CENTRAL STATISTICAL OFFICE

ENERGY

EFFICIENCY IN POLAND

IN YEARS 2004-2014

Warsaw, 2016

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Cover	*Statistical Publishing Establishment*

ISSN: 1732-4939

Publication available on www.stat.gov.pl

Supported by

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FOREWORD

This publication is successive edition of the study "ENERGY EFFICIENCY" published by the Central Statistical Office (GUS) as part of the series entitled "Information and statistical papers".

The aim of this publication is to present global and sector energy efficiency indicators with their analysis.

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 2016

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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].

Currently used classification is the Polish Classification of Activities - PKD 2007 developed on the basis of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2). PKD 2007 was introduced with effect from 01.01.2008 by the Regulation of the Council of Ministers of 24 December 2007 (Journal of Laws No. 251, item. 1885) and replaced PKD 2004.

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

	NACE rev. 1.1	NACE rev. 2
Food	15-16	10-12
Textile	17-19	13-15
Wood	20	16
Paper	21-22	17-18
Chemical	24	20-21
Mineral	26	23
Primary metals	27	24
Machinery	28-32	25-28, 33
Transport equipment	34-35	29-30
Other	25, 33, 36-37	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. Since year 2010 heat includes only heat sold (before 2010 also heat from recovery used for heating purposes). Transformation in blast furnaces is calculated using real transformation efficiency.

[1] www.odyssee-mure.eu

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.

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:

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

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.

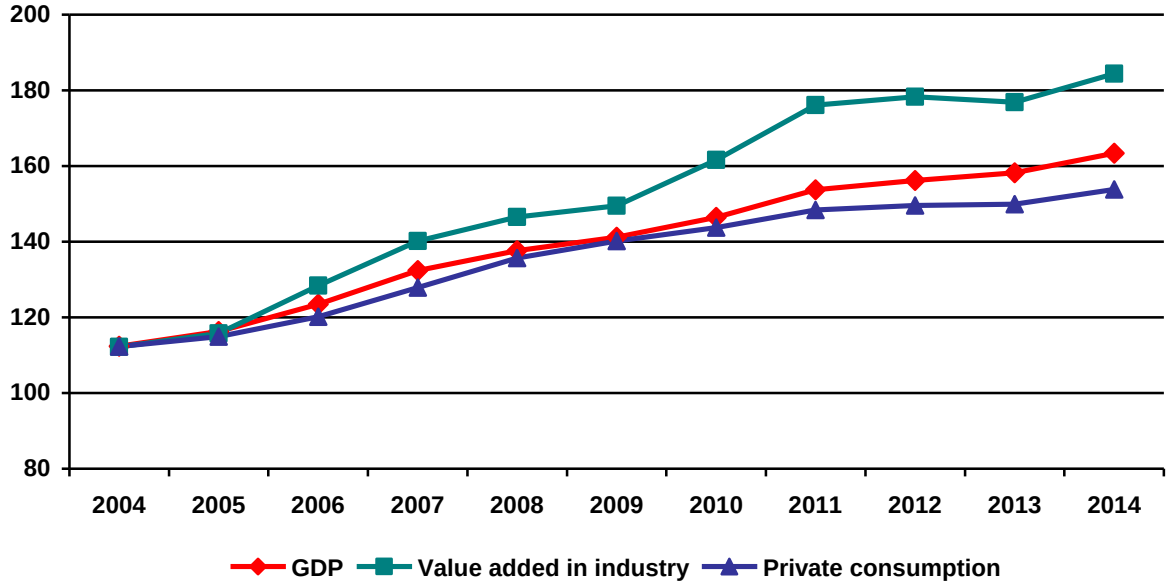
Energy efficiency index (ODEX) is calculated by aggregating the individual changes in energy consumption, observed on certain levels of end-use. ODEX indicator does not show the current level of energy intensity, but the improvement over the base year. ODEX is calculated for each year as the ratio of 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 2014 45% higher value than in 2004. The fastest rate of growth of value added at constant prices was recorded in industry. 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)



