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National Report

Energy Efficiency trends and policies in Poland in years 2006-2016

prepared in framework of

ODYSSEE- MURE project

Monitoring EU and national energy efficiency targets

Central Statistical Office (GUS)

The Polish National Energy Conservation Agency (KAPE)

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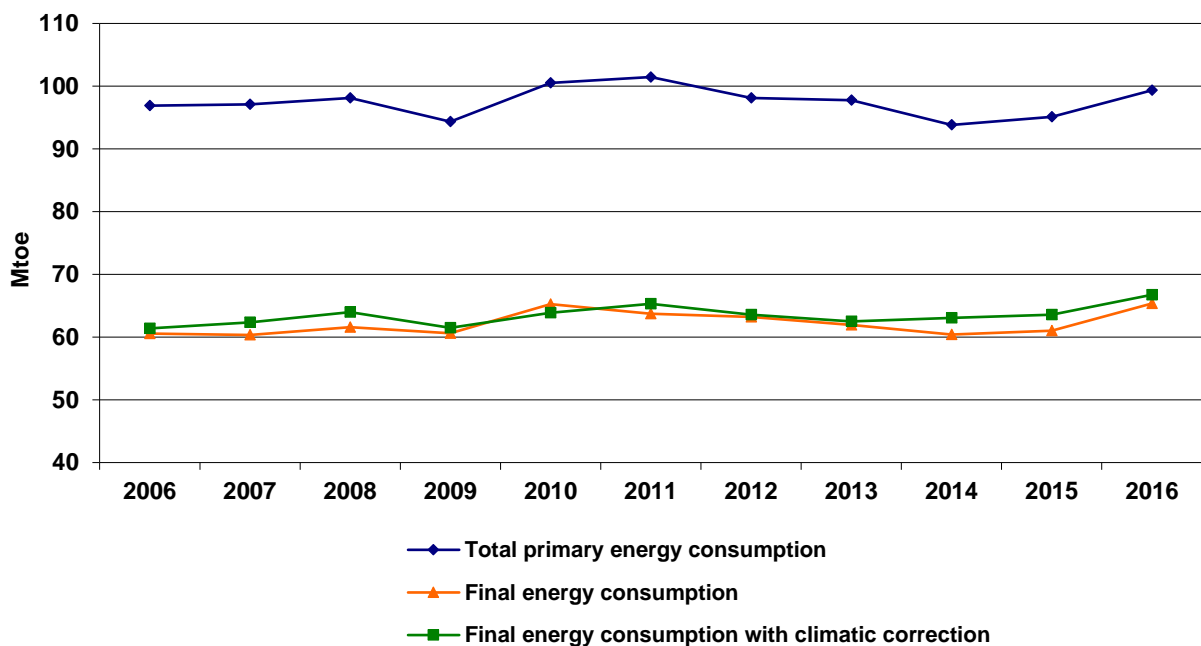
1. Energy efficiency indicators

1.1. Consumption and prices of energy

Total consumption of primary energy grew in years 2006-2016 from 97 Mtoe to 99 Mtoe (0.2%/year). Consumption tended to grow until 2011, when it reached the highest value in the period of 101.5 Mtoe and in 2015 and 2016. The lowest consumption was observed in 2014 (93.8 Mtoe).

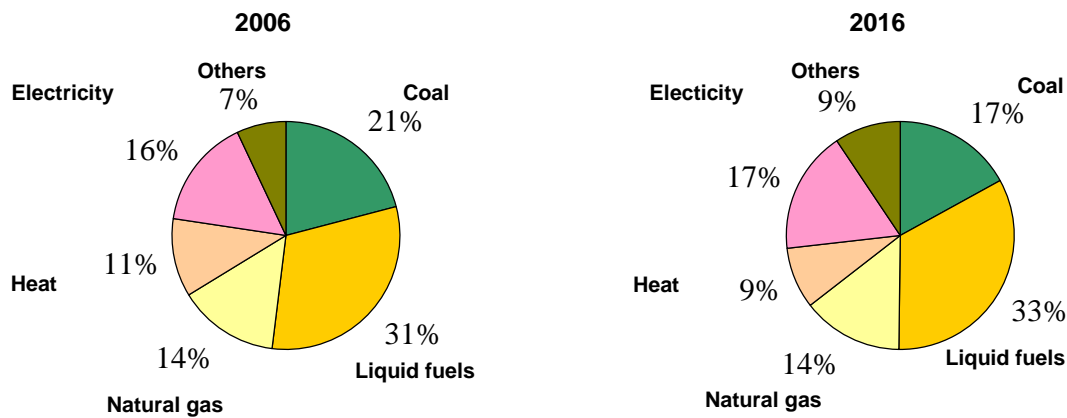
Final energy consumption increased during presented period from 61 to 65 Mtoe, which means an average annual growth rate of 0.8%. In that case, decrease of consumption was observed in years 2007 and 2009 and from 2011 to 2014. After taking into account different weather conditions, that is final energy consumption with climatic correction was increasing by 0.8%/year in 2007-2016.

Figure 1. Total primary and final Energy consumption



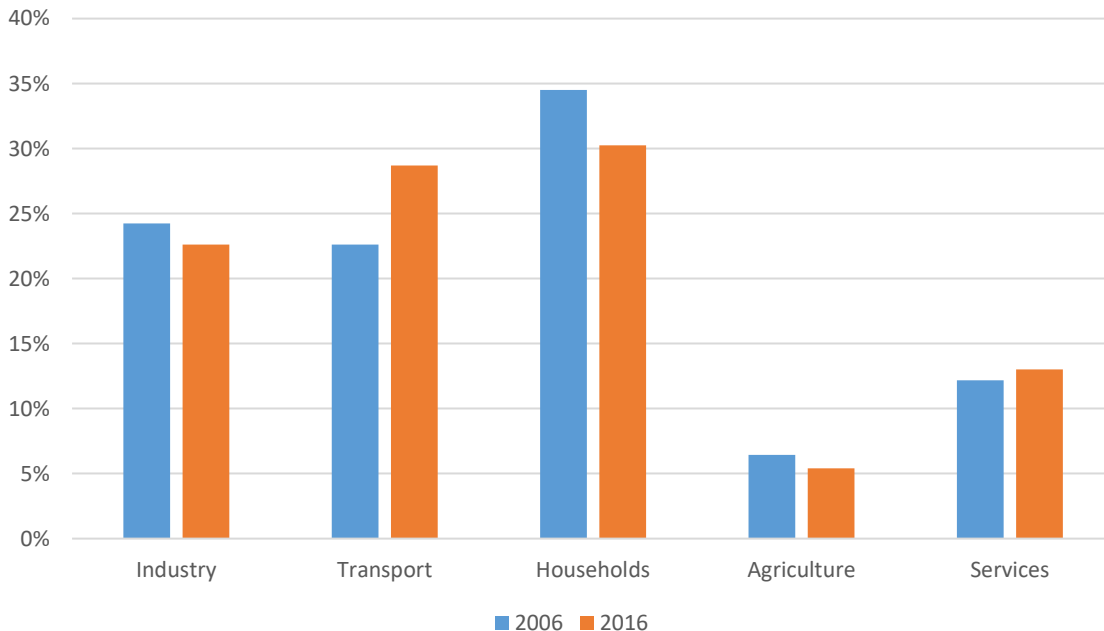
The consumption structure by energy carriers is determined by existing natural resources. The main sources of primary energy are hard coal and lignite. In case of final consumption, coal fuels are the second most important type of consumed carriers, which share decreased from 21% in 2006 to 17% in 2016. The most important energy carrier in 2016 were liquid fuels, which share amounted to 33% and increased by 2 pp compared to 2006. Among other carriers, the decrease was observed in heat consumption (from 11% to 9%). The increase in share was recorded in case of electricity - from 16% to 17% in the discussed period and other energy carriers (mainly energy from renewable sources) - from 7% to 9%. The share of natural gas has not changed.

Figure 2. Structure of final Energy consumption by carrier



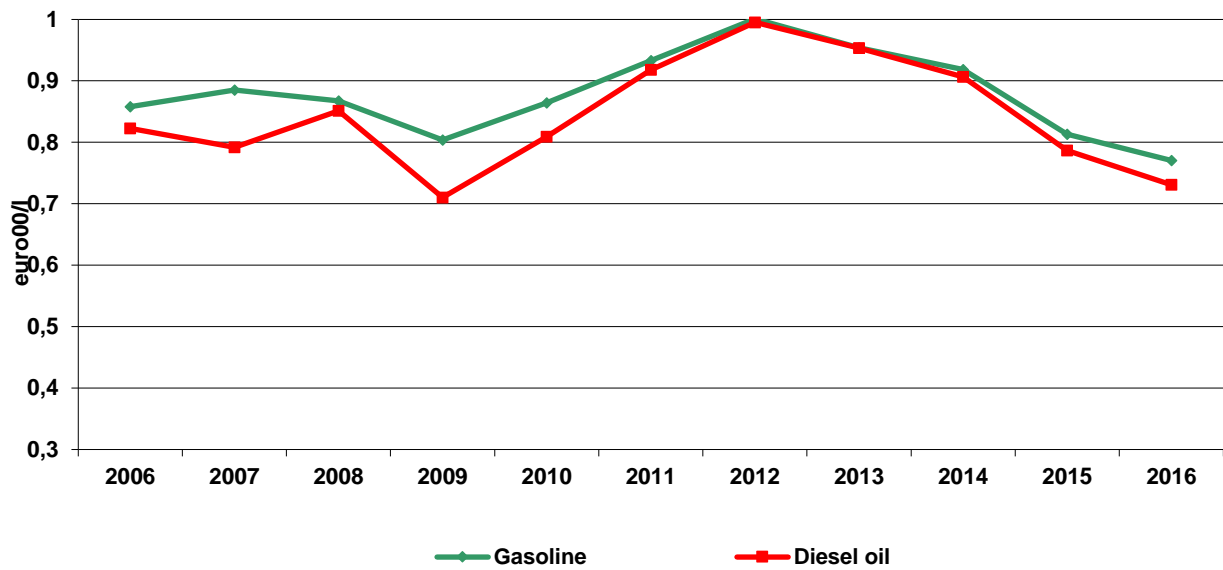
In the years 2006-2016, the share of transport and services sectors in final energy consumption increased, and the share of industry, households and agriculture decreased. The share of transport increased from 23 to 29%, which was the biggest change during presented period, and the reason was the growing role of road freight transport, as well as private passenger car transport. Households remained the largest consumer despite a decrease in share from 35 to 30%. The share of industry decreased from 24 to 23%, and agriculture from 6 to 5%. The share of services increased from 12 to 13%.

Figure 3. Structure of final Energy consumption by sector



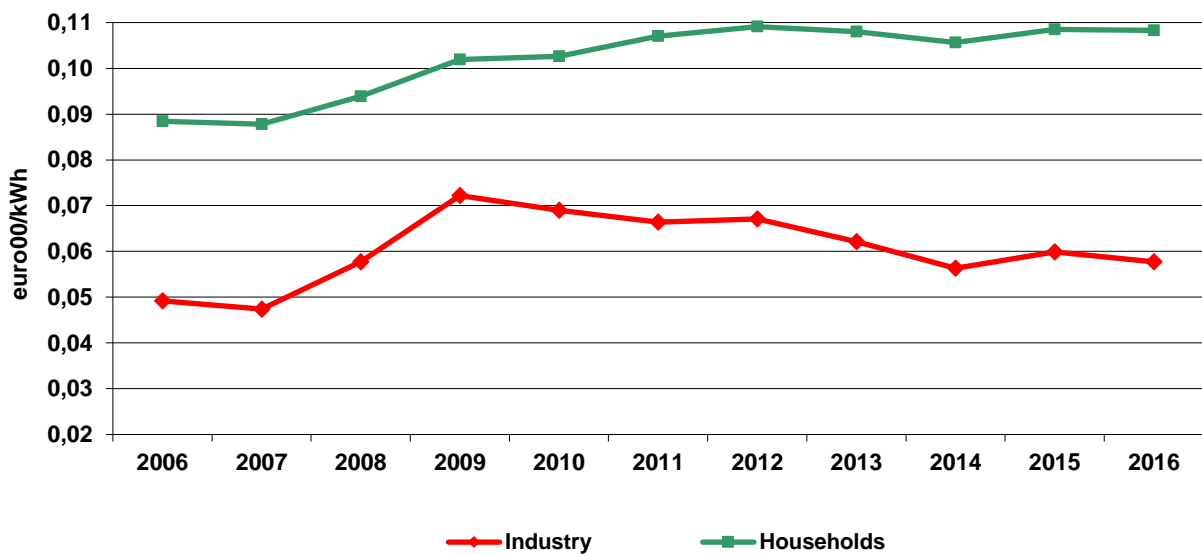
The prices of gasoline and diesel oil (expressed in constant prices) reached the highest value in 2012. Since then, a drop in prices of gasoline and diesel oil has been observed, which in 2016 amounted to 0.77 and 0.73 euro00/l respectively. In the case of gasoline, it was the lowest value in the presented period, while diesel oil prices were lower only in 2009.

Figure 4. Diesel oil and gasoline prices



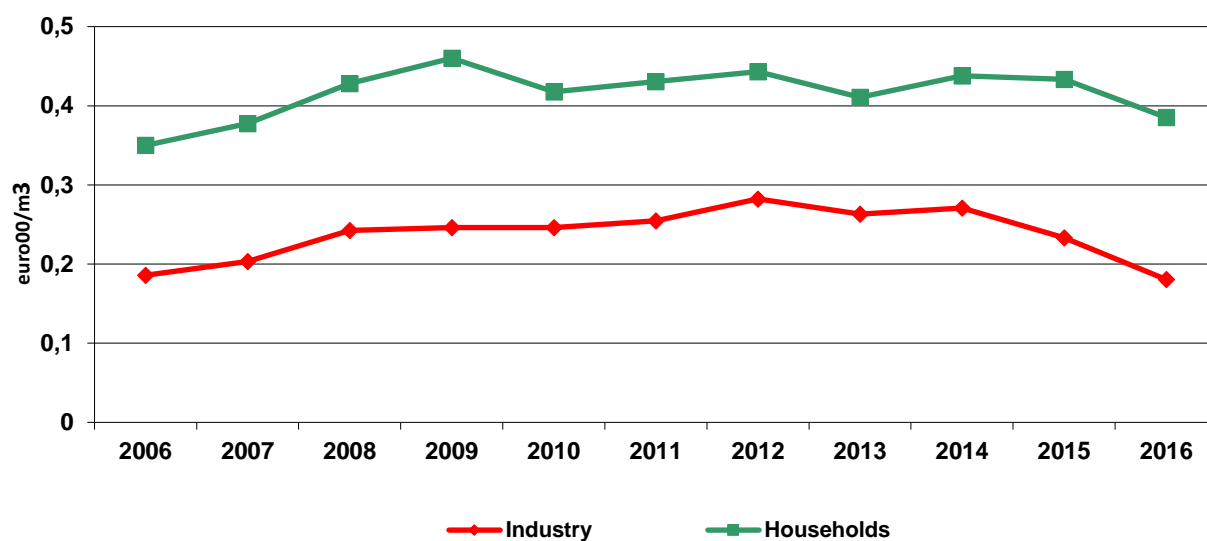
Electricity prices for households increased between 2006 and 2016 from 0.088 in 2006 to 0.108 euro00/kWh in 2016. Electricity prices for industry reached the highest value in 2009, followed by a downward trend. In 2016, they amounted to 0.058 euro00/kWh.

