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IN YEARS 2005-2015

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FOREWORD

This publication is successive edition of the study "Energy efficiency" published by the Central Statistical Office (GUS).

The aim of this publication is to present and analyze global and sector energy efficiency indicators as well as policies and measures towards its improvement.

The development of energy efficiency indicators adapting statistics to changing economy conditions and present needs (monitoring of energy economy and controlling its management towards "sustainable development") is realized on the level of European Union and International Energy Agency (IEA/OECD). Joined actions of Eurostat, IEA and Member States, aim at creation of statistical indicators system to assess trends in the field of energy efficiency.

The publication was elaborated by employees of the Polish National Energy Conservation Agency, Energy Market Agency and Central Statistical Office.

With passing this publication to the hands of the readers we would welcome any comments that will help to improve next editions of the publication.

Wanda Tkaczyk
Deputy Director of Production Department

Warsaw, June 2017

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1. Methodological remarks and definitions of basic concepts

The source of data for the publication are statistical surveys in the field of fuel and energy economy conducted by the Central Statistical Office in collaboration with the Ministry of Economy stored in the Odyssee database[1].

For the purposes of the publication industry activities are grouped as follows:

	NACE rev. 2
Food	10-12
Textile	13-15
Wood	16
Paper	17-18
Chemical	20-21
Mineral	23
Primary metals	24
Machinery	25-28, 33
Transport equipment	29-30
Other	22, 31-32

The value-added of industrial branches is the sum of value added of the respective divisions.

Total primary energy consumption includes the consumption of primary energy sources, as well as recovery, trade balance, (-) bunkers and stock changes of derived energy according to Eurostat methodology.

Final energy consumption means the final energy consumption for energy purpose calculated according to the methodology of Eurostat/IEA. Final consumption in the industry does not include the energy transformation sector. Transformation in blast furnaces is calculated using real transformation efficiency. In case of transport international air transport is also included.

Primary energy intensity of GDP is the ratio of total primary energy consumption to GDP. **Final energy intensity of GDP** is the ratio of final energy consumption to GDP. **Energy intensity of branches** is the ratio of the final energy consumption in these industries to their value added.

[1] www.odyssee-mure.eu

Energy consumption in constant structure is calculated using Divisia method in such a way that the product of the dynamic of energy intensity in constant structure and effect of the structural changes provides dynamics of the energy intensity. The effect of structural change was calculated as the weighted sum of the growth rates of the individual components. The growth rates are defined as the natural logarithm of the relative change in the value added of the total industry in the subsequent years, and the weights are the shares of average energy consumption in the industry in the total consumption in the subsequent years.

Climatic correction is based on the correlation between energy consumption and outdoor temperature. The consumption is proportional to the Heating Degree Days (SD). The constant heating share approach in calculating of final energy consumption with climatic correction ZEF^{kk} is based on the following formula:

$$ZFF^{kk} = \frac{ZFF}{1 - 0{,}9 \cdot \alpha \cdot \left(1 - \frac{Actual\,SD}{Long - term\,average SD}\right)}$$

where: ZEF - final energy consumption, SD - degree days number, α - heating share in total energy consumption in dwelling sector.

Heating Degree Days is introduced to enable control and comparison of energy consumption for heating. It expresses a product of number of heating days and difference between the average temperature of heated room and average outdoor temperature. Numbers of SD degrees in a given year according to Eurostat methodology is calculated as follows:

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

where: $t_{śr}(n) = \frac{t_{\min}(n) + t_{maks}(n)}{2}$ - mean outdoor temperature for *n* day, [°C]; $t_{\min}(n)$, $t_{maks}(n)$ - minimum and maximum temperature of the *n* day, [°C]; N - number of days per year. According to formula and the Eurostat assumption, the mean outdoor temperature of the heating day should be less than 15°C.

Long-term average calculated for years 1980-2004 amounts to 3615.77.

An equivalent car is a measure used in the calculation of energy efficiency indicators. Stock of equivalent cars is calculated as follows: Se = 0.15 * M + So + 4 * Sc + 15 * A, where Se - equivalent stock of cars, M - the stock of motorcycles, So - the stock of cars, Sc - stock of

trucks, A - the stock of buses. The coefficients are estimated relation of annual fuel consumption of a vehicle of a given type to the car.

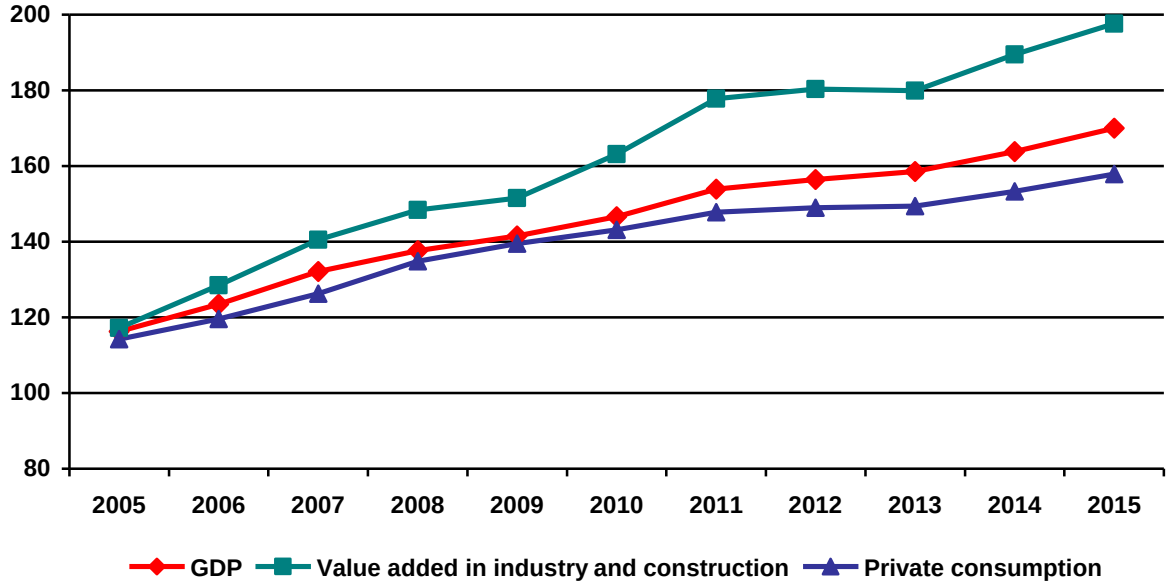
Energy efficiency index (ODEX) is calculated by aggregating the individual changes in energy consumption, observed on certain levels of end-use. ODEX indicator does not show the current level of energy intensity, but the improvement over the base year. ODEX is calculated for each year as the ratio of actual energy consumption in a given year and the theoretical energy consumption which does not take into account the individual effect (ie, assuming the previous level of energy intensity in the production processes). In order to reduce random fluctuations 3-year moving average is calculated. The decrease of indicator value represents an increase of energy efficiency.

2. Energy efficiency indicators for Polish economy and its sectors

2.1. Dynamic of development of the economy

Gross domestic product (GDP) was constantly increasing during the presented period reaching in 2015 45% higher value at constant prices than in 2005. Rate of growth of value added at constant prices in industry exceeded rate of growth of economy, while the rate of growth of private consumption was slightly lower than the growth rate of GDP.

Figure 1. Dynamics of basic macro-economic indicators (2000=100)

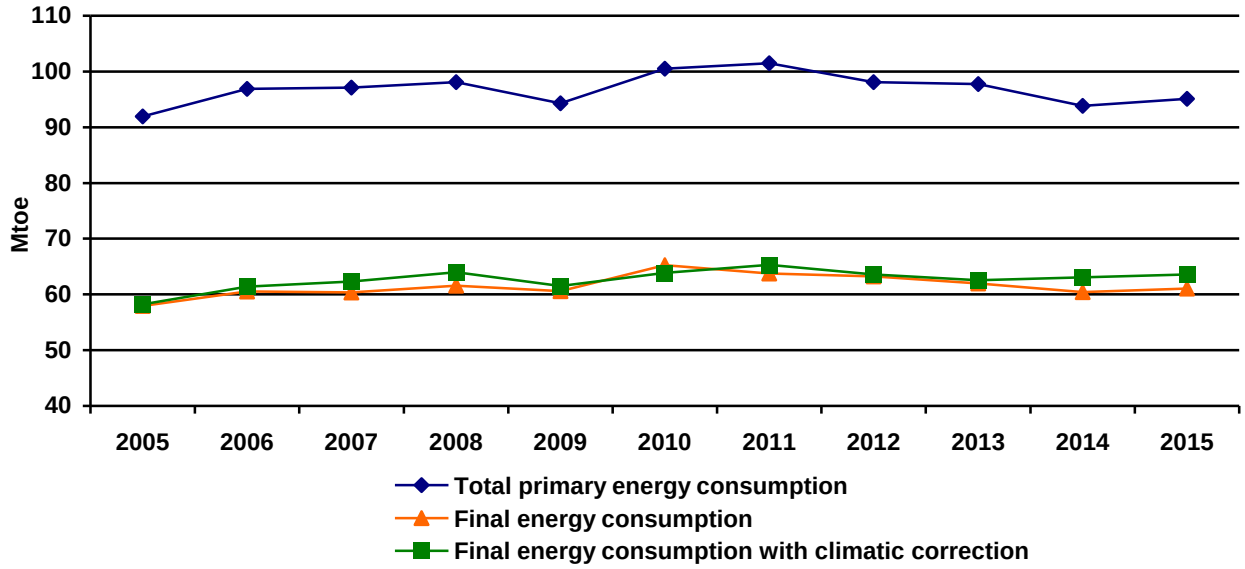


2.2 Energy consumption and prices of energy

Total primary energy consumption increased in years 2005-2015 from 92 Mtoe to 95 Mtoe (0.3%/year). Consumption tended to increase until 2011 (the only drop occurred in 2009), when it reached highest value during presented period of 101.5 Mtoe. In subsequent years energy consumption was declining, to grow in year 2015.

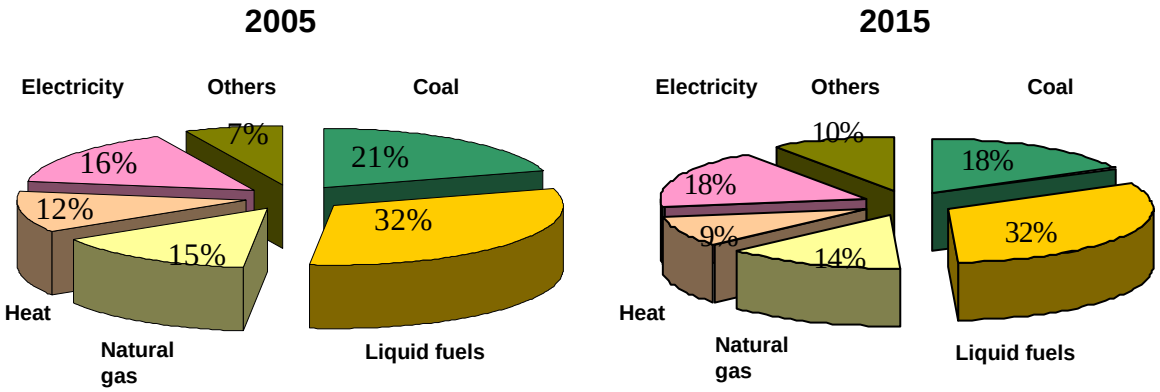
Final energy consumption has increased in presented period from 58 to 61 Mtoe, which means an average annual growth rate of 0.5%. The decrease in consumption was recorded in 2007, 2009 and in years 2011-2014. After taking into account different weather conditions, that is in case of final energy consumption with climatic correction consumption growth rate amounted to 0.9% in the period 2006-2015. Energy consumption with climatic correction determines the theoretical value of consumption for a given year, if the weather conditions were in line with long-term average. That calculated final consumption in 2015 amounted to almost 64 Mtoe.

Figure 2. Total primary and final energy consumption



Existing domestic natural resources have a significant impact on the structure of fuels used in the economy. The main source of primary energy is hard coal and lignite. In case of final energy consumption, coal fuels are the second most important energy carrier, with share decreased from 21% in 2005 to 18% in 2015 (Fig. 3). The most important energy carrier were liquid fuels, which share amounted to 32% in 2015 and remained unchanged in comparison with 2005. Among other energy carriers decrease occurred in case of gas (from 15 to 14%) and heat (from 12% to 9%). Growth was recorded in case of electricity - from 16 to 18% during this period and other energy sources (mostly renewables) - from 7 to 10%.

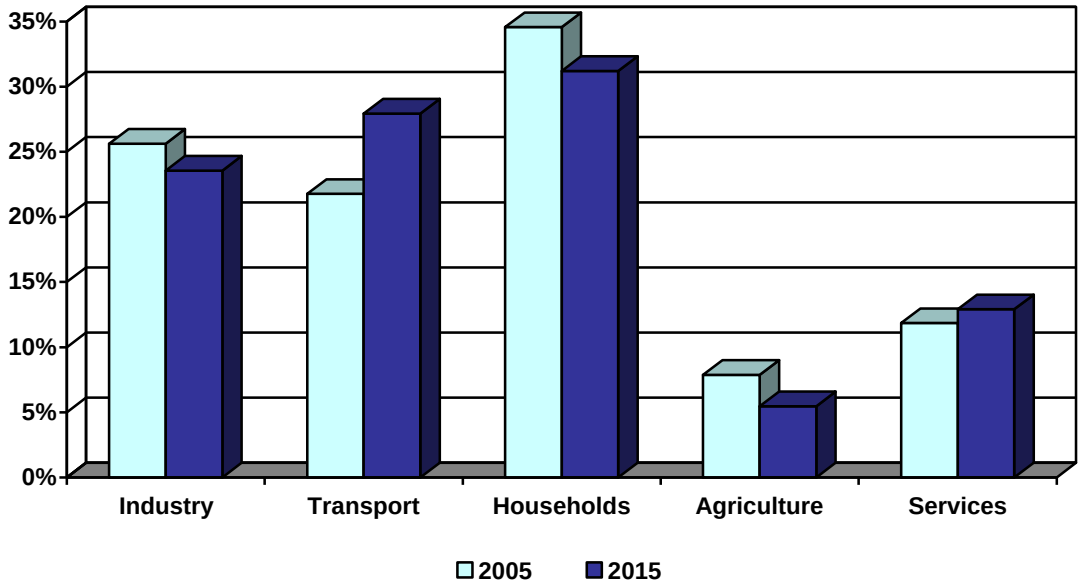
Figure 3. Final energy consumption by energy carrier



In years 2005-2015 an increase in the share of final energy consumption in the transport and services and a decline in the share of industry, households and agriculture was observed. The

share of transport increased from 22 to 28%, what was the biggest change during presented period and resulted from both growing role of road freight and passenger transport carried out by private cars. Households remained the largest consumer, despite the decline in the share from 35 to 31%. The share of industry decreased from 26 to 24%, and agriculture from 8 to 5%. The share of services grew from 12 to 13%.

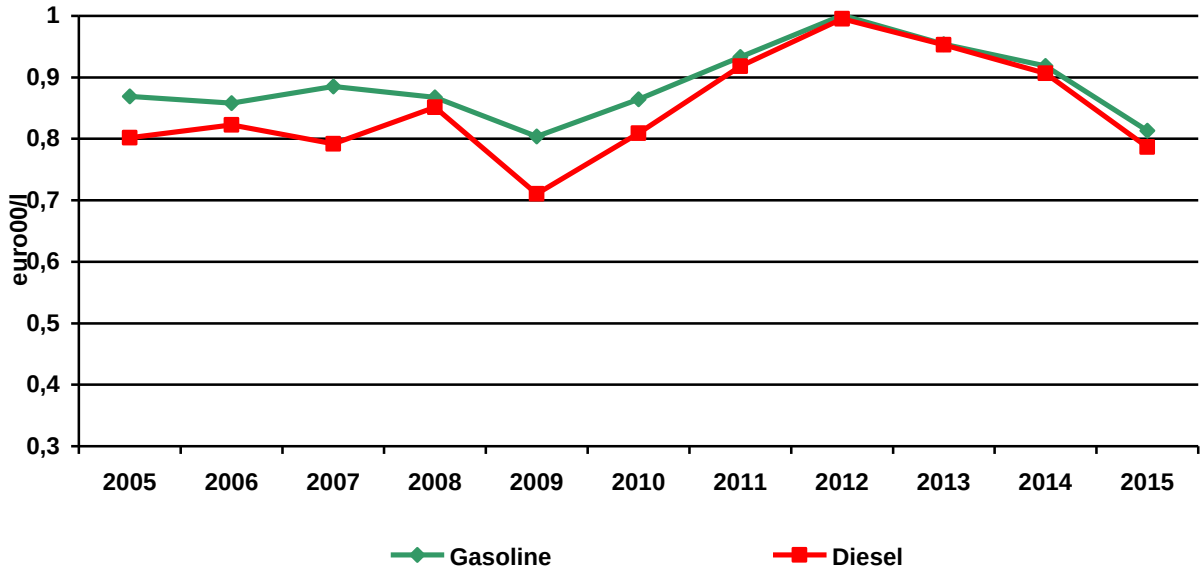
Figure 4. Final energy consumption by sectors



Gasoline prices fluctuated slightly between 2005 and 2009, when they reached the lowest value of 0.8 euro00/l. The next three years is a period of very dynamic growth resulting in reaching by the price of gasoline 1.0 euro00/l in 2012. The fall in prices in subsequent years made that it amounted to 0.81 euro00/l in 2015.

