategy" which includes:

1) an overview of the national building stock based, as appropriate, on statistical sampling;
2) identification of cost-effective approaches to renovations relevant to the building type and climatic zone;
3) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;
4) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions;
5) an evidence-based estimate of expected energy savings and wider benefits.

EU Member States are required to publish a first version of the "strategy" by 30 April 2014 and update it every three years thereafter and submit it to the Commission as part of the National Energy Efficiency Action Plans.

Article 4 of Directive 2012/27/EU sets out an obligation to establish a long-term strategy. Taking into account the scope of the long-term strategy, as well as the objectives of Directive 2012/27/EU, and the terminology used in national provisions and in literature, it was decided to use the word "modernisation". Renovation is understood as renewal, refreshment of something, or restoration, and usually refers to historical items, cultural properties, or works of art, although it also applies to buildings. On the other hand, the term "modernisation" should be understood as modernising and improving, which leads to an increase of useful value and incorporates such concepts as transformation, reconstruction, extension, which are used in the Act of 7 July 1994, the Construction Law.

It should also be stressed that this Annex focuses on measures related to the improvement of energy efficiency. This Annex does not refer to other aspects of modernisation, i.e.

modernisation of the construction of the building, telecommunications and electrical installations, sewage treatment, and other issues whose impact on the improvement of energy efficiency is limited.

The main targets set out in this Annex include: an indication of works feasible to carry out which would improve the energy performance of a building already used, and an inventory of available financial instruments which lead to a reduction of annual demand for final energy to be used for heating and ventilation, for preparing hot water, for cooling and for lighting incorporated in the buildings.

This Annex should be delivered to owners and administrators of buildings who envisage measures aimed at improving energy efficiency of buildings, and primarily to:

1) natural persons;
2) associations of owners of apartments;
3) housing cooperatives;
4) work establishments;
5) entities of the public finance sector.

Issues covered in this Annex are also addressed to designers and contractors involved in the above-mentioned activities.

As indicated in the introduction, this Annex was prepared on the basis of Article 4 of Directive 2012/27/EU and is to be part of the National Action Plan referred to in Article 6(1) of the Act of 15 April 2011 on energy efficiency.

The major documents related to this Annex are:

1. The Second National Action Plan regarding energy efficiency. This document was prepared in connection with the requirement to submit to the European Commission reports prepared pursuant to Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC (OJ L 114 of 27.04.2006, p. 64). The Second National Action Plan includes a description of energy efficiency improvement measures in different sectors of the economy, aimed at end-use of energy. The document also includes information on progress in the implementation of the national target for efficient management of energy, and measures taken in order to remove obstacles to meeting this target. The target consists of achieving by 2016 a minimum of 9 % of the end-use energy savings of the national average annual consumption (i.e. 53452 GWh energy savings by 2016). It was defined in Article 4(1) of the Act on energy efficiency. That document was adopted by the Council of Ministers on 17 April 2012.

2. The National Programme of Reforms for the implementation of the "Europe 2020" strategy (NPR) as the main tool for the implementation of the European Union economic strategy "Europe 2020". In accordance with the new coordination mechanism for the EU economic policy, the NPR is updated annually and sent to the European Commission together with the updating of the Stability or Convergence Programmes. NPR presents, among other things: a mid-term macroeconomic scenario; national ambitions regarding the implementation of five priority targets of "Europe 2020" strategy; identification of main obstacles for growth and employment, and measures to be taken to overcome these obstacles. The NPR also includes a time schedule for the implementation of reforms, as well as assessment of their budgetary impact. In the preparation of the National Programme of Reforms for the implementation of the "Europe 2020" strategy and in its annual updating, both the current microeconomic situation and the Government's forecasts and economic priorities are taken into consideration. The NPR is an element of the system of management of the national development policy, and reforms proposed in the Programme, in connection with the implementation of the long-term and mid-term development strategy for the country and with nine integrated national strategies, will make it possible to focus on areas of priority from the point of view of Poland's socio-economic development, leading at the same time to the implementation of targets of "Europe 2020" strategy. This document is in compliance with one of national targets indicated in the NPR, i.e. "Reduction of primary energy consumption to the level of approximately 96 Mtoe. Increased use of RES, reduction of CO_2 emissions".
3. The Communication from the Commission to the European Parliament, to the Council, to the European Economic and Social Committee, and to the Committee of the Regions. Energy Efficiency Plan 2011. The Communication from the European Commission indicating energy efficiency as being at the heart of the "Europe 2020" strategy, and the most cost effective ways to enhance security of energy supply, and to reduce emissions of greenhouse gases. This document emphasises the exemplary role of the public sector in the area of energy efficiency and demonstrates that the greatest potential as regards energy savings can be found in buildings.
4. Programming of the Financial Perspective 2014-2020 - Partnership Agreement - document specifying intervention directions in the years 2014-2020 for three EU policies in Poland: Cohesion Policy, Common Agricultural Policy, and Common Fisheries Policy. The document is based on the Partnership Agreement Objectives 2014-2020, adopted by the Council of Ministers on 15 January 2013. In preparing the Agreement, EU and national strategic documents were taken into account, as well as experience to-date connected with the

implementation of the 2004-2006 and 2007-2013 Perspectives. The Partnership Agreement was adopted by the Council of Ministers on 8 January 2014. The agreement includes topical objectives defined by the EU. One of them involved "Support for transition to low-emissions economy in all sectors". This is to include interventions covering a comprehensive, deep energy modernisation of public utility and residential buildings.

The building sector is pointed to as the one with the greatest potential for energy savings [47)]. The process of improvement of buildings' energy efficiency may at the same time bring an increase of innovativeness and an implementation of new technologies in construction and in installation techniques, a reduction of energy intensity, generation of new workplaces, and, consequently, it may improve the competitiveness of the economy and increase the level of prosperity of citizens.

There are other benefits resulting from the improvement of buildings' energy efficiency, including: reduced dependence on imports of energy materials, reduced negative impact on the natural environment, reduced bills for network heating, for fuels and for electricity, increased number of workplaces and support for local development.

To-date, the main legal instruments of the European Union regarding efficient use of energy in buildings were Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (OJ L 1 of 4.01.2003, p. 65) and Directive 2010/31/EC of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (revised version) (OJ L 153 of 18.06.2010, p. 13). Essential objectives of the above-mentioned Directives were the promotion of economically viable improvement of energy performance of buildings and setting of minimum requirements on the energy performance. The provisions of the Directives covered issues connected with the reduction of demand for energy in the case of newly-erected buildings and buildings already in use, through an introduction of differentiated regulatory instruments, such as: an obligation to set out minimum requirements on energy performance for new buildings, and also for buildings already in use with a useful floor area of more than 1000 sq. metres, which are subject to significant renovation; a requirement to analyse profitability of using alternative energy systems in new buildings with a useful floor area of more than 1000 sq. metres; and instruments based on information (energy performance certificates and reviews of heating and air-conditioning

[47)] Communication from the Commission to the European Parliament, to the Council, to the European Economic and Social Committee, and to the Committee of the Regions. Energy Efficiency Plan 2011. COM (2011) 109 final version.

systems). The obligation to analyse the profitability of using alternative energy supply systems for buildings and to set energy standards for buildings which are subject to significant renovation, applicable to-date on the basis of Directive 2002/91/EC for new buildings with a total useful floor area over 1000 m^2, was extended in Directive 2010/31/EU to cover all buildings, regardless of their total useful floor area.

The above-mentioned Directives were framework directives, i.e. there were no levels of requirements set throughout the European Union, but only the requirement that EU Member States set concrete requirements and promote relevant mechanisms.

The author of draft Directives considers that energy certification of buildings which come on the market, increased requirements regarding heat protection of buildings, and regular control of heating and air-conditioning systems, will contribute to an improvement of the entire building sector, from the point of view of reduction of non-renewable fuels consumption, environmental protection, safety and heat comfort for the users.

In addition, a special role of the public sector was emphasised as a sector leading by example and as a trend-setter in the energy efficiency area, in view of the fact that publicly owned or occupied buildings represent about 12 % of the total floor area of the EU building stock[48)].

Questions related to requirements regarding energy efficiency of buildings and improvement of energy standards of buildings are included in several legal acts.

The main provisions stipulating requirements concerning energy efficiency of buildings include: the Act of 7 July 1994, the Construction Law and a Regulation of the Minister of Infrastructure, issued on the basis of that Act on 12 April 2002 regarding technical conditions which should be met by buildings and their locations (Journal of Laws No 75, item 690, as amended[49)]), hereinafter referred to as "Regulation regarding technical conditions of buildings".

The Act of 7 July 1994, the Construction Law, provided regulatory arrangements for activities involving design, construction, maintenance and demolition of buildings. Principles governing the work of public administration bodies in these areas were also set out in that Act. In accordance with Article 5(1)(1) of this Act, a building, together with related building equipment

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[48)] Ecorys, Ecofys and BioIntelligence (2010): Study to Support the Impact Assessment for the EU Energy Saving Action Plan The estimation is based on the assumption that there is 5 m^2 of public buildings floor area per capita, which gives a total area of such buildings (excluding social housing) of 2.5 billion m^2. The total area of buildings in the EU amounts to 21 billion m^2.

[49)] Amendments to this Regulation were published in the Journal of Laws of 2003 No 33, item 270, of 2004 No 109, item 1156, of 2008 No 201, item 1238, of 2009 No 56, item 461, of 2010 No 239, item 1597, of 2012, item 1289, and of 2013, item 926.

must, taking into consideration anticipated service life, be designed and constructed in the manner defined in the rules, including technical and construction rules, and according to the principles of technical knowledge, ensuring, among other things, that 6 basic requirements are met. These requirements include:

- construction safety;
- safety in case of fire;
- safety of use;
- ensuring appropriate hygiene and health conditions and environmental protection;
- protection against noise and vibration;
- adequate energy performance of a building and rational energy usage.

Detailed requirements in terms of meeting the objectives of Article 5 of the Act of 7 July 1994, the Construction Law, are set in the Regulation regarding technical conditions of buildings.

Questions regarding energy savings and thermal insulation in respect of buildings designed, constructed, or rebuilt, or if the manner in which these buildings are used changes, are dealt with in Section X of the Regulation regarding technical conditions of buildings.

Buildings and their installations: heating, ventilation, air-conditioning, hot water, and, in the case of public utility buildings, lodgings, production premises, administrative and storage spaces, also for incorporated lighting, should be designed and made in such a way as to make it possible to maintain at a reasonably low level the amount of heat, cold, and electricity necessary to use the building in accordance with its intended use, while ensuring that the following minimum requirements are met:

- the value of the factor which determines annual measured demand for non-renewable primary energy to be used for heating, ventilation, cooling, hot service water preparation, and, in the case of public utility buildings, lodgings, production premises, administrative and storage premises, also for incorporated lighting, calculated according to the methodology for the calculation of the energy performance of buildings, is lower than the acceptable limit value, calculated taking into account partial maxima of this factor;
- partitions and technical equipment of the building are at least in compliance with thermal insulation requirements and the windows surface is in compliance with the requirements specified in Annex No 2 to the Regulation regarding technical conditions of buildings.

Minimum requirements are considered to be met for buildings subject to major renovation if walls and technical equipment of a building subject to major renovation meet at least thermal

insulation requirements and the windows surface is in compliance with the requirements specified in Annex No 2 to the Regulation mentioned above.

According to the provisions of the Regulation regarding technical conditions of buildings, requirements concerning energy performance of buildings which entered into force on 1 January 2014, will be successively tightened in accordance with the timetable for changes set out in the Regulation, so that by 2021 a target is achieved whereby all newly constructed buildings should be near-zero energy consumption buildings.

Technical and construction requirements operate in conjunction with the provisions laid down in the Regulation of the Minister of Transport, Construction and the Marine Economy regarding the detailed form and scope of a construction project (Journal of Laws, item 462, and of 2013, item 762).

The provisions of this Regulation cover, inter alia, the obligation to analyse possibilities to rationally use highly efficient alternative systems. In accordance with § 11 paragraph 2(12) of the above-mentioned Regulation, the technical description of the architectural and construction project should specify the analysis of possibilities to rationally use highly efficient alternative energy and heat supply systems. They include decentralised energy supply systems based on energy from renewable sources, cogeneration, local or block heating or cooling, in particular when it is based, totally or partially, on energy from renewable sources, and heating pumps. The use of these systems should be considered at the stage of preparation of a construction project.

The above-mentioned arrangements aim at popularisation of alternative solutions where economically, technically and environmentally justified.

In parallel, on the basis of the provisions of the Construction Act of 7 July 1994, an energy assessment of buildings is in operation. It includes obligations connected with the issuing and transferring of energy performance certificates in a situation involving sale and rental of buildings or parts thereof, as well as carrying out of periodic controls of boilers fired with non-renewable fuel, heating installations with boilers, and cooling equipment in the buildings.