Figure 5. Electricity prices for households and industry



The prices of natural gas for households in 2016 amounted to 0.39 euro00/m³, reaching the lowest level since 2007. Natural gas prices for industry decreased after 2014 by 33%, reaching in 2016 the value of 0.18 euro00/m³.

Figure 6. Natural gas prices for households and industry



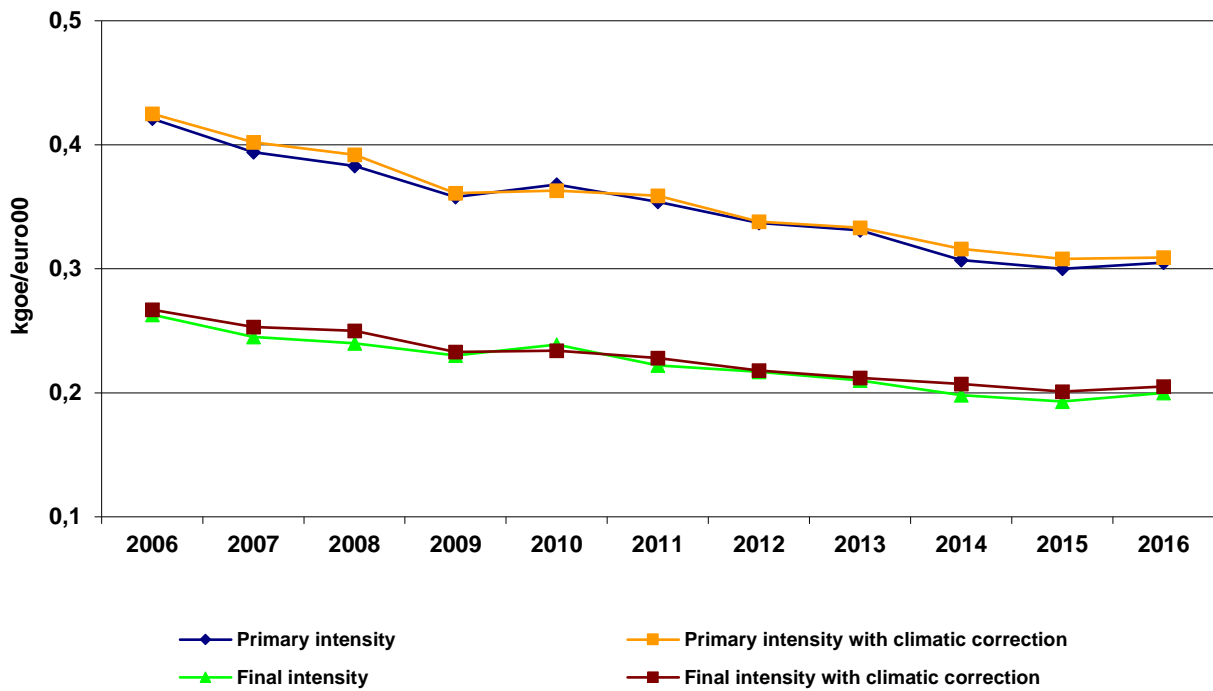
1.2. Macroeconomic indicators

The primary and final energy intensity of GDP decreased in 2016 compared to 2006 by 28% and 24% respectively; after taking into account the climate correction the rate of improvement was slightly lower. The rate of improvement in the first years of presented period (i.e. in 2006-2009) was higher than in 2010-2016, which was particularly visible in the case of primary energy consumption.

Table 1. Rate of change of energy intensity indicators (%/year)

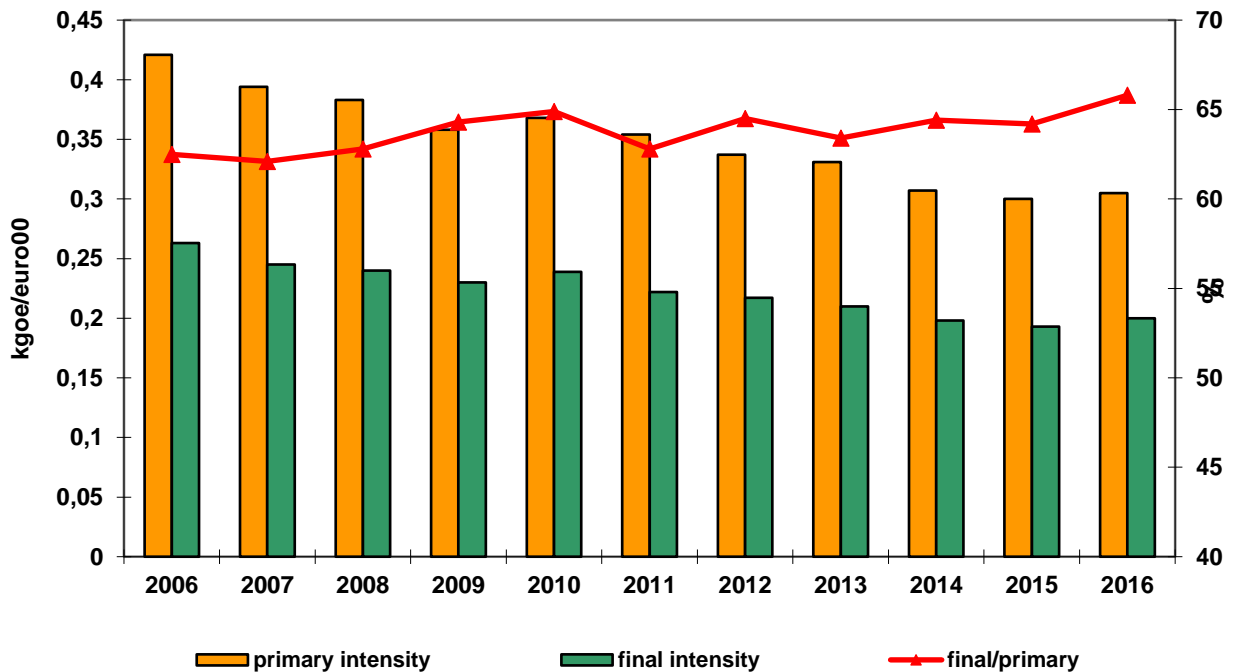
Average Annual Growth Rate	2007-2009	2010-2016	2007-2016
Primary intensity of GDP	-5,28	-2,26	-3,18
Primary intensity of GDP with climatic correction	-5,25	-2,20	-3,13
Final intensity of GDP	-4,41	-1,93	-2,68
Final intensity of GDP with climatic correction	-4,37	-1,84	-2,61

Figure 7. Energy intensity of GDP



The ratio of final energy intensity to primary energy consumption showed a growing tendency. In 2016 it reached the highest value (65.8%). Its level is mainly influenced by the efficiency of energy transformation (the higher the efficiency, the higher the value of the indicator) and the rate of increase in electricity consumption (the higher the lower the value of the indicator).

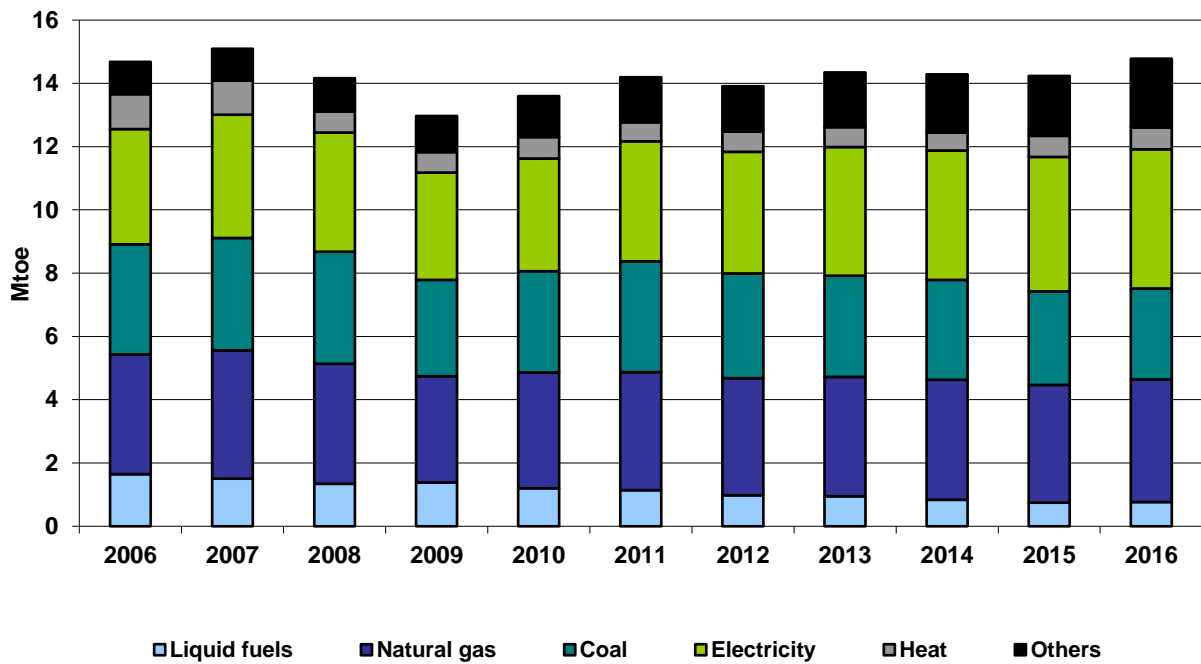
Figure 8. Relation of final to primary energy intensity



1.3. Industry

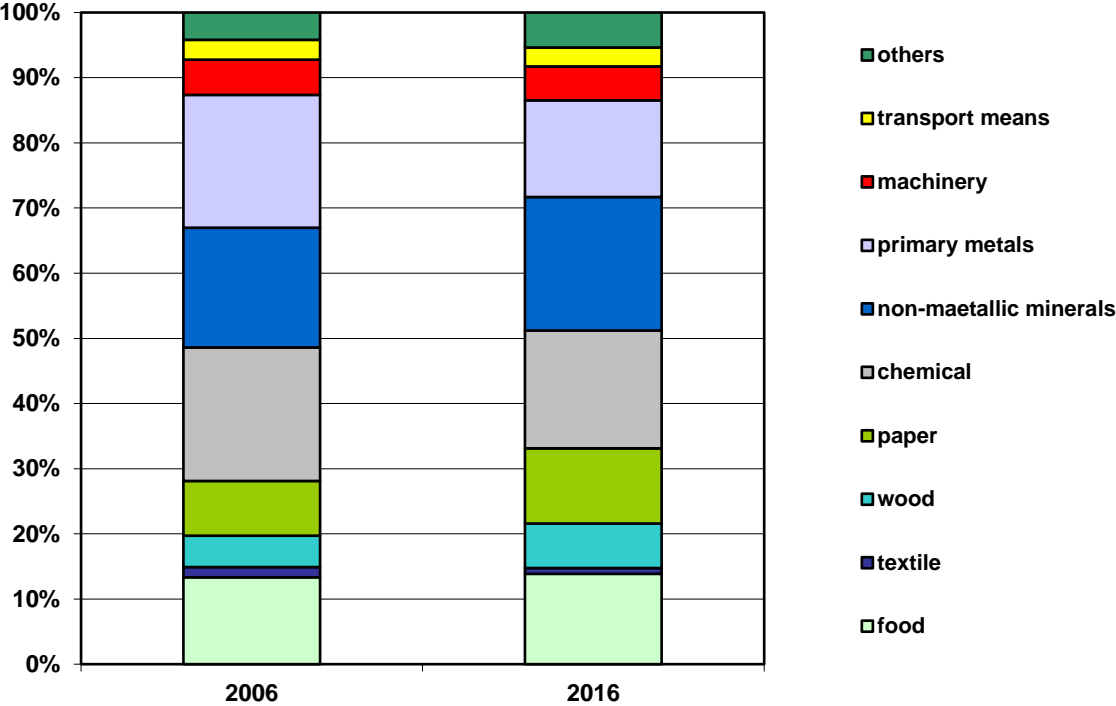
The final energy consumption in industry reached the highest value in 2007 when it amounted to 15 Mtoe, and the lowest, at 13 Mtoe two years later. In 2016, after a growth of 0.5 Mtoe, consumption amounted to 14.8 Mtoe. The largest decrease in consumption occurred in case of liquid fuels (decrease by 53%). The consumption of heat (by 38%) and coal (by 21%) also decreased. On the other hand, gas consumption (by 2%), electricity (by 21%) and other carriers increased by 115%.