Diesel prices in years 2005-2015, expressed in constant prices of 2000 showed higher volatility. The lowest price in this period occurred in 2009 and amounted to 0.71 euro00/l. Significant decline observed in this year, greater than in the case of gasoline, reflected the fact that diesel plays greater role in economic activity, being then in crisis worldwide (Fig. 5). Consecutive years (until 2012) was the period of high dynamics of prices. In years 2013-2015 trend reversed again and in 2015 diesel prices amounted to 0.79 euro00/l.

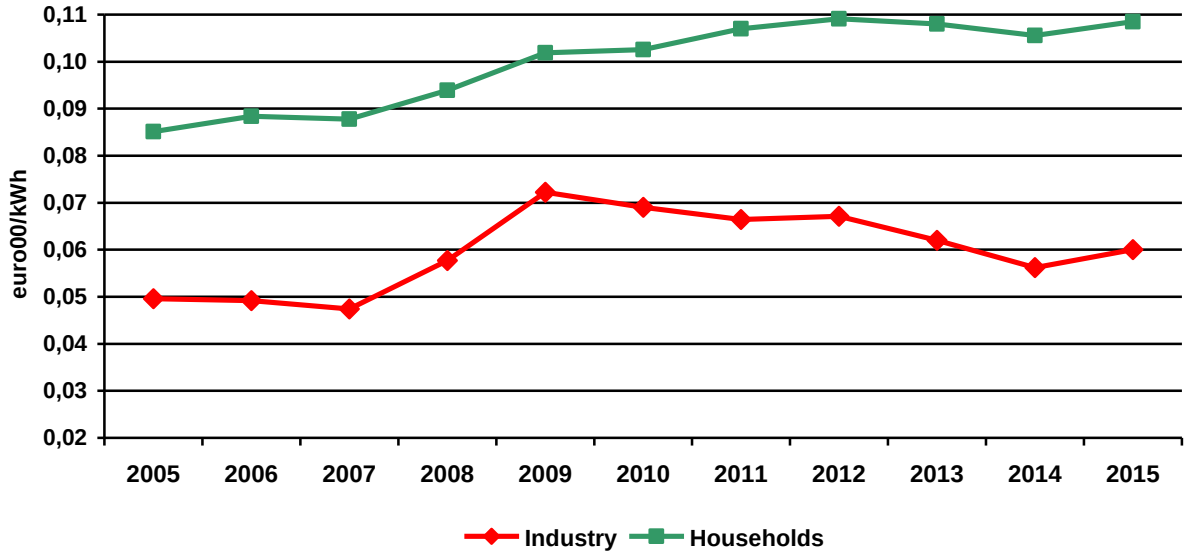
Figure 5. Gasoline and diesel oil prices



Electricity prices for households rose between 2005 and 2015 from 0,085 in 2005 to 0,109 euro00/kWh in 2015. The upward trend was clear by year 2012, since then fluctuations of price is observed.

In case of electricity prices for the industry, slight downward trend lasted until 2007, when prices reached their lowest level (0.047 euro00/kWh). Over the next two years a sharp increase in prices took place, which grew by over 50% and reached the highest value in the period under review (0.072 euro00/kWh). During following years the price of electricity tended to decrease and reached in 2015 level of 0.060 euro00/kWh.

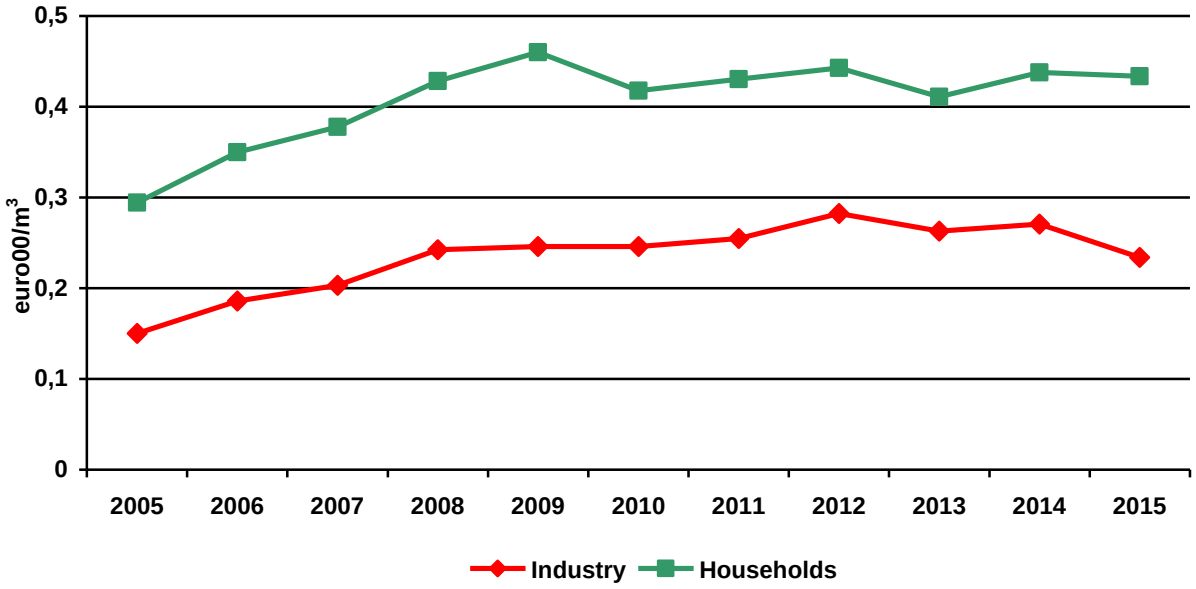
Figure 6. Electricity prices for households and industry



Natural gas prices for households were rising until 2009, when they reached the highest level in the presented period (0.46 euro00/m^3). In the consecutive years the price fluctuated above 0.4 euro00/m^3. In 2015, the price of gas for households amounted to 0.43 euro00/m^3.

Natural gas prices for industry were growing steadily until 2012, reaching level of 0.28 euro00/m^3. In the following years downtrend prevailed and prices decreased to the level of 0.23 euro00/m^3.

Figure 7. Gas prices for households and industry



2.3. Macro-economic indicators

Primary and final energy consumption of GDP decreased in 2015 compared to 2005 by 29% and 28% respectively (Fig. 8-9, Table. 1). The decrease in energy intensity was systematic, the only year when growth of energy intensity occurred was year 2010. After taking into account climatic correction pace of improvement was slightly lower.

The rate of improvement in the first years of presented period (that is in years 2006-2009) was higher than in years 2010-2015, which was especially visible in case of primary intensity.

Table 1. An average annual rate of changes in GDP energy intensity indicators (%/year)

Growth rate	2005-2009	2010-2014	2005-2014
Primary intensity of GDP……..	-3.81	-2.98	-3.40
Primary intensity of GDP with climatic correction…….	-3.76	-2.56	-3.16
Final intensity of GDP……..	-3.27	-2.94	-3.10
Final intensity of GDP with climatic correction……..	-3.19	-2.28	-2.74

Figure 8. Energy intensity of GDP

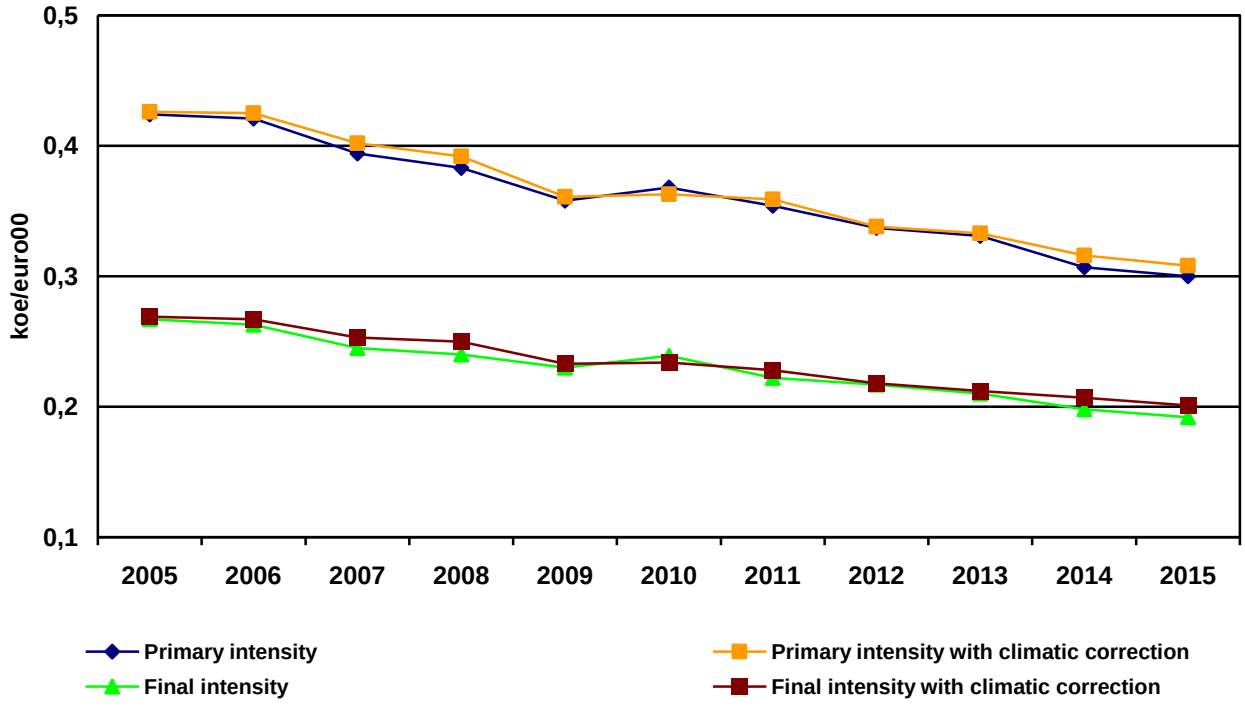
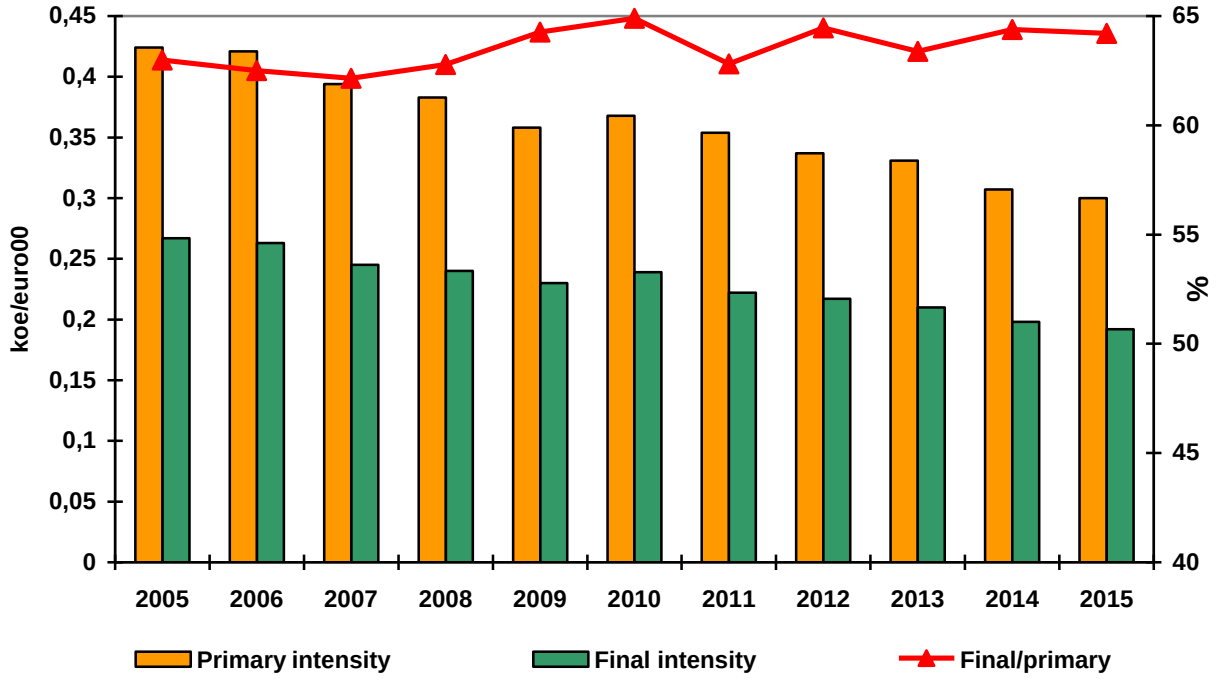


Figure 9. Ratio of final to primary intensity



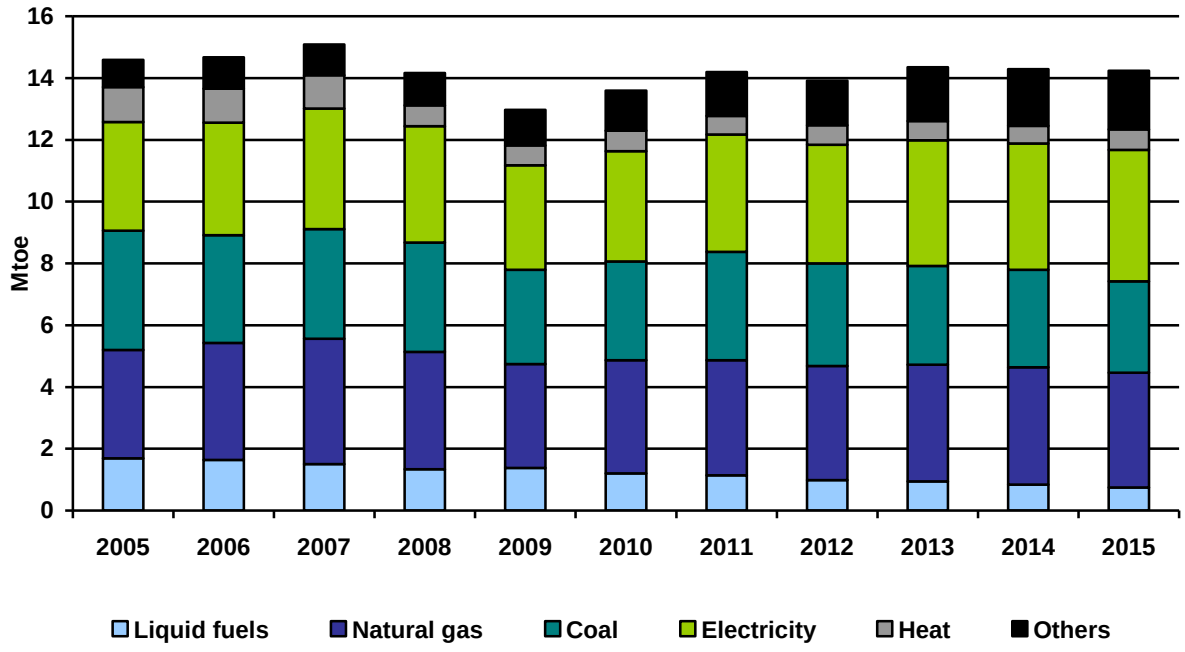
The ratio of final to primary intensity varied in the range from 62.1% to 64.9%. The highest rate was achieved in 2010 and amounted to 64.9%, in the subsequent years its value fluctuated, reaching in 2015 64.2%. The level of this indicator is mainly affected by the energy transformation efficiency (the higher the efficiency the greater the value of the indicator) and the rate of growth of electricity consumption (the higher consumption the lower value of the indicator).