In addition, one should mention the Government programme of support for renovations and thermomodernisation which operates on the basis of the Act of 21 November 2008 on supporting thermomodernisation and renovations. The objective of this programme is an improvement of the technical condition of existing residential buildings, lodgings, and buildings owned by local self-government entities and used by them for public tasks, taking into account in particular the reduction of annual demand for energy, reduction of annual energy losses, reduction of annual costs of acquisition of heat, change of energy sources to renewable sources, or using high-efficiency cogeneration.

Beneficiaries of this programme would include owners of the housing stock (municipalities, housing cooperatives, owners of company flats and private owners), owners of multi-apartment buildings, and local self-government entities.

The programme implemented on the basis of the Act of 21 November 2008 on supporting thermomodernisation and renovations covers two main modules: support for thermomodernisation projects and support for renovations. It also introduces additional support for owners of residential buildings which were in the past bound by regulated rent. The support is granted in the form of so-called grants, i.e. the repayment of a part of the credit used for the implementation of the project. The repayment is made out of the Thermomodernisation and Renovations Fund, serviced by the Bank Gospodarstwa Krajowego and funded from the State budget.

1. An overview of the national building stock

In accordance with Article 4(a) of Directive 2012/27/EU, one of the elements of the "strategy" should include "an overview of the national building stock based, as appropriate, on statistical sampling". This overview covers only buildings within the meaning of the Act of 7 July 1994, the Construction Law[50)]. It does not include information concerning other buildings.

In preparing an overview of the building stock, it is necessary to identify the criteria of buildings classification which would be appropriate for using in this Annex. Classification included in the Act of 7 July 1994, the Construction Law, in technical and construction regulations, in the Polish Classification of Construction Works[51)] , and in the Classification of Fixed Assets[52)] could be helpful in performing this task. The overview was carried out taking into account the following aspects: function of the building (designation), age structure, and the form of ownership.

The energy efficiency of buildings is influenced primarily by their thermal insulation, technical equipment, and heat source. Thus, thermal properties of building envelope and the

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[50)] In accordance with Article 3(2) of the Act of 7 July 1994 Construction Law, a building means a structure over a plot of land to which it is permanently attached, separated from the space by building envelope, and has foundations and a roof.

[51)] the Polish Classification of Construction Works (PKOB) was defined in a Regulation of the Council of Ministers of 30 December 1999 on the Polish Classification of Construction Works (Journal of Laws No 112, item 1316, as amended) and constitutes a systematic list of construction works understood as finished products of construction activities. It was prepared on the basis of the European Classification of Construction Works.

[52)] the Classification of Fixed Assets (KŚT) was defined in a Regulation of the Council of Ministers of 10 December 2010 on the Classification of Fixed Assets (Journal of Laws No 242, item 1622). The Classification of Fixed Assets is a systematic list of fixed assets items which is used, among other things, for reporting purposes, for determining depreciation rates, and for statistical research.

manner in which heat is supplied were given as additional indicators in accordance with which the Overview was prepared.

The energy efficiency of buildings also derives from their shapes and location in a climatic zone. Therefore, these parameters were also taken into account during the Overview.

1.1. Buildings' age structure and their energy efficiency

The assessment of buildings' age structure was done on the basis of data from a publication "Inhabited buildings" which presents the results of the National General Population and Housing Census carried out in 2011[53)], and a publication "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations"[54),] and on the basis of own studies.

According to the 2011 National General Population and Housing Census, approximately 6 million buildings with at least one apartment were located in Poland.

Table 1 presents the age structure of housing stocks in Poland, together with estimates regarding their unitary demand for primary energy and for final energy from these resources. "EP" represents an indicator defining annual requirement for non-renewable primary energy per unit of floor area of premises with regulated air temperature, expressed in kWh/(m^2year). "EP" represents an indicator defining annual requirement for final energy per unit of floor area of premises with regulated air temperature, expressed in kWh/(m^2year).

Table 1 Age structure of housing stocks in Poland, and their indicators defining annual requirement for energy

No	Period of building's construction	Buildings		apartments		EP	EK
	years	000	%	million	%	kWh/(m^2· year)	kWh/(m^2·year)
1	before 1918	404.7	7.3	1.18	9.1	> 350	> 300
2	1918 – 1944	803.9	14.5	1.45	11.2	300 – 350	260 – 300
3	1945 – 1970	1363.9	24.6	3.11	24.0	250 – 300	220 – 260

53) Inhabited buildings. 2011 National General Population and Housing Census, GUS, Warsaw 2013

54) Collective work edited by Stanisław Mańkowski and Edward Szczechowiak "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations". Volume I, Part A. Conditions for transformations in construction. Study task No 2, carried out under the Strategic Research Project "Integrated system for reducing operating energy intensity of buildings", commissioned by the National Research and Development Centre.

No	Period of building's construction	Buildings		apartments		EP	EK
	years	000	%	million	%	kWh/(m^2·year)	kWh/(m^2·year)
4	1971 – 1978	659.8	11.9	2.07	16.0	210 – 250	190 – 220
5	1979 – 1988	754.0	13.6	2.15	16.6	160 – 210	140 – 190
6	1989 – 2002	670.9	12.1	1.52	11.7	140 – 180	125 – 160
7	2003-2007	321.6	5.8	0.60	4.6	100 – 150	90 – 120
8	2008-2011	205.1	3.7	0.41	3.2	-----	-----
9	under construction	27.7	0.5	0.04	0.3	-----	-----
10	not stated	332.7	6.0	0.43	3.3	-----	-----
	Total	5544.3	100.0	12.96	100.0	**-----**	**-----**

Source: Inhabited buildings. 2011 National General Population and Housing Census GUS 2013 [6], Collective work edited by Stanisław Mańkowski and Edward Szczechowiak "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations".[7]

In 2011, there were approximately 405 thousand buildings from the oldest group, i.e. built before 1918. They constituted 7.3 % of all inhabited residential buildings. There were approximately 1.2 million apartments in these buildings, i.e. 9.0 % of the total number of apartments.

Buildings erected after the Second World War constitute 72.1 % of the total of inhabited residential buildings. In the cities this percentage was 71.1 % and in the countryside 72.7 %. Apartments located in post-war buildings constituted 76.5 % of all apartments.

In the years 2003-2011, 522 600 residential buildings were put into service, while almost 30 thousand were under construction. The number of apartments in new buildings, i.e. those put into service after 2002, was approximately one million. This number of apartments may not be identified with the number of apartments built after 2002. Part of the number of apartments from that period was the result of extension of older buildings or adding extra floors.

The structure of residential buildings is considerably diversified age-wise (period of construction) throughout the country. In Lubuskie, Dolnośląskie and Opolskie Voivodships there is a much higher percentage of buildings constructed before 1945, compared with the Voivodships in central and eastern Poland.

In the cities, the highest percentage of pre-war buildings was noted in the following Voivodships: Dolnośląskie - 40.4 % of the total of inhabited residential buildings, Lubuskie - 37.4 %, Opolskie - 36.1 % and Zachodniopomorskie – 35.1 %. The lowest percentage of buildings put into service before 1945 in the cities are to be found in Lubelskie – 11.6 %, Podlaskie –11.7 % and Mazowieckie – 12.4 % Voivodships.

In the countryside, buildings constructed before 1945 constituted more than half of all inhabited residential buildings in some Voivodships. In Lubuskie Voivodship the proportion of such buildings in the countryside was 64.0 %, in Dolnośląskie – 60.6 %, in Zachodniopomorskie – 55.6 %, in Warmińsko-Mazurskie – 53.0 %, and in Opolskie – 52.3 %. The lowest percentage of buildings constructed pre-1945 was in the countryside in Mazowieckie (7.9 %), Świętokrzyskie (8.1 %) and Lubelskie(10.1 %) Voivodships.

In the towns, the proportion of the most recent buildings, i.e. those built after 2002 or still under construction was the highest in the following Voivodships: Mazowieckie (13.7 %), Podkarpackie (12.7 %) and Pomorskie (12.5 %), while the lowest percentage was in the towns of Opolskie (7.5 %) and Świętokrzyskie (8.4 %) Voivodships. In the countryside the highest number of buildings constructed after 2002, in proportion to all inhabited residential buildings in that area was recorded in Pomorskie (15.5 %), Dolnośląskie (12.2 %) and Wielkopolskie (11.8 %) Voivodships. The lowest number of such buildings in the countryside was in Opolskie (4.8 %), Świętokrzyskie (5.8 %), Podlaskie (6.0 %) and Lubelskie (6.1 %) Voivodships.

Requirements regarding energy efficiency of the buildings from the middle of 20th century until 1998 were determined by indicating an acceptable thermal insulation of envelopes of buildings and consisted of setting limits to the value of the heat penetration coefficient of building envelope elements, according to the following formula:

$$k \leq k_{\max}$$

where the different symbols mean:

k - heat penetration coefficient for wall [W/(m^2·K)],

k_{max} - maximum acceptable value of the heat penetration coefficient for a given envelope [W/(m^2·K)].

In 1998, symbols "k" and "k_{max}" were replaced by the symbols "U" and "U_{max}" used in international standards.

In 1998 a new system of formulation of energy requirements came into operation. It was only used for some categories of residential buildings: multi-dwelling buildings and lodgings. This system consisted of setting limits to the value of the E coefficient which determines measured

requirement for final energy for heating a building during the heating season, for 1 cubic meter of the heated part of a building,

$$E \leq E_0$$

where the different symbols mean:

E - seasonal heat requirement indicator [kWh/(m^3·year],

E_0 - maximum acceptable value of the seasonal heat requirement indicator [kWh/(m^3·year].

Values of "E_0" indicator were determined in relation to the building's shape coefficient A/V, where A represents the external surface of the envelope of the heated part of the building, and V represents its air space.

This was the first time that technical and construction regulations permitted meeting the requirements in an alternative manner. For individual residential buildings energy requirements were considered to me met if thermal insulation of building's envelope met the requirement defined by the formula: $U \leq U_{max}$

or when the value of "E" indicator met the requirement:

$$E \leq E_0 .$$

In 2002, new technical and construction regulations entered into force. They introduced significant changes in comparison with earlier regulations as regards energy requirements for buildings. They consisted of introducing for multi-family residential buildings and for lodgings an obligation to meet at the same time requirements expressed by the "U" coefficient and the "E" indicator.

In technical and construction regulations regarding heat protection and rationalisation of energy use, in force in Poland from the beginning of 2009 to the end of 2013, requirements based on the provisions of Directive 2002/91/EC on the energy performance of buildings were included. Their objective was to reduce the amount of energy used in buildings.

A new method of energy assessment was introduced for all categories of buildings, new and already in use, by applying the "EP" indicator defining the annual requirement for non-renewable primary energy per 1 m^2 of floor area of buildings with regulated internal temperature. However, an alternative method of assessment was also possible. It consisted of ensuring a required thermal insulation of individual elements of buildings' envelope, expressed by heat penetration coefficient "U_{max}", and by ensuring a required thermal insulation of installation techniques used. Requirements regarding energy savings were considered to be met if thermal insulation of building's envelope met the requirements defined by the formula:

$$U \leq U_{max}$$

or when the value of the "EP" indicator met the requirement:

$$EP \leq EP_{\max}.$$

The use of general requirements expressed by "EP" indicator requires calculations of energy performance of a building in accordance with a procedure set out in a Regulation of the Minister of Infrastructure of 6 November 2008 on methodology for the calculation of energy performance for buildings, apartments, or parts of buildings constituting a self-contained technical and functional entity, and the method of preparation of energy performance certificates (Journal of Laws No 201, item 1240, and of 2013, item 45).

New requirements concerning energy efficiency of buildings are in force since 1 January 2014. In the case of newly erected buildings, all of the following additional minimum requirements must be met:

- the value of the "EP" indicator which determines annual measured demand for non-renewable primary energy to be used for heating, ventilation, cooling, hot service water preparation, and, in the case of public utility buildings, lodgings, production premises, administrative and storage premises, also for incorporated lighting, calculated according to the methodology for the calculation of the energy performance of buildings, is lower than the acceptable limit value, calculated taking into account partial maxima of this indicator $(EP \leq EP_{\max})$,
- envelope and technical equipment of the building are at least in compliance with thermal insulation requirements and the windows surface is in compliance with the requirements specified in Annex No 2 to the Regulation regarding technical conditions of buildings $(U \leq U_{\max})$.

Minimum requirements are considered to be met for buildings subject to major renovation if walls and technical equipment of a building subject to major renovation meets at least thermal insulation requirements and the windows surface is in compliance with the requirements specified in Annex No 2 to the Regulation regarding technical conditions of buildings.

These requirements will be successively tightened in accordance with the timetable for changes specified in the Regulation regarding technical conditions of buildings, so that by 2021 the target is achieved whereby all newly constructed buildings should be nearly-zero energy buildings.

The following table presents requirements concerning maximum thermal insulation (maximum values of the heat penetration coefficient for partitions in the envelope of heated premises in a building), which illustrate the evolution in the standard for thermal insulation of buildings over the years.

Table 2 Requirements concerning maximum values of the heat penetration coefficient for partitions in the envelope of heated premises in a building.