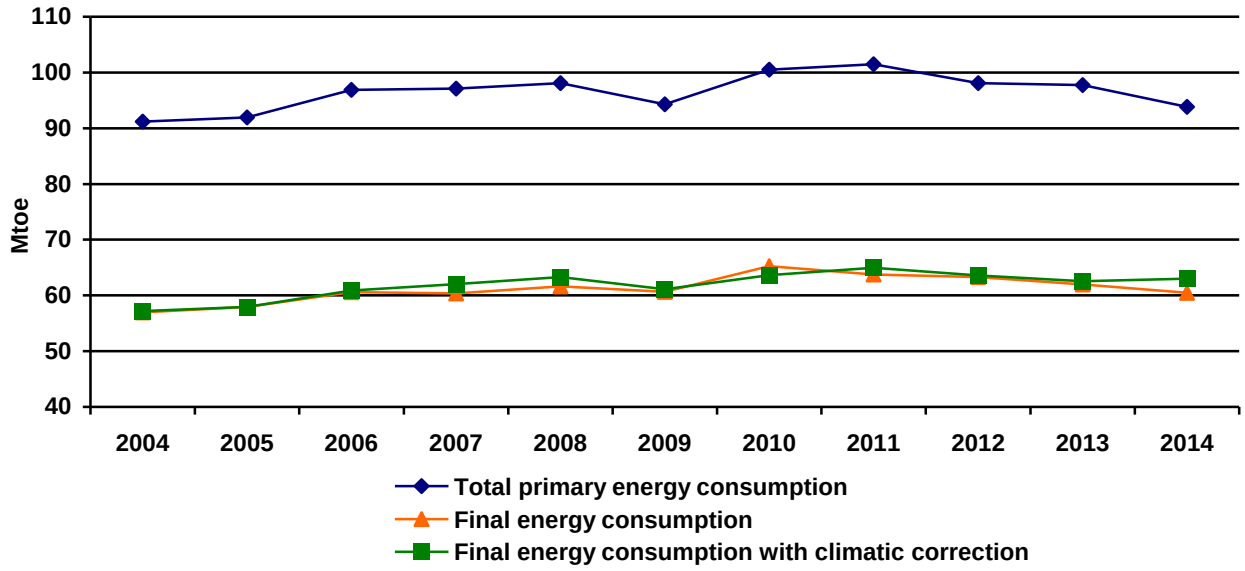
2.2 Energy consumption and prices of energy

Total primary energy consumption increased in years 2004-2014 from 91 Mtoe to nearly 94 Mtoe (0.3%/year). Consumption was increasing (except in 2009) until 2011, when it peaked during this period at the level over 101 Mtoe. From that moment, a decline in consumption is observed.

Final energy consumption has increased in presented period from 57 to more than 60 Mtoe, which means an average annual growth rate of 0.6%. In this case, the decrease in consumption was recorded in 2007, 2009 and after 2011. After taking into account different weather conditions, that is in case of final energy consumption with climatic correction consumption growth rate amounted to 1.0% in the period 2005-2014. Energy consumption with climatic correction determines the theoretical value of consumption for a given year, if

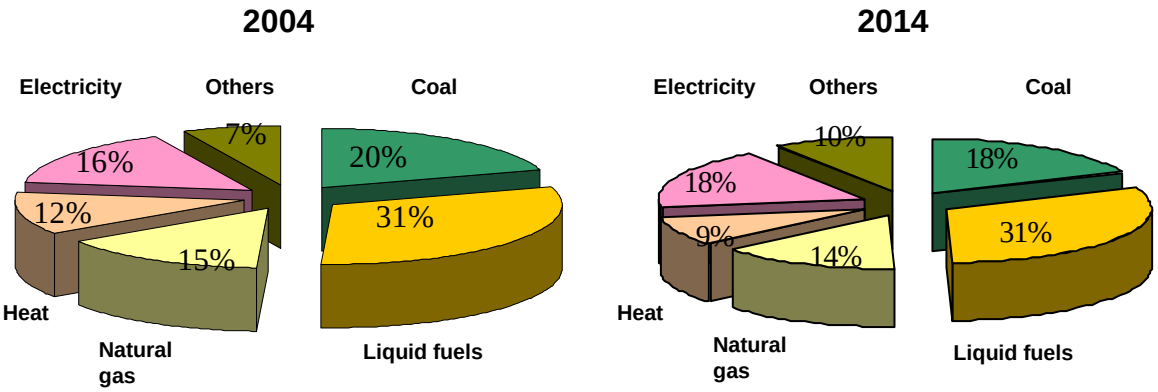
the weather conditions were in line with long-term average. That calculated final consumption in 2014 amounted to almost 63 Mtoe.