2.4. Industry

Final energy consumption in industry reached highest value in 2007, when it amounted to 15 Mtoe and the lowest, at the level of 13 Mtoe two years later (Fig. 10). In years 2010-2011 consumption was growing, afterwards it was subject to slight fluctuations around 14 Mtoe.

Energy carrier, which consumption decreased the most were liquid fuels (down by 56%). Reduction of consumption concerned also heat (by 42%) and coal (by 23%). The growth was observed in case of consumption of gas (by 6%), electricity (by 21%) and other energy carriers (by 114%).

Figure 10. Final energy consumption in industry by energy carrier

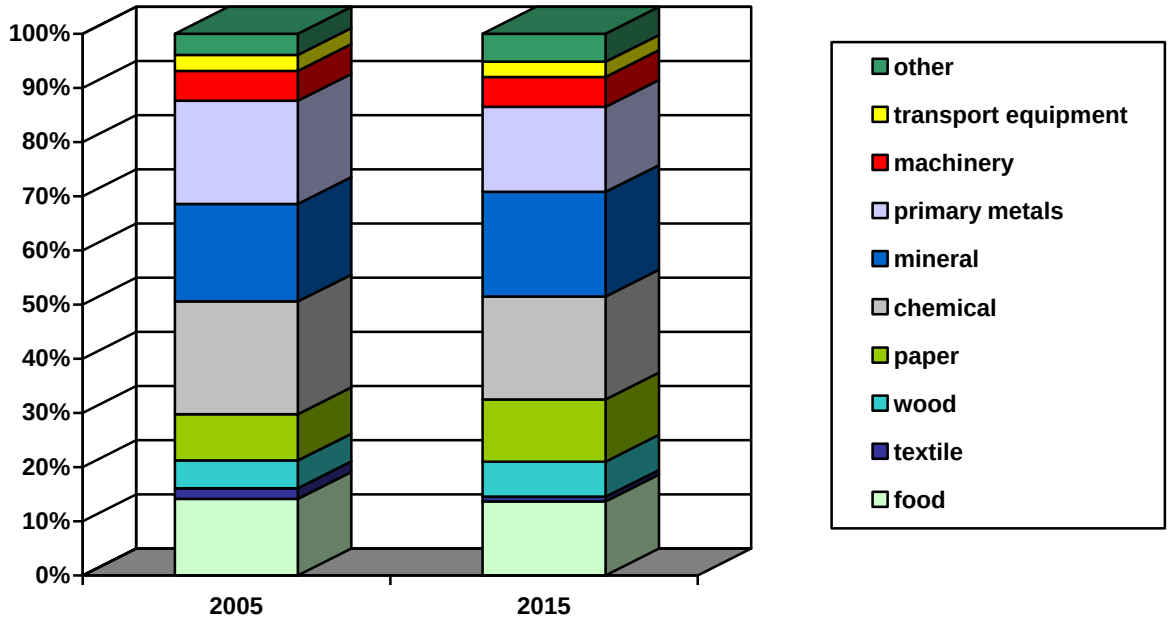


The structure of energy consumption in manufacturing is dominated by three energy-intensive industries: primary metals, chemical and non-metallic minerals, which total share in energy consumption amounted to 54% in year 2015 (58% in 2005). Significant, exceeding 10% share was reached also by food and paper industry.

Decline of share in energy consumption in comparison with 2005 was recorded by food, textile, chemical industry, primary metals and transport equipment, while the increase in the share occurred in the wood, paper, mineral industry, machinery and others.

In absolute terms, the biggest drop was recorded by primary metals (3 percentage pts.), while growth by the paper industry (3 percentage pts.). In relative terms, the biggest drop was recorded by textile industry (56%), and growth again by paper industry (35%). Significant increases in these terms were achieved also by other (32%) and wood industries (26%).

Figure 11. Energy consumption in manufacturing by branch



Figures 12 and 13 present energy intensity (final energy consumption/value added) of selected industrial branches in years 2005-2015.

Figure 12. Energy intensity of energy intensive industry branches

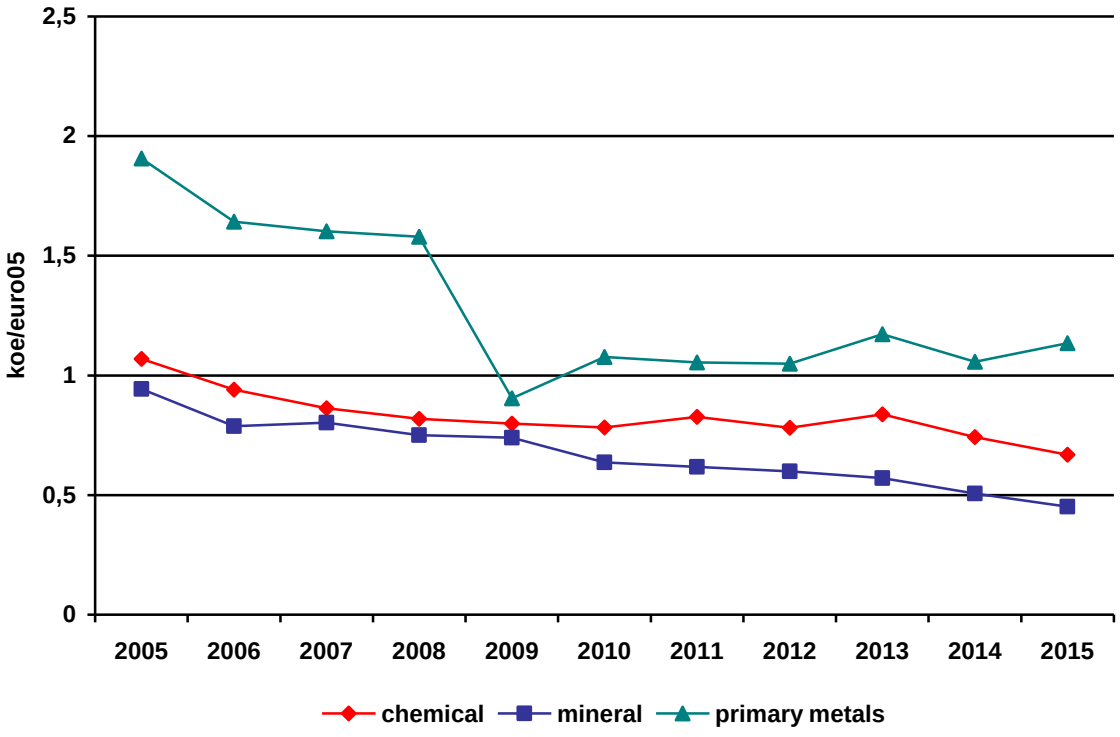
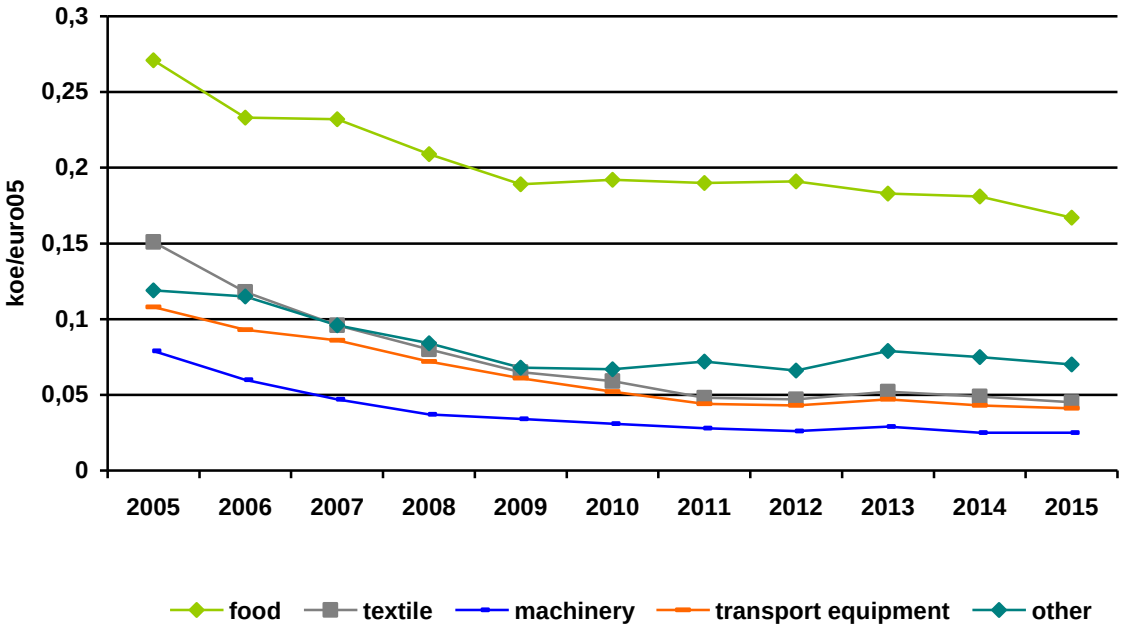


Figure 13. Energy intensity of low energy intensive industry branches



The most dynamic energy efficiency improvements were achieved by: machinery, textile industry and transport equipment. The slowest improvement occurred in food and other industry.

Overall, the rate of improvement of energy intensity of manufacturing in 2006-2009 was high (Fig. 14 and Table. 2) and amounted on the average to 12.1%/year. The impact of structural change was positive, but small - contributed to a decline in energy intensity by 1.5%/year. The energy intensity of manufacturing in constant structure, i.e. after eliminating the effect of variation of shares of individual sectors in the total volume of manufacturing was decreasing by 10.8%/year. The situation changed significantly in years 2010-2015 - the rate of decline in energy intensity amounted to 4.5%/year, the effect of structural changes amounted to -1.7 %/year and the rate of energy intensity at constant structure improvement decreased to 2.8 %/year.

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

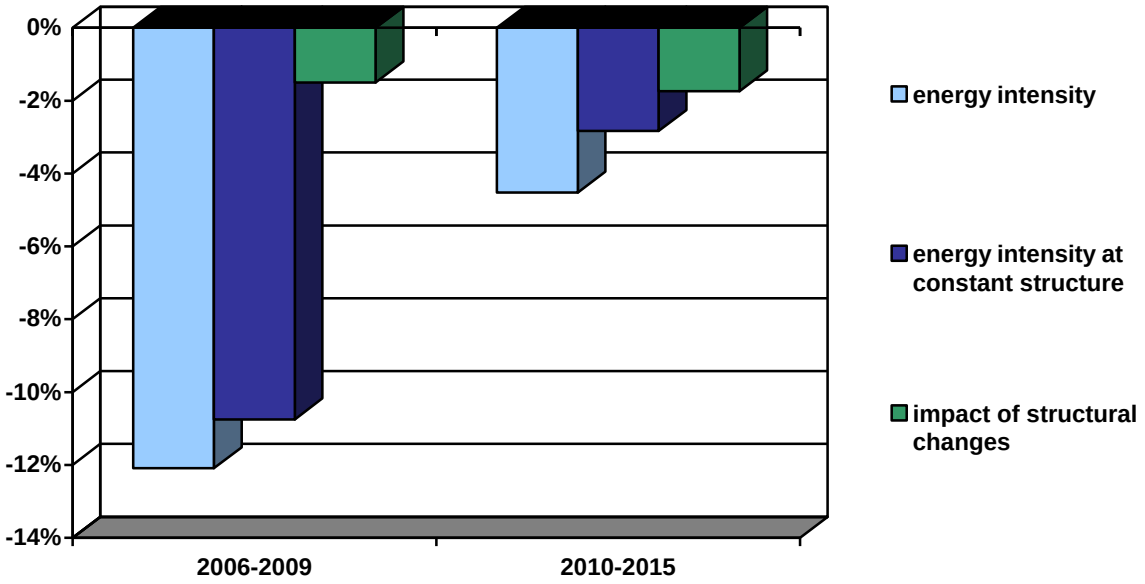


Table 2. Dynamics of energy intensity and impact of structural changes (%/year)

Specification	2006-2009	2010-2015
Energy intensity	-12.09	-4.52
Energy intensity at constant structure	-10.75	-2.83
Impact of structural changes	-1.50	-1.74

Energy consumption for the production of steel[2], cement[3] and paper[4] accounted for 33% of energy consumption in manufacturing in 2015. Figure 15 presents energy intensity of production of these products in years 2005-2015.

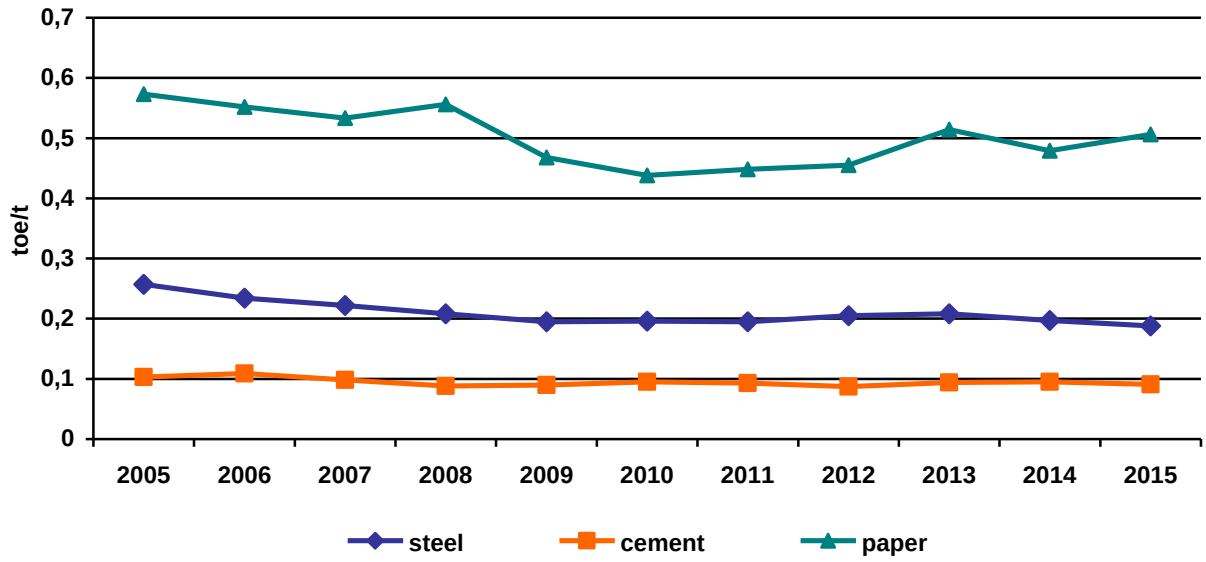
Energy intensity of cement production remained during most of the presented period slightly below 0.1 toe/t, thus exceeding European average, which amounted to 0.08 toe/t in 2014[5]. The lowest energy intensity was recorded in 2012, when it amounted to 0.087 toe/t. Simultaneously, the share of alternative fuels (wood, wastes) in final consumption in cement production grew from 7% in 2005 to 40% in 2015. In case of steel production energy intensity

[2] Calculated as final energy consumption in steel industry (since 2009 in groups 24.1, 24.2, 24.3 and classes 24.51 and 24.52 according to NACE Rev. 2) divided by steel production
[3] Calculated as final energy consumption in cement industry (since 2009 in group 23.5 according to NACE Rev. 2) divided by cement production
[4] Calculated as final energy consumption in paper industry (since 2009 in division 17 according to NACE Rev. 2) divided by paper production
[5] Source: Odyssee

was decreasing during majority of given period, noticeable growth occurred in years 2012-2013, followed by return to downtrend. Energy intensity of paper industry tended to decrease until 2010, when it reached its lowest value of 0.44 toe/t. After that energy intensity tended to increase and amounted to 0.51 toe/t in 2015.

In 2015 compared to 2005, energy intensity of crude steel production fell by 27.0% (3.1%/year) and paper and cement by 11.7% (1.2%/year).