Explanations: a) θ_i = 18 °C, b) θ_i = 20°C, c) depending on the type of a wall (with openings or without), d) depending on the type and construction of a wall

Standard/provision	Heat penetration coefficient U_{max} [W/(m^2·K)]				
	Wall external	Flat roof	Ceiling over an unheated cellar	Floor under the attic	Balcony windows and doors
PN-57/B-024051 [a)]	1.16 ÷1.42	0.87	1.16	1.04 ÷1.163	-
PN-64/B-034041 [a)]	1.16	0.87	1.16	1.04 ÷1.163	-
PN-74/B-034042 [b)]	1.16	0.70	1.16	0.93	-
PN-82/B-020202 [b)]	0.75	0.45	1.16	0.40	2.0 ÷2.6
PN-91/B-020202 [b)]	0. 55 ÷ 0.70 [d)]	0.30	0.60	0.30	2.0 ÷2.6
Technical and construction regulations (1997) [b)]	0.30 ÷ 0.65 [c)]	0.30	0.60	0.30	2.0 ÷2.6
Technical and construction regulations (2002 r.) [b)]	0.30 ÷ 0.65 [d)]	0.30	0.60	0.30	2.0 ÷2.6
Technical and construction regulations (2009) [b)]	0.30	0.25	0.45	0.25	1.7÷1.8
Technical and construction regulations (2014) [b)]	0.25	0.20	0.25	0.20	1.3÷1.5

Source: Pogorzelski J. A., Kasperkiewicz K., Geryło R.: Large-panel buildings - basic requirements. Booklet 11 - Energy saving and thermal insulation of envelopes. Conditions of existing large-panel buildings. ITB Warsaw 2003, own study MIR.

The majority of Polish buildings, in particular multi-apartment residential buildings, were put into service several dozens years ago, i.e. in times when prices of energy were low and did not reflect its economic value. Technical solutions used then did not properly take into consideration

proper thermal insulation of buildings, and proper internal temperature was ensured by highly developed heating systems which consumed relatively high amounts of energy. Existing buildings constructed before 1998 have much higher levels of primary, non-renewable energy demand than buildings constructed at present.

The energy standard for buildings used is a derivative of buildings' age and requirements which were in force during their construction. One should also take into account reduction of energy efficiency of buildings through their use, and, on the other hand, improvements in energy efficiency as a result of construction, installation and assembly works carried out.

Buildings' structure in Poland in relation to their construction technology is diversified. In pre-war urban housing apartment houses dominate. These are mostly brick and mortar structures, usually several floors high. Many buildings of this type are still in poor technical condition and require major renovation. Heating systems and the method of preparation of hot service water varies. Coal boilers are still widely used as the main source of heat. Flueless instantaneous water heaters are also popular. A number of the apartments are equipped with central single-storey heating system with gas boiler, or working with solid fuel.

In the years 1946 – 1990 construction of buildings was intensified (see Table 1), and in the mid-1960s there was a brisk development of large-panel technologies. Buildings constructed using this technology are high-rising, or four-floors high. At present, they frequently require modernisation, in particular taking into account measures which would improve their envelopes' thermal insulation. Central heating installations also often have to be replaced. Usually these buildings get their heat from heat distribution networks.

A document prepared by the Urban Development Institute[55)] demonstrates that comprehensive, major renovations are carried out in a very small part of housing stocks and cover less than 1 % of the total number of multi-apartment buildings countrywide.

In 2012, average spending for technical maintenance of municipal housing stocks, covering buildings' maintenance and major renovation work was at the level of PLN 1.67 per square metre of floor area per month. On the other hand, in the case of privately-owned rental stocks these monthly costs were PLN 2.46 per square metre of floor area.

Average spendings for technical maintenance of cooperative housing stocks, where standards are the best, cover only approximately 50 % of requirements in this area. This means that in 2012 there was a so-called "renovation gap" - or renovation requirements not covered - of about 50 %.

[55)] Urban Development Institute "Information on housing. Results of monitoring for 2012". Kraków 2013

The situation in municipal and privately-owned rental accommodation in multi-apartment housing stocks is much more serious. The renovation gap in municipal housing stocks has been there for many years and decreasing expenditure and privatisation process (sale of the best apartments) result in the gap growing to almost 70 %.

For many years the most difficult situation as regards technical maintenance has been in privately owned buildings with rented accommodation. Calculations indicate that even though spending on technical maintenance of housing stocks increased year by year, renovation requirements in privately owned rental buildings were covered on average in approximately 25 % of cases. This means that the renovation gap in this form of housing stocks is at the level of approximately 75 %, although, unlike in other forms of ownership, this level remains stable.

Table 3 Level of the renovation gap for buildings' maintenance in different forms of multi-apartment housing stocks in 2012

Form of the housing stock	Spendings [PLN per m^2 of floor area per month]		Level of renovation gap [%]
	actual	necessary	
municipal	1.67	5.63	65-70
cooperative	1.57	3.00	50
privately owned rental	2.46	9.38	75

Source: Urban Development Institute "Information on housing. Results of monitoring for 2012". Kraków 2013

According to a GUS study[56)], in 2011 major renovation works were carried out in 2890 apartments, i.e. in less than in 1 % of housing stocks.

[56] Housing administration in 2011, GUS 2012.

1.2 Intended use of the buildings

An overview of buildings depending on their intended use was done on the basis of a study of the Central Statistical Office "Information on the socio-economic situation of the country" for different years. The results are presented in Table 4.

Table 4 Structure (in current prices) of construction and assembly production by types of building structures

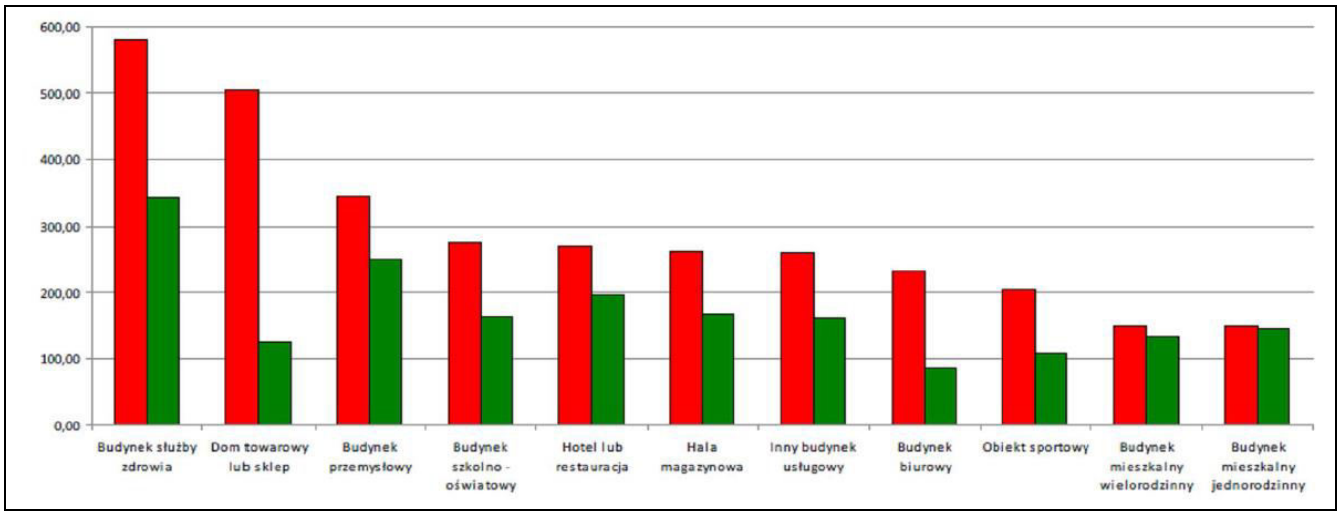
Types of building structures	Structure (%)									
Year	2013	2012	2011	2010	2009.	2008	2007	2006	2005	2004
TOTAL	100	100	100	100	100	100	100	100	100	100
Total buildings	48	44.7	39.9	40.6	41.7	48.7	47.8	45.3	46.4	45.2
Residential buildings	13.1	14	12.4	12.7	14.4	17.4	16.1	13.4	13.9	14
of which:										
single-family, individual houses	1.4	1.6	1.3	1.5	1.7	1.8	1.5	1.4	1.7	1.7
with two apartments and multi-apartment buildings	10.2	10.7	9.7	10	11.1	13.9	13.4	10.7	11.1	10.9
non-residential buildings	34.9	30.7	27.5	27.9	27.3	31.3	31.7	31.9	32.5	31.2
including:										
office	4	3.8	3.1	3.2	3.2	3.7	3.5	3.6	4	3.9
commercial/service	7.4	6.4	6.5	6.2	6.3	7	6.6	6.2	6	5
industrial/warehouse	12.1	9.7	8.3	7.9	9.4	11.4	13.3	12.2	12.7	11.6
buildings used for educational and cultural activities hospitals and healthcare centres, building used for sports activities, and other	7.9	7.3	6.6	7.7	7.5	5.4	5.3	6.4	6.8	7.7
Civil engineering structures	52	55.3	60.1	59.4	58.3	51.3	52.2	54.7	53.6	54.8

Source: "Information on the socio-economic situation of the country", years 2004-2013, GUS.

Table 4 indicates that the structure (in current prices) of construction and assembly production, by types of building structures was similar for the last 10 years. Among building structures (not including accessory structures), buildings constituted from 39.9 % to 48.7 %, and

other structures from 51.3 % to 60.1 %. Within the buildings, the structure of construction and assembly production was as follows: the value of residential buildings constituted from 12.4 % to 16.1 % of the entire production, while the value of non-residential buildings was from 27.5 % to 34.9 % of the entire production.

A figure below shows average values of "EP" and "EK" for different categories of buildings



Source: Institute of Construction Technology [10)]

Translation of captions for the figure above (left to right):

Building housing healthcare establishment

Department store or shop

Industrial building

Building housing a school or an educational institution

Hotel or restaurant

Warehouse

Other building housing a service sector entity

Sport facility

Multi-apartment residential building

Individual (single family occupied) residential building

Average values of "EP" indicators (colour red) and "EK" (colour green) for buildings, according to their intended use, are determined on the basis of energy performance certificates, based on a research carried out by the Institute of Construction Technology[57)].

[57) "The analysis of technical and construction purposes requirements regarding thermal protection of buildings, in order to set minimum requirements for energy performance and to present proposals for changes in accordance with Directive 2010/31/EC of the

1.3 Ownership of residential buildings

A summary of the structure of inhabited residential buildings by form of ownership is prepared on the basis of data contained in a publication "Inhabited buildings" which presents the results of the 2011 National General Population and Housing Census[6].

As a result of the introduction of new legal regulations regarding ownership of premises and activities of housing cooperatives, in the period between the National General Population and Housing Censuses in 2002 and 2011 changes in the structure of ownership of residential buildings and of apartments in these buildings were observed. Compared with the Census carried out in 2002, the number of inhabited residential buildings in co-ownership, with separated ownership rights to individual dwellings has considerably increased[58]. The number of residential buildings belonging to natural persons and to social housing associations also increased. At the same time, the share of other forms of ownership in the structure of housing stocks decreased.

Table 5 presents ownership structure of inhabited housing stocks in Poland as at 2011.

Table 5 Inhabited residential buildings and apartments in inhabited residential buildings in the years 2002 and 2011.

Type of ownership		Buildings ('000)l		Apartments ('000)l	
		year 2011	year 2002	year 2011	year 2002
ownership	of natural persons	4616.1	4204.8	5408.8	4819.0
	of housing cooperatives	20.4	82.3	239.3	3031.5
	of municipalities	56.8	95	282.6	595.5
	of the State Treasury:	19.6	27.1	62	146.4
	of employers	28.3	39.4	84.7	192.6
	of social housing associations	3.1	2	43.1	33.2
	of other entities	12	12.8	22.9	33
co-	with separated ownership rights to dwellings	505.1	268.3	6505.0	2935.3

European Parliament and of the Council of 19 May 2010 on the energy performance of buildings" Institute of Construction Technology, Warsaw 2012, collective work edited by Prof. Krzysztofa Kasperkiewicz ITB.

[58]) Buildings in co-ownership, with separated ownership rights to individual dwellings: these are buildings which are a joint property, in which all, or only some dwellings are in separate ownership of natural and/or legal persons (e.g. co-ownership of natural persons, co-ownership of natural persons and a municipality, co-ownership of natural persons and an employer). All the owners with separated ownership rights to apartments in a given building constitute a so-called "association of owners of apartments" (after the entry into force of the Act of 15 December 2000 on housing cooperatives, separated ownership rights to some individual dwellings were established for natural persons).

Type of ownership		Buildings ('000)		Apartments ('000)	
		year 2011	year 2002	year 2011	year 2002
ownership	Without separated ownership rights to dwellings	36.7	42	50.6	79.1
Total		5298.1	4773.6	12960.5	11865.8

Source: Inhabited buildings. National General Population and Housing Census, GUS, Warsaw 2013 [6)]

In 2011, most buildings were owned by natural persons (83.3 % of the total number of inhabited residential buildings). These persons were the owners of more than 4.6 million of residential buildings, with approximately 5.4 million apartments. Compared with 2002, the number of residential buildings increased by 9.8 %.