Figure 9. Final Energy consumption in industry by carrier



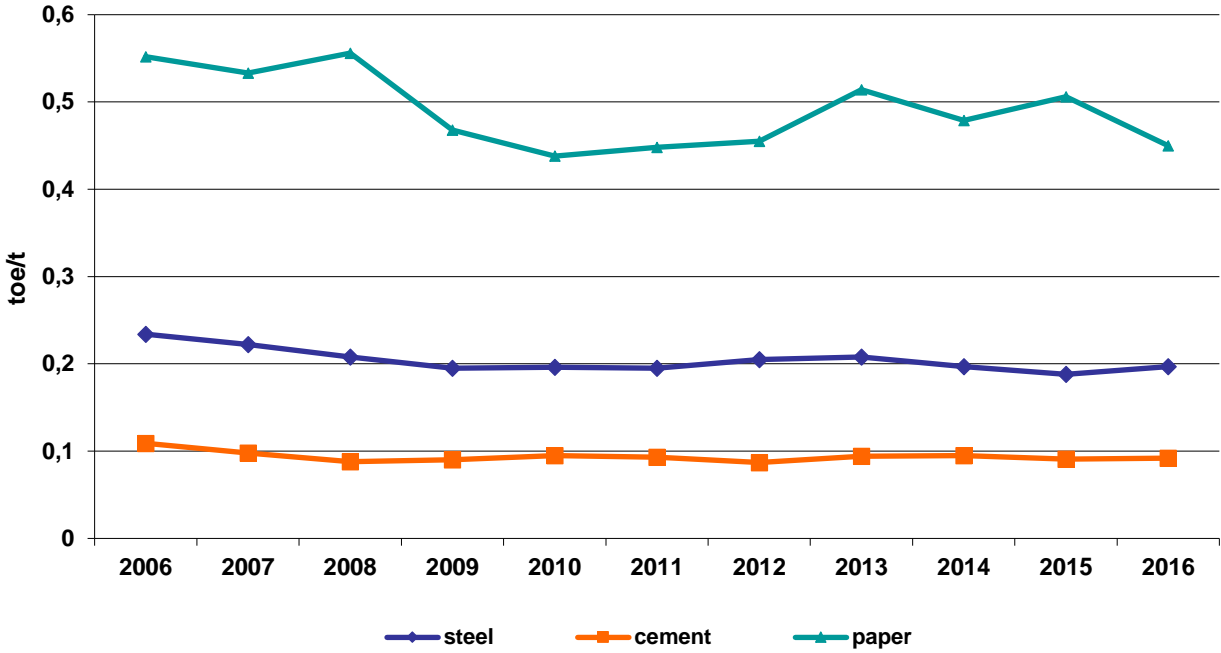
Three energy-intensive industries dominate in the structure of energy consumption in manufacturing: primary metals, chemical and non-metallic minerals, which total share in energy consumption amounted to 53% in 2016 (59% in 2006). A significant, over 10% share was also achieved by food and paper industries.

Figure 10. Structure of final Energy consumption in manufacturing by branch



The energy consumption for the production of cement, paper and steel accounted for 33% of consumption in manufacturing in 2016. Unit consumption in cement production in 2016 amounted to 0.092 toe/t. The lowest energy intensity was recorded in 2012, when it amounted to 0.087 toe/t. In case of steel, the energy intensity of production amounted to 0.197 toe/t, after an increase from 0.188 toe/t in the previous year. The energy intensity of steel production was the lowest in the presented period in 2015. The energy intensity of the paper industry decreased in 2016 by 11% to the level of 0.45 toe/t. In 2016, compared to 2006, the energy intensity of crude steel production fell by 16.0% (1.7%/year), paper by 18.5% (2.0%/year) and cement by 15.6% (1.7%/year).

Figure 11. Energy intensity of production



The highest Energy intensity was observed in primary metals, chemical and paper industry and the lowest in machinery, transport means and others.

Figure 12. Energy intensity in high energy intensive industries

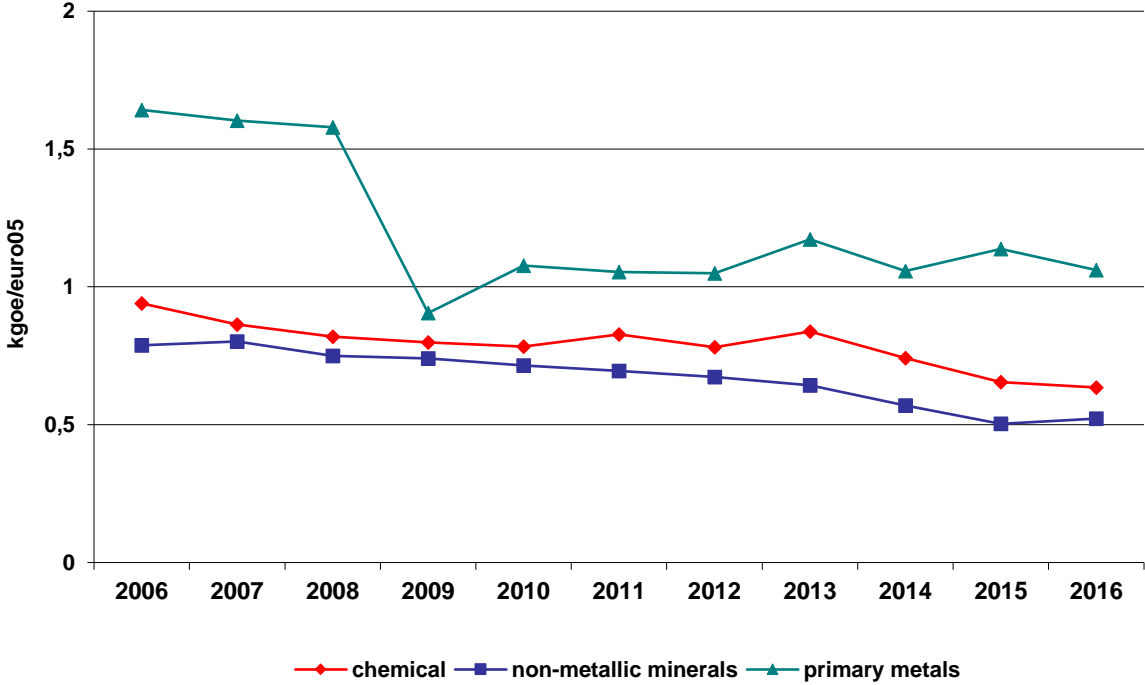
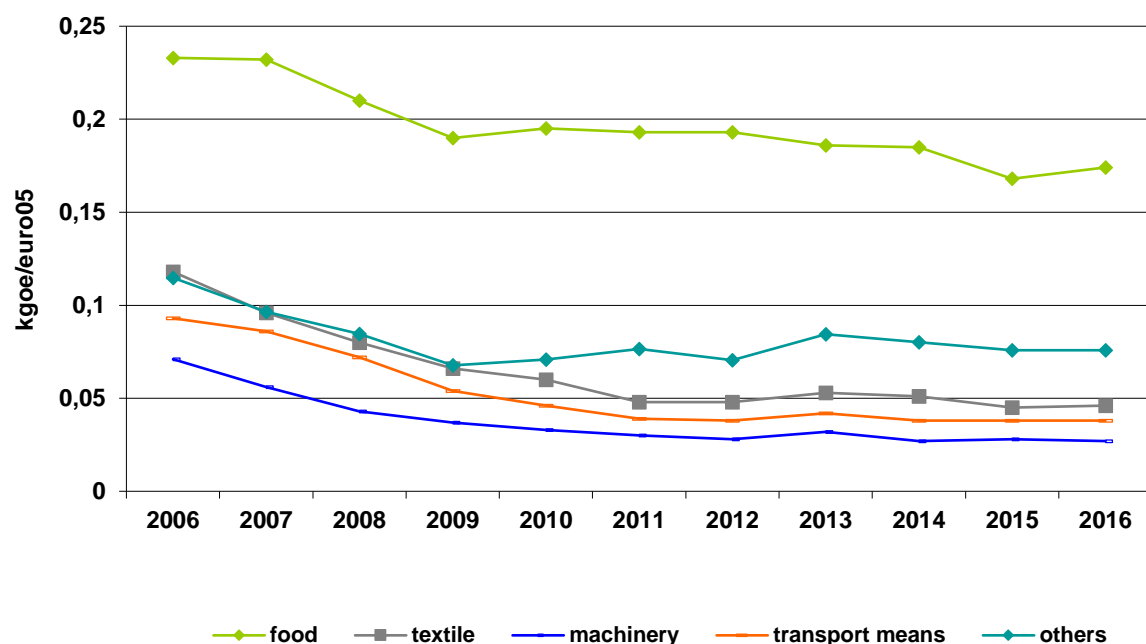


Figure 13. Energy intensity in low energy intensive industries



The highest rate of decrease in energy intensity of value added was recorded in machinery and textile industry, and the lowest in wood and food industry.

Table 2. Annual rate of change of Energy intensity of value added 2007-2016

Industry	Average annual change (%)
food	-2,8%
textile	-9,0%
wood	-0,8%
paper	-3,0%
chemical	-3,8%
non-metallic minerals	-4,0%
primary metals	-4,3%
machinery	-9,2%
transport means	-8,5%
others	-4,1%

Overall, the rate of improvement in the energy intensity of manufacturing in 2007-2009 amounted on average to 12.3%/year. The impact of structural changes was positive, but little - contributed to a decrease in energy intensity by 2.8%/year. The energy intensity of manufacturing at constant

structure, i.e. after eliminating the influence of changing shares of individual industries in the total size of manufacturing, decreased by 9.8%/year. The situation changed significantly in years 2010-2016 - the rate of decline in energy intensity decreased to 3.4%/year, with the effect of structural changes amounting to -1.3%/year, and the rate of improvement in energy intensity with a constant structure decreased to 2.0 %/year.

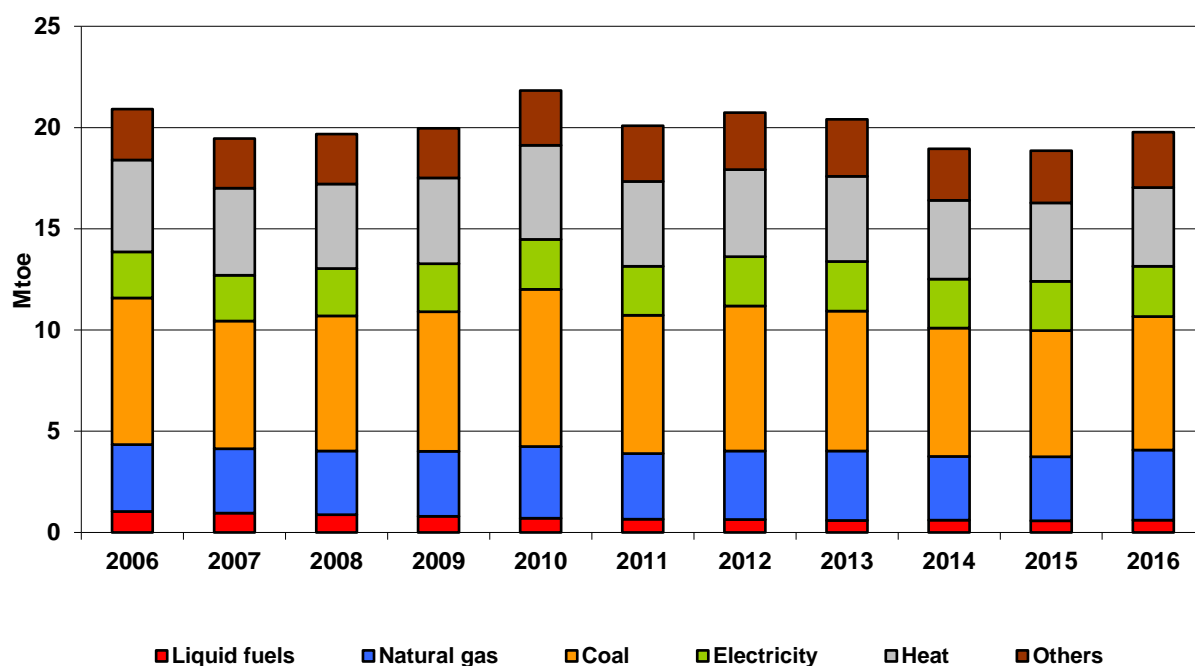
Figure 14. Energy intensity of manufacturing – role of structural changes



1.4. Households

The share of energy consumption in households in the final energy consumption amounted to 30% in 2016. The most commonly used carrier was coal, which share dropped from 35% in 2006 to 33% in 2016. Second biggest carrier was heat, which share amounted to 20% in 2016 after a drop from 22% in 2006. In 2016, natural gas accounted for 18% of households' energy consumption, electricity for 13%, other energy carriers for 14%, and liquid fuels for 3%.

Figure 15. Final Energy consumption in households by carrier



The most important end use was space heating, whose share amounted to 66.4% in 2016. Water heating consumed 15.8% of energy, lighting and electrical appliances 9.7%, and cooking meals 8.0%.

Table 3. Structure of energy consumption in households by end use (%)

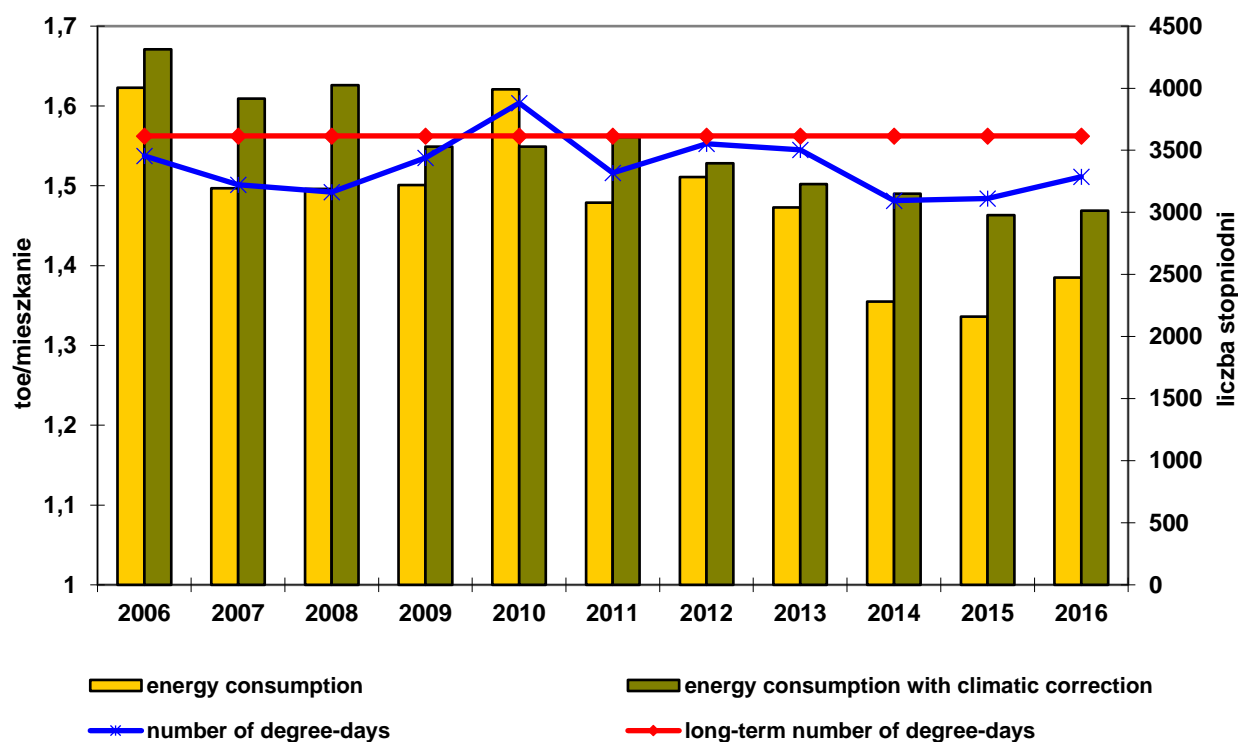
Specification	2002	2009	2012	2015	2016
Total	100,0	100,0	100,0	100,0	100,0
Space heating	71,3	70,2	68,8	65,5	66,4
Water heating	15,0	14,4	14,8	16,2	15,8
Cooking	7,1	8,2	8,3	8,5	8,0
Lighting	2,3	1,8	1,5	9,8*)	9,7*)
Electrical appliances	4,3	5,4	6,6		

*) – together lighting and electric appliances

Energy consumption per dwelling without climate correction decreased in 2007-2016 at the rate of 1.6% per year. The highest consumption was recorded in 2006, and the lowest in 2015, when it amounted to 1.34 toe/dwelling.