Figure 15. Unit consumption of selected industrial products

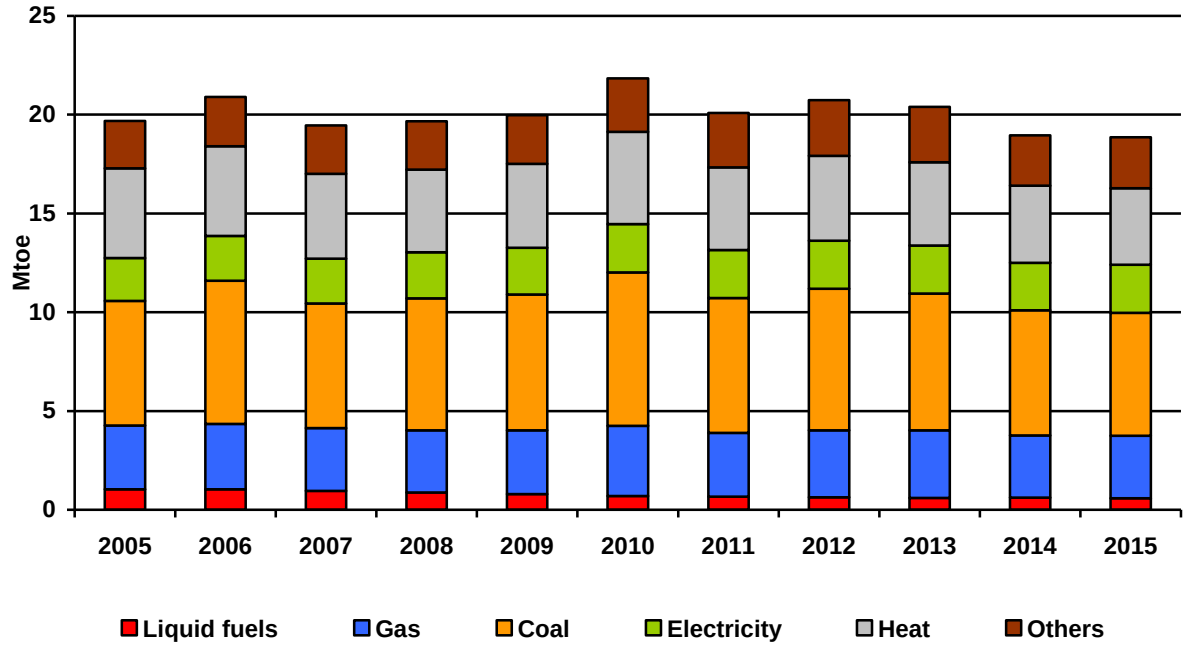


2.5. Households

The share of energy consumption in households in final energy consumption amounted to 31% in 2015.

Energy consumption by energy carrier is presented in Fig. 16. The most often used carrier was coal and other solid fuels, which share increased from 32% in 2005 to 33% in 2015. The second biggest energy carrier was heat, which share in 2015 amounted to 21% after a decline from 23% in 2005. In 2015, natural gas amounted to 17% of energy consumption in households, both electricity and others to 13% and liquid fuels to 3%.

Fig. 16. Final energy consumption in households by energy carriers



In structure of consumption by end uses steady decline of the share of heating is noticeable, which was associated with the installation of more efficient gas and electric appliances, carried out thermal modernizations and stricter building standards. Higher penetration of electrical equipment and behavioral changes (eg changes in the intensity of use of equipment - washing machines, dishwashers, TV, computers) have contributed to the doubling of the share of energy consumption for electrical equipment between 1993 and 2015.

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

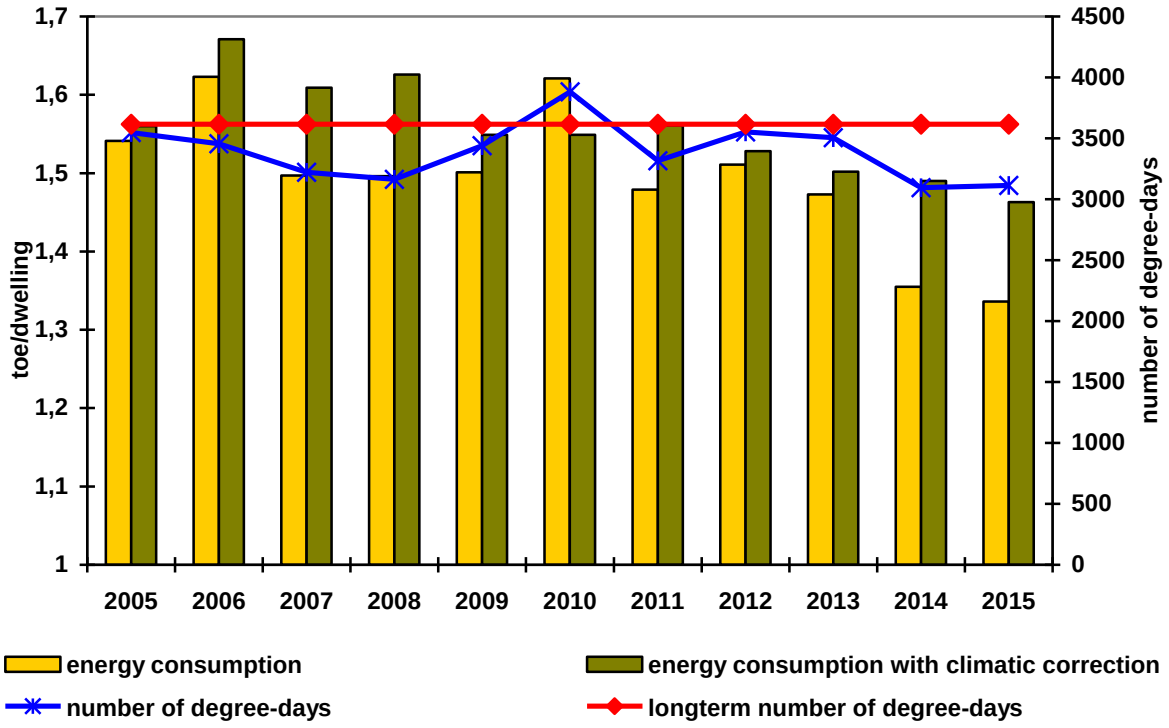
Items	1993	2002	2009	2012	2015
Total	100.0	100.0	100.0	100.0	100.0
Heating	73.1	71.3	70.2	68.8	65.5
Water heating	14.9	15.0	14.4	14.8	16.2
Cooking	7.1	7.1	8.2	8.3	8.5
Lighting	1.6	2.3	1.8	1.5	9.8*)
Electrical equipment.....	3.3	4.3	5.4	6.6	

*) jointly lighting and electrical equipment

Energy consumption per dwelling without climatic correction declined in the period 2006-2015 at a rate of 1.4% per year (Fig. 17). The highest consumption was recorded in 2006 and the lowest in 2015, when it amounted to 1.34 toe/dwelling.

The value of this indicator with climatic correction decreased between 2005 and 2015 from 1.56 to 1.46 toe/dwelling, which means an average annual decrease of 0.6%. The lowest value occurred in 2015.

Figure 17. Energy consumption in households per dwelling



source: Eurostat and Joint Research Center, GUS

Table 4. Heating degree-days in years 2005-2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sd - annual	3547	3454	3222	3164	3439	3881	3317	3552	3505	3095	3113

source: Eurostat and Joint Research Center

Energy consumption in households per m^2 also tended to decrease, growth of consumption took place in 2006, 2010 and 2012, during the rest of the period a decrease of consumption was observed. Consumption per m^2 amounted to 18,1 kgoe/m^2 in 2015, in comparison with 22,2 kgoe/m^2 in year 2005 (2.0%/year decline). Taking into account the climatic correction the decrease of consumption per m^2 amounted to 1.2%/year. The dynamics of the improvement is higher than those calculated for dwellings, due to the increase in the average size of the apartment.

Electricity consumption in households per dwelling was increasing irregularly until 2010, since then it was declining and in 2015 amounted to 2003 kWh/dwelling and was 1.3% higher compared to year 2005 (Fig. 19).

Figure 18. Energy consumption in households per m^2

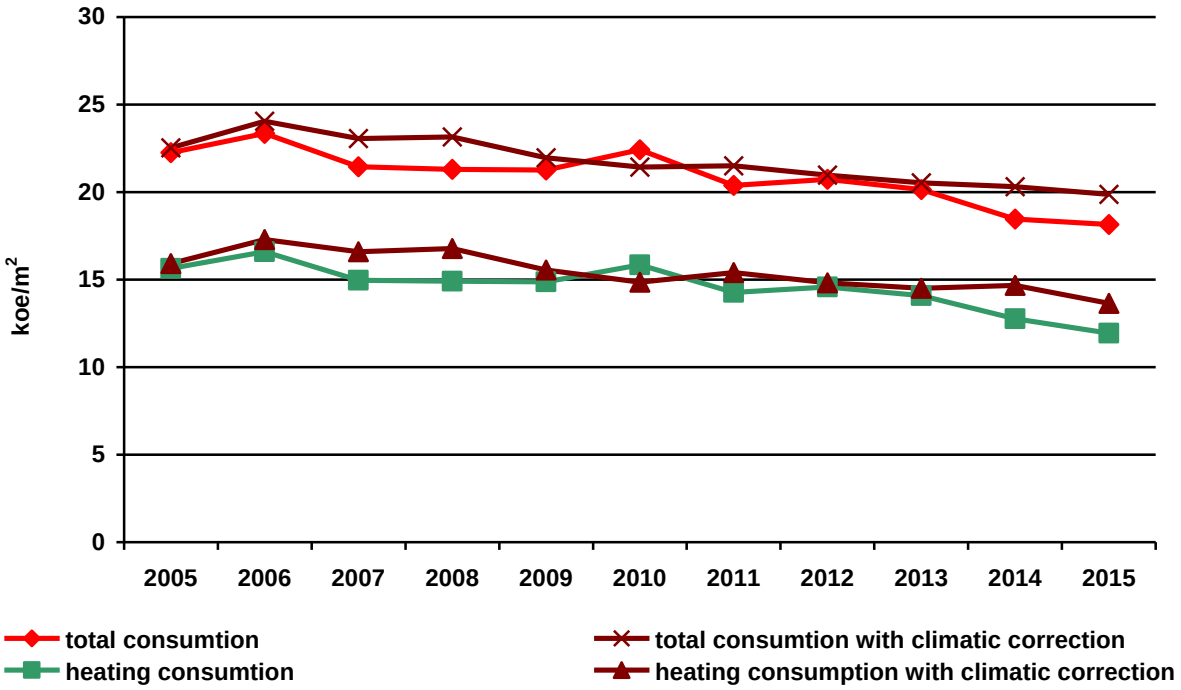
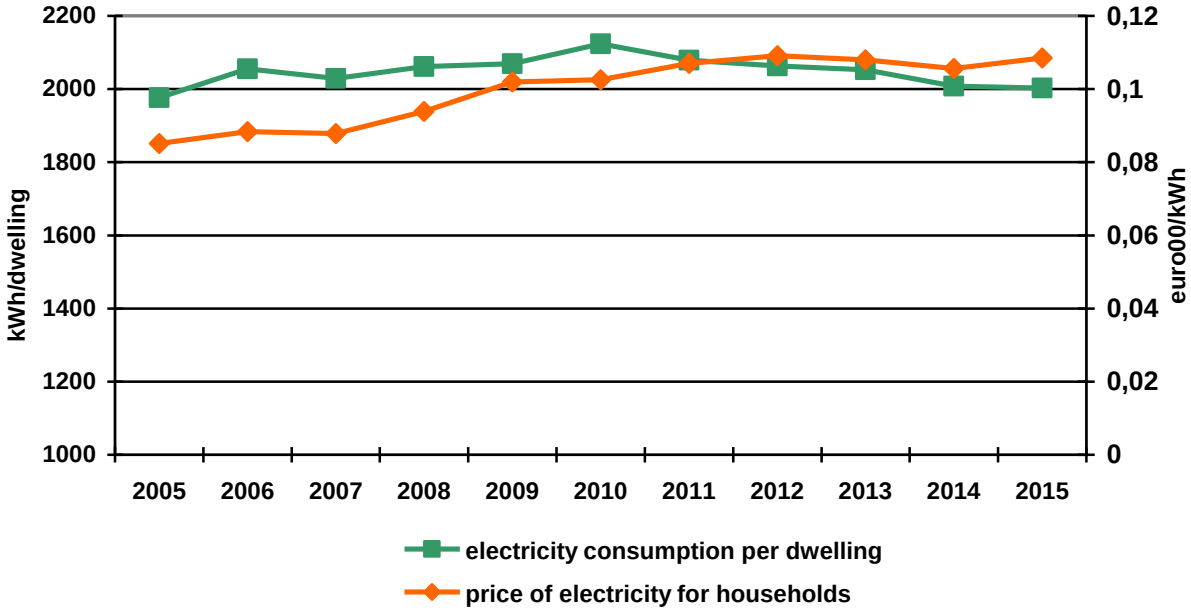


Figure 19. Electricity consumption and price in households per dwelling

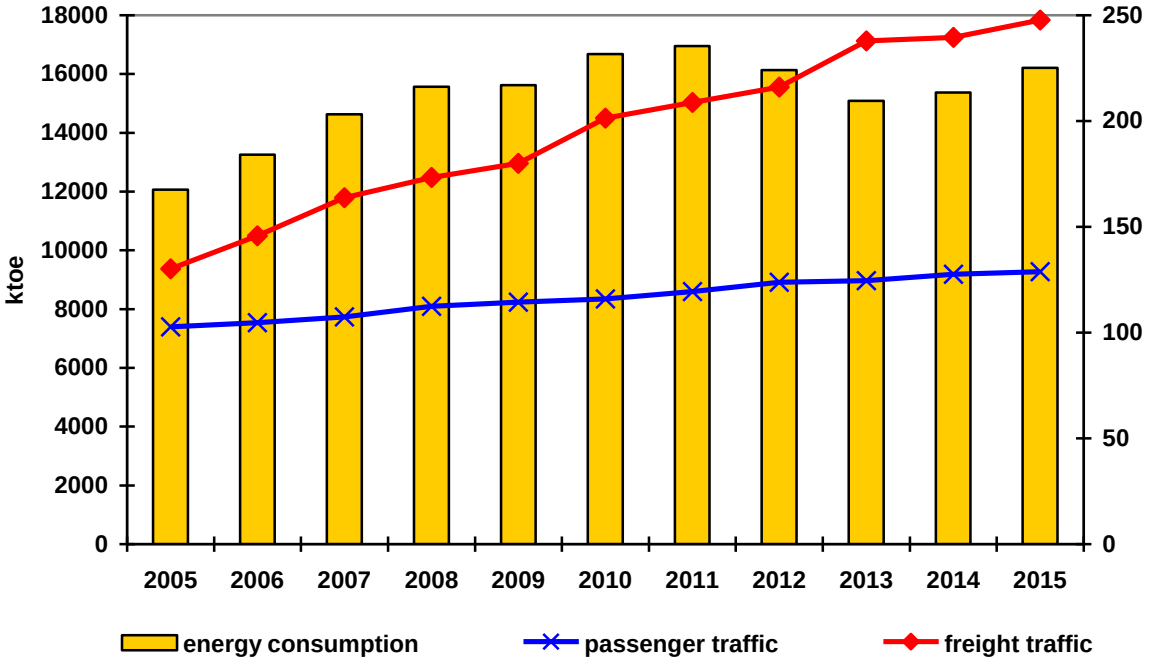


2.6. Transport

In Poland, more than 94% of the energy consumed in transport in 2015 was used in road transport, more than 2% in rail transport, almost 4% of the energy was consumed in air transport, and small amounts by the inland and coastal shipping.

Fuel consumption in road transport increased by 40% (annual growth rate of 3.4%) between 2005 and 2015, while significant (by 30%, 3.6%/year) decline in energy consumption occurred in rail transport. Total average annual growth rate of fuel consumption in transport (excluding air transport) amounted to 3.0% in years 2006-2015 and was in 2015 by 34% higher in comparison with year 2005.