Figure 2. Total primary and final energy consumption



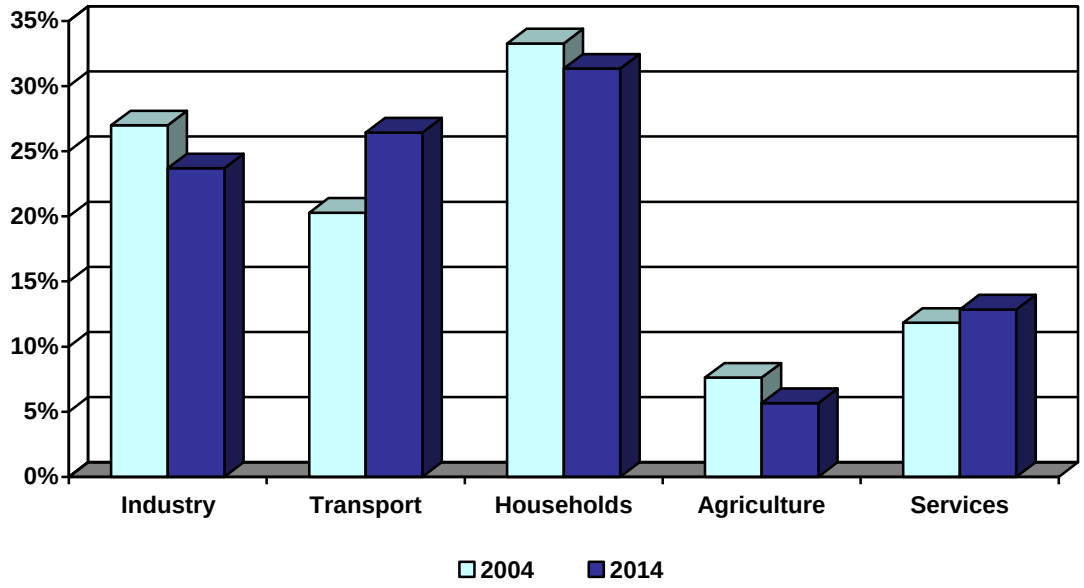
Existing country natural resources have a significant impact on the structure of fuels used in the economy. The main source of primary energy was and is hard coal and lignite. In case of final energy consumption, it is dominated by liquid fuels, which share amounted to 31% in 2004 and 2014 (Fig. 3). The share of coal in final energy consumption decreased from 20% in 2004 to 18% in 2014. A significant decrease, from 12% to 9% occurred in the use of heat, the share of gas was also reduced (from 15 to 14%). Significant growth was recorded in case of electricity - from 16 to 18% during this period and other energy sources - from 7 to 10%.

Figure 3. Final energy consumption by energy carrier



In years 2004-2014 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 20 to 26%, and services from 12 to 13%. Households remained the largest consumer, despite the decline in the share from 33 to 31%. The share of industry decreased from 27 to 24%, and agriculture from 8 to 6%. The biggest change occurred in the transport sector, which increased importance is related both to the growing role of road freight as well as passenger transport carried out in private cars.

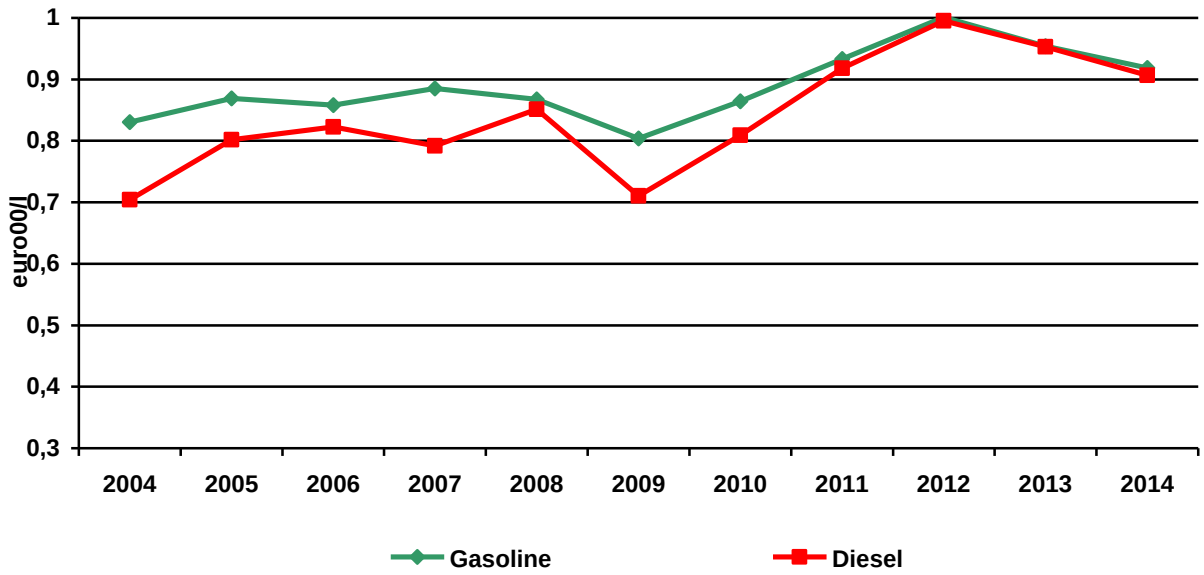
Figure 4. Final energy consumption by sectors