The second highest position as regards the share in the number of residential buildings was held by stocks which are in co-ownership with separated ownership rights to dwellings (9.1 %). In 2011, the number of residential buildings with this type of ownership amounted to over 500 thousand. More than 6.5 million apartments were located in these buildings.

Compared with the previous Census the number of residential buildings in co-ownership with separated ownership rights to dwellings increased by 88 %, and the number of apartments in such buildings more than doubled. An increase in the number of buildings with this type of ownership was the effect of commissioning of new buildings which were in co-ownership. At the same time, separated ownership rights were granted to apartments in buildings which were previously owned by a single entity. In the years 2002 - 2011, approximately 172 thousand residential buildings changed the ownership status to co-ownership with separated ownership rights to dwellings.

1.4 The manner in which heat is supplied to dwellings in residential buildings

An important criterion in the overview of buildings is the method of heat supply for heating these buildings. In residential buildings heating requirements contribute to the consumption of approximately 70 % of final energy used by households[59)].

According to a GUS study "Energy consumption in households in 2009"[60], solid fuels and network heating clearly dominate in the heating of dwellings. More than half of

[59)] Efficiency of energy use in the years 1999-2009. Information and statistical study. GUS, Warsaw 2011

[60)] Energy consumption in households in 2009. Information and statistical study. GUS, Warsaw 2012

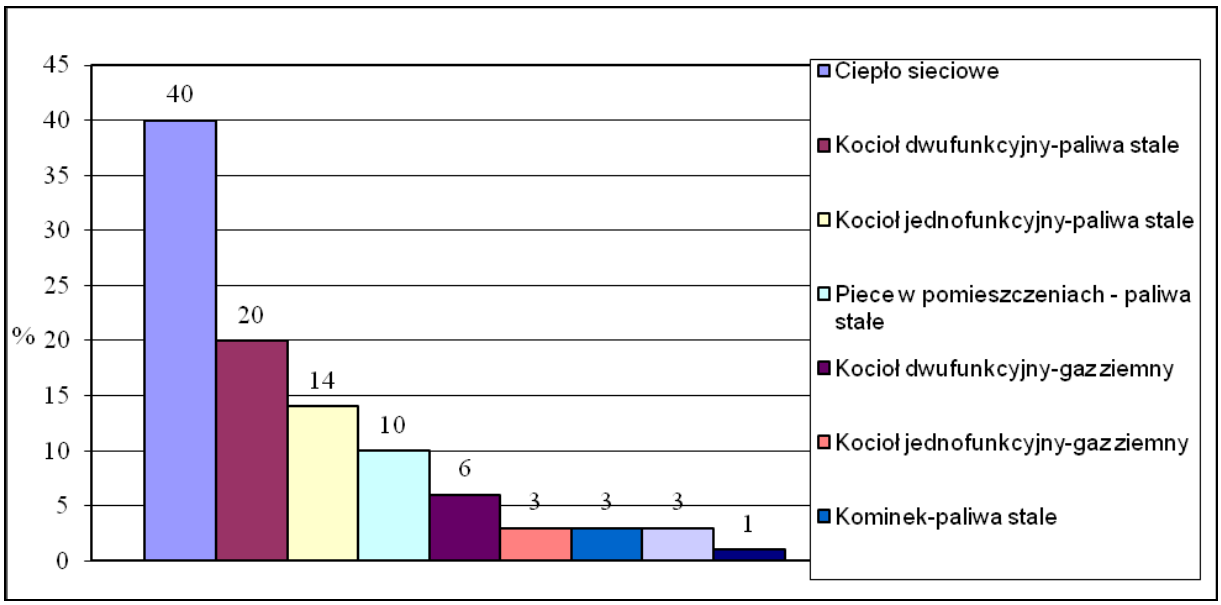
Polish households (51.1 %) used heating appliances working with solid fuels. The most commonly used were double-function central heating boilers which could be used for heat generation and for preparing hot service water. Such boilers were used in 40.5 % of households using solid fuels for heating. Single function boilers were used in 29.6 % of households using solid fuels for heating. In 22.4 % of households, the most traditional heating appliances were used: stoves, mainly ceramic (tiled) stoves. In 6.8 % of households using solid fuels, fireplaces were used, usually with a closed combustion chamber. In other 0.7 % households, the only heating appliance was a solid fuel cooker. 40 % of all households used network heating. Among network heating recipients the great majority were inhabitants of multi-apartment residential buildings. Among network heating consumers, 60 % used the network also to prepare hot service water. This relatively low proportion of households using heating installation for this purpose has two reasons:

- network heating is used for supplying heat to older buildings, where there was a central heating installation, but there was no internal hot water installation;
- there are small, local central heating systems whose operation in summer period is not economically viable.

Gas central heating boilers were also used for heating premises. They were used by 10 % of households. On the other hand, electric heating appliances were used by 7.8 % of households. However, they were additional (auxiliary) heating source, alongside the main heating system.

Figures below present the shares of different methods of heating premises and preparation of hot service water, based on a study "Energy consumption in households in 2009."[11)].

Figure Heat sources for heating premises in buildings



Source: GUS [11].

Translation of figure above (top to bottom):

Network heat distribution

Double-function boiler – solid fuels

Single function boiler – solid fuels

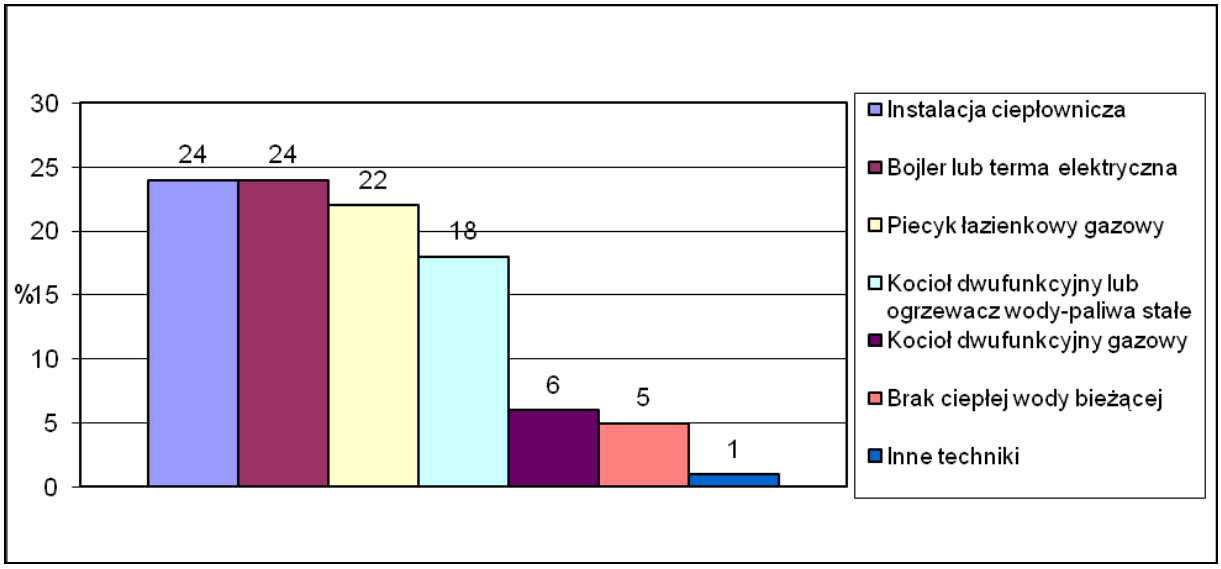
Stoves in the premises - solid fuels

Double-function boiler – natural gas

Single function boiler - natural gas

Fireplace - solid fuels

Figure Means of preparation of hot water in residential buildings



Source: GUS [11)].

Translation of figure above (top to bottom):

Central heating installation

Boiler or electric heater

Bathroom gas heater

Double-function boiler or water heater – solid fuels

Double-function boiler – natural gas

No running hot water

Other techniques

2. Identification of cost-effective approaches to renovations relevant to the type of building

One of the tools which can be used in order to determine cost-effective methods of renovation for a particular building is an energy audit carried out on the basis of the Regulation of the Minister of Infrastructure of 17 March 2009 on the detailed scope and form of energy audit and a part of repairs audit, templates of audit sheets, and the algorithm for evaluating the cost-effectiveness of thermomodernisation investments. Then, on the basis of calculations, measures can be selected which result in the highest energy savings with a short period of return on the investments involved.

When planning modernisation, the following information should be taken into consideration:

1) increasing thermal insulation of the building envelope;
2) improving energy efficiency if the following installations: heating, hot water, ventilation, cooling and lighting;

3) replacement or modernisation of the heating source.

The best available techniques (BAT) for cost-effective approaches to renovations, appropriate for particular types of buildings were determined of the basis of the following sources:

1) "The analysis of technical and construction purposes requirements regarding thermal protection of buildings, in order to set minimum requirements for energy performance and to present proposals for changes in accordance with Directive 2010/31/EC of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings"– Stage II Final study"[10)],
2) "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations", Volume Three, Part B, Catalogue of the best possible options from the energy efficiency point of view as regards buildings' installations solutions [61],
3) "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials and installations", Volume Two, Part A, Recommendations regarding design and selection of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and construction"[62)],
4) "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials and installations", Volume Three, Part A, Recommendations regarding design and selection of the best possible options from the energy efficiency point of view as regards buildings' installations"[63)].

2.1 Building envelopes

2.1.1 Non-transparent envelopes [10), 14), 15)]

[61] Collective work edited by Stanisław Mańkowski and Edward Szczechowiak "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations". Volume Three, Part B, Catalogue of the best possible options from the energy efficiency point of view as regards buildings' installations solutions. Research task No 2, carried out under a Strategic Research Project in the Centre for Research and Development. Politechnika Poznańska (Poznań Technical University), 2013

[62])Collective work edited by Stanisław Mańkowski and Edward Szczechowiak "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations", Volume Two, Part A, Recommendations regarding design and selection of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and construction", Study task No 2, carried out under the Strategic Research Project "Integrated system for reducing operating energy intensity of buildings", commissioned by the National Research and Development Centre. Politechnika Poznańska (Poznań Technical University), 2013

[63])Collective work edited by Stanisław Mańkowski and Edward Szczechowiak "Development of the best possible options from the energy efficiency point of view as regards buildings' structure, materials, and installations", Volume Three, Part A, Recommendations regarding design and selection of the best possible options from the energy efficiency point of view as regards buildings' installations", Study task No 2, carried out under the Strategic Research Project "Integrated system for reducing operating energy intensity of buildings", commissioned by the National Research and Development Centre. Politechnika Poznańska (Poznań Technical University), 2013

The measure of thermal insulation of walls is the value of heat penetration coefficient "U". The heat penetration coefficient of the envelope depends on the heat resistance of individual construction and insulating materials "R", and thus it depends on the thermal conduction coefficient λ. The lower the material's thermal conduction coefficient, the higher thermal insulation. This means in practice that the use of construction and heat insulating materials with lower thermal conduction coefficient results in a wall which is thinner than the envelope with the same value of heat penetration coefficient, but with a higher thermal conduction coefficient.

In addition, thermal insulation of the envelope in buildings depends on:

1) correct arrangement of thermal insulation, in particular as regards a reduction of heat leakage bridges;
2) the number of window and door openings and their arrangements in conjunction with thermal insulation.

The role of thermal insulation in a building consists of:

1) reducing heat losses from a building to the environment;
2) maintaining an appropriate temperature of internal surfaces of the envelope, so as not to allow dampness and consequently to prevent the development of fungi.

Thermal insulation is one of the main factors affecting the level of heat requirements for heating a building, and consequently the operating costs for a building. Well insulated envelopes in buildings contribute to low values of the heat penetration coefficient of these envelopes. This results in reduced energy losses and reduced heating costs. One-off investment in good thermal insulation makes it possible to save on heating costs during each heating season throughout the entire service life of the building.

A minimum thickness of thermal insulation should be based on the maximum values of the heat penetration coefficient as required by technical and construction regulations. To determine the thickness of insulation, one should take into account the impact of construction heat leakage bridges and mechanical fittings fixing a layer of thermal insulation.

In order to limit heat losses and maximise benefits from solar radiation, it is worthwhile to consider a so-called transparent insulation, i.e. the system of heating external walls by using light transmitting capillary panels made of polycarbonate, covered with transparent glass plastering. A capillary plate transmits heat obtained from solar radiation to absorptive mass which is located closest to the insulated wall. In turn, the absorptive mass accumulates thermal energy and may give-up the heat even for 6 to 8 hours after solar radiation stopped. Such insulation is the most effective in winter. In summer it practically does not operate and does not result in overheating the premises. The effect is achieved as a result of light transmitting capillary panels. They

transmit most sun rays when their angle of incidence is the smallest. When the angle of incidence increases, more rays are deflected and they do not penetrate to the absorptive mass.