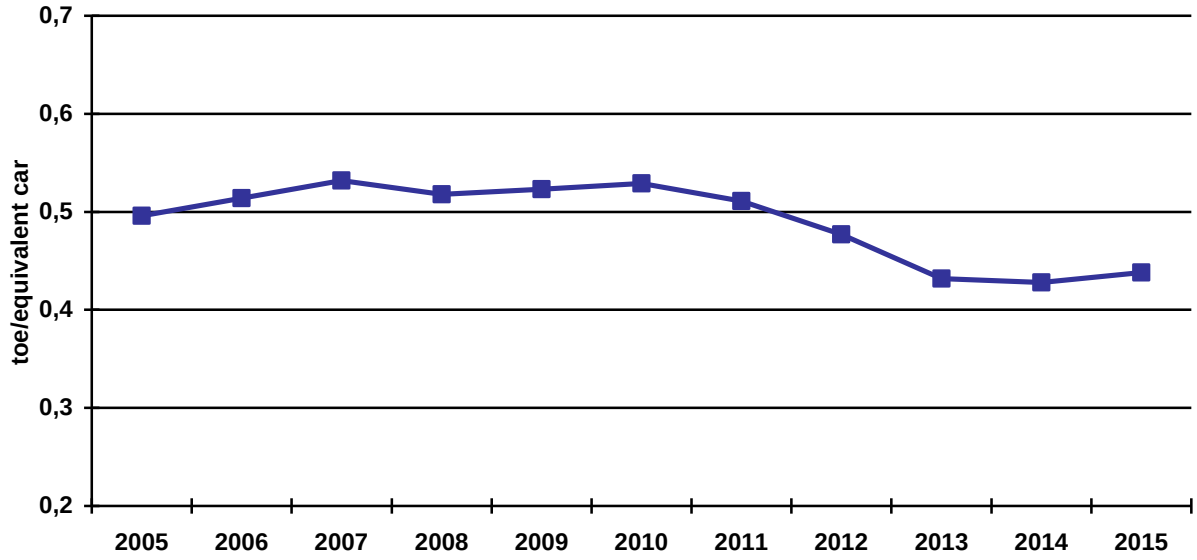
Figure 20. Passenger and freight traffic and energy consumption in transport*



** excluding air transport, source: DG TREN, GUS*

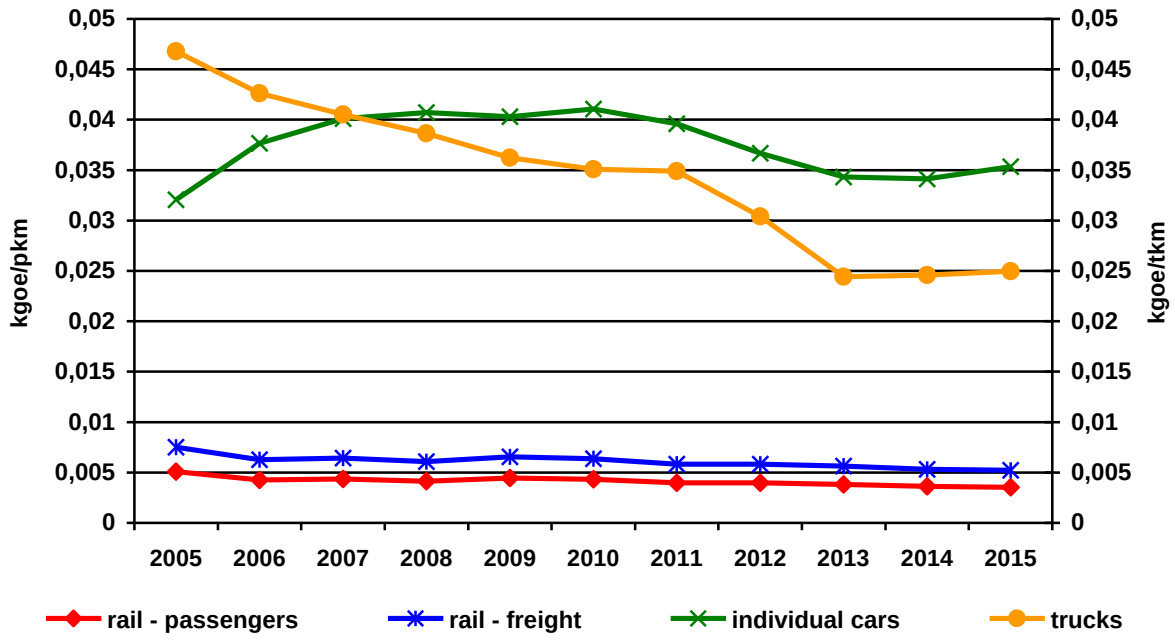
Fuel consumption per equivalent car was fluctuating above 0.5 toe/equivalent car (Fig. 21) in years 2005-2010. After 2010 the decline in the value of the indicator is observed. In 2015, it amounted to 0.438 toe/equivalent car. The value of this indicator is mainly influenced by the economic situation of enterprises and households, fuel prices and increasing efficiency of new cars.

Figure 21. Fuel consumption per equivalent car



In terms of modes, the situation is shown in Figure 22. During presented period, the fastest pace of improvement was observed in the freight trucks; where the rate of improvement amounted to 6.1%/year. In case of rail transport the rate of efficiency improvement amounted to 3.6%/year. However, in case of passenger cars decrease in efficiency at a rate of 1.0%/year was observed. The decrease in efficiency was due to a sharp increase in stock of cars which has led to a reduction in the average number of passengers.

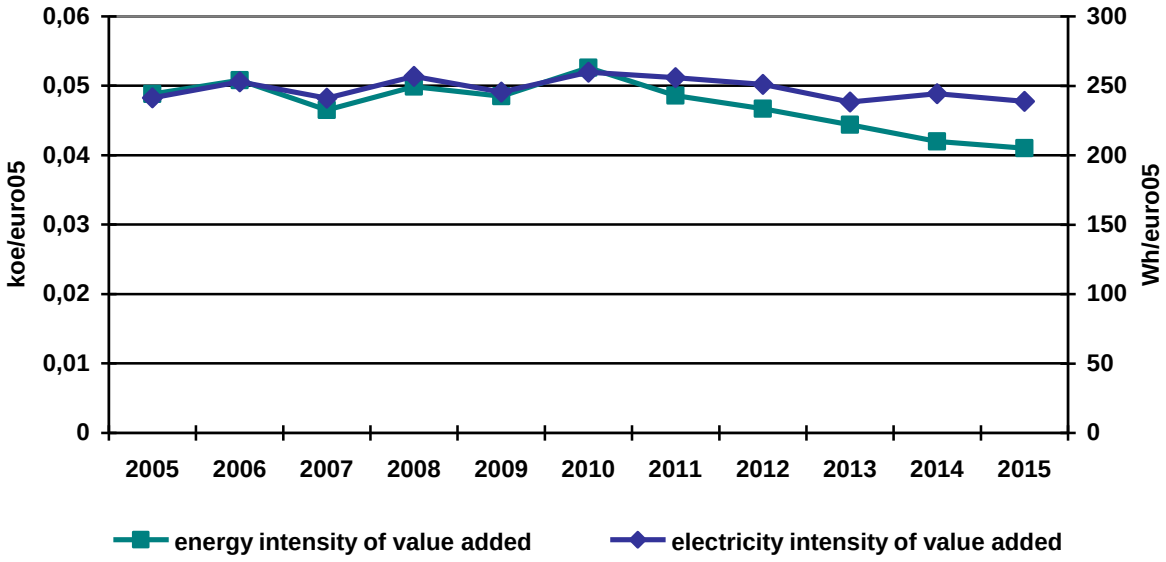
Figure 22. Energy intensity in transport



2.7. Service sector

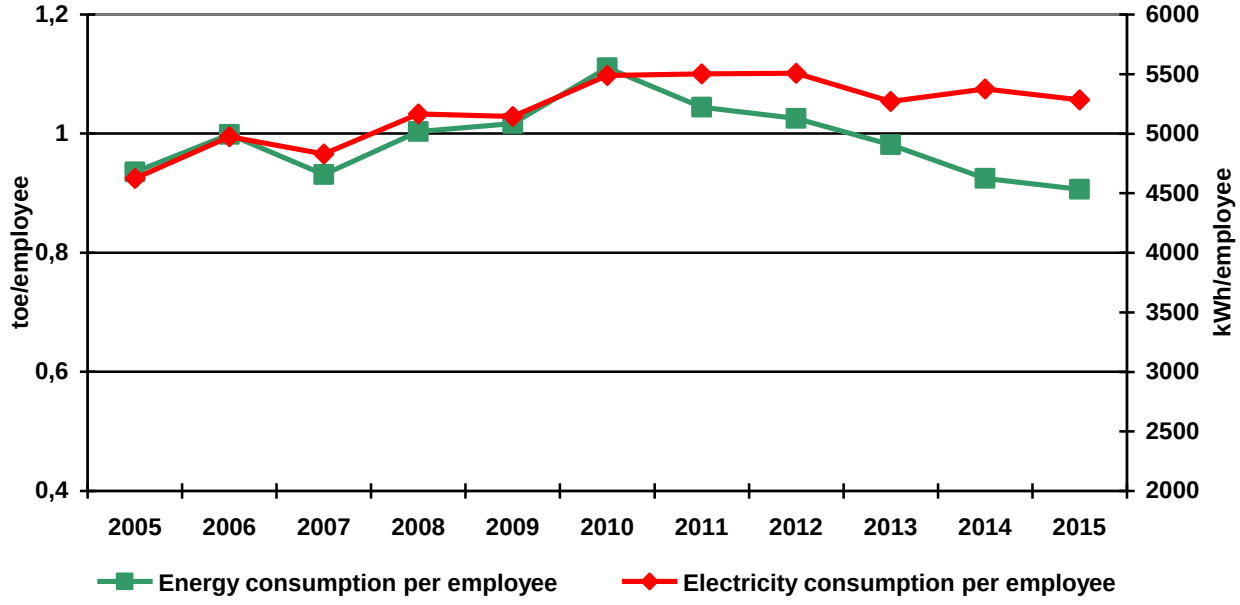
Energy intensity of service sector value added slightly fluctuated in years 2005-2010, followed by decrease of the indicator, which amounted to 0.042 kgoe/euro05 in 2015. The average annual rate of decline in energy intensity in this period amounted to 1.7%. In case of electricity intensity of added value it was decreasing at the rate of 0.1%/year. After 2010 the downward trend of energy intensity was clearer than of electicity intensity what was the effect of increasing share of electricity consumption in service sector.

Figure 23. Energy intensity and electricity intensity in service sector



Energy consumption per 1 employee in the service sector was increasing irregularly until 2010 (Fig. 24). Following years brought decline of the indicator and in effect the average rate of decline in the reporting period amounted to 0.3% per year. Energy consumption per 1 employee amounted to 0.91 toe. In case of electricity consumption per 1 employee growth rate amounted to 1.3% per year. Electricity consumption was increasing irregularly until 2012, then slightly decreased and amounted in 2015 to 5284 kWh/employee.

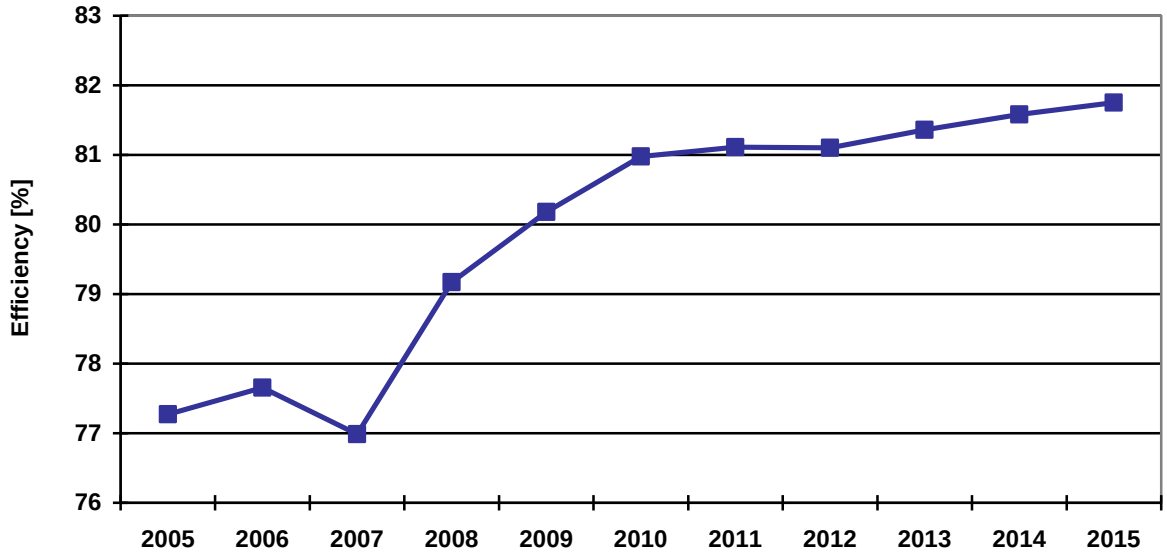
Figure 24. Energy consumption and electricity consumption per employee of the service sector



2.8. Heat plants

The efficiency of heat plants producing district heat was increasing systematically, except for year 2007. In 2015 efficiency of heat plants amounted to 81.8%.

Figure 25. Efficiency of heat plants



2.9. ODEX indicators and energy savings

ODEX indicator calculated on the basis 2000=100 declined in the years 2005-2015 from 83.2 to 66.8 points. The average rate of improvement amounted to 2.2%/year. The fastest rate (3.9%/year) was recorded in manufacturing. The slowest pace of improvement was achieved in household sector, where the annual improvement in the period 2006-2015 amounted to 1.1%. In transport sector the average rate of improvement amounted to 2.8%/year.

Figure 26. ODEX indicators

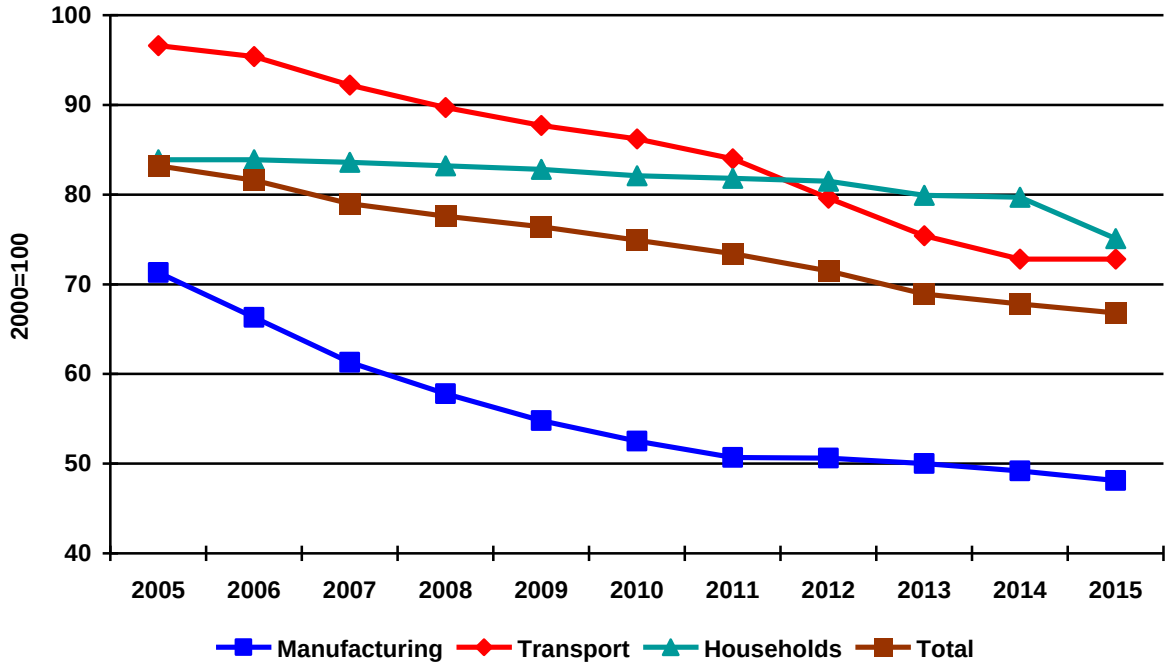
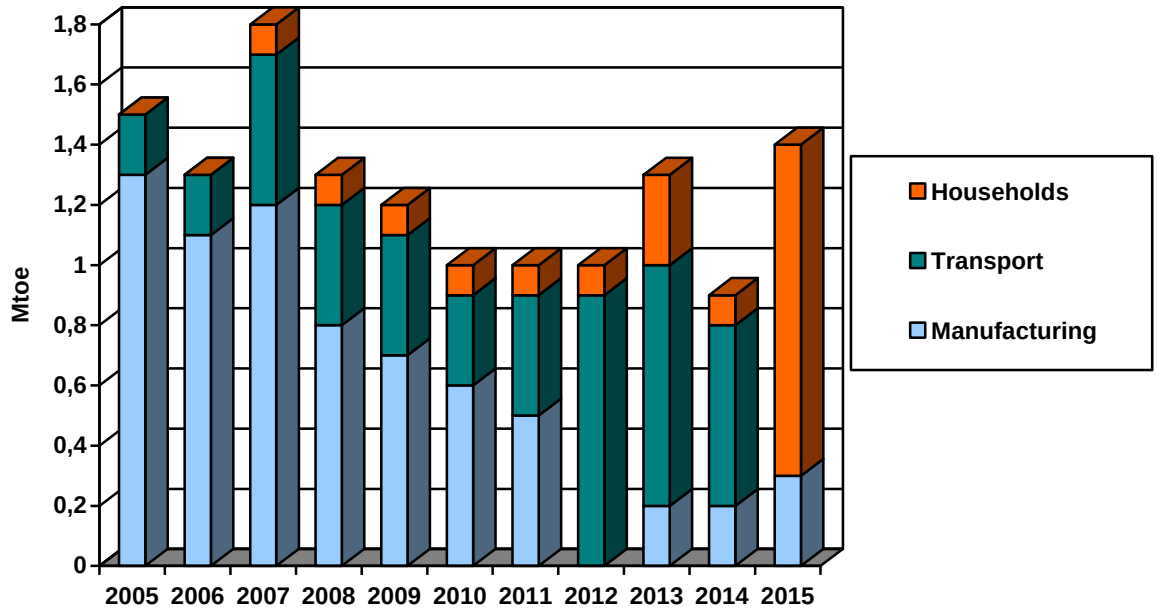