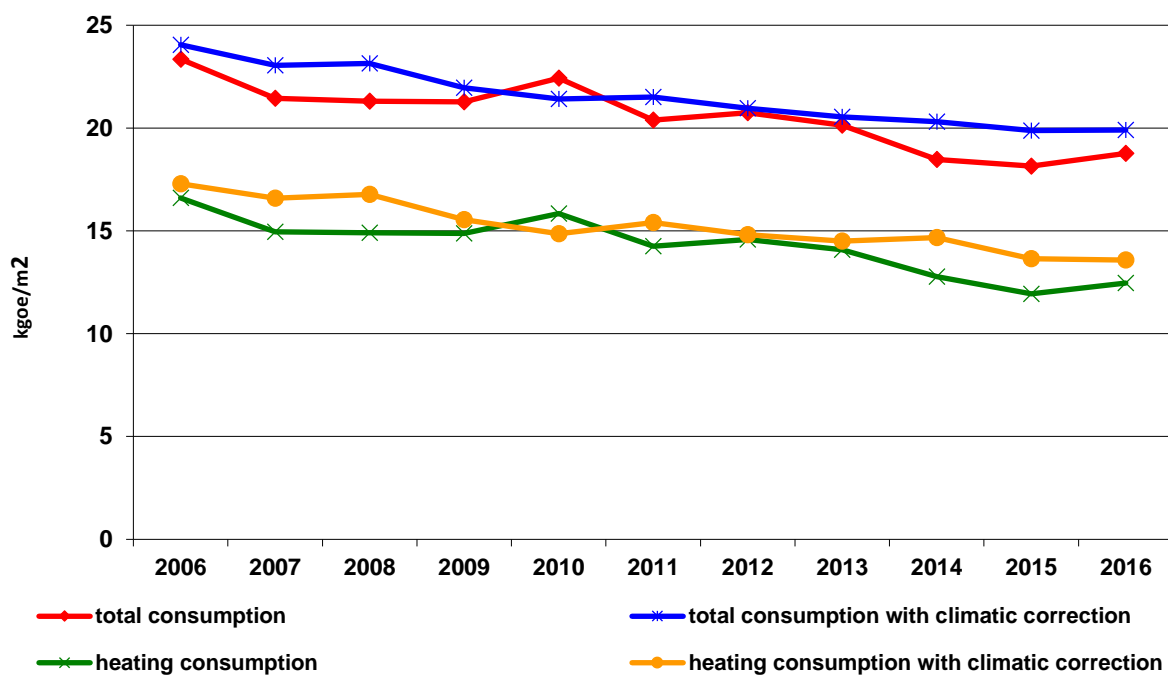
Energy consumption per dwelling with climate correction, showed much smaller fluctuations and decreased between 2006 and 2016 from the level of 1.56 to 1.47 toe/dwelling, which means an average annual decrease of 1.3%. The lowest value was reached in 2015.

Figure 16. Energy consumption in households per dwelling



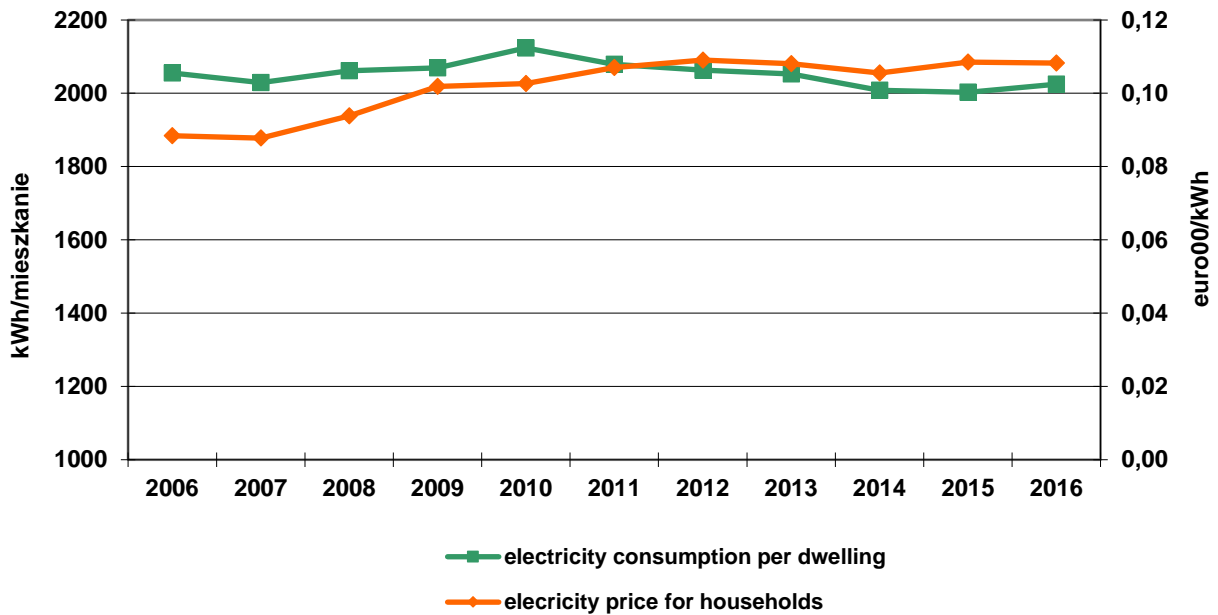
Energy consumption in households per m² also tended to decrease; the increase in consumption was observed in 2006, 2010 and 2012, in the remaining years a decrease was noted. The consumption in 2016 amounted to 18.8 kgoe/m², compared to 23.4 kgoe/m² in 2006 (down by 2.2%/year). After taking into account the climate correction, the consumption per m² decreased by 1.9%/year.

Figure 17. Energy consumption in households per m²



Electricity consumption in households per dwelling in 2016 amounted to 2025 kWh/dwelling and was 1.1% higher compared to 2015 and 1.5% lower than in 2006.

Figure 18. Price and consumption of electricity in households per dwelling

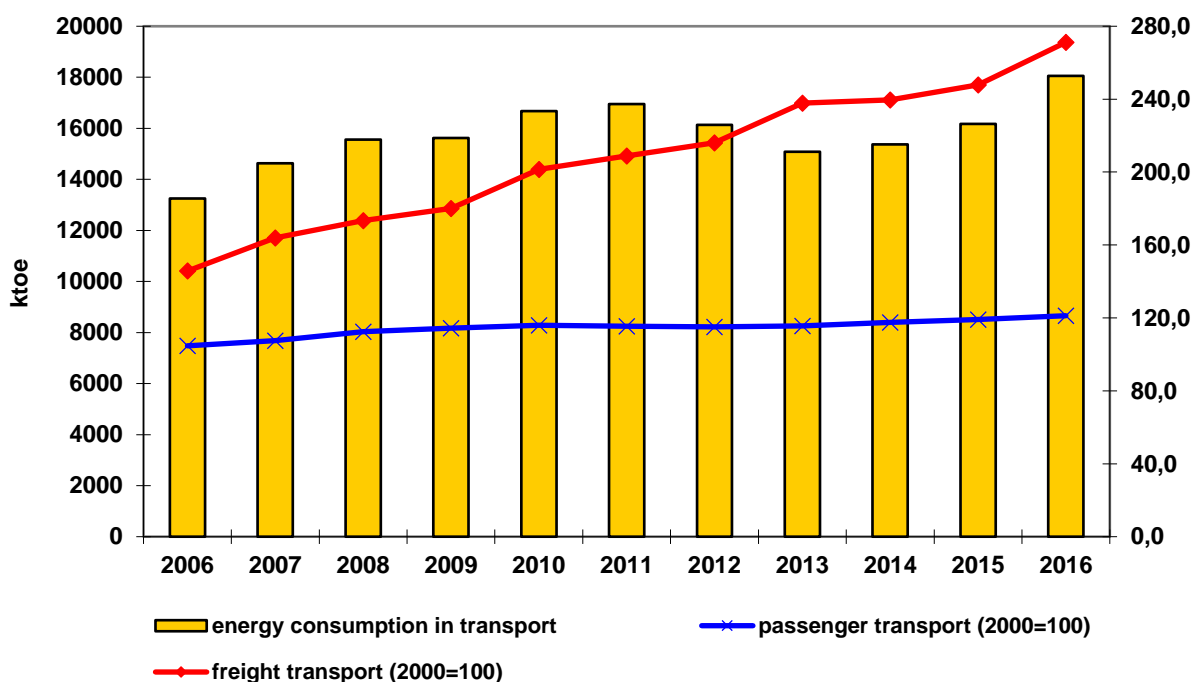


1.5. Transport

Over 94% of energy consumed in transport in 2016 was used in road transport, less than 4% of energy was consumed in air transport, less than 2% in rail transport, and small amounts by inland and coastal shipping.

Energy consumption in road transport between 2006 and 2016 increased by 42% (annual growth rate of 3.5%), accompanied by decrease (by 19%, 2.0%/year) in energy consumption in rail transport. Overall, the average annual growth rate of fuel consumption in transport (excluding air transport) amounted to 3.1% in 2007-2016 and in 2016 consumption was 36% higher than in 2006.

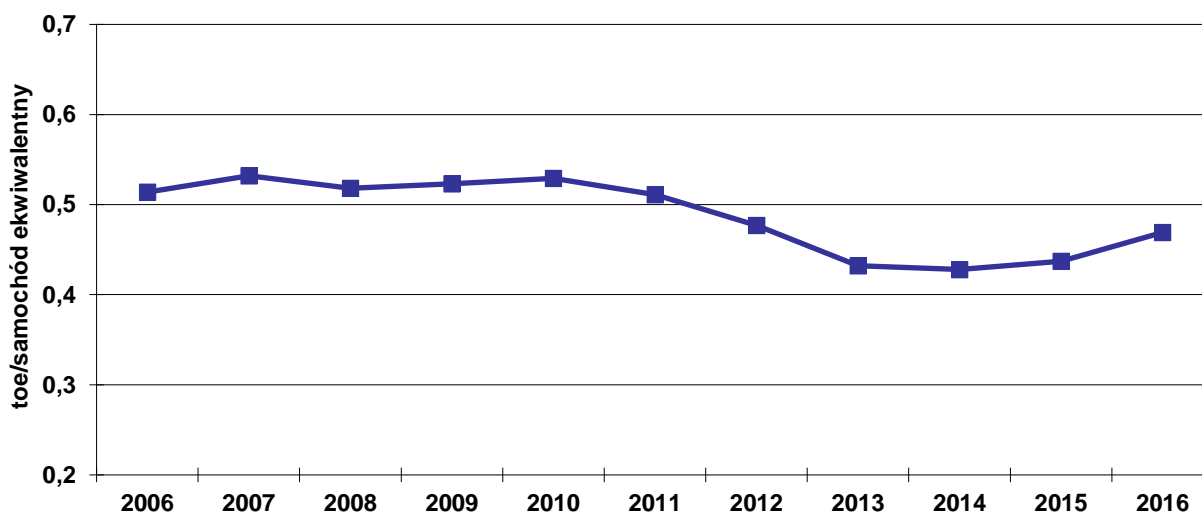
Figure 19. Transport and energy consumption in transport sector*



* excluding air transport, source: Eurostat, ITF, GUS

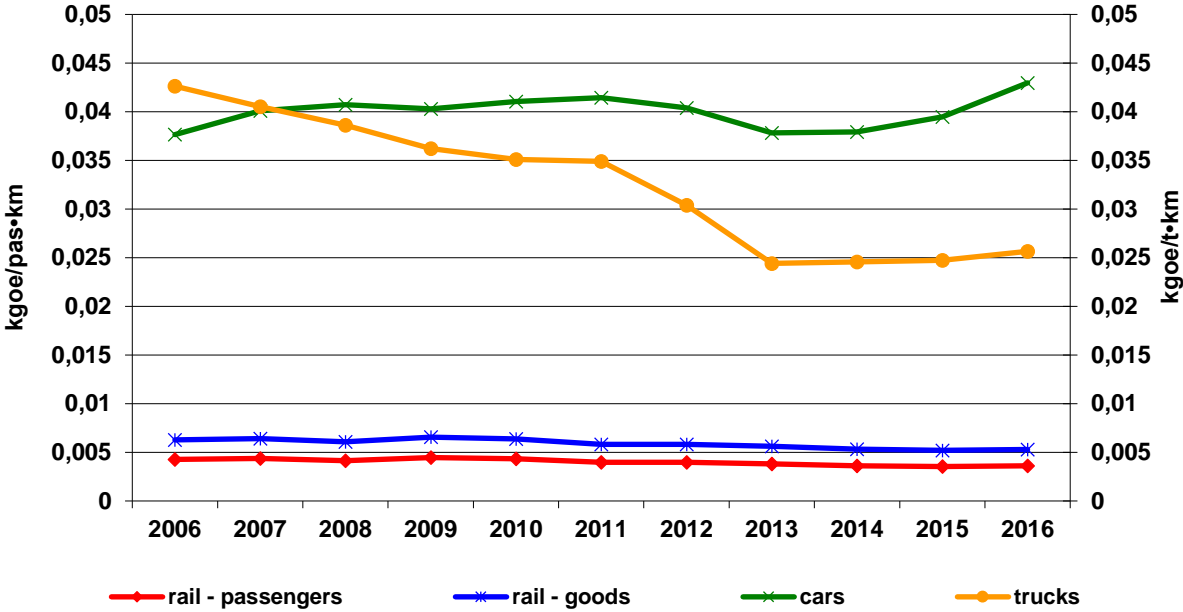
Fuel consumption per equivalent car in 2006-2010 ranged above 0.5 toe/equivalent car. After 2010, the value of indicator fell and reached the lowest value in 2014. In 2016, after two years of growth, its value amounted to 0.469 toe/equivalent car.