Gasoline prices fluctuated slightly between 2004 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 0.92 euro00/l in 2014.

Diesel prices in years 2004-2014, expressed in constant prices of 2000 showed higher volatility. The lowest price in this period occurred in 2004. and amounted to 0.70 euro00/l. By 2008, prices were showing rising trend, which finished in 2009 by a sharp drop to the level of 0.71 euro00/l. The decline was greater than in the case of gasoline, due to the fact that diesel plays greater role in economic activity, passing at the time the crisis in the world (Fig. 5). Then prices began to rise again reaching the highest level in 2012. In 2013 and 2014 the price of diesel fuel fell, and in 2014 amounted to 0.91 euro00/l.

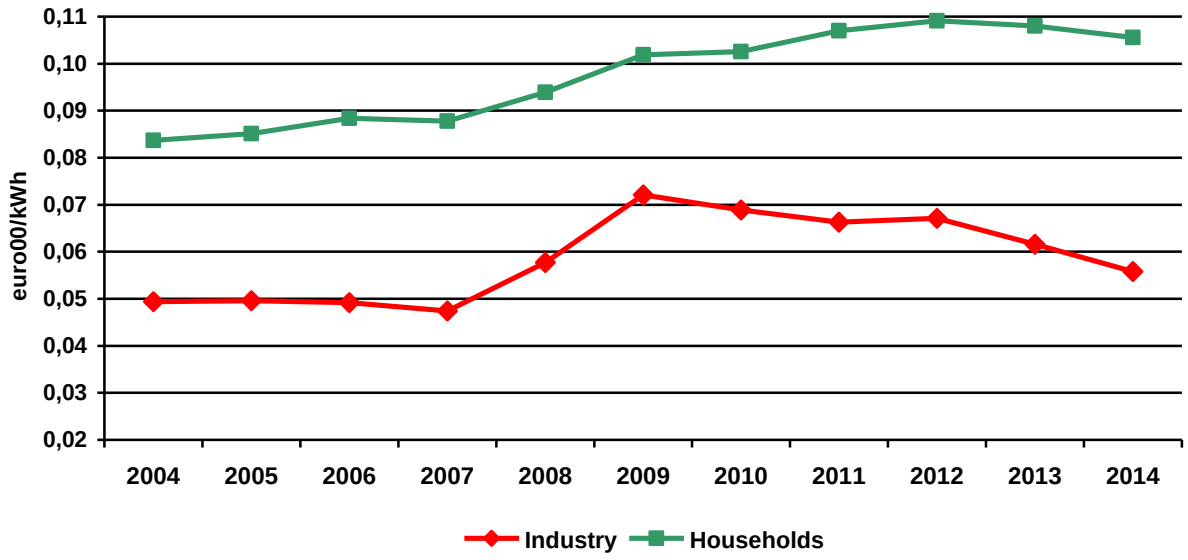
Figure 5. Gasoline and diesel oil prices



Electricity prices for households rose between 2004 and 2014 from over 0,084 in 2004 to 0,106 euro00/kWh in 2014. The upward trend was evident by the year 2012, since then decline of price is observed.

In case of electricity prices for the industry, slight downward trend lasted until 2007 can be observed, when prices reached their lowest level (0.047 euro00/kWh). Over the next two years a sharp increase in prices, which grew by over 50% and reached the highest value in the period under review (0.072 euro00/kWh) took place. In the following years the price of electricity tended to decrease and reached in 2014 level of 0.056 euro00/kWh.