2.1.2 External transparent envelopes [10), 14), 15)]

Transparent envelopes such as windows, balcony doors, protective walls or skylights are composed of two principal parts: see-through, i.e. window package and no see-through, i.e. window/door frames or the post and beam construction in light curtain wall. Basic parameters deciding about heat losses through this type of elements of the envelope is the heat penetration coefficient: "U_w" for windows, "U_D" for doors, "U_{cw}" for curtain wall. The value of heat penetration coefficient is decided by components: related to glass "U_g", related to window/door frames U_f, and related to the post and beam construction $U_{m/t}$, as well as linear heat penetration coefficients which characterise thermal insulation of fittings.

From the point of view of energy savings, the method of assembling is also important. The smallest heat leakage bridges occur when windows and doors are set in a layer of thermal insulation or at the contact point between the wall and insulation.

Window frames

Frames available on the market are aluminium frames, and frames made of PVC, timber, and timber-clad aluminium sections.

In order to obtain the lowest value of heat penetration coefficient from U_f frame, the following factors must be taken into account:

1) thickness of window sections;
2) layout of hollows, so-called chambers in the sections;
3) filling the hollows with thermal insulation;
4) appropriate location (depth) of glazing;
5) improvement of thermal insulation in the area of glass edges, using additional insulators made of foam composite.

When frame sections are thicker, the number of hollow chambers in the profile increases. This in turn makes it possible to lay them up properly and ensures better thermal insulation of the frame, and a lower value of the heat penetration indicator "U_f".

Glazing

Glazing usually constitutes 70 % of the window surface, or more for light curtain wall with the post and beam construction. Therefore it has a considerable impact on heat parameters of such transparent envelope.

Three types of glass units are available:

1) standard double glazed insulating glass units with the heat penetration indicator U_g 1.0 W/(m^2K);
2) triple glazed insulating units with the heat penetration indicator U_g from approximately 0.3 to 0.7 W/(m^2K);
3) quadruple glazed insulating units with the heat penetration indicator U_g from approximately 0.3 to 0.7 W/(m^2K).

Gas enclosed in the space between window panes constitutes thermal insulation. Argon is the gas most commonly used, krypton or xenon are used to a lesser degree. The use of different types of gas is due to the fact that the greater the gas atomic mass, the better are its insulation properties.

Low-emission window panels, in view of low radiation transmittance, have a capacity to reflect the greater part of long-wave radiation, emitted by internal partitions and by elements of equipment in the premises.

Reflective window panels belong, just like absorption panels, to the solar-reflecting category of glass. The coatings reflects sun rays, or they result in a selective transmission in the visible spectrum
and a reduction of transmission in infra-red and in ultraviolet. Reflective window panels have light transmittance within the 40 to 70 % bracket, and reflexivity of 15 to 45 %.

Properties of windows resulting from the use of solar radiation coefficient are strictly connected with the type of window panels used to glaze window construction. The total energy transmittance (TET) factor "g" is the quotient of the total energy transmittance of a window panel and the solar energy received by the panel (from 300 nm to 2500 nm). This value indicates what part of solar radiation energy received by the panel is transmitted through the panel to the premises. It is a sum of energy transmitted directly through the glass and of energy absorbed by the glass and subsequently emitted to the inside the premises.

The spacer frame in a multiple glazed panel is to create an intended distance between window panels and to provide a possibility to place material absorbing water vapour in order to dry a layer of gas introduced between the panels of the glass unit. Standard frames are made of aluminium or of stainless steel, perforated from the chamber side, in order to permit the operation of humidity absorber within the spacer frame. However, a metal spacer frame constitutes a heat leakage bridge and this contributes to a deterioration of window's thermal insulation. For that reason so-called "warm spacer frames" are used, made of plastic of stainless steel. The use of "warm spacer frames" makes it possible to arrive at higher window panel's temperature at the edges. This reduces the risk of water vapour condensation.

As a result, acceptable relative humidity of the air, at which water vapour becomes liquid on the surface of glass may be approximately 10-15 % higher through the use of a "warm spacer frame".

It should be noted that the real effect of a heat leakage bridge at the edge of a glass unit installed in the window depends on the type of a spacer frame, thermal insulation of the middle part of a glass unit, and the depth at which a window panel is set in the profile as well as the heat penetration coefficient "U_f" of the profile. With an increase of the depth of a window panel' setting, the proportion of heat losses in the window through the edges decreases and the possibility of water vapour condensation around the edges is minimised. Warm spacer frames make it possible to reduce the average heat factor of a window by approximately 0.1÷0.2 W/(m^2K), compared with the windows glazed with aluminium framed glass units.

2.1.3 Sun protection systems

Sun protection systems should:

1) provide protection against too much sun exposure (i.e. insolation) (during summer);
2) permit insolation (during winter and transitional periods);
3) increase the comfort of life for people;
4) let sun rays penetrate the premises;
5) keep the place cool during the summer season.

Sun protection systems can be fixed or movable.

Fixed systems:

1) protruding cornices;
2) larger or longer balconies;
3) eaves;
4) canopies;
5) panels.

Movable systems:

1) awnings;
2) sliding panels;
3) external blinds;
4) external roller blinds;
5) shutters;
6) perforated canopies.

2.2 Airtightness [15)]

Adequate building airtightness is important from the point of view of energy savings. Airtightness is measured by the n_{50} factor, which means the air exchange rate for the whole air space of a building resulting from a pressure difference of 50 Pa between inside and outside.

Building airtightness is closely related to thermal insulation, but is not equivalent to it. A well insulated building may not be sufficiently airtight, and, at the same time, a sufficiently airtight building may not have adequate thermal insulation of envelope.

In relation to airtightness the following factors are important:

1) gaps in a building's envelope as a result of installation passages;
2) finials of top walls where they join construction elements of hipped roof end (rafters, wall plates, etc.);
3) elements of the roof (tiles, roof covering plates);
4) passages of sanitary installations in the basement or in the attic;
5) setting of doors;
6) setting of windows;
7) electrical installations in the roof and close to the surfaces of external walls.

Technical and construction regulations include the following recommendations concerning building airtightness:

- building with gravitation or hybrid ventilation $n_{50} \leq 3{,}0\ h^{-1}$;
- building with mechanical ventilation or air-conditioned $n_{50} \leq 1{,}5\ h^{-1}$.

Recommended materials to ensure airtightness and detailed solutions:

1) expanding tapes for circumferential sealing when setting windows and doors; after the expansion, they adhere strongly to the surface, eliminating leakages;
2) polyurethane foam which expands and fills in gaps or openings. It is intended for sealing joints of windows or doors, and openings around wiring or other leakages generated during assembly work;
3) wind-protection insulation to be used in the ventilated partition frame, on the thermal insulation from the side of the gap. This insulation eliminates heat losses connected with aeration of the insulation as a result of air movement in the gap.

For checking of airtightness in the entire building "Blower Door" method is recommended. This method is a non-invasive measurement of airflow within the building with pressure method, using a ventilator. Testing procedures and the preparation of results are carried out on the basis of recommendations of Polish Standard PN-EN:13829.

2.3 Diffusion tightness [15)]

The question of diffusion tightness is strictly connected to the humidity condition of envelopes, and in particular with ensuring (securing) a correct moisture level in envelopes, i.e. one which does not have negative thermal and operating consequences. A diffusion-tight envelope is an envelope into which water should not penetrate through diffusion, in a situation where the type and layout of layers indicate that it is in danger of internal condensation, in particular growing condensation, which may lead to increasing dampness in some of its layers.

A small condensation of water vapour is acceptable if moisture will completely evaporate in the spring season and does not cause damages to some layers of the envelope. In certain cases a total cutting off the water vapour flow in the envelope is unjustified, and may even be harmful, e.g., when it makes it difficult to eliminate initial dampness, in particular from timber parts. For this reason, different solutions were developed using foil which permit a certain flow of water vapour (indicated in the product characteristics).

In order to ensure a real vapour tightness of an envelope, it is not sufficient to have appropriate insulation foils. During installation of vapour-tight insulation, there are cases of errors or negligence, as a result of which water vapour penetrates through a coating designed as vapour-tight.

We present below procedures recommended to ensure vapour tightness of partitions:

1) a vapour-tight insulation should be laid down providing adequate overlays in joints of the foil pieces, and not to lay them edge to edge;
2) each passage through vapour insulation of different types of installations and wiring must be tightened using vapour-tight tapes, self-adhesive or attached using special glues for joining vapour insulation. In these places vapour insulation should be folded down and the area of non-tightness should be sealed with vapour-tight self-adhesive tape.

2.4 Installations

2.4.1 Heating, ventilation and service hot water installations [10), 16)]

In the majority of buildings the common source of heating requires a comprehensive review of central heating and hot service water installations and selection of an arrangement which would be the best for the particular conditions.

The selection of central heating and hot service water systems, including the selection of the heating source, depends on a number of factors, such as:

- the architectural layout and construction of a building, and the manner in which it is used;
- the requirements for the comfort of use;
- the local conditions of heat supply;

- relationships between prices of energy carriers and elements of installations and sources and trends in their changes;
- ecological requirements;
- requirements and financial possibilities of the investor;
- requirements of technical and construction regulations and available programmes supporting energy-efficient and environmentally-friendly solutions;

Central heating and hot service water installations should be arranged in such a way as to provide adequate, possibly high levels of efficiency of both systems. High levels of efficiency of installations can be obtained by using highly efficient heat sources, reducing heat losses in distribution, accumulation, regulation, and use of heat.

Maximum possible part-efficiencies can be obtained through:

- the use of condensing boilers and of heat pumps with a high COP value;
- correct layout of networks distributing heating medium (compact installation) and their proper thermal insulation;
- adequate insulation of accumulation and buffer tanks and loading and unloading steering appropriate for the specificity of their operation and use;
- low-temperature heating systems (panel heating systems, radiators, or mixed);
- selection of regulation and steering technique ensuring the highest efficiency of regulation in a given structure of installation and with a given manner of using the system;
- selection of the method of hot water heating ensuring high efficiency with a particular type of use;
- use of highly efficient pumps with low electric power, resulting in low usage of ancillary energy;
- elimination of maximum reduction of highly efficient circulation installations;
- adequate insulation of hot service water tanks and loading and unloading steering appropriate for the specificity of their operation and use.

In order to reduce heat losses in distribution, the installation's layout should be compact. Water collection points should be close to each other. In the architectural and construction design it is recommended to locate kitchen areas, sanitary premises (bathroom, WC) and other damp places possibly close to each other and aligned in such a way as to be above and under damp places in a multi-storey building. This makes it possible to design compact water supply and sewerage system (cold water, hot water and sewerage) and mechanical ventilation with extractor,

and consequently reduces investment and operating costs for these installations (lower heat losses and lower pressure losses, and therefore lower costs of pumping).

Conduits and fittings for hot service water, e.g. storage tanks, should be placed within the heated part of a building. This reduces heat losses in conduits and in the storage tank and, at the same time, makes it possible to use them for heating the building. In the summer period it reduces internal heat gains, and therefore reduces the risk of overheating premises in summer. In small installations, circulation circuits should be eliminated. A negative side of circulation is considerable heat losses. These losses can be reduced by providing proper thermal insulation of hot service water conduits and circulation conduits. The best solution is to have both conduits side by side and to insulate them together, and to put installation conduits inside the insulation casing of the building.

Hot service water installations should be adapted to energy-efficient operation, among other things through the selection of high-quality plumbing fittings (taps, showers, etc.) adapted to efficient use of water and through individual calculation of water charges for the users.

As regards the selection of the heat sources structure, alongside the selection of highly efficient equipment, one should consider the use of renewable energy sources.

The selection of the supply system for hot service water depends not only on buildings' energy standards, but also on the proportion of energy used for hot service water in the total energy consumption in the building. In the case of small proportion, energy for hot service water installations can be supplied from direct heaters or from flow heat exchangers.

Where the proportion is high, energy for hot service water installations is supplied from an independent source and most frequently uses solar energy.

A selection of hot service water system and completion of its source of heat depends each time on the destination of the building.

In public utility buildings hot service water systems are usually independent, with energy supplied from direct heaters or from local mini-stations, to which energy is supplied from a heat distribution centre, or from another source of heat.

It should be noted that hot service water systems may be arranged as independent, with the source of heat mainly using solar energy by using solar panels with a collector which plays the role of a long-term storage place for energy.

In the arrangements for ventilation installations, the dominating arrangement is a pressure-exhaust ventilation with a highly efficient heat recovery with efficiency ratio ≥ 75 % and with regulation according to load. In hybrid ventilation arrangements, hygro-adjustable ventilators are used and mechanical extraction adjusted by load.

2.4.2 Recommended components for heating, ventilation, and preparing warm service water installations

Individual residential buildings (without the cooling option)

For individual residential buildings (without air conditioning) the following best basic available components for heating, ventilating, and preparing warm service water installations can be suggested:

1) heating with low-temperature water:
   a) floor heaters or convection floor heaters,
   b) installation parameters: 55/45°C or 40/30°C,
   c) heaters' adjustment devices with accuracy 1K,
   d) a source of heat:
   – gas condensing boiler,
   – heat pump $PC_{COP\ 6,0}$,
   – low-temperature boiler;
2) use of solar energy - thermal solar collectors;
3) installation for preparing warm service water, energy supplied by bivalent storage tank, installation without circulation;
4) mechanical pressure-exhaust ventilation, with highly efficient heat recovery, regulated according to the load.