Figure 20. Energy consumption per equivalent car



During presented period, the fastest pace of improvement was recorded in freight transport on roads; where the rate of improvement amounted to 5.0%/year. In case of rail transport, the efficiency improvement rate amounted to 1.7%/year. On the other hand, in case of passenger cars, an average efficiency decrease was noted at the rate of 1.3%/year. The decrease in efficiency was the result of a sharp increase in the number of cars, which led to a reduction in the average number of passengers.

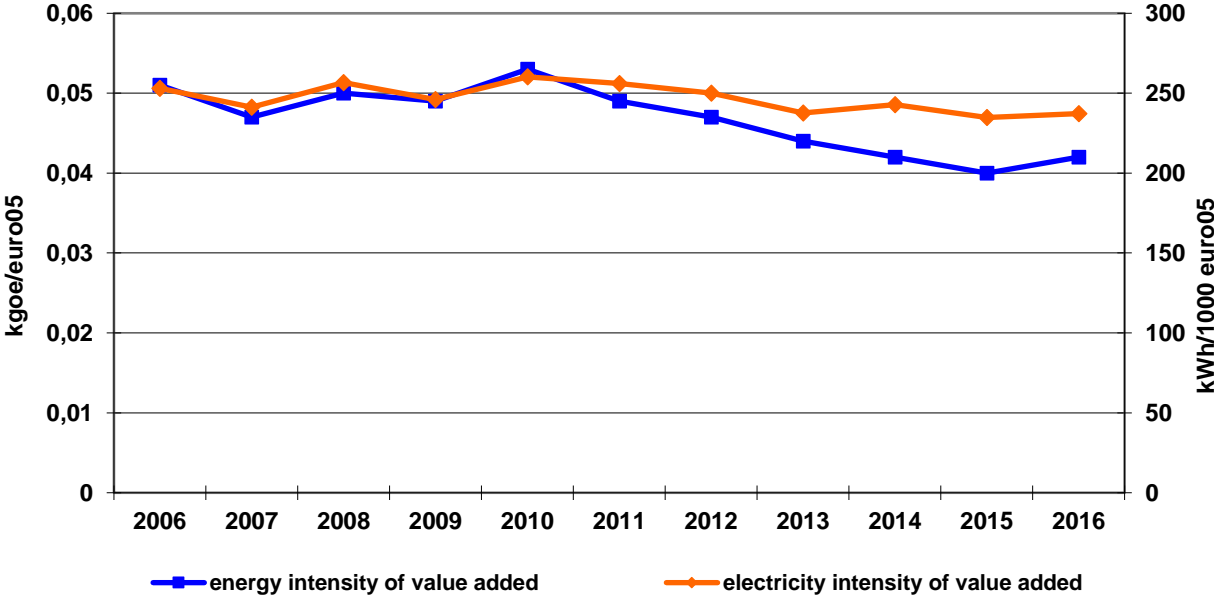
Figure 21. Energy intensity of transport



1.6. Service sector

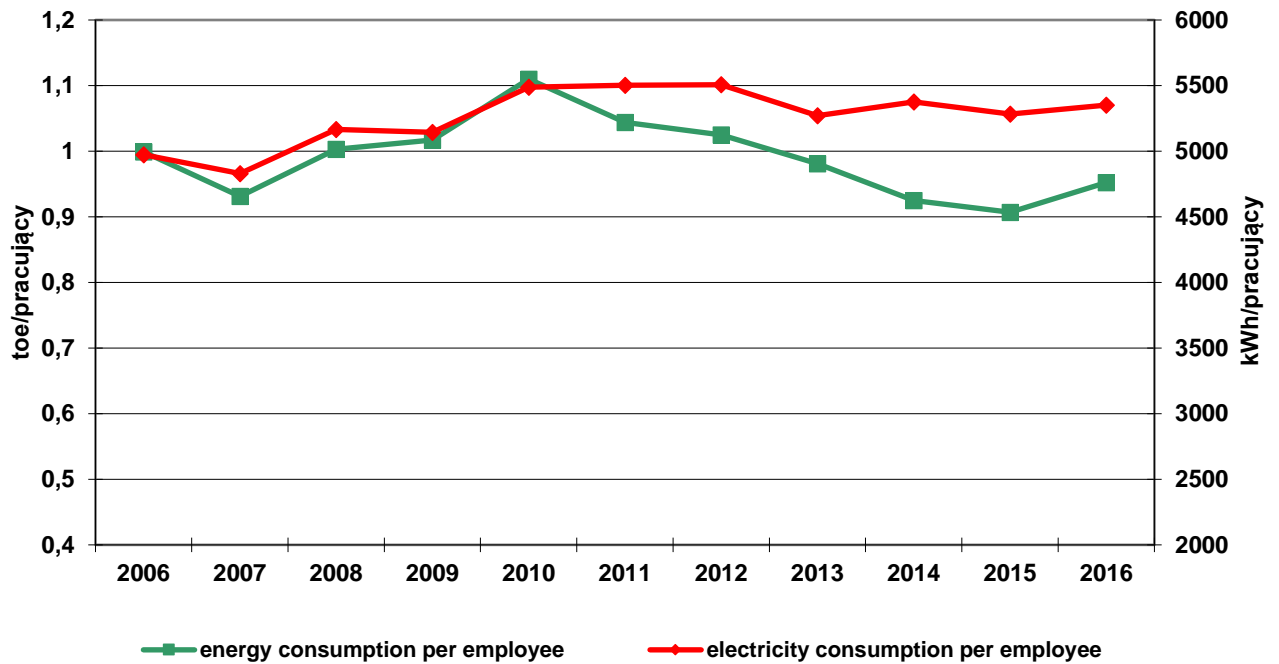
The energy intensity of value added in the services sector in 2016 amounted to 0.042 kgoe/euro05, after an increase of 5% compared to the previous year. Previously, since 2010, a systematic decrease in energy intensity has been observed. In case of electricity intensity of value-added, the value of the index increased in 2016 by 1.0% and amounted to 237 kWh/1000 euro05.

Figure 22. Energy and electricity intensity of value added in service sector



The energy consumption per one employee in the services sector in 2016 amounted to 0.95 toe and increased in relation to 2015 by 5.0%. In case of electricity consumption per one employee, the average consumption growth rate in years 2007-2016 amounted to 0.7% per year. In 2016, there was an increase of 1.3% compared to the previous year.

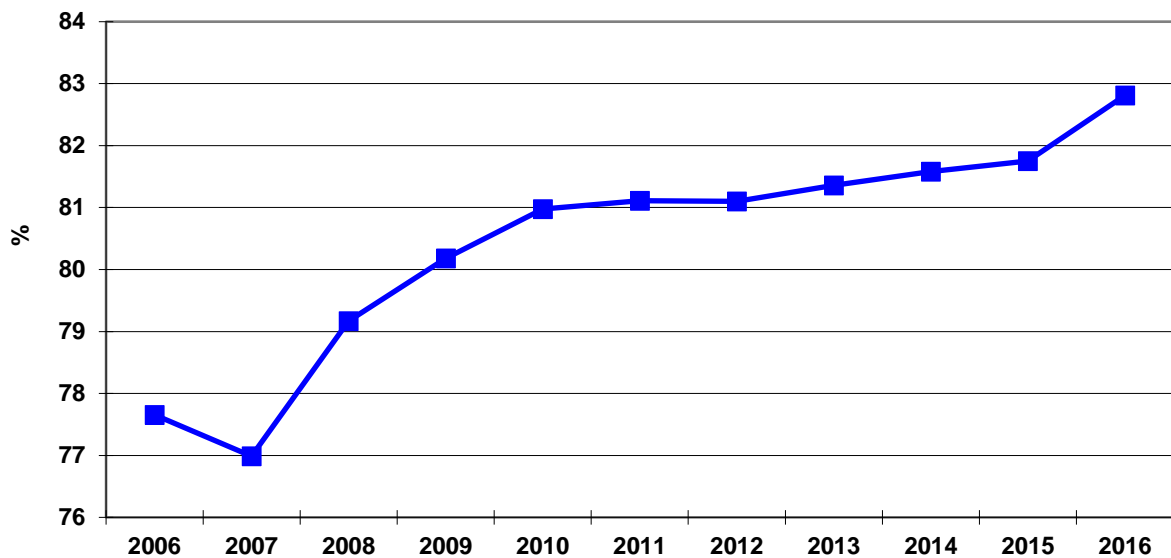
Figure 23. Energy and electricity consumption per employee in service sector



1.7. Heat plants

The efficiency of heat plants producing district heating has been steadily increasing, with the exception of 2007. In 2016, the efficiency of the heating plant amounted to 82.8%.

Figure 24. Efficiency of heat plants

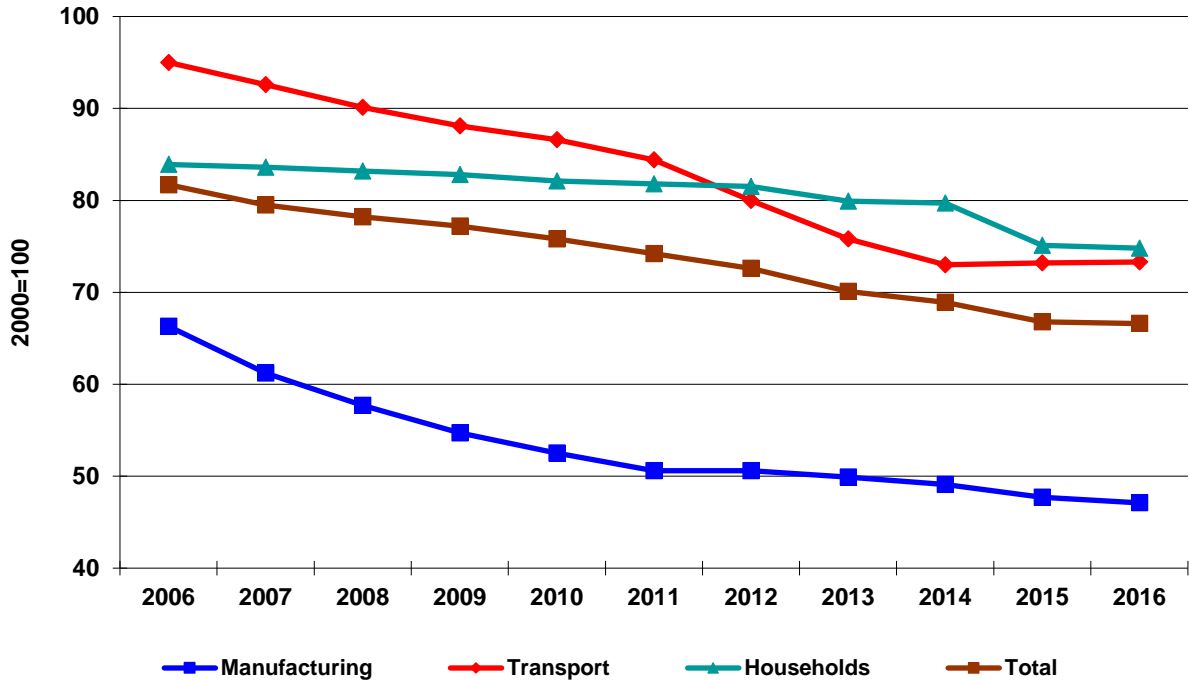


1.8. Odex indicators and energy savings

The ODEX indicator calculated at the base of 2000 = 100 decreased in 2006-2016 from 81.7 to 66.6 points. The average rate of improvement amounted to 2.0%/year. The fastest improvement (3.4% yearly) was recorded in manufacturing, for which the value of the index amounted to 47.1 in 2016. The slowest rate of improvement took place in the households sector, where the annual

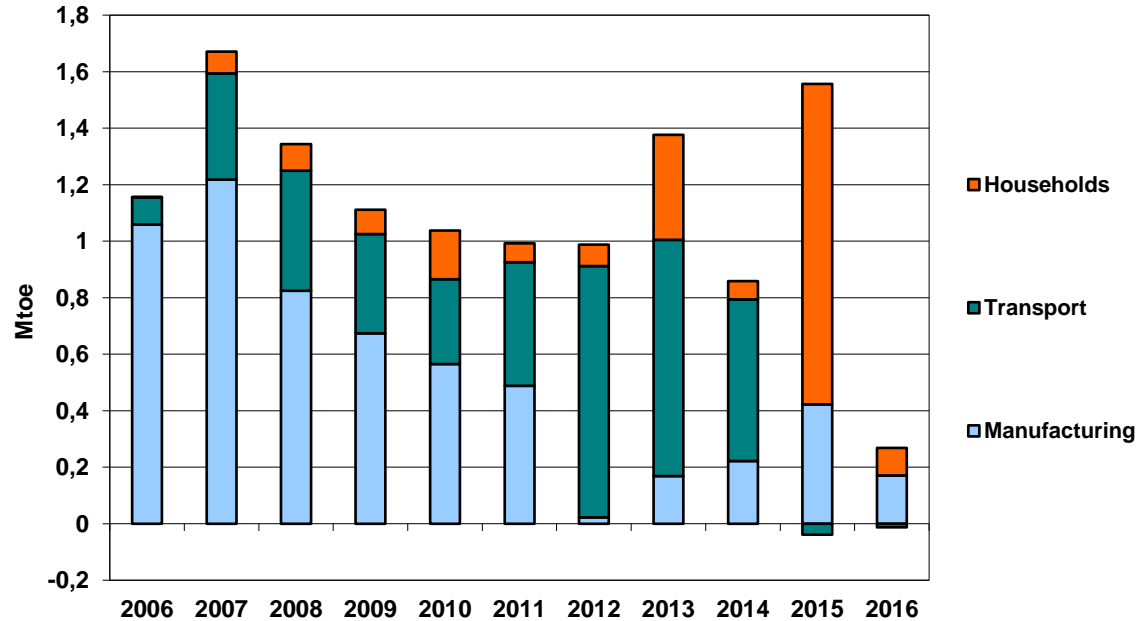
improvement in years 2007-2016 amounted to 1.1%. In transport sector, the average rate of improvement amounted to 2.8%, and the value of the indicator in 2016 amounted to 73.3.