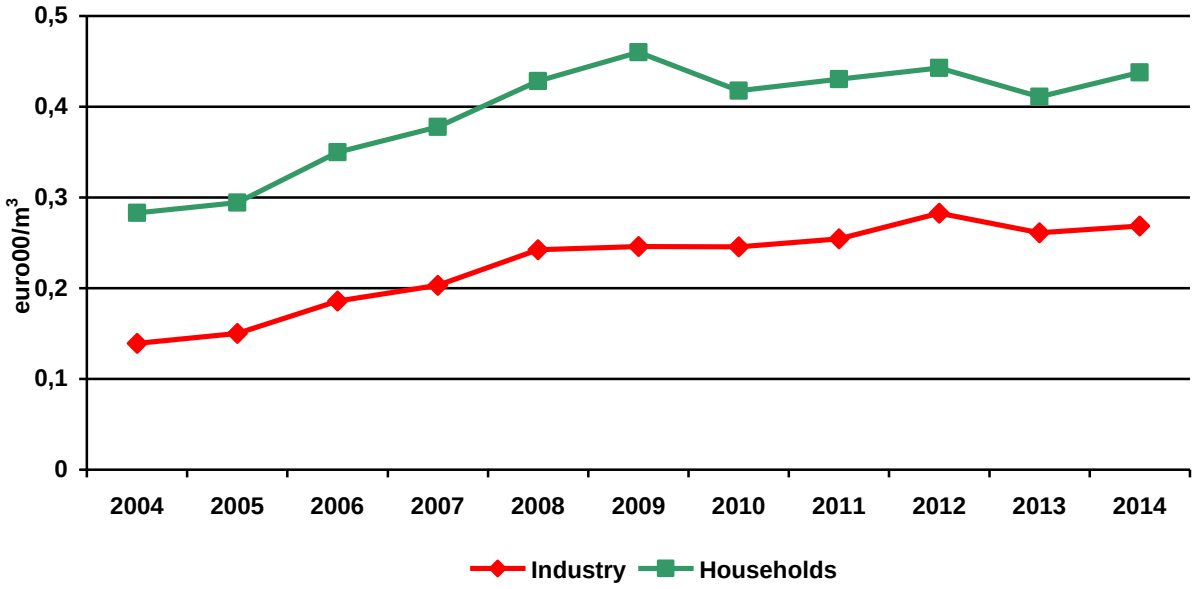
Figure 6. Electricity prices for households and industry



Natural gas prices for households were rising until 2009, when reached the highest level in the presented period (0.46 euro00/m^3). In the following years the price fluctuated but did not fall below 0.4 euro00/m^3. In 2014, the price of gas for households was 0.44 euro00/m^3.

Natural gas prices for industry were growing continuously in the period 2004-2012, reaching level of 0.28 euro00/m^3. After a decline in 2013, prices rose in the next year, reaching 0.27 euro00/m^3.

Figure 7. Gas prices for households and industry



2.3. Macro-economic indicators

Primary energy consumption and final GDP decreased in 2014 compared to 2004 by 29% and 27% (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 half of the period was higher than in the second, which was particularly evident in the 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