Multi-apartment residential buildings (without the cooling option)

For multi-apartment residential buildings (without air conditioning) the following best basic available components for heating, ventilating, and preparing warm service water installations can be suggested:

1) heating with low-temperature water:
   a) convection heaters or convection floor heaters,
   b) installation parameters: 55/45°C, 45/35°C, or 40/30°C,
   c) heaters' adjustment devices with accuracy 1K,
   d) a source of heat:
   – gas condensing boiler,
   – heat distribution centre,
   – mini – CHP – cogeneration ((combined heat and electric power generation),
   – heat pump $PC_{COP\ 4,2}$,
   – low-temperature boiler;

2) use of solar energy - thermal solar collectors in arrangements with storage tank;
3) warm service water installation with energy supplied by bivalent storage tank, or warm service water installation with energy supplied from mini-apartment based stations (apartment based installation without circulation);
4) mechanical pressure-exhaust ventilation, with highly efficient, minimum 75 %, heat recovery, regulated according to the load.

Public utility buildings (without the cooling option)

For public utility buildings (without air conditioning) the following best basic available components for heating, ventilation, and preparing warm service water installations can be suggested:

1) heating with low-temperature water:
   a) convection heaters or heating with heating panels,
   b) installation parameters: 55/45°C, 45/40°C, or 40/30°C,
   c) heaters' adjustment devices with accuracy 1K,
   d) a source of heat:
   – gas condensing boiler,
   – heat distribution centre,
   – heat pump $PC_{COP\ 4,5}$,
   – low-temperature boiler;
2) use of solar energy - thermal solar collectors in arrangements with storage tank;
3) warm service water installation with energy supplied by bivalent storage tank, or indirect storage tank, installation with circulation, or warm service water installation with energy supplied from a mini-station (apartment based installation without circulation);
4) mechanical pressure-exhaust ventilation, with highly efficient, minimum 70 %, heat recovery, or decentralised ventilation with heat recovery, with heat flow variable, according to the needs.

2.4.3 Installation of air conditioning [10)]

It is recommended to eliminate or to considerably reduce cooling systems for air conditioning, using refrigerating units through:

1) reduction of heat gains (reduction of solar gains by using solar protection and by limiting internal heat gains);
2) adjustment of air stream to actual load;

3) use of alternative cooling methods (night-time cooling, use of soil energy, free cooling, passive cooling).

For small facilities, systems with direct evaporation, based on individual air conditioners "SPLIT" or "MULTISPLIT" type are recommended.

For larger buildings, with a big number of premises, it is recommended to use systems based on cooling water circuits with parameters $15/18^0$C or $18/21^0$C, cooperating with cooling ducts or with thermally active floor systems and other cooling surfaces with a possibility of using free cooling.

In buildings with a considerable concentration of people, it is worthwhile to install air cooling through a central cooling system which at the same time supplies a necessary fresh air stream. The flow of air and technical parameters are adjusted to the current heat and pollutants (CO_2) load.

2.4.4. Lighting installations[10)]

For artificial lighting to work properly, and at the same time to reduce energy use for lighting purposes, it must be properly regulated. The main purpose of lighting which is to provide comfort of seeing, can be achieved with natural and artificial lighting, preferably the two cooperating with each other.

In the case of artificial lighting, illumination of premises where there are no people should be avoided. This can be done through sensors which, using infra-red rays or microwaves, detect presence of people, through light sensors, etc.

The introduction of LED lighting (Light Emitting Diode) provides new possibilities for adjusting not only the intensity but also the colour of light. Another modern solution is a "dynamic lighting" system which stimulates people's activity by modelling the intensity of lighting and colour temperatures of light during the day. LED diodes have another important feature. They work with constant current which means that they can get power supply from, e.g. PV panels, fuel cells, etc. New technologies provide a significant reduction of installed power and a considerable reduction of final energy consumption, as well as primary energy savings for the lighting of premises.

2.4.5 Automatic regulation systems for installations [16)]

Automatic regulation systems implemented in the building always cooperate with technical equipment provided in the building. Therefore, the configuration of an automatic regulation system depends, to a large extent, on the degree of technical sophistication of the specific building. Thus, it is not possible to propose automatic regulation systems without regard to

technical equipment of a building. The sole area where the automatic system is practically independent is the level of building management, or building management system (BMS).

3. Policies and measures supporting renovation at present and future perspectives

3.1 Economic aspects of projects affecting better energy efficiency of existing building stocks

3.1.1. Spending on investment

Table 6 presents expenditure incurred to maintain housing stocks, including expenditures for maintenance and renovation/repairs in 2012, taking into account different types of organisational entities at whose disposal housing stocks (dwellings) are.

Table 6 Level of operating costs in buildings, ownership groups [64)]

Description	Total	Operating costs elements			
		Management and administration	Maintenance and repairs	Taxes and fees paid to municipalities	Other costs
	in PLN million				
Total	15 224.3	4 015.6	6 537.6	555.7	4 115.5
Including: Municipality	1 169.7	418.7	467.7	-	283.3
Housing cooperatives;	8 609.5	2 162.9	3 421.1	528.6	2 496.9
State Treasury:	4.5	0.8	2.3	0.5	0.8
Work establishments	130.2	35.3	52.9	10.9	31.0
Associations of owners of apartments;	5 065.4	1 297.8	2 543.6	-	1 223.9
Social housing associations	234.8	96.1	44.6	14.9	77.2
Other entities	10.3	3.9	*3.3*	0.8	2.3

Costs of maintenance and renovations, mean expenditure related to current repairs and major renovations; breakdown service; technical supervision; current checks and maintenance of installations and equipment; costs of maintenance and renovation of green areas; repairs of

[64)] Housing management in 2012, Central Statistical Office, Warsaw 2013, p. 23

road/pavement surface between buildings; costs of purchase of external services related to maintenance and current repairs of housing stocks and common areas.

Depending on the scope of work carried out, the type of building, or solutions applied, expenditures for investments to improve energy efficiency of existing building stocks will be at different levels.

3.1.2 Profitability of investments

Appropriate management of the financial profitability of work is an important task. In many cases it is recommended, or even required, to carry out an energy audit prior to starting planned investment to improve energy efficiency of an existing building. The objective of auditing is to select the most profitable arrangements as regards the relation of the cost of investment to the anticipated benefits.

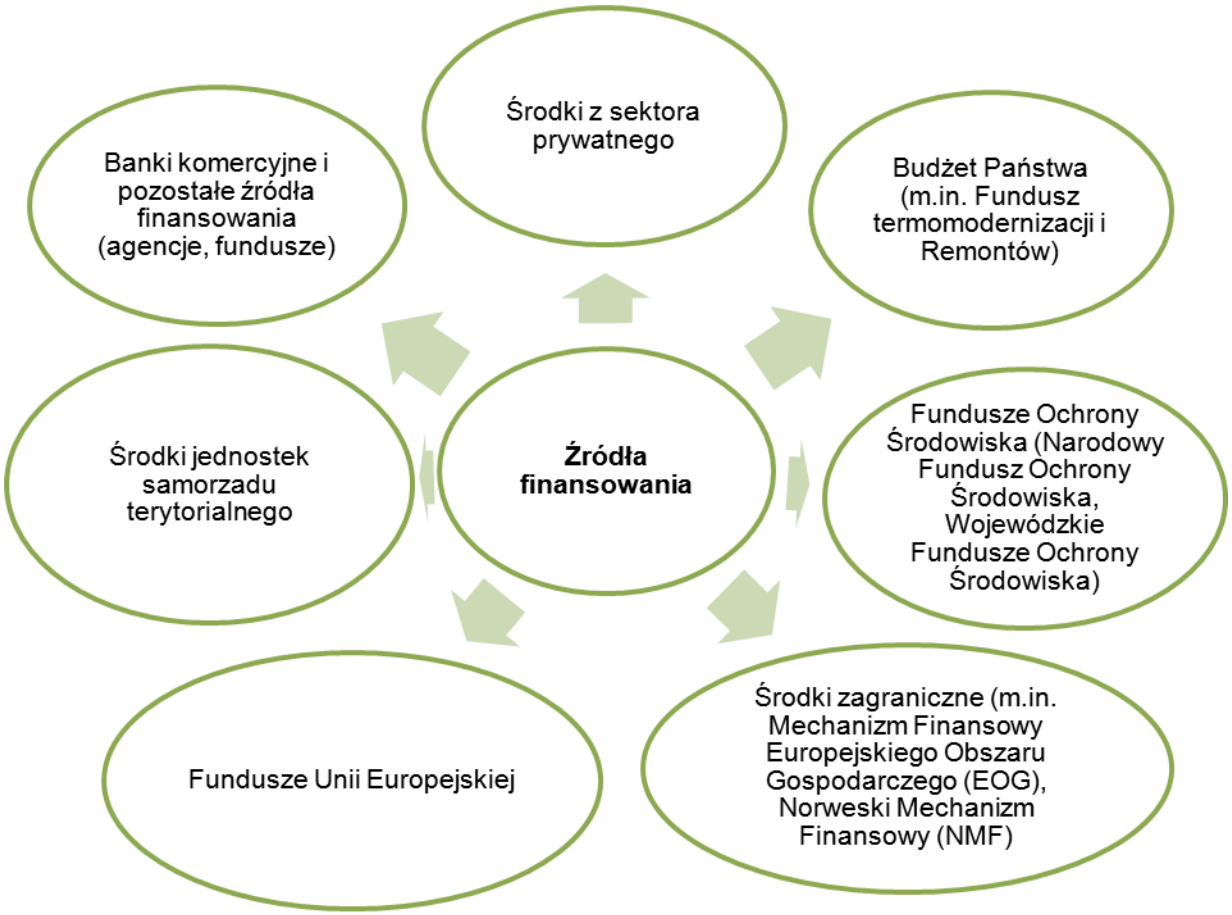
Moreover, the level of requirements set in technical and construction regulations is also optimal from the point of view of cost of investment. It is defined on the basis of a study "Analysis of technical and construction requirements regarding thermal protection of buildings, in order to determine minimum requirements on the energy performance and to propose amendments in accordance with Directive 2010/31/EC on the energy performance of buildings"[8)]. Gradual changes in energy efficiency indicators will make it possible to adapt construction market realities to the provisions of law, and will contribute to new, energy efficient building practices and installation arrangements to be used.

3.1.3 Sources of financing

In accordance with Article 4(c) of Directive 2012/27/EU, measures indicated above constitute policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations, and, to a certain extent, constitute a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions.

The measures presented determine the main, but not the only, sources of co-financing of investments supporting the development of an energy efficient construction sector and supporting the use of renewable energy sources (RES) in existing buildings. Availability of different projects under specific forms of co-financing supports both deep renovations and staged deep renovations. An appropriations division of available funds between different groups of beneficiaries, or between specific investments is also important. This division of funds, beside providing material and environmental benefits, should also contribute to a development of energy-efficient technologies in Poland, better education, and gathering of competences.

A diagram below presents new sources of financing.



Translation of figure above, clockwise, starting from the top (Srodki z sektora prywatnego):

Private sector funds

State budget (i.a. Thermomodernisation and Renovation Fund)

Environmental Protection Funds (National and Regional ones)

Foreign funds (i.a. EEA Financial Mechanism, Norwegian Financial Mechanism)

European Union Funds

Funds from local self-governments

Commercial banks and other sources of financing (agencies, funds)

In the centre: **Sources of financing**

Financing from the private sector

There are no reliable data on the degree of financing of investments aimed at improving energy efficiency of the existing building stocks by private owners of residential real estates. This situation is the result of many measures which require insignificant financial outlays, and at the same time significant differences in the size and scope of other works carried out, in particular concerning individual residential housing, where it is to be expected that private sector

provides the bulk of financing for projects involving renovation in the existing buildings. At the same time, in the non-residential sector the scale and the costs of investments are usually higher. However, also in this case there is no comprehensive information in relation to the private sector.

Thermomodernisation and Repairs Fund (funded from the State budget)[65)]

The aid scheme regarding support for thermomodernisation projects for owners of buildings was introduced by the Act of 18 December 1998 regarding the support of thermomodernising undertakings. The concept developed made it possible to finance comprehensive thermomodernisation of a building, leading to a reduction in energy consumption, and consequently to a reduction in the demand for heat, warm service water, ventilation, air conditioning, and cooling.

On 19 March 2009 a new Act of 21 November 2008 on supporting thermomodernisation and renovations entered into force. It replaced the Act of 18 December 1998 regarding the support of thermomodernising undertakings. The Act of 21 November 2008 on supporting thermomodernisation and renovations introduced new principles governing financial support for thermomodernisation and the system of aid granted in the case of a specific group of renovation projects. The objective of the amendment was also to determine principles governing the financing from the Thermomodernisation and Repairs Fund.