Figure 25. ODEX indicators



Energy savings have been achieved in all sectors in all years, with the exception of the transport sector in 2015 and 2016. Savings achieved in 2016 amounted to 0.25 Mtoe and were the lowest in this period.

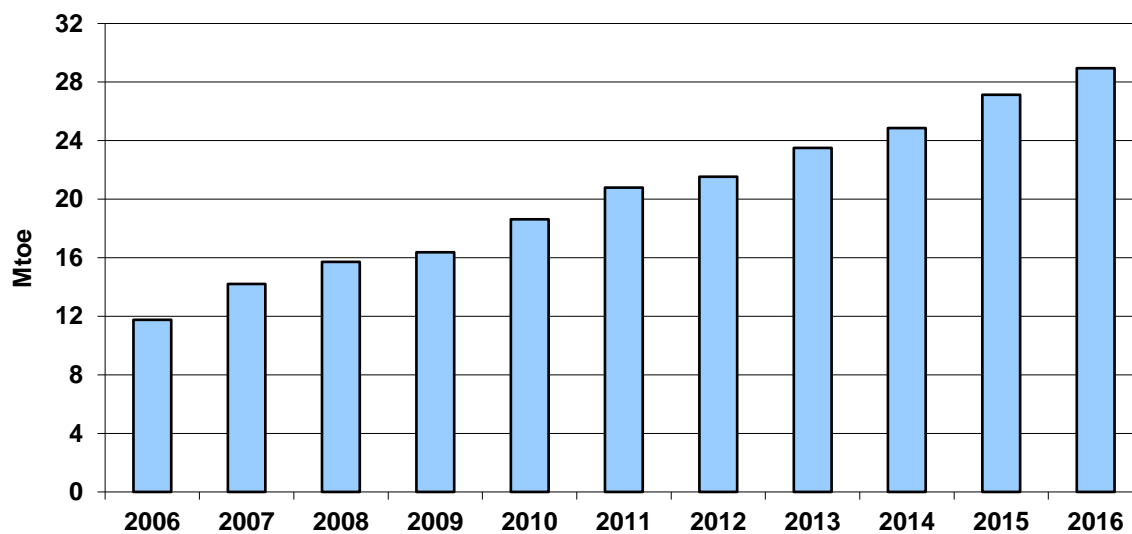
Figure 26. Energy savings by sector



Energy savings from 2000 (calculated assuming that the ODEX value in 2000 is equal to 100), showing how much higher energy consumption would be in a given year, if no improvements in energy

efficiency after 2000 were introduced, amounted in 2016 to 29.0 Mtoe. This result also includes savings achieved by the sectors covered by the European Emissions Trading Scheme (ETS).

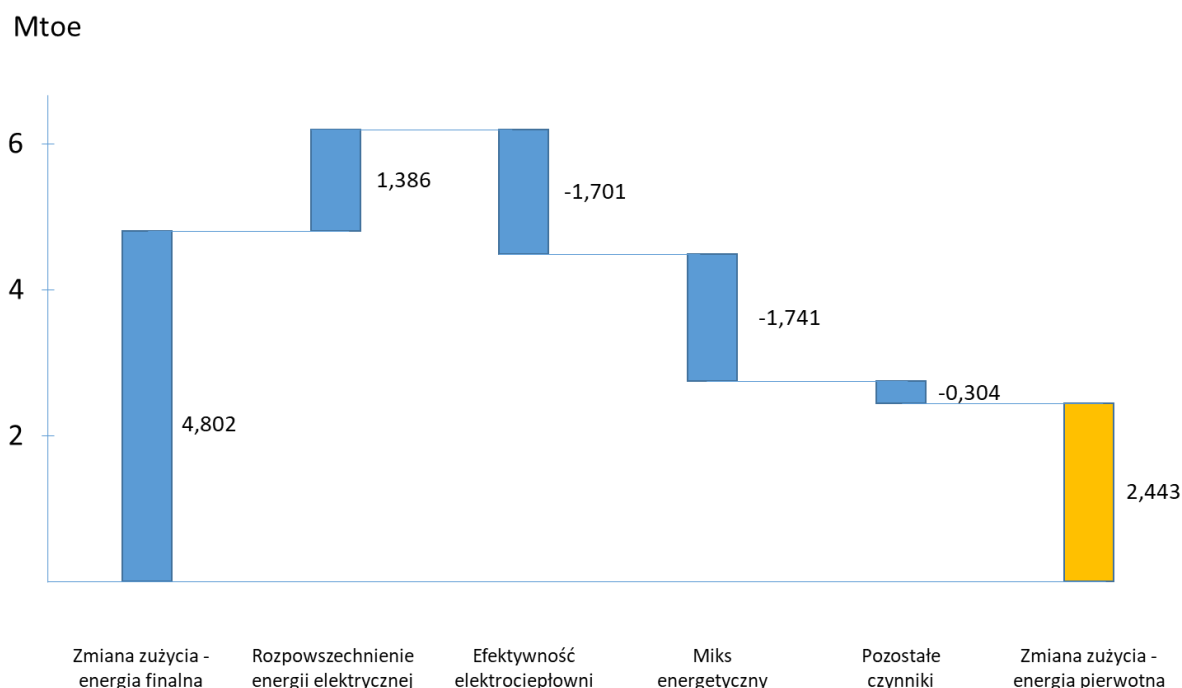
Figure 27. Energy savings since year 2000



1.9. Decomposition of energy consumption

The total primary energy consumption increased between 2006 and 2016 by 2.4 Mtoe. The increase in this consumption was influenced by the increase in final energy consumption by 4.8 Mtoe and higher penetration of electricity (mainly due to the increase in electricity production by 5.1%), which corresponded to an increase in the primary energy demand by 1.4 Mtoe. On the other hand, the reduction of primary energy demand was caused by the improvement of efficiency of thermal power plants (decrease by 1.7 Mtoe), increased use of energy from renewable sources (decrease by 1.7 Mtoe) and other factors (decrease by 0.3 Mtoe).

Figure 28. Impact of selected factors on primary Energy consumption in years 2006-2016



Economic activity had the greatest impact on the change in final energy consumption, the increase of which contributed to the increase in energy demand by 5.7 Mtoe in case of industry and transport, by 2.8 Mtoe in case of services and 0.1 Mtoe of agriculture. In case of households, the factors influencing the increase in energy demand were an increase in the number of dwellings and a change in lifestyle (larger dwellings). Structural changes in industry have reduced energy consumption by 1.0 Mtoe, while in transport they increased it by 1.5 Mtoe. Energy savings totaled 10.5 Mtoe, and were achieved mostly in industry (4.8 Mtoe). Weather conditions reduced energy consumption by 0.9 Mtoe, and remaining factors by 2.2 Mtoe.

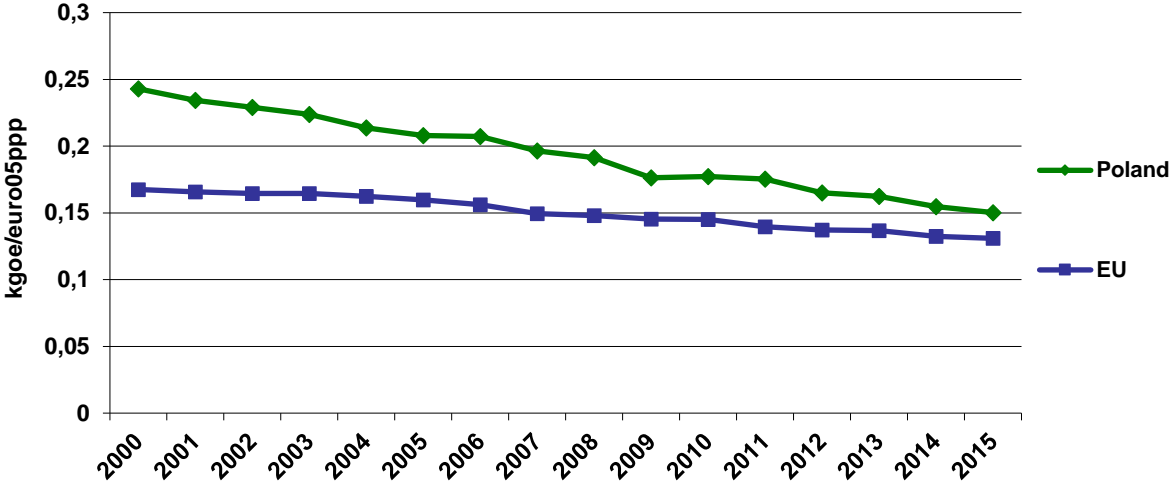
Table 4. Impact of selected factors on final energy consumption in years 2006-2016 (Mtoe)

Specification	Industry	Households	Transport	Services	Agriculture	Total
Variation of consumption	0,1	-1,1	5,1	1,1	-0,4	4,8
FACTORS						
Activity	5,7	–	5,7	2,8	0,1	14,3
Stock of dwellings	–	2,2	–	–	–	2,2
Lifestyle	–	1,4	–	–	–	1,4
Structural changes	-1,0	–	1,5	–	–	0,5
Energy savings	-4,8	-2,1	-3,1	0,0	-0,5	-10,5
Climate correction	–	-0,6	–	-0,3	–	-0,9
Others	0,2	-2,1	1,0	-1,3	–	-2,2

1.10. Poland in comparison with other countries

Primary energy intensity of GDP with climatic correction, expressed in constant prices of 2005 and taking into account the purchasing power parity amounted to 0.150 kgoe/euro05ppp in 2015 and was 15% higher than the European average (0.131). This difference dropped by 30 percentage points compared to year 2000. The rate of improvement of energy intensity in Poland (3.2%/year) was in the years 2000-2015 almost twice as high as the average in the European Union (1.6%/year).

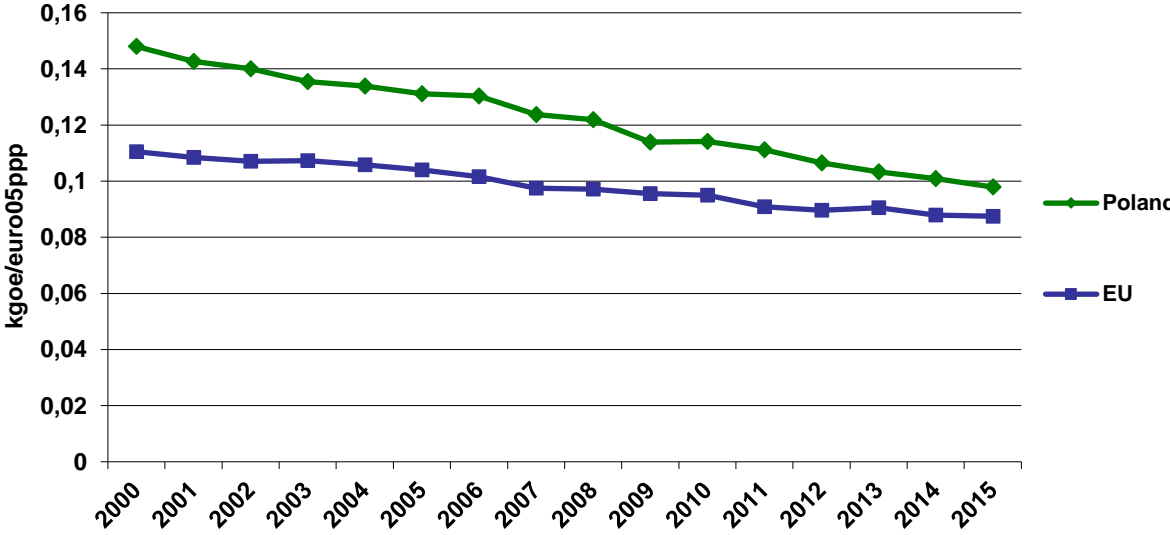
Figure 29. Primary intensity of GDP with climatic correction



Source: Odyssee

In case of final energy consumption, the difference is slightly smaller and in 2015 amounted to 13% between Poland (0.098) and the EU average (0.088). Also the difference between the rate of efficiency improvement in years 2000-2015 was lower; for Poland it amounted to 2.7%/year in the presented period, compared to 1.5% / year for the European average.

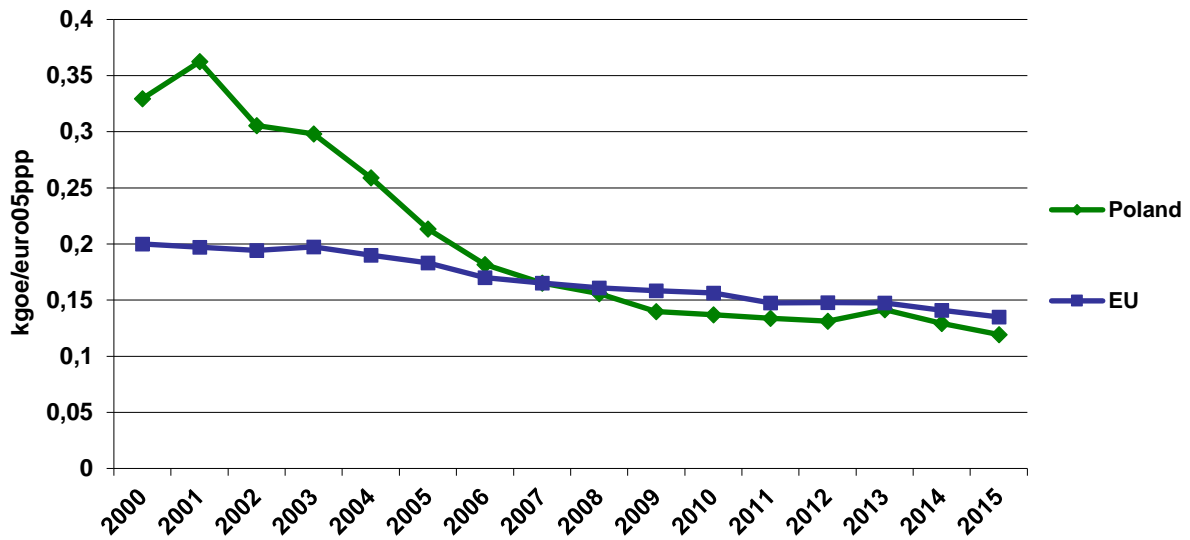
Figure 30. Final intensity of GDP with climatic correction.