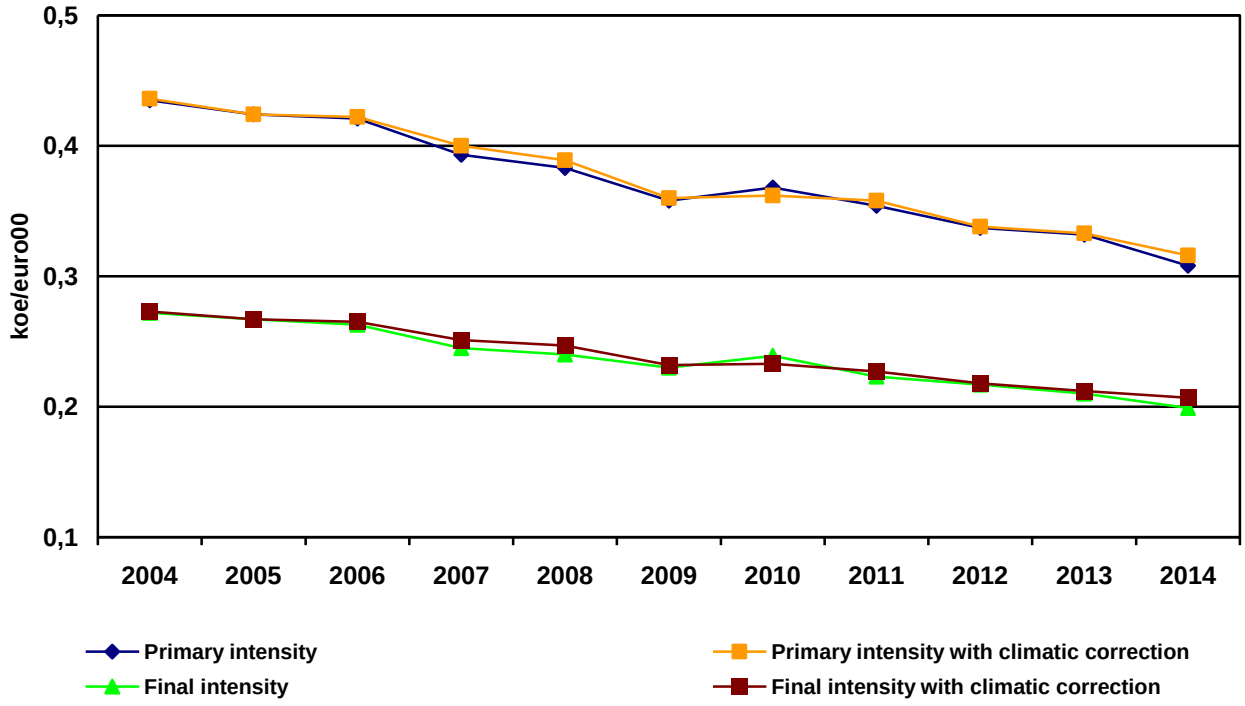
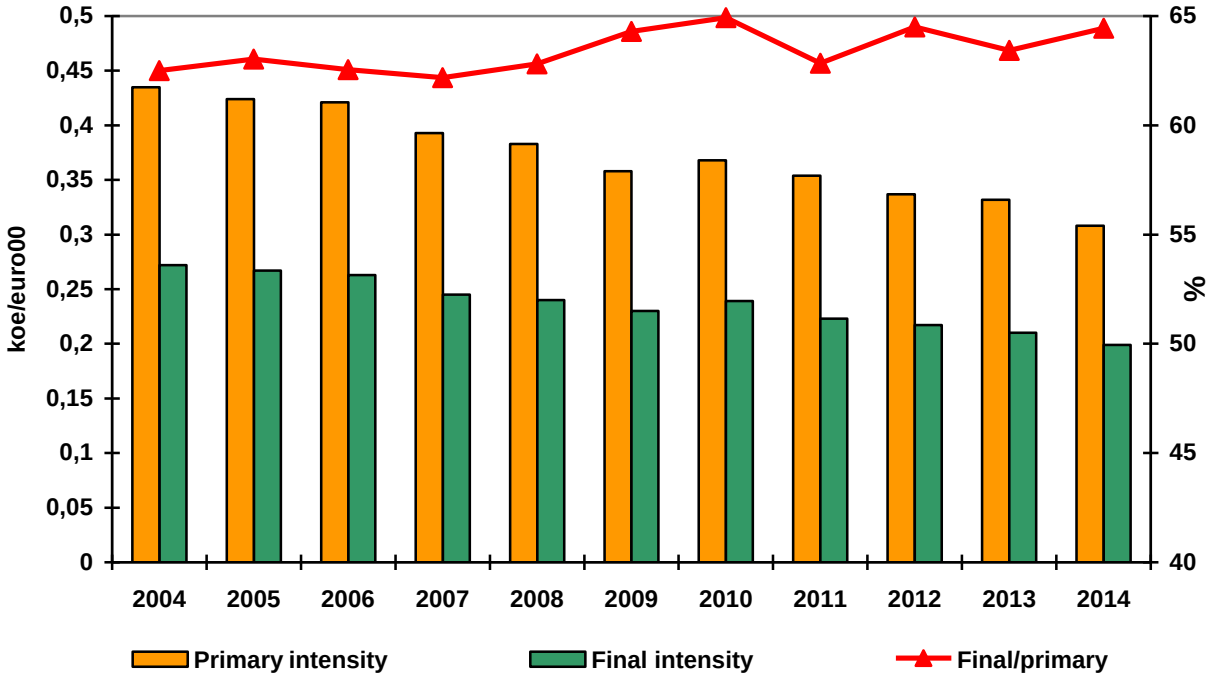