The basic objective of the fund is to aid investors who implement projects involving thermomodernisation, repairs, and renovation of existing houses, using credits obtained in commercial banks. This aid, called respectively: a thermomodernisation grant, a repairs and renovation grant, and a compensation grant, constitutes a repayment of a part of a credit drawn for the implementation of a project, or for renovation.

Bank Gospodarstwa Krajowego (BGK) is the main entity competent for awarding budget resources from the Fund. It allocates grants within the available resources and within the limits of different types of bonuses specified in the financial plan of the Fund.

Thermomodernisation grant

Beneficiaries

Owners and administrators of:

[65] Information from Bank Gospodarstwa Krajowego.

- residential buildings;
- multi-apartment units;
- public utilities owned by local government authorities and used by them for public tasks;
- local heat distribution networks;
- local heat sources.

Investors, regardless of their legal status, may avail of the grants. They may include, for example, legal persons (e.g. housing cooperatives and corporations), local government entities, associations of owners of apartments, and natural persons, including owners of individual residential buildings. State-owned entities and plants financed from the State budget are not eligible for the grant.

Projects

The thermomodernisation bonus is applicable to thermomodernisation projects whose objectives are:

- reducing the consumption of energy for heating and service water heating purposes in housing units, multi-apartment units, and facilities owned by local government units and used by them for public tasks;
- reducing the cost of acquiring heat delivered to the buildings – as a result of building a technical connection to a centralised heating source due to the liquidation of a local heat source;
- reducing primary energy losses in local heating grids and local heat sources;
- a complete or partial change of energy sources to renewable sources, or using high-efficiency cogeneration – with the obligation to achieve energy savings defined in the Act.

A condition for a project to qualify for a grant is the presentation of an energy audit and its positive verification by the Bank Gospodarstwa Krajowego.

Financing

The amount of the thermomodernisation bonus constitutes 20 % of the amount of loan taken for the thermomodernisation project, but no more than:

1) 16 % of expenses actually incurred for the project, and
2) twice the amount of expected annual energy savings, assessed on the basis of an energy audit.

Repairs and renovation grant

Beneficiaries

Owners or administrators of multi-apartment buildings which entered into service before 14 August 1961 may apply for repairs and renovation grant.

The repairs and renovation grant may only be allocated to:

- natural persons;
- associations of owners of apartments in which natural persons have the majority of share;
- housing cooperatives;
- social housing associations.

Projects

The repairs and renovation grant may be applied for when thermomodernisation projects involving thermomodernisation are carried out in multi-apartment buildings, which consist of:

- repairs and renovation of these buildings;
- replacement of windows, or repairs of balconies (even if they are used exclusively by the apartment's owners);
- alterations of buildings, resulting in improvements,
- equipping buildings with installations and devices required for buildings approved for housing according to technical and construction regulations,
- meeting the obligation to achieve energy savings defined in the Act and meeting the conditions regarding the level of the project's cost efficiency ratio.

A condition for a project to qualify for a grant is the presentation of a renovation audit and its positive verification by the Bank Gospodarstwa Krajowego.

Financing

The amount of the repairs and renovation grant constitutes 20 % of the amount of loan taken for the repairs and renovation project, but no more than 15 % of the actually incurred costs of the project.

Compensation grant

Beneficiaries

Investor described in Article 10 of the Act of 21 November 2008 on supporting thermomodernisation and renovations may apply for a compensation grant.

Projects

The compensation grant covers the implementation of:

- repairs and renovation projects;
- repairs and renovation of an individual residential building.

Financing

Investors interested in obtaining a compensation grant may finance a renovation project of a multi-apartment residential building and renovation of an individual residential building using credit or own funds.

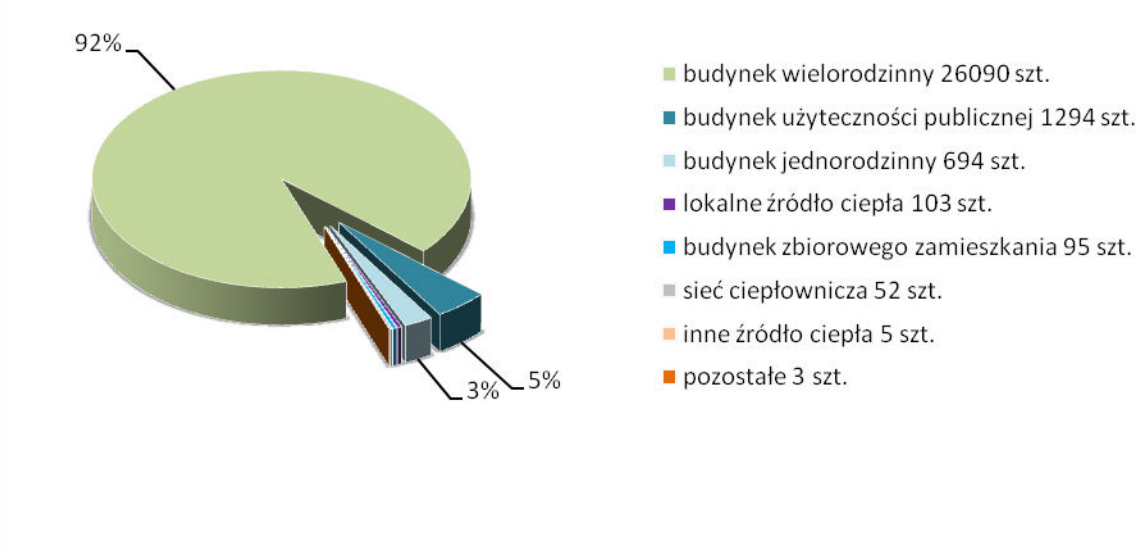
In the case of an investor:

- financing a project using credit, an application for a compensation grant is to be submitted together with the application for a renovation grant, in the bank giving the credit. A compensation grant is granted together with the renovation grant;
- financing the project using own funds, an application for compensation grant together with the documents specifying material scope and estimated costs of works shall be submitted directly in the Headquarters of the Bank Gospodarstwa Krajowego.

A compensation grant is intended to finance the entire costs of a renovation project, or the entire costs of renovation of an individual residential building, or part of the costs incurred after a decision about a compensation grant is taken by the Bank Gospodarstwa Krajowego (BGK).

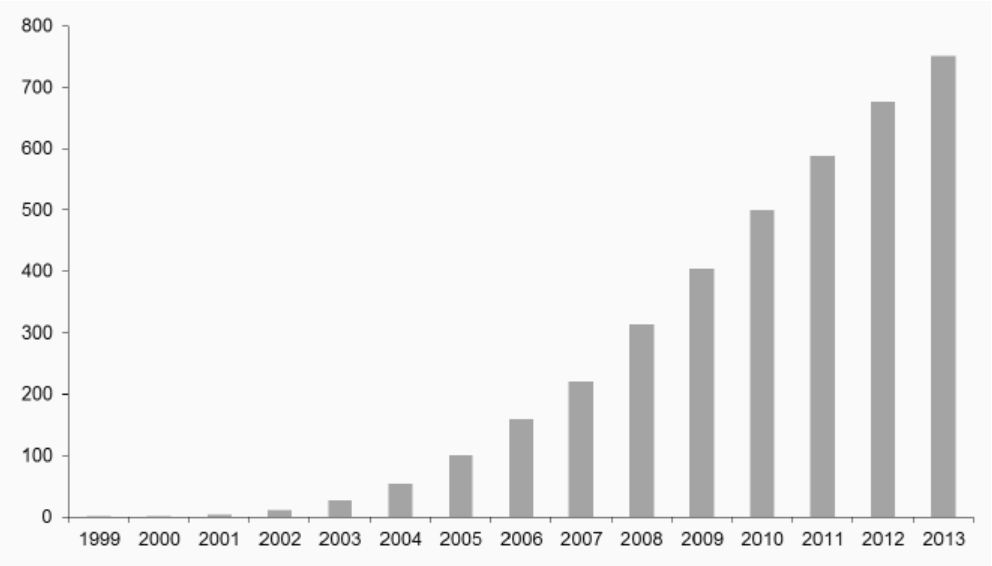
A compensation grant can be granted only once in respect of a residential building or a part thereof.

Effects of operation of the Fund in the years 1999-2013 (data provided by the Bank Gospodarstwa Krajowego)



Translation of Figure above (top to bottom):
Multi-apartment building 26090 pcs
Public utility building 1294 pcs
Individual residential building 694 pcs
Local source of heating 103 pcs
Lodging 95 pcs
Heat distribution network 52 pcs
Other sources of heating 5 pcs
Other 3 pcs

Figure Savings of energy costs (in PLN million) resulting from the implementation of thermomodernisation projects (cumulative energy savings, i.e. in a given year, total savings of buying energy costs resulting from grants awarded in previous years)



As regards sources of financing presented in a further part of the document, until 31 December 2013 the amount of approximately PLN 1 555 million was put into the Thermomodernisation and Repairs Fund.

As at 31 December 2013, BGK had the following resources within the limits for individual types of grants: thermomodernisation PLN 60.7 million; renovation PLN 23.5 million; compensation PLN 15.3 million.

National Fund for Environmental Protection and Water Management (NFOŚiGW)[66)]

Funds available under the NFOŚiGW are the source of financing of different measures whose objective is to improve energy efficiency, also in existing buildings. NFOŚiGW has at its disposal a certain amount of national, EU, as well as Norwegian and EEA (European Economic Area) funds.

Subsidised loans for solar collectors (national measures)

Financial support may be granted for the purchasing and assembling of solar collectors for heating of service water and for an additional energy supply for other heat receivers in buildings used, or intended to be used for residential purposes.

The objective of the programme is to reduce or avoid CO_2 emissions by increasing heat energy production from renewable sources. The period of implementation is planned for the years 2010 – 2015. Funds to be spent until 31.12.2015.

Beneficiaries.

- natural persons who have the right to take decisions about the residential building, or the right to take decisions about a residential building under construction;
- associations of owners of apartments which install solar collectors for their own multi-apartment buildings (housing several families).

Projects

Purchasing and assembling of solar collectors for heating of service water or for heating of service water and which are at the same time an additional energy supply for other heat receivers in buildings used, or intended to be used for residential purposes. The effects of implemented projects may not be used in the future for business activities.

[66)] Information provided by NFOŚiGW

Financing

Grants are provided for a partial repayment of the bank loan capital, provided by the bank, on the basis of an agreement on cooperation. Co-financing is in the form of a grant amounting to 45 % of the bank loan capita, used for financing eligible costs of the project.

- PLN 450 million was reserved by NFOŚiGW to pay grants in respect of loan agreements concluded in the years 2010-2014.
- The budget for the programme for the years 2010-2013 amounts to PLN 371 167 thousand, out of which 99 % of the plan, i.e. PLN 368 190 thousand was executed. In 2014, in accordance with the plan, PLN 78 833 was put aside for the programme. Out of this sum, PLN 6 209 thousand was used, i.e. 8 % of the plan. Grants were awarded for 56 036 projects, for a total amount of PLN 374 399 thousand (including those given to 46 associations of owners of apartments, for the amount of co-financing of PLN 2 071 thousand. The average unit cost of co-financing per 1 m^2 of collectors was PLN 2.23 thousand, and the average area of solar collectors installed (gross) was 6,92 m^2.

Green Investment Scheme Energy management in public utility facilities

As a result of co-financing obtained from this programme, it is possible to reduce energy consumption in buildings used by: local governments, healthcare establishments, universities, non-governmental organisations, Voluntary Fire Brigades, church legal persons.

Beneficiaries.

- local government entities and associations thereof;
- entities which are not entrepreneurs and which provide public services as part of local government own tasks;
- Voluntary Fire Services;
- universities, within the meaning of the Act on university education, and research institutes;
- independent public healthcare centres and healthcare establishments operating as enterprises (within the meaning of Article 551 of the Civil Code) providing healthcare services;
- non-governmental organisations, churches, other religious associations, church legal persons;
- entities or units defined above, which are parties to a loan agreement in a collective project.

Projects

- Co-financing may be granted for: investments in public utility buildings, i.e. buildings assigned to be used for the following purposes: to house local administration, to house fire protection services (Voluntary Fire Services), to be used by cultural institutions, by religious associations, by educational institutions, by science and research institutions, by the health

service, by social welfare and social assistance organisations, and also for investments in multi-apartment buildings intended to temporarily house people outside their permanent residence (in particular boarding schools, and student houses), as well as in buildings intended to permanently house a significant number of people (in particular retirement homes, orphanages, nursing homes, monasteries, and convents);

- thermomodernisation of public utility facilities, including equipping facilities with appliances of the highest, economically justified energy efficiency standards, directly related to the thermomodernisation of the facilities, in particular: insulation of a building, replacement of windows, replacement of external doors, alterations to the heating system (including the change of the heat source), replacement of ventilation and air conditioning systems, preparation of technical documentation for the investment, and the use of energy management systems in buildings, the use of technologies of renewable energy sources,
- replacement of internal lighting with an energy-efficient one (as additional work performed together with facility thermomodernisation).
- Collective projects can be implemented under the programme.