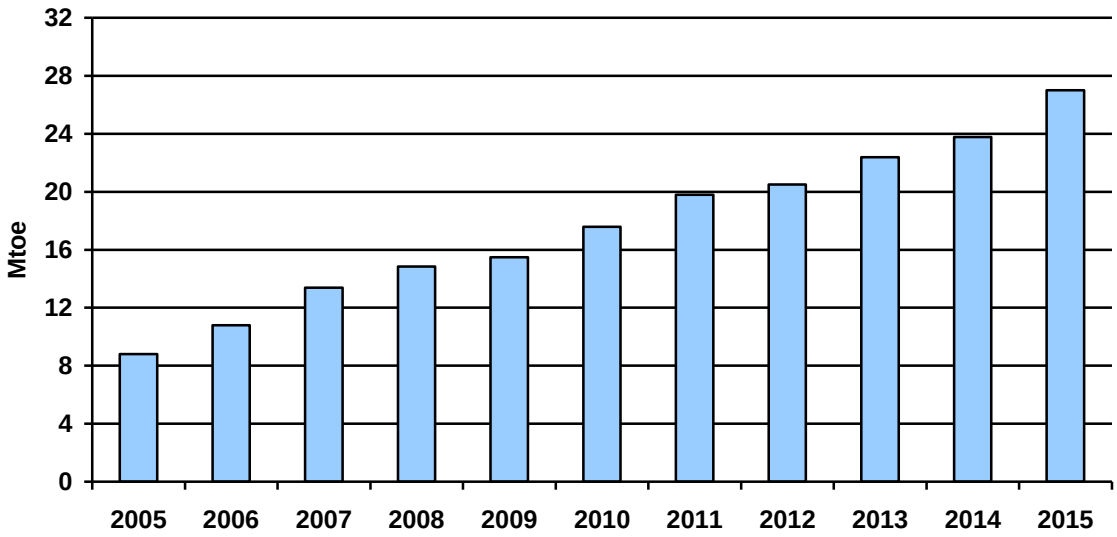
Figure 27 shows energy savings achieved in subsequent years in manufacturing, households and transport sector after 2000 calculated using ODEX indicators. Energy savings were achieved in all three sectors each year except for transport sector in 2015. The sum of energy savings amounted usually to around 1 Mtoe, with small tendency to decrease.

Figure 27. Annual energy savings



The energy savings since year 2000, showing as far as energy consumption would be higher in a given year if improvements in scope of energy efficiency had not been introduced after 2000, amounted in 2015 to 27.0 Mtoe. This result takes into account also the savings achieved by the sectors covered by the European Emissions Trading Scheme (ETS). Energy savings in the long term better show the accumulated amount of savings.

Figure 28. Energy savings since year 2000



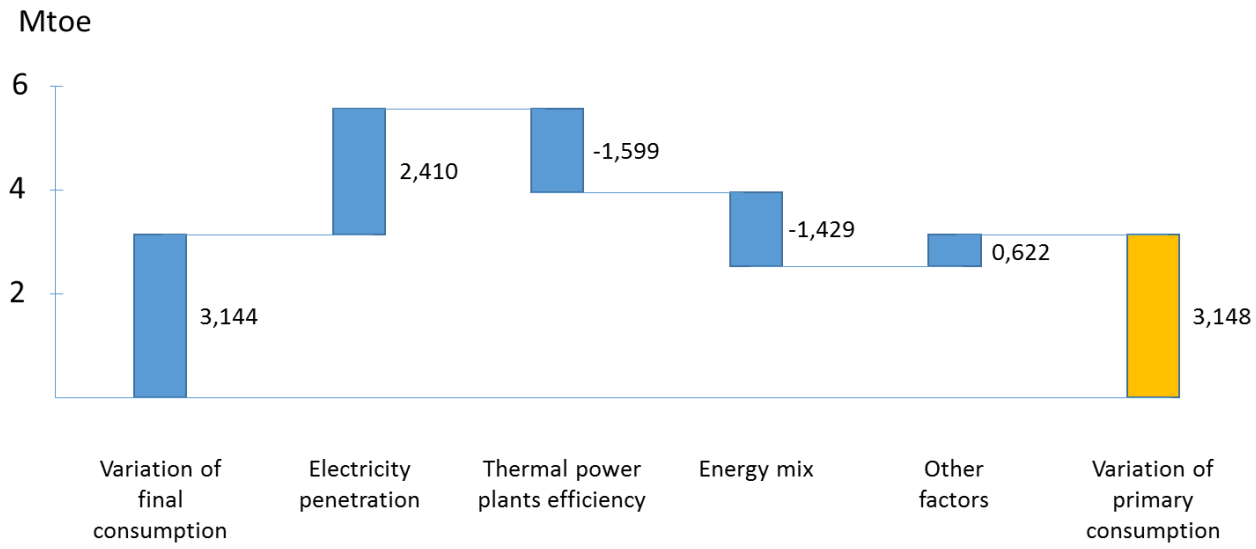
2.10. Decomposition of energy consumption

Total primary energy consumption increased by 3.1 Mtoe between 2005 and 2015. This growth of consumption was influenced by: an increase in final energy consumption by 3.1 Mtoe and increased electricity production (mainly due to electricity generation growth by 5.1%), which caused an increase in primary energy demand of 2.4 Mtoe. Also other factors contributed to the increase of primary consumption (by 0.6 Mtoe).

In contrast, a reduction in primary energy demand was caused by improvement of the efficiency of thermal power plants (primary consumption down by 1.6 Mtoe), and bigger use of renewable energy (down by 1.4 Mtoe).

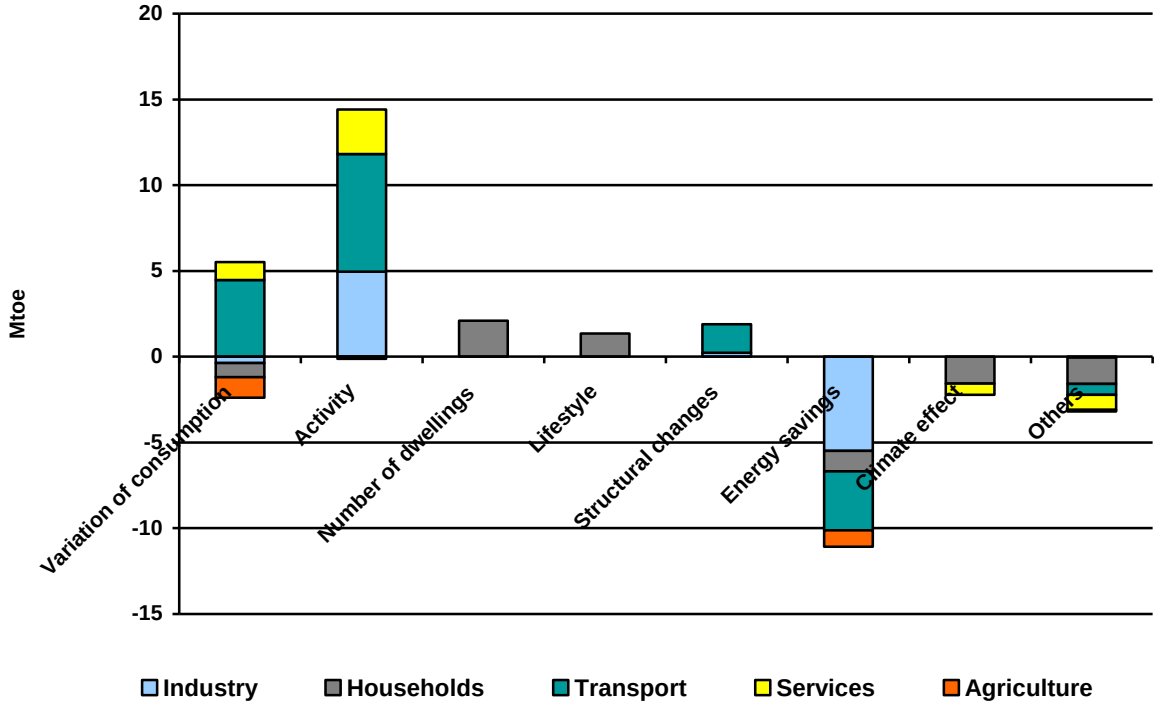
The figure below shows the decomposition of primary energy consumption driving forces, on the basis of the above mentioned factors.

Figure 29. Impact of selected factors on total primary energy consumption in years 2005-2015



In case of final consumption, the factors that have an impact on consumption in different sectors were selected. These are: activity, housing resources, lifestyle, structural changes, energy savings resulting from efficiency improvement of end-users, weather conditions and other factors. Pooled results illustrate the impact on final consumption, as shown on the figure 30.

Figure 30. Impact of selected factors on final energy consumption in years 2005-2015



Energy consumption in industry slightly decreased between 2005 and 2015. Growth of activity contributed to growth of final energy consumption by 5.0 Mtoe, while energy efficiency improvement caused decline of energy consumption by 5.5 Mtoe. Structural changes which contributed to the growth of consumption and other factors (mainly the difference between the increase in activity measured by value added and production index) which resulted in the decline had smaller impact.

In households, energy consumption between years 2005 and 2015 decreased by 0.8 Mtoe. The increase in stock of dwellings and lifestyle change (larger apartments) affected the increase in consumption by 2.1 and 1.4 Mtoe respectively. Weather conditions contributed to a reduction in energy consumption by 1.6 Mtoe. In addition, a reduction in consumption was affected by the improvement of energy efficiency (1.2 Mtoe) and other factors (1.5 Mtoe).

In transport sector occurred the greatest increase in energy consumption (4.5 Mtoe). Increase in activity and structural changes (increase in the share of road transport) have contributed to that growth. Energy savings have reduced consumption by 3.4 Mtoe.

In services sector growth of consumption amounted to 0.1 Mtoe. An increase in activity resulted in the growth of consumption by 2.6 Mtoe. There was no improvement in energy efficiency observed. Increase in productivity (value added per capita) of employed in this sector and weather conditions reduced energy consumption.

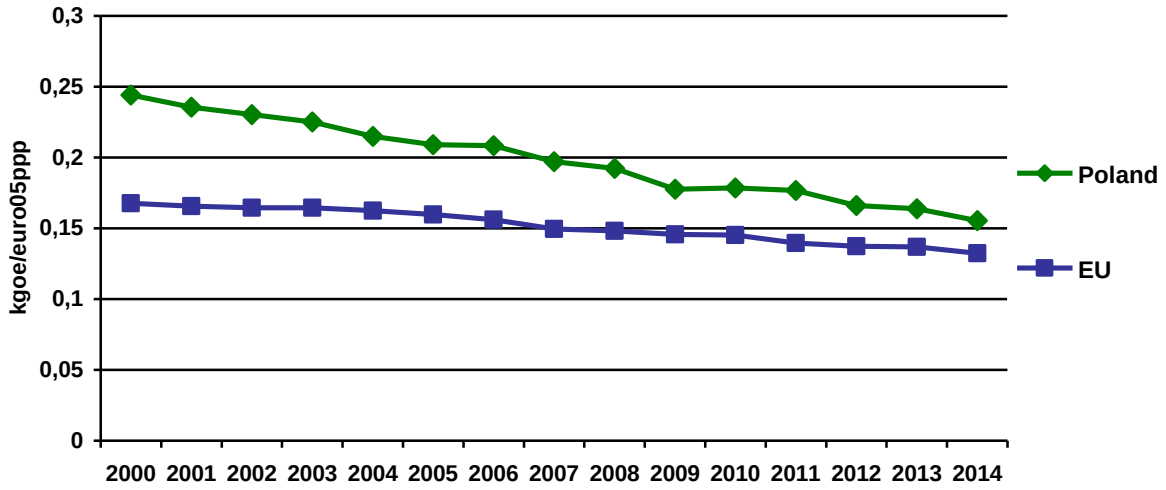
In the agricultural sector decline in consumption by 1.2 Mtoe was achieved mostly due to the energy savings (1.0 Mtoe). Decreasing activity lowered consumption by 0.1 Mtoe, similary as other factors.

Summary data are presented in tabular part.

2.11. Poland against a background of other EU countries

Primary intensity of GDP at constant prices and purchasing power parity (base year 2005) amounted in Poland in 2014 to 0.156 koe/euro05ppp and was 17% higher than European average. This difference fell by 28 percentage points compared to the year 2000. The rate of improvement of energy intensity in Poland (3.2%/year) was in years 2000-2014 almost twice higher than in the European Union (1.7%/year).

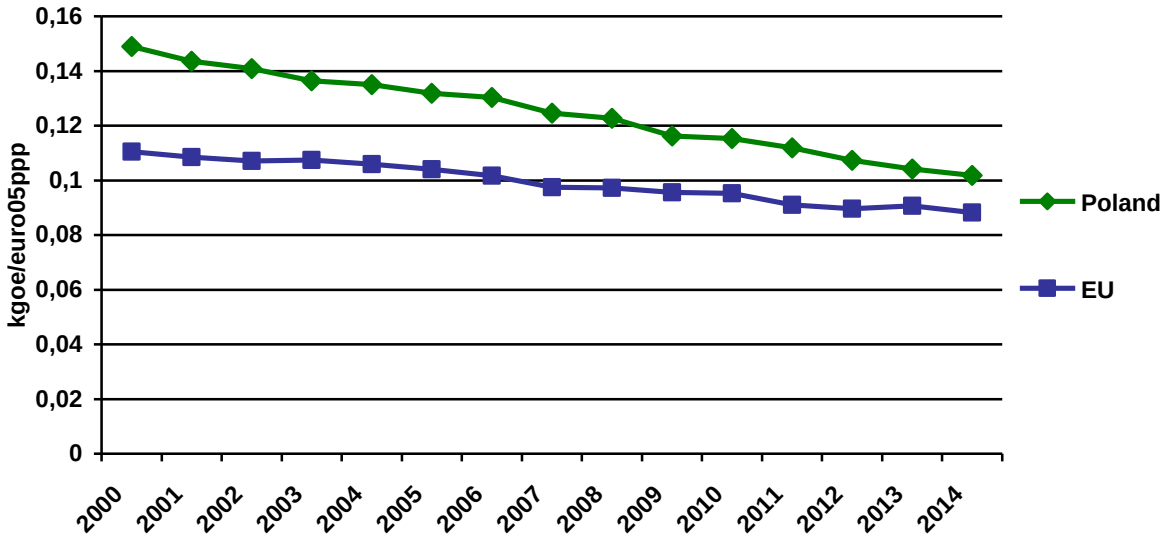
Figure 31. Primary intensity of GDP with climatic correction (euro05, ppp)



Source: Odyssee database, www.odyssee-mure.eu

In case of final energy intensity difference is smaller and amounted in 2014 to 11% between Poland (0.102) and EU average (0.088). The difference between rate of improvement which amounted in year 2000-2014 to 2.7%/year for Poland and 1.6%/year for European average is also smaller in comparison with primary intensity achievements.