Source: Odyssee

The rate of improvement in the energy intensity of manufacturing in Poland also exceeded the European average and amounted to 6.5%/year compared to 2.6%/year achieved by the entire EU (energy intensity calculated in the average European structure, the indicator eliminates most of the differences resulting from different industry structure in individual countries). Despite the lower energy intensity than in the European Union, the pace of improvement in Poland remained higher.

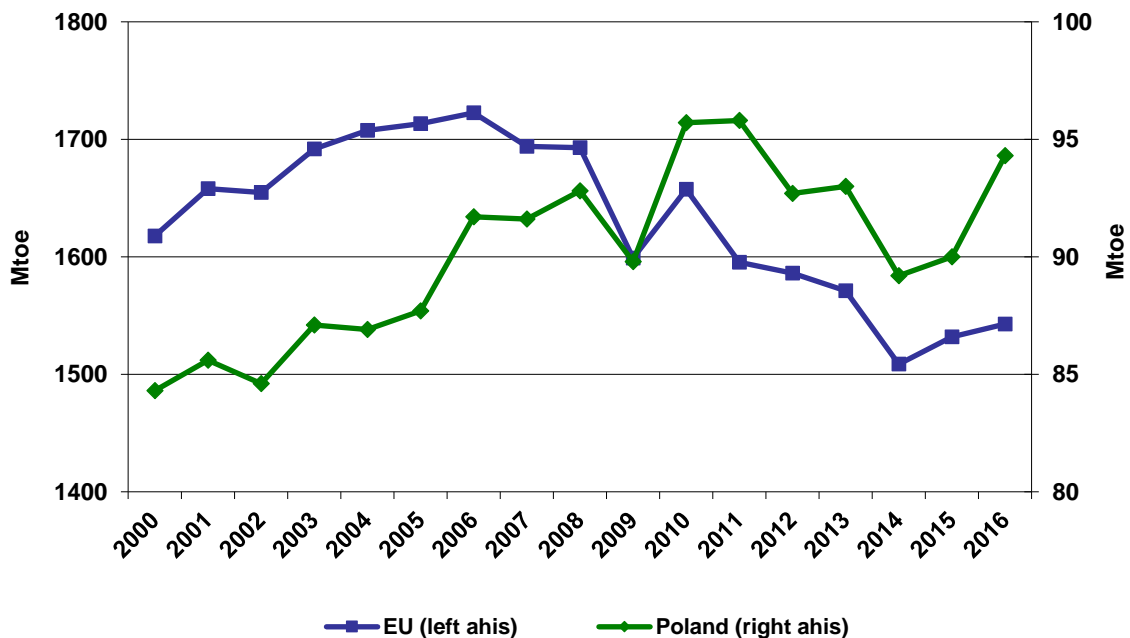
Figure 31. Energy intensity of manufacturing at average European structure



Source: Odyssee

As part of monitoring the Europe 2020 Strategy, the indicator "Primary energy consumption" is currently calculated in accordance with Directive 2012/27 / EU as gross domestic energy consumption excluding non-energy consumption. The value for Poland in 2016 amounted to 94.3 Mtoe and is below the target adopted for 2020 (96.4 Mtoe).

Figure 32. Primary energy consumption.



Source: Eurostat

2. Energy efficiency policy and measures towards its improvement

2.1. Energy efficiency policy of the European Union

The European Union is actually establishing targets for consecutive few years since 2020 in a range of climate protection, increase energy efficiency and using renewable energy sources.

These goals were suggested under discussion named “winter package”.

By 2020, the energy and climate package which was published in January 2008 is being implemented, according to which Member States are obliged to:

- Reduce CO₂ emissions in 2020 by 20%, with respect to 1990 levels;
- Increase the EU’s share of renewable energy sources (RES) by 20% in the year 2020, for Poland the target is 15%,
- Increase energy efficiency in 2020 by 20%, with respect to 2005.

The importance of increasing energy efficiency is expressed in subsequent communications and EU directives, chiefly, Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amendments to Directives 2009/125/WE and 2010/30/UE and the repeal of Directives 2004/8/WE, 2006/32/WE and 2012/27/UE. Article 3, paragraph 1 of Directive 2012/27/EU provides that each Member State shall set an indicative national energy efficiency target, based on either primary or final energy consumption, primary or final energy savings, or energy intensity. In doing so, they shall concurrently express these goals in terms of absolute levels of primary energy consumption and final energy consumption in 2020.

Article 7 of the Directive 2012/27/EU requires each Member State to set up an energy efficiency obligation scheme. That scheme should ensure that energy distributors and/or retail energy sales companies, which are designated as obligated parties operating within each Member State’s territory, achieve a cumulative end-use energy savings target by 31 December 2020. This target is equivalent to all distributors or all enterprises which provides retail sale of energy achieving at least 1.5% annual of the energy sales volume to end-users, averaged in last 3 year time before 1 January 2013, in new energy savings every year from 1 January 2014 to 31 December 2020. The Sale volume of energy consumed in transport can be partially or completely excluded from this calculation.

2.2. Energy Efficiency Policy in Poland

The key documents which define the energy efficiency policy in Poland are:

- Poland’s Energy Policy until 2030;
- National Energy Efficiency Action Plans (the plans no. 1, 2, 3, 4, were drawn up in 2007, 2012, 2014, 2017 respectively); drawing up plans was required by Directive 2006/32/WE and 2012/27/UE.

The adopted in 2018, and prepared in 2017, Fourth Action Plan (4th KPD) on energy efficiency, summarized the achieved goals of energy efficiency improvement, presented the objectives for 2020 and updated the measures and means planned of their achievement.

With regard to regulation, the Act on Energy Efficiency (Law Gazette No. 94, pos. 551) was enacted in 2011. Its aim was the development of mechanisms for stimulating improvements in energy efficiency. Primarily, the law introduced obligations for obtaining an appropriate amount of energy efficiency certificates, called white certificates, by energy sales companies selling electricity, heat or natural gas to end-users connected to the grid in the Republic of Poland territory. The Act from 2011 was replaced by a new Act from 20 May 2016 (Law Gazette, pos. 8310) aimed at further improvements to the energy efficiency of the Polish economy and ensuring the achievement of national energy efficiency target.

The Act introduces a regulation, in accordance with which sector public entities can accomplish and finance enterprises on the basis of energy efficiency improvement agreements. All Polish public authorities are required to purchase and use energy efficient energy products and services. They are also required to buy or rent energy efficient buildings and complete orders concerning the energy efficiency of modernized and refurbished buildings owned by the treasury.

The Act preserves the energy efficiency certification system (white certificate scheme) functioning since 2013.

One of the provisions from the 2016 act obliges all large companies to carry out energy audits. Conducting an audit not only fulfils the statutory obligation but may also as give a hand the managerial staff to get information about optimizing and controlling enterprise energy consumption. Revised white certificate system within the framework of which the decision to allocate funds is made smoothly, support the carrying out of such investments. The new system makes it possible to apply for funds only for planned investments.

2.3. National energy efficiency targets and the energy savings achieved

Setting a national energy efficiency target until 2020 is a realization of Art. 3 paragraph 3 of Directive 2012/27/EU, as presented in Table 5. The target is defined as the achievement of 13.6 Mtoe reduction in primary energy consumption in the years 2010-2020 which, with economic growth, means improving the energy efficiency of the country's economy. The target is also expressed in terms of absolute levels of primary energy consumption and final energy consumption in 2020. The energy efficiency target for 2020 was set based on data gathered from the analyses and forecasts, in turn carried out for the needs of the government document "Energy Policy of Poland until 2030".

Table 5. Energy efficiency targets for 2020, pursuant to Directive 2012/27/EU

Energy efficiency target	Energy consumption in 2020	
	Final energy consumption (Mtoe)	Primary energy consumption (Mtoe)
Reduction of primary energy consumption in the years 2010-2020 (Mtoe)		
13,6	71,6	96,4

Analyses indicate that the reduction of primary energy consumption will be the result of a number of already implemented projects, as well as the implementation of energy efficiency improvement measures provided under the country's energy policy.

2.4. Final energy consumption savings

Calculations of savings in final energy consumption were made on the basis of statistical data of the Central Statistical Office – <http://www.stat.gov.pl>, Eurostat – <http://ec.europa.eu/eurostat> and data located in ODYSSEE–MURE databases – <http://www.odyssee-mure.eu>. Database ODYSSEE and database MURE contain information about indexes of energy efficiency and activities on improving energy efficiency.

Presented below are calculations of final energy consumption savings made by using the top-down method, according to the methodology published by the European Commission in a „Recommendations on Measurement and Verification Methods in the Framework of Directive 2006/32/EC on Energy end-use Efficiency and Energy Services”. 2007 was recommended by the European Commission, as the base year. Based on the analysis of the available data, regarding to particular economy sectors, it is possible to use indicators used for calculating energy savings as shown in table 6. Preferred indicators are marked by the letter P, minimal indicators by the letter M.

Table 6. Indicators for to calculating energy savings

No.	Economy sector	Indicators
1.	Households	P1
2.	Services	M3, M4
3.	Transport	P9, P8
4.	Industry	P14

- P1 defines specific energy consumption by heating in households;
- M3 defines specific energy consumption in services, without electricity;
- M4 defines specific electricity consumption in services;
- P8 defines energy consumption by cars per passenger per kilometre;
- P9 defines energy consumption in road supply transport;
- P14 defines energy consumption in industry sector related to the production index.

The values of the achieved saving in final energy consumptions between 2010 and 2015 presented in the tables may be different from those presented in 3 NEEAP and the “Efficient usage of energy in years 2005-2015” publication on account of adjustment made using data from 2010-2015.

Table 7 present final energy savings achieved up to 2016 divided by energy end-use sector. Presented energy savings are related to the base year, 2007.

Table 7. Overview on achieved final energy savings by sectors (Mtoe)

Economy sector	2010	2011	2012	2013	2014	2015	2016
Households	1,986	1,238	1,947	2,281	1,936	3,050	3,780
Services	0	0	0,140	0,281	0,326	0,461	0,336
Industry	1,660	2,146	2,317	2,146	2,618	3,116	3,245
Transport	1,165	1,334	3,078	5,417	5,500	5,312	4,519
Total	4,811	4,719	7,341	9,844	10,054	11,477	11,879

The table shows that savings of total final energy consumption in the years 2010 - 2016 were increased more than doubled.

On the other hand Table 8 presents energy savings targets calculated according to directive 2006/32/WE, that is 9% annual final energy consumption from the 2001-2005 period and the achieved energy savings.

Table 8. Overview of targets in terms of final energy savings

Years	Target in final energy savings		Final energy savings achieved in 2010 in 2016	
	In absolute values (Mtoe)	Percentage – to annual consumption from 2001-2005 (%)	In absolute values (Mtoe)	Percentage – to annual consumption from 2001-2005 (%)
2010 r.	1,02	2%	4,81	10,04
2016 r.	4,59	9%	11,88	23,29

The amount of realized final energy savings exceeds the goals set for the years 2010 and 2016.

2.5. Activities for improving energy efficiency in EU

Taken or planned activities and measures for energy efficiency improvement are presented in the MURE database (*Mesures d'Utilisation Rationnelle de l'Energie*). The MURE database shows descriptions of realised, planned and completed activities for energy efficiency improvement with their quantitative and qualitative assessment. Involvement of all European countries guarantees continuous updating of the database, which also contains some statistical data and outlines the issues of energy efficiency in individual countries. The database consist 5 sections classifying information on energy efficiency improvement programs concerning the 4 fundamental economy sectors: industry, households, transport and services, as well as horizontal measures (affecting the entire economy).

The next chapter presents the selected measures of energy efficiency improvement in Poland for particular sectors of the economy.

2.6. Actions for improve energy efficiency in Poland

In the 4th National Action Plan on energy efficiency for Poland (2017), the following measures to improve energy efficiency have been identified in relation to economic sectors.

I. Horizontal measures

- 1) The system obliging to energy efficiency (white certificates);
- 2) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.3.3 - Nationwide support system for public sector, housing sector and enterprises in the field of energy efficiency and RES);
- 3) Information and educational campaigns.

II. Measures in the field of energy efficiency in buildings and public institutions

- 1) Operational Program PL04 - "Saving energy and promoting renewable energy sources" under the EEA Financial Mechanism in 2009-2014;
- 2) Green investment scheme (GIS - Green investment scheme). Part 5) - Energy management in buildings of selected entities of the public finance sector;
- 3) Green investment scheme (GIS - Green investment scheme). Part 6) - SOWA - Energy-efficient street lighting;
- 4) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.3.1 - Supporting energy efficiency in public utility buildings);
- 5) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.3.2 - Supporting energy efficiency in the housing sector);
- 6) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.7.1 - Supporting energy efficiency in residential buildings in the Śląskie Voivodeship);
- 7) Regional operational programs for the years 2014-2020.

III. Energy efficiency measures in industry and SMEs

- 1) Support for entrepreneurs in the field of low-emission and resource-efficient economy. Part 1 - Energy / electric energy audit of the company;
- 2) Support for entrepreneurs in the field of low-emission and resource-efficient economy. Part 2 - Increasing energy efficiency;
- 3) Access program for financial instruments for SMEs (PolSEFF);
- 4) Program POIŚ 2007-2013 (Measure 9.1) - High-efficiency energy production;
- 5) Program OPIŚ 2007-2013 (Measure 9.2) - Effective energy distribution;
- 6) Improving energy efficiency. Part 3 - Energy-saving investments in small and medium-sized enterprises;
- 7) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.2 - Promotion of energy efficiency and use of renewable energy sources in enterprises);
- 8) Support for projects in the field of low-emission and resource-efficient economy. Lot 4 - Energy efficiency in enterprises;
- 9) Regional operational programs for the years 2014-2020.

IV. Energy efficiency measures in transport

- 1) Program OPIŚ 2007-2013 (Measure 7.3) - Urban transport in metropolitan areas and (Measure 8.3) - Development of intelligent transport systems;
- 2) Green investment scheme (GIS - Green investment scheme). Lot 7) - GAZELA - Low-emission urban transport;
- 3) Green investment scheme (GIS - Green investment scheme). Lot 2) - GEPARD - Non-emission public transport;
- 4) Operational Program Infrastructure and Environment 2014-2020 (Measure 6.1 - Development of public transport in cities);
- 5) Regional operational programs for the years 2014-2020.