Figure 9. Ratio of final to primary intensity



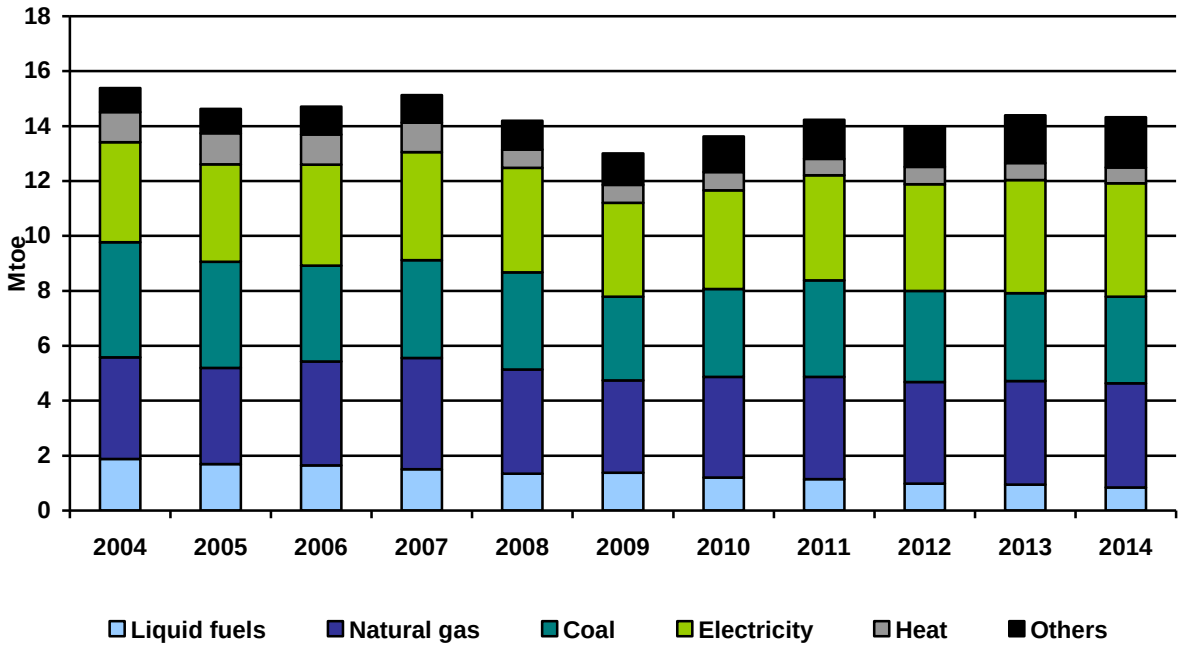
The ratio of final to primary intensity varied in the range from 62% to 65%. The highest rate was achieved in 2010 and amounted to 64.9%, in the subsequent years its value fluctuated, reaching in 2014 64.4%. The level of this indicator is mainly affected by the energy transformation efficiency (the higher 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 tended to decline during the period 2004-2009. In 2009, consumption reached the lowest value in this period (2004 to 2014) and amounted to 13 Mtoe (Fig. 10). After 2009, consumption was subject to slight fluctuations in the upward trend. The biggest consumption was in 2004 and amounted to more than 15 Mtoe.

Energy carrier, whose consumption decreased the most were liquid fuels (down by 55%). Reduction concerned also the heat (by 48%) and coal (by 25%) consumption. The growth was observed in case of consumption of gas (by 2%), electricity (by 13%) and other carriers (by 110%).