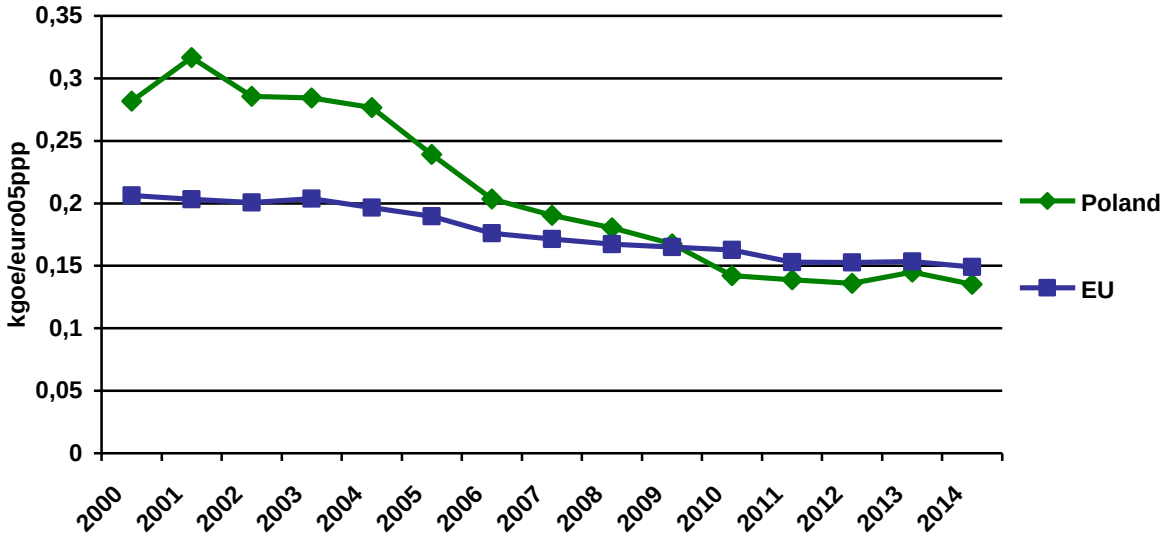
Figure 32. Final intensity of GDP with climatic correction (euro05, ppp)



Source: Odyssee database, www.odyssee-mure.eu

The rate of improvement of energy intensity in manufacturing in Poland also exceeded the European average and amounted to 5.1%/year, compared with 2.3%/year achieved by the whole EU (calculated at the average structure in Europe; indicator eliminates most of the differences resulting from different industrial structure among the countries). Despite lower energy intensity than in the European Union, the rate of improvement in Poland is still higher.

Figure 33. Energy intensity of manufacturing at average European structure (euro05, ppp)

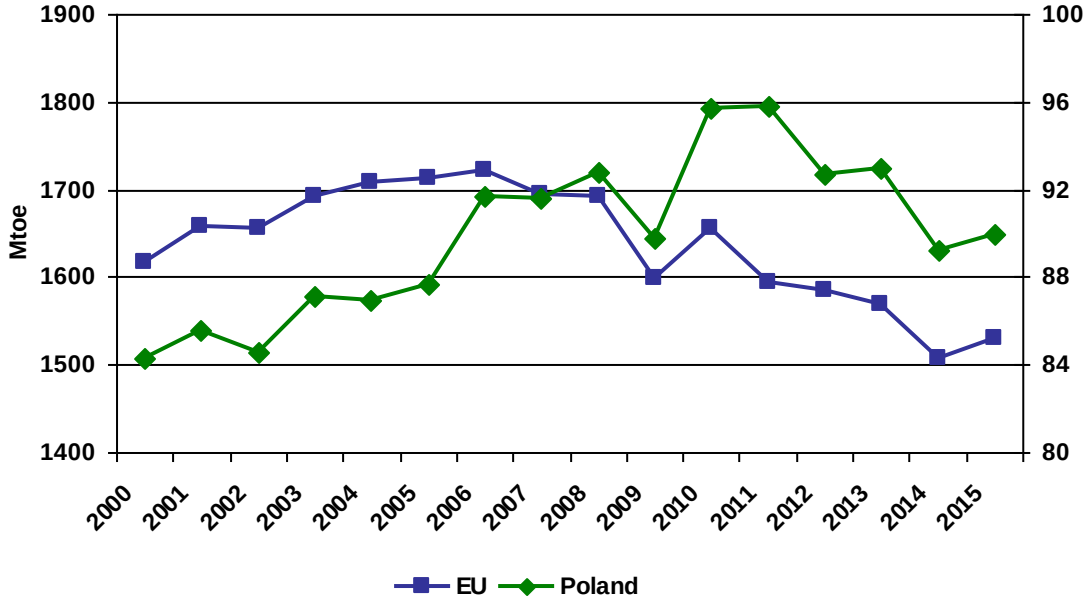


Source: Odyssee database, www.odyssee-mure.eu

For the purpose of monitoring of the Europe 2020 Strategy currently is used indicator of "Primary energy consumption". It is defined according do Directive 2012/27/EU as gross

inland consumption excluding all non-energy use of energy carriers. Values for the Poland in year 2015 amounted to 90.0 Mtoe and remains below target for year 2020 (96.4 Mtoe).

Figure 34. Primary energy consumption



Source: Eurostat

3. Energy efficiency Policy and measures towards its improvement

3.1. EU Energy Efficiency Policy

The European Union is actually establishing targets for consecutive years beyond 2020 in a range of climate protection, increase energy efficiency and using renewable energy sources. These goals were suggested under discussion on so called “winter package”.

At the present moment, the energy and climate package which was published in January 2008 is implementing, according to which Member States are required to:

- Reduce CO_2 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 obliged 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.

3.2. 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 such plans was required by Directive 2006/32/WE and 2012/27/UE.

NEEAP 3 adopted in 2014 reviews the energy efficiency improvement targets achieved, presents targets for 2020 and updates the measures and means planned of their achievement.

With regard to regulation, the Energy Efficiency Act (Official Journal 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 above Act was replaced by a new law from 20 May 2016 (Official Journal, pos. 8310) aimed at further improvements to the energy efficiency of the Polish economy and ensuring the achievement of national energy efficiency target. New Act on energy efficiency entered into force on 1st October 2016

The new 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 new Act preserves the energy efficiency certification system (white certificate scheme), functioning since 2013. One of the provisions 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, is supposed to support the carrying out of such investments. The new system makes it possible to apply for funds only for planned investments.

3.3. National energy efficiency targets and the energy savings achieved[6]

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	
Reduction of primary energy consumption in the years 2010-2020 (Mtoe)	Final energy consumption (Mtoe)	Primary energy consumption (Mtoe)
13.6	71.6	96.4[7]

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 for under the country's energy policy.

3.4. Final energy consumption savings

Calculations were based on official statistic data GUS – 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 the „Recommendations on Measurement and Verification Methods in the Framework of Directive 2006/32/EC on Energy end-use Efficiency and Energy Services". Year 2007 was recommended by the European Commission, as the reference year. Based on the analysis of

[6] Cited in accordance with 3 KPD.

[7] According to Poland's benchmarks in the forecast for the European Commission (PRIMES - Baseline 2007) primary energy consumption is projected at 110 Mtoe in 2020, thus taking into account the reduction of energy consumption by 13.6 Mtoe, received: 110 Mtoe - 13, 6 Mtoe = 96.4 Mtoe.

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 energy savings calculation

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

- P1 defines specific energy consumption for households heating;
- M3 defines specific energy consumption, without electricity, in services;
- M4 defines specific electricity consumption in services;
- P8 defines energy consumption by cars per passenger per kilometer;
- P9 defines energy consumption in road goods 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 2004-2014" publication on account of adjustment made using data from 2010-2014.

Table 7 presents final energy savings achieved up to 2015 divided by energy end-use sector. Presented energy savings are related to the reference year, 2007.

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

Economy sector…...……	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Households……..	1.986	1.238	1.947	2.281	1.936	3.050
Services…….....	0	0	0.140	0.281	0.326	0.461
Industry……	1.660	2.146	2.317	2.146	2.618	3.116
Transport…….	1.165	1.334	3.078	5.417	5.500	5.312
Total…….	**4.811**	**4.719**	**7.341**	**9.844**	**10.054**	**11.477**

The table shows that savings of total final energy consumption in the years 2010 - 2015 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

	Target in final energy savings		Final energy savings achieved in 2010 and planned to achieve 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%	7.09	13.9

Table 7 shows, that both the size of the realized and planned final energy saving will exceed the calculated target.

3.5. 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*) - http://www.measures-odyssee-mure.eu/. The MURE database shows descriptions of realised, planned and finished 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 selected measures of energy efficiency improvement in Poland concerning particular sectors of the economy.

3.6. Measures in the public sector in Poland

Street and park lighting

The regional and operational programs of particular voivodships are primary and fundamental source of support in a range of street, road and park lighting. Almost all of them support efficient lighting.

Regional Operational Programs

Beyond the possibilities of support of measures for energy-saving street lighting, roads and parks, Regional Operational Programs also provide support of activities in framework of wide range of thermal modernization of public buildings, district heating connection, intelligent energy management (including energy audits), internal lighting and use of renewable energy sources. Division in the range of support from Regional Operational Programs and other operational programs on the national level for example: Infrastructure and Environment Operational Program (POIŚ) is defined by records – demarcation line.

Operational Program Infrastructure and Environment (POIŚ)

The main source of support for the energy efficiency of public buildings within the Operational Program Infrastructure and Environment 2014-2020, are measures: axis 1 Reducing of emission of the economy, including activity 1.3. Supporting energy efficiency in buildings and sub-activity: 1.3.1. Supporting energy efficiency in public buildings. Furthermore within the same axis 1 partial measures can be used to support the activities of comprehensive thermal modernization of public buildings using measure 1.7 comprehensive elimination of low emissions in the śląsko-dąbrowski conurbation within the framework of the implementation of comprehensive program in the Silesian voivodship. Individual projects implemented by individual beneficiaries will be correlated with the projects within the strategy of ZIT supported by the ROPs of the Silesian voivodship.

Programs realized by National Fund for Environmental Protection and Water Management (NFOŚiGW).

In framework of core business of the NFOŚiGW the support for measures of public institutions in the energy efficiency of public buildings is implemented within the context of the priority program Air Quality Improvement.

In presented above priority program is also implemented Part 1) Energy use of geothermal resources. In November 2016, the target of reducing primary energy consumption (both part

1) and 2)), by 2025, was estimated to be equal to 150 000 MWh/year, according to program assumptions.

The Energy Efficiency Improvement Program is also realized by NFOŚiGW. Part 1) LEMUR – Energy-efficient Public Buildings. On 29 June 2016 the Management Board of the National Fund for Environmental Protection and Water Management decided to finish with the day 30 June 2016 recruitment for applications for co-financing within this program. Applications will be examined under the new name: Improvement of air quality. Part 4) LEMUR - Energy-efficient Public Buildings[8].

Norway Grants and European Economic Area (EOG).

Funds for public buildings thermal modernization are planned in implemented program by the end of 2016, in framework of Financial Mechanism EOG during 2009 – 2014 activity number 5 – energetic efficiency and activity number 6 – renewable energy.

3.7. Improving energy efficiency in the industrial sector

The energy efficiency obligation scheme in the form of energy efficiency certificates (white certificates)

The white certificate system is horizontal support focusing on the industry sector.

The energy efficiency obligation scheme was introduced on the basis of the Energy Efficiency Act of 15 April 2011 (Official Journal: No. 94, item 551; and of 2012, items 951, 1203 and 1397), hereinafter referred to as „the Act". The scheme has been operating since 1 January 2013. The Act requires energy sales companies which sell energy to final customers to obtain energy efficiency certificates, hereinafter referred to as „white certificates", and submit those certificates for redemption to the President of the Energy Regulatory Office, hereafter referred to as the „President of ERO".

Pursuant to Article 25 of the Act, the energy efficiency certificates are a source of transferable property rights which constitute a commodity tradable on commodity exchanges, as understood under the Act of 26 October 2000 on commodity exchanges (Official Journal of 2014, item 197), and are thus tradable at the Power Exchange. According to the 2011 act, projects were selected by way of tender organized by president of ERO. The successful winners are those entities which declare the largest energy savings compared to the value of energy efficiency certificates obtained.

[8] https://www.nfosigw.gov.pl/oferta-finansowania/srodki-krajowe/programy-priorytetowe/lemur-energooszczedne-budynki-uzytecznosci-publicznej
(view 14.10.2016)

The first tender to select energy efficiency improvement projects for which energy efficiency certificates could be obtained was announced by the President of ERO on 31 December 2012, and covered the following three categories:

- increase in energy savings by final customers,
- increase in energy savings by devices operated to meet own needs, which were understood as a set of auxiliary facilities or installations used for electricity or heat generation process,
- reduction of transmission losses or distribution losses of electricity, heat or natural gas.

Under the scheme, companies subject to the energy efficiency obligation have to obtain certificates with a specific value and present those certificates for redemption each year starting from 2013. The certificates' value and the method of its calculation is set out in the Regulation of the Minister of Economy of 4 September 2012 on the method of calculating primary energy amount corresponding to the value of an energy performance certificate, and on the unit value of the substitution fee (Official Journal, item 1039).

Until 2017 five tenders were closed:

- The First tender (announcement of President of ERO No. 1/2012 from 31 December 2012) was decided on 31 August 2013. 102 offers were chosen out of 212, with a pool of certificates equivalent to 550000 toe. The first tender awarded energy efficiency certificates of value 20.5 ktoe, which is 3.8% of the available pool of 550 ktoe.

- The Second tender (announcement of President of ERO No. 1/2013 from 27 December 2013) was decided on 29 October 2014. 302 offers were chosen out of 383, with a pool of certificates equivalent to 57 180.74 toe, 4.2% out of the 1 368 296 toe pool.

- The Third tender was announcement by President of ERO on 19 December 2014 and decided on 21 October 2015. The results were announced on 7 November 2015 from which it follows that from 736 offers, 502 were chosen, equivalent to 149 886.169 toe from the available pool of 2 179 481 toe, which represents 6.9%.

- On December 29, 2015. President of ERO announced fourth tender for choice of projects to improve energy efficiency, with the submission of tenders on 28 January 2016.

Under the new rules since 1 October 2016, applications for white certificates can be submitted on a continuous basis.

The act of 29 December 2015 amending the Energy Efficiency Act prolonged the functioning of the pro-efficiency investment support system in 2016. The fifth tender for the white certificates was the last one running on the old rules. It was possibility to submit applications for projects completed after the first of January 2011 in this tender. It was the last chance for entrepreneurs who have not used the white certificate system yet and have made their own investments without using state budget assistance.

Amendment of the Act on Energy Efficiency – most important changes

The new Energy Activity Act of 2016 abolished the obligation to conduct the tender, as a result the President makes the choice of measures for improving energy efficiency for which you can achieve energy efficiency certificates. The aim was to simplify the procedure for issuing energy efficiency certificates.

The new law introduces changes to the method of accounting for energy savings based on final energy rather than how it was before – primary energy.

Legislative changes also enable to participate in the system of white certificates to entities that were excluded from the tender by the system EU-ETS. It has been estimated that in the area of EU-ETS sector in 2016-2020, final energy value saved as a result of the investment can be up to 2.645 Mtoe.

The regulatory changes to the white certificate system are compiled below:

Energy Efficiency Act obligatory during the period: 15.04.2011 - 30.09.2016	**Energy Efficiency Act obligatory since 01.10.2016:**
The tender announced once a year by the President of ERO.	Continuous recruitment of applications, decision within 45 days.
Energy effect calculated on the basis of primary energy.	Energy effect calculated on the basis of final energy.
No possibility of applying for white certificates in case of investments covered by ETS.	Possibility of applying for white certificates in case of investments covered by ETS.
Projects ended after 1 January 2011 can be proposed.	Planned projects can be proposed.
Substitute fee 1000 zł/toe.	Substitute fee in 2017 1500 zł/toe, then valorisation 5 % every year.

Obligatory energy audit

Important change in the regulations that came into force with the amendment of the Energy Efficiency Act is obligation to perform energy audits for large enterprises, covering minimum 90 % of energy consumption (all carriers), including transport.

By performing an energy audit, the company is informed about potential energy savings. Audit results are used to analysis and control. The audit report may be subject to review by the President of ERO. According to the directive 2012/27/UE – "Minimum criteria for energy audits including audits carried out within energy management systems" and article 37 of the Energy Efficiency Act from 20 May 2016 – energy audits are based on the following guidelines:

- Audit should be based on current, representative, measured and identifiable data on energy consumption and in case of electricity – power demand.
- Audit includes detailed overview of energy consumption in buildings or building complex, in industrial installations and transport, representing at least 90% of total energy consumption by the company.
- Audit should be based as much as possible on cost analysis of the building life cycle or building complex and industrial installations, rather than return period of investments, as to take into account energy savings in the long-term, residual values of long-term investments and discount rates.

3.8.. Measures to improve Energy efficiency in residential sector

Support for investments in energy efficiency of buildings is provided based on the Act of 21 November 2008 on support for thermal modernisation and renovation of buildings.

Thermal Modernisation and Renovation Fund, funded from the state budget, is a support program for thermal modernisations and related renovation measures carried out in old multi-family residential buildings. In its current form the programme is being implemented since 2009. The Fund's resources were allocated for partial re-financing of the costs of thermal modernisation and renovation projects aimed at improving the technical condition of the existing housing stock and reducing its heat demand.