Financing

Forms of co-financing: grants and loans.

Minimum total cost of investment: exceeds PLN 2 million. In the case of collective projects, the total amount of the investment, resulting from the agreement on supplementary financing by means of subsidies and loan/s must exceed PLN 5 million.

Summing up the call for applications for the 4th competition, NFOŚiGW received applications for co-financing for 149 projects, with a total cost of PLN 712.75 million. The amount of the grant allocated to co-financing projects in that contest was PLN 40 million.

Financial support from European Union funds

According to the Europe 2020 strategy, energy efficiency is one of the priorities of the European Union. Therefore, measures leading to an improvement in the energy performance of buildings have a possibility to obtain support from EU funds. There are several sources of financing, including financing under the cohesion policy (operational programmes), financing of research, financing of competitiveness and innovations.

In Poland, implementation of the projects from Financial Perspective 2007-2014 is done at the national and regional levels. The largest amount of funds is available at the national level under the Operational Programme Infrastructure and Environment (OPI&E). Under this programme, funds from the European Regional Development Fund and from the Cohesion Fund provide

support for investments from the following sectors: environment, transport, energy, culture, protection of health, higher education.

Energy efficiency in construction under OPI&E in the years 2007-2013

The total sum of funds involved in the implementation of the Operational Programme Infrastructure and Environment for the years 2007-2013 was EUR 37.7 billion. From this sum the European contribution was EUR 28.3 billion and the national contribution EUR 9.4 billion.
Out of fifteen priorities implemented, the ninth one involved support for environment-friendly energy infrastructure. EUR 1 403.0 million was allocated for that project (including EUR 748.0 million from the Cohesion Fund).

One of the measures of the above-mentioned priority concerned thermomodernisation of public utility buildings: Measure 9.3 Thermomodernisation of public utility buildings

Objectives of the measure

Reduction of energy consumption in the public sector

Beneficiaries.

- public finance sector entities;
- local government entities and groups: unions and associations thereof;
- entities which are not entrepreneurs and which provide public services as part of local government own duties;
- official authority bodies, including government administration units, state inspection bodies, law enforcement bodies, courts and tribunals;
- police bodies, fire services (including Voluntary Fire Services), and municipal police bodies;
- state universities;
- independent public healthcare centres;
- non-governmental organisations, churches, church legal persons and associations thereof, and other religious associations.

Projects

Under the measure, investments in the area of thermomodernisation of public utility buildings were supported (buildings for housing public administration, administration of justice, culture, religious cult, education, higher education, science, healthcare, social welfare and social care, and sport), including changes in the equipment of these facilities replacing the existing equipment by equipment with the highest economically justifiable energy efficiency class, and changes in the preparation/updating of low-emissions economy in municipalities.

Co-financing could be obtained for:

- insulation of buildings;
- replacement of windows, external doors, and lighting with energy-saving;
- alterations of the heating system (including the replacement of the heat source), ventilation and air-conditioning systems.
- preparation of documents in respect of the implementation of projects.

In addition, support can be provided for a possibility to prepare or update low-emissions economy plans in municipalities.

Financing

Grants amounting to 85 % of eligible expenditure, and for State-owned budget entities to 100 % of eligible expenditure.

116 correctly completed applications were submitted concerning thermomodernisation projects under that measure; 39 agreements on the co-financing of projects were signed; 23 projects were completed and settled. On the basis of indicators declared in agreements on the co-financing of projects, the following effects of the programme can be presented:

- the number of buildings covered by thermomodernisation: 560 thousand;
- the amount of energy saved: 268 615 MWh/ year;
- avoided CO_2 emissions connected with energy savings: 275 950 tonnes.

Energy efficiency in construction under OPI&E in the years 2014-2020

The major beneficiaries of OPI&E 2014-2020 will be public entities (including local government entities) and private entities (primarily large enterprises).

The main objective of OPI&E 2014-2020 is the support for the economy effectively using resources and eco-friendly, and promoting territorial and social cohesion. Compared with the OPI&E 2007-2013 implemented at the national level, in the OPI&E 2014-2020 there will be more emphasis on the support of economy efficiently using available resources, and as a result eco-friendly and, at the same time, more economically competitive.

Under the 1st Priority axis Reduction of emissions in the economy, compliant with the topical objective 4 (defined by the EU under the package of regulations) "support for moving towards low-emissions economy in all sectors", there is investment priority 4.3 Support for energy efficiency, smart energy management and the use of renewable energy sources in public infrastructure, including public buildings, and in residential sector. Proposed allocation of funds is approximately EUR 450 million from the Cohesion Fund.

Potential beneficiaries and target groups

The support is envisaged for, inter alia, public authorities, including Governmental administration and its subordinate entities, local authorities and organisational entities acting on their behalf (in particular for Voivodship capitals and their functional areas, and for regional and sub-regional centres), state-owned budget entities, housing cooperatives and associations of owners of apartments, as well as entities which are not entrepreneurs and which provide public services as part of local government own tasks. In view of the fact that the intervention will be of a horizontal nature and will apply to the entire country, target group will consist of users of supported infrastructure.

Projects

Support for a comprehensive energy modernisation of public utility buildings and residential buildings is envisaged, together with a replacement of these buildings' equipment by more modern one. The activities envisaged would include, among other things:

- insulation of a building, replacement of windows, external doors, and replacing and lighting with energy-efficient one;
- alterations of the heating system (including the change of the heat source), ventilation and air-conditioning systems, installation of weather-sensitive automatic temperature regulation and of building management systems;
- construction or modernisation of internal receiving installations, and removal of existing heat sources;
- installation of micro-generation or micro-trigeneration for own needs;
- installation of RES in energy-modernised buildings;
- installation of cooling systems, also including the use of RES.

These activities can be coordinated with the implementation of projects involving modernisation of heating networks and the development of high-efficiency cogeneration leading to reduced requirements for heat and cold.

It is anticipated that, as a result of this priority, primary energy consumption will drop by 0.9 Mtoe, and the share of renewable energy sources will increase by approximately 4.6 %.

Regional Operational Programmes (ROPs)

In addition to the financing under the OPI&E, it is also possible to get support under Regional Operational Programmes (ROPs). According to the provisions of the Partnership Agreement, 60 % of structural funds (the European Regional Development Fund and the European Social Fund) will be allocated for 16 regional programmes in 2014 - 2020. Every

Voivodship with an appropriate part of funds at its disposal will prepare a Regional Operational Programme, adapted to the needs and specificity of the regions concerned.

All Voivodships Administrations envisaged under their RPOs for 2014-2020 support for energy efficiency in public buildings and in the residential sector. and most of the Administrations also envisaged support for the SME sector. Beneficiaries, examples of types of investments, and the method of financing are individually defined for each Voivodship and will be presented under specific topical objectives and investment priorities. Detailed information will be presented in implementing documents of ROP.

Other, selected sources of financing, including commercial banks

Support of commercial banks for the improvement of energy efficiency of existing building stocks is mainly based on credits granted for specific actions of different groups of investors. Preferential terms of credit repayments are intended as an incentive. It is also possible to receive financial support with the participation of a project supervisor, i.e. a specialised enterprise performing specific work in the area concerned. This idea combines granting of appropriate technical support with providing finances needed to implement the project. Another incentive is a possibility of repayment of liabilities vis-à-vis a third party from savings of energy costs resulting from the investment. Detailed rules governing the provision of support are determined by institutions which are the source of financing.

3.2 Other activities

Information and education

It should be noted that NFEP&WM carried out actions which raised popular awareness renewable energy sources by conducting a programme called "Ecological education". In 2011 NFEP&WM was involved in 20, and in 2012 in 23 educational projects regarding the above-mentioned subject.

In addition, on websites of financial institutions financing projects involving modernisation of existing building stocks and on the website of the Ministry, there is a lot of valuable information on the process of financing, as well as on issues connected with energy efficiency in the building sector.

Research and development.

The National Research and Development Centre carried out a research project called ""Integrated system for reducing operating energy intensity of buildings". Its objective was to develop technical and organisational solutions regarding design, construction, and use of residential buildings and public utility buildings which will result in reduced energy use by them

and would increase the use of renewable energy sources in the buildings' energy balance. Implementation of 7 research tasks under the project started in 2010 and was of between 12 and 36 months duration.

Topics of research tasks implemented under the project:

- Analysis of possibilities and socio-economic consequences of the increase of energy efficiency in construction;
- Development of the best possible options from the energy efficiency point of view as regards buildings;
- Increased use of renewable energy sources in construction;
- Development of thermal diagnostics for buildings;
- Optimisation of electricity use in buildings;
- Analysis of technical and operational requirements for buildings with energy supplied from centralised heating sources;
- Conditions and possibilities of energy savings through urban policy instruments.

3.3 Analysis of barriers

In view of a considerable progress achieved in recent years in improving energy efficiency indicators in buildings, an improvement in thermal parameters of existing building stocks can also be observed. Nevertheless, these buildings continue to have considerable heat losses in view of inadequate thermal insulation and of systemic defects concerning ventilation, airtightness and heating installation, as well as preparation of hot water.

The high costs of investment in a deep, comprehensive energy modernisation of a building continue to be a barrier to achieving good energy efficiency indicators in buildings. There is a considerable gas between the price of standard building materials and materials which have good thermal insulation parameters. The problems with performance of construction works are similar. There is still not enough highly qualified and reliable specialists.

As regards buildings renovation, it is difficult to take into account the method, type, and scope of works in the existing building. An in-depth modernisation of the entire building is required. Often, it is not possible to carry out this type of project without moving out the occupants. It should be noted that in view of the ownership structure of apartments, in many cases the implementation of such comprehensive modernisation in Polish realities may cause a serious problem.

A separate group are buildings entered into a register of historical monuments and protected under a preservation order. In view of important social and cultural aspects, not all works and

technical solutions may be permitted. Taking into account historical nature and architectural values of this type of buildings, the costs of investment have to increase.

3.4 Perspectives for the future

As regards an improvement in the regulatory environment, as already mentioned in this document, regulations in force regarding technical conditions of buildings provide for a gradual raising of requirements, in the present form, until 2012. This provides an encouragement for achieving better parameters and for using and developing new, alternative construction practices in this field.

Even though there is reasonably good access to financing measures for improving energy efficiency of building stocks, it is still possible, however, to considerably improve and develop this situation. At the same time, there is support envisaged for the coming years from the sources of funding mentioned above. Regardless of the assessment of activities carried out and general summaries, it is always worthwhile to work on the simplification of procedures governing the submission of applications and to help to improve knowledge of possibilities of receiving financial support, especially at the local level. By providing objective, credible and normalised information on period of repayment, or return on investment, it is possible to make private sector more interested in offering loans in respect of the matter in question.

There is a need to help to overcome market failures which continue to considerably restrict improvements in energy efficiency of buildings. Still, the essential problem is the cost of investments and the period of return on investment.

In the future, it would be worthwhile to focus on raising the level of public knowledge (public to include owners and users of buildings, but also specialists from the financial and construction sectors), to provide reliable information regarding energy savings, considerable benefits arising from measures aimed at improving the condition of existing building stocks, primarily financial benefits, as well as development of adequate standards and monitoring methods for works and their results.

4. Benefits, including estimates of anticipated energy savings

Translation of figure above (top to bottom):

Savings in energy consumption

Increased demand for materials for thermal insulation of buildings and for equipment used in modern, energy-efficient systems for heating, ventilating, cooling and lighting buildings and in systems for preparation of hot service water

Reduction in the use of non-renewable primary energy carriers, such as natural gas, heating oil and coal

Increased demand for renewable primary energy carriers

Increased employment in enterprises producing goods for which the demand will increase; smaller number of unemployed

Increased State budget revenues from VAT on the increased sales of thermoinsulation materials, and elements of heating-ventilating-cooling systems using renewable primary energy sources

Table 7 presents estimated savings of the non-renewable primary energy factor EP, achieved as a result of modernisation, depending on the type of building and the source of heat.

Table 7 Estimated savings of the non-renewable primary energy factor EP, achieved as a result of modernisation, depending on the type of building and the source of heat

Existing buildings	Average value of the non-renewable primary energy factor EP, achieved as a result of modernisation, depending on the source of heat before the modernisation	Average value of the non-renewable primary energy factor EP, achieved as a result of modernisation, depending on the source of heat after the modernisation	Savings on the value of non-renewable primary energy factor EP [%]

	kWh/(m^2·year)		kWh/(m^2·year)		
Single-family residential building	coal boiler/gas boiler	551.5	boiler using biomass heat distribution network/geothermal heat pump / gas boiler	42.7-137.0	75-92
Multi-apartment residential building	gas boiler/ coal boiler	366.2	boiler using biomass heat distribution network geothermal heat pump gas boiler	34.8-104.3	72-90
Public utility building - office building	coal boiler/gas boiler	318.2	heat distribution network gas boiler	54.7-74.2	77-83