V. Effectiveness of energy production and supply (Article 14 of the Directive)

- 1) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.5) - Effective distribution of heat and cold;
- 2) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.6) - Promoting the use of high-efficiency cogeneration of heat and electricity based on for the useful heat demand;
- 3) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.7.2 - Effective distribution of heat and cold in the Śląskie Voivodship);
- 4) Operational Program Infrastructure and Environment 2014-2020 (Measure 1.7.3 - Promoting the use of high-efficiency cogeneration of heat and electricity in the Śląskie Voivodship);
- 5) Support for projects in the field of low-emission and resource-efficient economy. Part 3 - Effective heating and cooling systems.

Horizontal measures, including the system of white certificates, are presented in the publication "Energy efficiency in 2005-2015". This section presents measures to improve the energy efficiency of buildings.

2.7. Measures in the field of energy efficiency in buildings, including buildings of public institutions

The National Fund for Environmental Protection and Water Management is the main source of financing for pro-ecological investments in Poland, including in the construction sector. The most important programs of the Fund are presented below, in accordance with the 4th National Action Plan on energy efficiency.

I. Supplements to loans for the construction of energy-efficient houses

The aim of the program is to achieve energy savings and reduce or avoid CO₂ emissions by co-financing projects that improve the efficiency of energy use in newly built residential buildings.

Budget: withdrawals of funds from the undertaken and planned commitments for non-returnable forms of co-financing of the program amount to PLN 300 million.

Implementation period: the program is being implemented in 2013-2018.

Forms of co-financing: subsidy for partial repayment of bank loan capital made via the bank on the basis of a cooperation agreement concluded with National Fund for Environmental Protection and Water Management.

Beneficiaries:

- natural persons who have valid building permits and have the right to dispose of the property on which they will build a residential building. By "disposing of" the property should be understood:
 - a) ownership (including co-ownership),
 - b) perpetual usufruct;

- natural persons holding the right to transfer by the developer for their benefit: ownership of the property, together with a single-family house, which the developer will build on it or perpetual usufruct of land and ownership of a single-family house, which will be located on it and will constitute a separate property or property residential. The developer is also understood as a housing cooperative.

One of the conditions for obtaining support is to achieve the required demand for usable energy by meeting the conditions of the guidelines: minimum technical requirements, requirements for the construction project, requirements for the implemented project, quality assurance of construction works.

The NF40 and NF15 standard for residential buildings set a series of requirements developed specifically for the needs of the financing program, which in many aspects outweigh and extend those resulting from the applicable laws and the definition of a building with low energy consumption.

Effects:

- Until 2017, contracts for co-financing the construction of 349 single-family buildings were concluded, in the amount of approximately PLN 12.4 million. The average area of energy-efficient houses being built is 132.5 m², while the demand for usable energy for heating and ventilation (EUco) is on average 26.4 kWh/(m²·year).
- 17 positively verified housing estates of single-family and multi-family houses.

II. LEMUR – Energy-efficient public buildings

The aim of the program is to reduce energy consumption and, consequently, to reduce or avoid CO₂ emissions in connection with the design and construction of new energy-efficient public buildings and collective housing.

The budget for the implementation of the program is up to PLN 97.4 million, including non-returnable forms of co-financing - PLN 1.4 million, and for refundable forms of co-financing - PLN 96 million

Implementation period: the program is being implemented in 2013-2020. Expenditure period until 2020 The call for proposals under the program lasted until 30.06.2016.

Forms of financing:

- subsidy for project documentation 60%, 40%, 20% depending on the class of energy saving of the building (A, B or C);
- loan for the construction of new energy-efficient buildings, up to PLN 1,200.00 per m² for class A, for class B and C up to PLN 1,000.00 per m², with the possibility of redemption 60%, 40%, 20% depending on the energy efficiency class of the building (A , B or C)

Beneficiaries:

- entities of the public finance sector, excluding state budgetary units;
- local government legal entities, commercial law companies in which local government units (JST) hold 100% shares or stocks and which are appointed to implement JST own tasks;

- non-governmental organizations, including foundations and associations, as well as churches and other religious organizations entered in the register of churches and other religious associations, and church legal entities that perform public tasks on the basis of separate regulations;

The program covers the design and construction of new buildings:

- public utilities - intended for the needs of public administration, culture, education, higher education, science, upbringing, health, social or social care, tourism, sport;
- a collective residence - intended for temporary stay of people (boarding houses, student houses) and for permanent residence of people (orphanages, pensioners' houses).

Buildings covered by the program are to comply with technical guidelines, defining detailed principles of shaping and the level of energy standard requirements, prepared for the needs of the program, which take into account the applicable technical and construction regulations and those concerning the calculation of energy performance of buildings.

III. Prosumer - a co-financing line intended for the purchase and installation of micro-installations of renewable energy sources

The aim of the program "Supporting distributed, renewable energy sources Part 2) Prosumer - the co-financing line intended for the purchase and installation of renewable energy micro-installations" is to reduce or avoid CO₂ emissions as a result of increasing energy production from renewable sources, through the purchase and installation of small installations or micro-installations renewable energy sources, for the production of electricity or heat and electricity for individuals and housing communities or cooperatives. The program promotes new technologies for renewable energy sources and prosumer attitudes (raising investor and environmental awareness), and also affects the development of the equipment and installer market, and the increase in the number of jobs in this sector.

The budget of the program amounts to PLN 340,402 million, including:

- for non-returnable forms of co-financing - PLN 122.968 million,
- for returnable forms of co-financing - PLN 217,434 million

Implementation period: 2014-2022 with the possibility to conclude loan agreements by 30/06/2017.

Forms of financing:

Loans with subsidies total up to 100% of eligible costs, including:

- subsidy of 20-40% of the co-financing (15 or 30% after 2015);
- loan with an annual interest rate - 1% (loan financing period up to 15 years).

Beneficiaries:

- natural persons who have the right to dispose of a residential building;
- housing communities and cooperatives;
- local government units and their associations.

Co-financing will be granted for installations for the production of electricity or heat and electricity using:

- biomass heat sources, heat pumps and solar collectors with installed thermal power up to 300 kW;

- photovoltaic systems, small wind farms, and micro-cogeneration systems (including micro-biogas plants) with an installed electrical capacity of up to 40 kW, for the needs of single-family or multi-family residential buildings, including those under construction.

High quality of installed devices is required, manufacturer's warranty of the main equipment for at least 5 years, contractor's warranty for at least 3 years, design and assembly by authorized persons.

IV. BOCIAN - dispersed, renewable energy sources

The goal of the program is to reduce or avoid CO₂ emissions by increasing energy production from installations using renewable energy sources.

Budget: planned commitments for returnable forms of co-financing amount to PLN 570 million from NFOŚiGW.

Implementation period in the years: 2014-2022.

Forms of financing: loan.

Beneficiaries are entrepreneurs within the meaning of art. 43 of the Civil Code, undertaking the implementation of projects in the field of renewable energy sources in the Republic of Poland.

The program includes the construction, extension or reconstruction of renewable energy sources installations with capacities within certain ranges, wind farms up to 3 MW, solar systems from 200 kW to 1 MW, geothermal plants from 5 MW to 20 MW, small 5 MW hydroelectric plants.

V. Improvement of air quality. Part 2 - Reduction of energy consumption in buildings

The aim of the program is to improve air quality by limiting or avoiding CO₂ emissions as a result of increasing energy production from renewable energy installations or by reducing energy consumption in buildings.

The budget of the program is up to PLN 500 million, including:

- for non-returnable forms of co-financing - up to PLN 300 million,
- for returnable forms of co-financing - PLN 200 million

Implementation period: 2016-2022

Forms of co-financing: subsidy (up to 85% of eligible costs), loan (up to 100% of eligible costs).

Beneficiaries are registered in the Republic of Poland:

- 1) entities carrying out medical activities in the field of stationary and round-the-clock health services, in particular hospitals, care and treatment centres, nursing and care facilities, hospices, entered into the register of entities performing medical activities, referred to in the Act of 15 April 2011 about therapeutic activity;
- 2) entities running museums entered into the State Museum Register;

- 3) entities running student hostels, in accordance with the Act of July 27, 2005. Law about higher education;
- 4) entities that own the building entered in the Register of Monuments in accordance with the Act of 23 July 2003 on the protection of monuments and the protection of monuments;
- 5) churches and religious associations entered in the Register of Churches and other religious associations, referred to in the Act of 17 May 1989 on guarantees of freedom of conscience and religion.

Thermomodernisation concerns the following buildings not supported by EU funds:

- museums,
- hospitals, care and treatment centres, nursing and care facilities, hospices,
- historic buildings,
- sacred buildings with accompanying facilities,
- student dormitories,

in the scope of changing the equipment of facilities with devices with the highest, economically justified energy efficiency standards directly related to the implemented thermomodernisation of buildings, in particular:

- insulation of the facility, including: walls, floors on the ground, ceilings, roofs, roofs and other partitions,
- replacement of windows,
- replacement of external doors,
- reconstruction of heating systems (including replacement of heat source),
- replacement of ventilation and air-conditioning systems,
- application of energy management systems in buildings,
- use of renewable energy technologies,
- preparation of technical documentation, including energy audits and mycological expert opinions,
- liquidation of dampness and its effects on a thermomodernised building,
- replacement of indoor and outdoor lighting for energy-saving.

VI. Green investment system GIS. Part 1) - Energy management in public buildings

The aim of the program is to reduce or avoid carbon dioxide emissions by co-financing projects that improve the efficiency of energy use by public buildings.

Budget: PLN 501 million - non-returnable forms (subsidies), PLN 462 million - repayable forms (loans) / funds derived from the transaction of sale of AAU emission units or other NFEPWM funds.

Implementation period: the program is implemented in 2010-2018

Forms of financing:

- support;
- loan

Beneficiaries:

- local government units and their associations;
- entities providing public services as part of the implementation of own tasks of local government units that are not entrepreneurs;
- Volunteer Fire Department;
- universities within the meaning of the Law on Higher Education and research institutes;

- independent public health care centres and medical entities running an enterprise within the meaning of art. 55 of the Civil Code in the scope of providing health services;
- non-governmental organizations, churches and other religious organizations entered in the register of churches and other religious associations, and church legal persons.

Thanks to obtaining funding from this program, it is possible to reduce energy consumption in used buildings. Activities include thermo-modernization of public buildings, in particular insulation of the building, replacement of windows, replacement of external doors, reconstruction of heating systems, replacement of ventilation and air-conditioning systems, preparation of project documentation for the project, application of energy management systems in buildings, the use of renewable energy technologies, or the replacement of internal lighting with energy-efficient ones (an additional task carried out in parallel with thermomodernisation of buildings). Group projects can be implemented as part of the program.

VII. Funds of the European Union. Operational Program Infrastructure and Environment.

Operational Program Infrastructure and Environment 2014-2020 Measure 1.3.1, 1.3.2 - Supporting energy efficiency in public utility buildings and in the housing sector

The aim of the program is to increase energy efficiency in multi-family housing and public buildings.

Budget: EUR 431.10 million (including public utility buildings - EUR 205.52 million and housing sector - EUR 225.58 million), from EU funds (Cohesion Fund).

Implementation period: 2014-2023

Beneficiaries:

As part of the investment priority, support is provided for public authorities, including state budgetary units and government administration as well as subordinate bodies and organizational units, housing cooperatives and housing associations, state legal persons, as well as entities that provide energy services within the meaning of Directive 2012/27/EU.

It is planned to support deep, comprehensive energy modernization of public and residential buildings, together with the replacement of equipment for these facilities with energy-saving facilities in the area related to, e.g. from:

- insulation of the building, replacement of windows, external doors and lighting for energy-efficient,
- reconstruction of heating systems (including replacement and connection of a heat source), ventilation and air-conditioning systems, related to the use of weather automation and building management systems,
- construction or modernization of internal reception installations and elimination of existing heat sources,
- installation of microgeneration or micro-generation for own needs,
- installation of renewable energy in energy-efficient buildings (if it results from energy audit),
- installation of cooling systems, including renewable energy sources.

VIII. Regional Operational Programs

Another source of funding is the Regional Operational Programs. According to the Partnership Agreement, 60% of Structural Funds (European Regional Development Fund and European Social Fund) are allocated to 16 regional programs in 2014-2020. Each province has a part of all financial resources available in the program and develops its own Regional Operational Programs.

The proposed actions also include those concerning the improvement of energy efficiency building. In the case of selected Regional Operational Programs on the basis of ex-ante analyses carried out, support under broadly defined energy efficiency will be available under financial instruments. The beneficiaries, type of project and method of financing are determined individually for each voivodship, but within the framework of specific thematic objectives and investment priorities.

The information includes activities planned under the investment priority PI 4.III (previously used numbering is PI 4.3) concerning increasing the energy efficiency of public and multi-family residential buildings. However, it is not out of the question to implement projects from the discussed scope in another investment priority, in particular PI 4.II (promoting energy efficiency and use of renewable energy sources in enterprises) and PI 4.V (promoting low-emission strategies). However, it should be borne in mind that projects regarding the energy efficiency of buildings in these investment priorities will, as a rule, be part of larger projects resulting from energy audits carried out or low-emission strategies developed.

The total amount foreseen for investment priority of PI 4.III in the years 2014-2020 is EUR 1,545,941,800. As part of the priority, tasks will be carried out consisting of a deep comprehensive energy modernization of public utility buildings and multi-family residential buildings, together with the replacement of equipment for these facilities with energy-efficient ones, to the extent related to, e.g. from:

- insulation of the building, replacement of windows, external doors and lighting for energy-efficient,
- reconstruction of heating systems (including replacement and connection of a heat source), ventilation and air-conditioning systems,
- construction or modernization of internal reception installations and elimination of existing heat sources,
- using renewable energy technologies in buildings,
- installation of cooling systems, including those using energy from RES.

The investments should come out from energy audits. Often, the projects also involve the construction or reconstruction of electricity and heat generation units in high-efficiency cogeneration.

An important factor for the buildings sector is the thermo-modernization program defined by the Act on thermo-modernization and renovations. From the beginning of its existence, the Thermo-modernization and Renovation Fund was subsidized with the amount of PLN 2,324 million.

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