Thermal Modernization and Renovation fund

The purpose of the program is financial assistance for investors implementing thermal modernisation, renovation projects of single family dwellings with credits taken in commercial banks.

Target of the thermal modernisation projects is:

- Reduction of energy consumption for space heating and domestic hot water in residential buildings, collective residence and owned by local government units, which serves to perform their public tasks.
- Reduction of cost obtaining heat supplied to above mentioned buildings – as a result of the technical connection to centralized heat source due to liquidation of the local heat source.
- Reduction of primary energy losses in local heating networks and local and supplying them local heat sources.
- Total or partial change of energy sources to renewable sources or application of high-efficient cogeneration.

Table 9 shows energy savings for 2015 with forecast for 2020.

Table. 9 Energy savings within Thermal Modernization and Renovation Fund[9][10]

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy savings [GWh]	3 765	4 283	4 801	5 321	5 584	6 246	6 863	7 379	7 895	8 411	8 928	9 444

Within the framework of buildings energy efficiency improvement, including residential buildings, activities were taken, among others, to set the minimal requirements in energy savings and thermal insulation, along with outlining a path for meeting the requirements which have to be fulfilled until 2021, when new build buildings should be characterized by almost zero energy consumption – Ordinance of the Minister of Transport, Building and Sea Economy from 5 July 2013, changing Regulation on the technical requirements, which should be met by buildings and their location.

[9] In the years 2013-2015, energy savings were calculated on the basis of the number of thermo-modernization bonuses granted

[10] In the years 2016-2020 the annual increase in final energy were assumed at 516 GWh, which is the average of 2009-2015

4. Summary

Increasing the energy efficiency of the processes of generation, transmission and use of energy is a pillar of a sustainable energy policy. This is reflected in legislation and actions undertaken by national and EU institutions. Directive 2012/27/EU of 25 October 2012 on energy efficiency, adopted in order to increase efforts in this area obliges EU Member States to introduce instruments to improve energy efficiency for achieving the target of 20% savings in primary energy consumption by 2020. In case of Poland target of primary energy consumption was set at 96.4 Mtoe. The implementation of the directive into national law is a law on energy efficiency of 20 May 2016.

In Poland in the years 2005-2015 consistent improvement of energy efficiency took place. Primary and final energy intensities were decreasing in this period by more than 3% per year. The fastest rate of energy efficiency improvement was recorded in the industrial sector. Despite fast energy efficiency improvement primary energy consumption grew, remaining however below projected path.

Among the pro-efficiency measures most significant are projects supported by national funds through environmental funds and from the European Union Cohesion Fund within the framework of Regional Operational Programs and the Operational Program Infrastructure and Environment. Stimulating for improvement of energy efficiency in industry is a modified "white certificate" system implemented by the law on energy efficiency. The information and education campaigns of the National Fund for Environmental Protection and Water Management and, for example, of the Ministry of Energy raise awareness and knowledge on energy efficiency improvement options and serve practical help to citizens and institutions.

The necessity of monitoring the effects of measures to improve energy efficiency, the pursuit of harmonization and making international comparisons, force changes in the process of collection of statistical data, ie. extending the subject and object scope of surveys in official statistics and the availability of administrative data sources.

TABLES

Table 1. Energy consumption and intensity of GDP

No.	Specification	Unit	2005	2006	2007
1	Total primary energy consumption…….	Mtoe	92,0	96,9	97,1
2	Total primary energy consumption with climatic correction……	Mtoe	92,3	97,7	99,1
3	Final energy consumption ……..	Mtoe	57,9	60,6	60,3
4	Final energy consumption with climatic correction…….	Mtoe	58,2	61,4	62,3
5	Primary energy intensity of GDP……..	kgoe/euro00	0,424	0,421	0,394
6	Primary energy intensity of GDP with climatic correction ……	kgoe/euro00	0,426	0,425	0,402
7	Final energy intensity of GDP…..……	kgoe/euro00	0,267	0,263	0,245
8	Final energy intensity of GDP with climatic correction……...	kgoe/euro00	0,269	0,267	0,253

Table 2. Energy intensity of industry branches

No.	Specification	Unit	2005	2006	2007
1	Food.....	kgoe/euro05	0.271	0.233	0.232
2	Textile.....	kgoe/euro05	0.151	0.118	0.096
3	Wood.....	kgoe/euro05	0.479	0.421	0.337
4	Paper.....	kgoe/euro05	0.587	0.545	0.419
5	Chemical.....	kgoe/euro05	1.069	0.940	0.863
6	Mineral.....	kgoe/euro05	0.943	0.788	0.802
7	Primary metals.....	kgoe/euro05	1.907	1.642	1.603
8	Machinery.....	kgoe/euro05	0.079	0.060	0.047
9	Transport equipment.....	kgoe/euro05	0.108	0.093	0.086
10	Other.....	kgoe/euro05	0.119	0.115	0.096
11	Manufacturing…….	kgoe/euro05	0.356	0.306	0.276

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
98.1	94.3	100.5	101.5	98.1	97.7	93.8	95.1	1
100.5	95.2	99.2	103.0	98.4	98.3	96.5	97.6	2
61.6	60.6	65.2	63.7	63.2	62.0	60.4	61.1	3
64.0	61.5	63.9	65.3	63.6	62.5	63.1	63.6	4
0.383	0.358	0.368	0.354	0.337	0.331	0.307	0.300	5
0.392	0.361	0.363	0.359	0.338	0.333	0.316	0.308	6
0.240	0.230	0.239	0.222	0.217	0.210	0.198	0.192	7
0.250	0.233	0.234	0.228	0.218	0.212	0.207	0.201	8

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
0.209	0.189	0.192	0.190	0.191	0.183	0.181	0.167	1
0.080	0.065	0.059	0.048	0.047	0.052	0.049	0.045	2
0.344	0.331	0.375	0.352	0.357	0.416	0.360	0.364	3
0.459	0.422	0.413	0.382	0.374	0.448	0.413	0.405	4
0.819	0.799	0.783	0.827	0.781	0.838	0.742	0.668	5
0.750	0.740	0.636	0.618	0.599	0.571	0.506	0.451	6
1.579	0.905	1.077	1.054	1.049	1.172	1.057	1.135	7
0.037	0.034	0.031	0.028	0.026	0.029	0.025	0.025	8
0.072	0.061	0.052	0.044	0.043	0.047	0.043	0.041	9
0.084	0.068	0.067	0.072	0.066	0.079	0.075	0.070	10
0.238	0.214	0.206	0.199	0.189	0.195	0.180	0.167	11

Table 3. Energy intensity of production

No.	Specification	Unit	2005	2006	2007
1	Steel.……	toe/t	0,257	0,234	0,222
2	Cement..……....	toe/t	0,103	0,109	0,098
3	Paper..…….……	toe/t	0,573	0,552	0,533

Table 4. Energy efficiency indicators in households sector

No.	Specification	Unit	2005	2006	2007
1	Energy consumption per dwelling.....	toe/dwelling	1,541	1,623	1,497
2	Energy consumption per dwelling with climatic correction.....	toe/dwelling	1,560	1,671	1,609
3	Energy consumption per m^2.....	kgoe/m^2	22,2	23,4	21,4
4	Energy consumption per m^2 with climatic correction.....	kgoe/m^2	22,5	24,0	23,1
5	Energy consumption for heating per m^2.....	kgoe/m^2	15,6	16,6	15,0
6	Energy consumption for heating per m^2 with climatic correction.....	kgoe/m^2	15,9	17,3	16,6
7	Electricity consumption per dwelling.....	kWh/dwelling	1976,6	2055,4	2029,4

Table 5. Energy efficiency indicators in service sector

No.	Specification	Unit	2005	2006	2007
1	Energy intensity.....	kgoe/euro05	0.049	0.051	0.047
2	Energy intensity with climatic correction.....	kgoe/euro05	0.049	0.052	0.050
3	Electricity intensity.....	Wh/euro05	241.3	252.9	241.2
4	Energy consumption per employee.....	toe/emp.	0.936	0.999	0.931
5	Energy consumption per employee with climatic correction.....	toe/emp.	0.948	1.028	1.001
6	Electricity consumption per employee.....	kWh/emp.	4625.0	4974.2	4829.9

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
0.208	0.195	0.196	0.195	0.205	0.208	0.197	0.188	1
0.088	0.090	0.095	0.093	0.087	0.094	0.095	0.091	2
0.556	0.468	0.438	0.448	0.455	0.514	0.479	0.506	3

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
1.496	1.501	1.621	1.479	1.511	1.473	1.355	1.336	1
1.626	1.549	1.549	1.561	1.528	1.502	1.490	1.463	2
21.3	21.3	22.4	20.4	20.7	20.1	18.5	18.1	3
23.2	22.0	21.4	21.5	21.0	20.5	20.3	19.9	4
14.9	14.9	15.8	14.3	14.6	14.1	12.8	11.9	5
16.8	15.6	14.9	15.4	14.8	14.5	14.7	13.6	6
2061.9	2069.9	2124.3	2079.8	2063.5	2053.1	2008.4	2003.0	7

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
0.050	0.049	0.053	0.049	0.047	0.044	0.042	0.041	1
0.054	0.050	0.050	0.051	0.047	0.045	0.046	0.045	2
256.7	245.5	259.9	256.0	251.0	238.3	244.3	238.9	3
1.003	1.017	1.110	1.044	1.025	0.981	0.925	0.907	4
1.091	1.050	1.061	1.102	1.037	1.001	1.017	0.993	5
5165.6	5144.4	5488.8	5502.1	5506.6	5270.7	5375.8	5283.6	6

Table 6. Energy efficiency indicators in transport and energy sector

No.	Specification	Unit	2005	2006	2007
1	Fuel consumption per equivalent car……..	toe/eq. car	0,496	0,514	0,532
2	Energy intensity of private cars……..….	goe/p·km	32,1	37,6	40,1
3	Energy intensity of trucks……....	goe/t·km	46,8	42,6	40,5
4	Energy intensity of passenger rail transport ...	goe/p·km	5,1	4,3	4,4
5	Energy intensity of freight rail transport …….	goe/t·km	7,5	6,3	6,4
6	Efficiency of heat plants……...	%	77,3	77,7	77,0

Table 7. ODEX indicator

No.	Specification	Unit	2005	2006	2007
1	Manufacturing.....	2000=100	71,3	66,3	61,3
2	Transport.....	2000=100	96,6	95,4	92,2
3	Households.....	2000=100	83,9	83,9	83,6
4	Global ODEX.....	2000=100	83,2	81,6	79,0

Table 8. Selected indicators for Poland and the EU (kgoe/euro2005ppp)

No.	Specification		2004	2005	2006
1	Primary energy intensity of GDP with climatic correction	Poland	0.215	0.209	0.208
		EU	0.162	0.160	0.156
2	Final energy intensity of GDP with climatic correction	Poland	0.135	0.132	0.130
		EU	0.106	0.104	0.102
3	Energy intensity of manufacturing at average European structure	Poland	0.277	0.239	0.204
		EU	0.197	0.190	0.176

Source: Odyssee

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
0.518	0.523	0.529	0.511	0.477	0.432	0.428	0.438	1
40.7	40.3	41.1	39.6	36.7	34.3	34.1	35.3	2
38.6	36.2	35.1	34.9	30.4	24.4	24.6	25.0	3
4.1	4.5	4.3	4.0	4.0	3.8	3.6	3.5	4
6.1	6.6	6.4	5.8	5.8	5.6	5.3	5.2	5
79.2	80.2	81.0	81.1	81.1	81.4	81.6	81.8	6

2008	2009	2010	2011	2012	2013	2014	2015	Lp.
57.8	54.8	52.5	50.7	50.6	50.0	49.2	48.1	1
89.7	87.7	86.2	84.0	79.6	75.4	72.8	72.8	2
83.2	82.8	82.1	81.8	81.5	79.9	79.7	75.1	3
77.6	76.4	74.9	73.4	71.5	68.9	67.8	66.8	4

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
0.197	0.192	0.178	0.178	0.177	0.166	0.164	0.156	1
0.150	0.148	0.146	0.145	0.140	0.137	0.137	0.132	
0.125	0.123	0.116	0.115	0.112	0.107	0.104	0.102	2
0.098	0.097	0.096	0.095	0.091	0.090	0.091	0.088	
0.191	0.181	0.168	0.142	0.139	0.136	0.145	0.135	3
0.171	0.167	0.165	0.163	0.153	0.153	0.154	0.149	

Table 9. Impact of selected factors on variation of final energy consumption in years 2005-2015 (Mtoe)

Specification	Industry	Households	Transport	Services	Agriculture	Total
Variation of final consumption……..	-0.4	-0.8	4.5	1.0	-1.2	3.1
FACTORS						
Activity……...	5.0	–	6.9	2.6	-0.1	14.3
Number of dwellings…….....	–	2.1	–	–	–	2.1
Lifestyle..…….	–	1.4	–	–	–	1.4
Structural changes	0.2	–	1.7	–	–	1.9
Energy savings…..	-5.5	-1.2	-3.4	0.0	-1.0	-11.1
Climate effect…….	–	-1.6	–	-0.7	–	-2.2
Other……..	-0.1	-1.5	-0.6	-0.9	-0.1	-3.2

Attachment. EU documents concerning issues related to energy efficiency

List of legal acts

1) *Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC.*
2. *Directive 2010/30/EU of the European Parliament and of the of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products.*
3. *Commission Delegated Regulation (EU) No 1059/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household dishwashers.*
4. *Commission Delegated Regulation (EU) No 1060/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household refrigerating appliances.*
5. *Commission Delegated Regulation (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines.*
6. *Commission Delegated Regulation (EU) No 1062/2010 of 28 September 2010supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of televisions.*
7. *Commission Delegated Regulation (EU) No 626/2011 of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners.*
8. *Commission Delegated Regulation (EU) No 392/2012 of 1 March 2012 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household tumble driers.*
9. *Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers.*
10. *Council Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.*

11. *Commission Directive 2002/340/EC of 8 May 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric ovens.*
12. *Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.*
13. *Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast).*
14. *Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment.*
15. *Commission Regulation (EC) No 107/2009 of 4 February 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for simple set-top boxes.*
16. *Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps.*
17. *Commission Regulation (EC) No 245/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaries able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council.*
18. *Commission Regulation (EC) No 278/2009 of 6 April 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies.*
19. *Commission Regulation (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors.*
20. *Commission Regulation (EC) No 641/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products.*

21. *Commission Regulation (EC) No 642/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for televisions.*
22. *Commission Regulation (EC) No 643/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for household refrigerating appliances.*
23. *Commission Regulation (EC) No 859/2009 of 18 September 2009 amending Regulation (EC) No 244/2009 as regards the ecodesign requirements on ultraviolet radiation of non-directional household lamps.*
24. *Commission Regulation (EU) No 347/2010 of 21 April 2010 amending Commission Regulation (EC) No 245/2009 as regards the ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps.*
25. *Commission Regulation (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household washing machines.*
26. *Commission Regulation (EU) No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers.*
27. *Commission Regulation (EU) No 327/2011 of 30 March 2011 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.*
28. *Commission Regulation (EU) No 206/2012 of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans.*
29. *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.*
30. *Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.*
31. *Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics.*

32. *Commission Regulation (EU) No 147/2013 of 13 February 2013 amending Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, as regards the implementation of updates for the monthly and annual energy statistics.*
33. *Commission Regulation (EU) No 431/2014 of 24 April 2014 amending Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, as regards the implementation of annual statistics on energy consumption in households.*
34. *Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO 2 emissions from new passenger cars.*

Information and communications

1) *Green Paper for a European Union Energy Policy (1995).*
2) *Energy Charter Treaty and Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA).*
3) *White Paper Energy for the Future: RES.*
4) *Council Resolution on energy efficiency in the European Community (1998).*
5) *Action Plan to Improve Energy Efficiency in the European Community.*
6) *European Climate Change Programme (ECCP).*
7) *A sustainable Europe for a better world – A European Union strategy for sustainable development.*
8) *Green Paper - Towards a European Strategy for Energy Supply Security.*
9) *White Paper. European Transport Policy for 2010: Time to Decide.*
10) *EUROPE 2020 - A European strategy for smart, sustainable and inclusive growth.*
11) *White Paper. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system.*
12) *Energy Efficiency Plan 2011.*
13) *Green Paper. Lighting the Future - Accelerating the deployment of innovative lighting technologies.*
14) *Communication from the Commission to the European Parliament and the Council - Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy, COM(2014) 520 final.*