Figure 10. Final energy consumption in industry by energy carrier

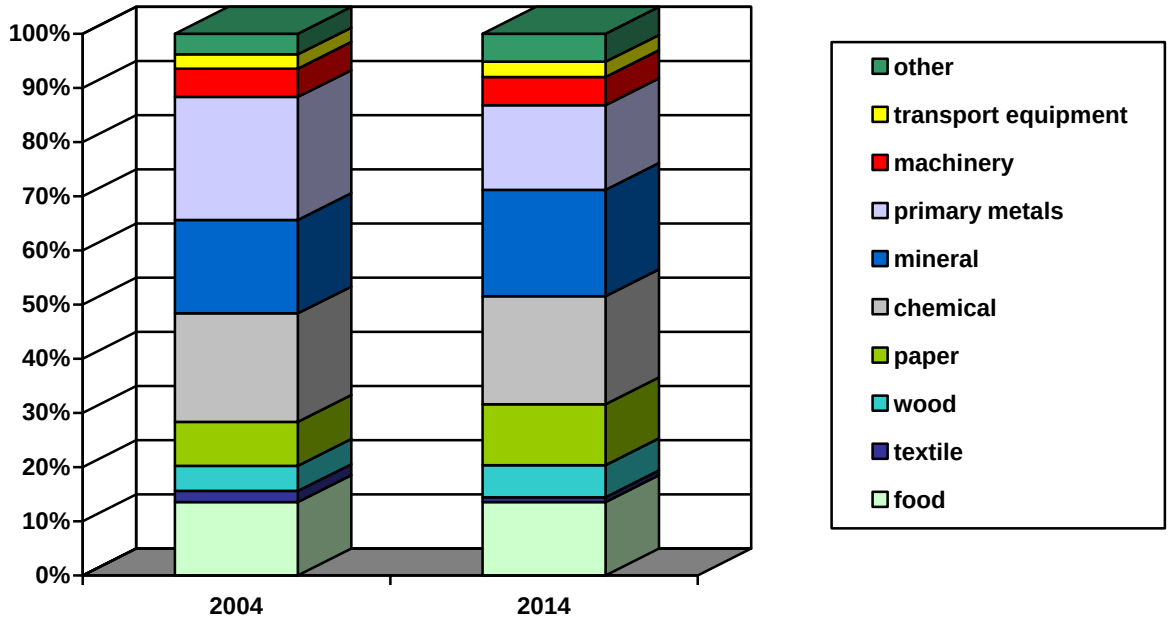


Manufacturing is dominated by three energy-intensive industries: primary metals, chemical and mineral, which total share in energy consumption amounted to 55% in 2014 (60% in 2004). Significant, exceeding 10% share was reached by food and paper industry.

Decline of share in energy consumption in comparison with 2004 was recorded by textile industry, primary metals, chemical industry and machinery, while the increase in the share occurred in the wood, paper, mineral industry, transport equipment and others. The share of food industry did not change.

In absolute terms, the biggest drop was recorded by primary metals (7 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 (39%). Significant increases in these terms was achieved also by other (36%) and wood industries (27%).

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 2004-2014.

Figure 12. Energy intensity of energy intensive industry branches

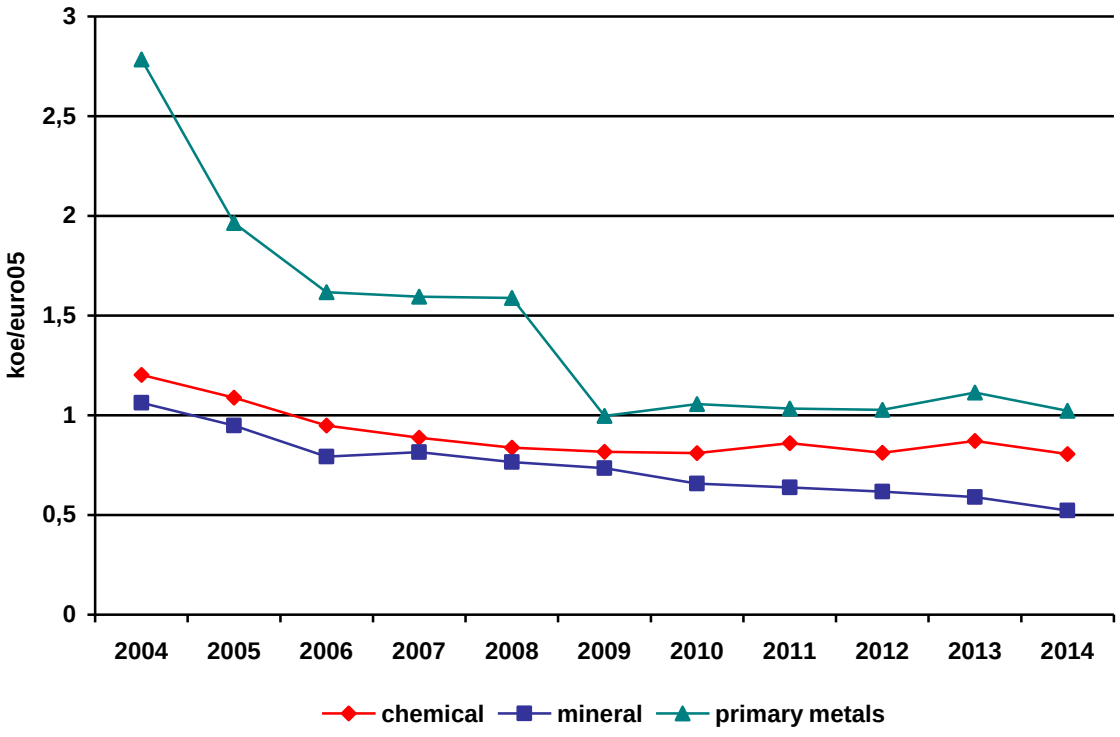
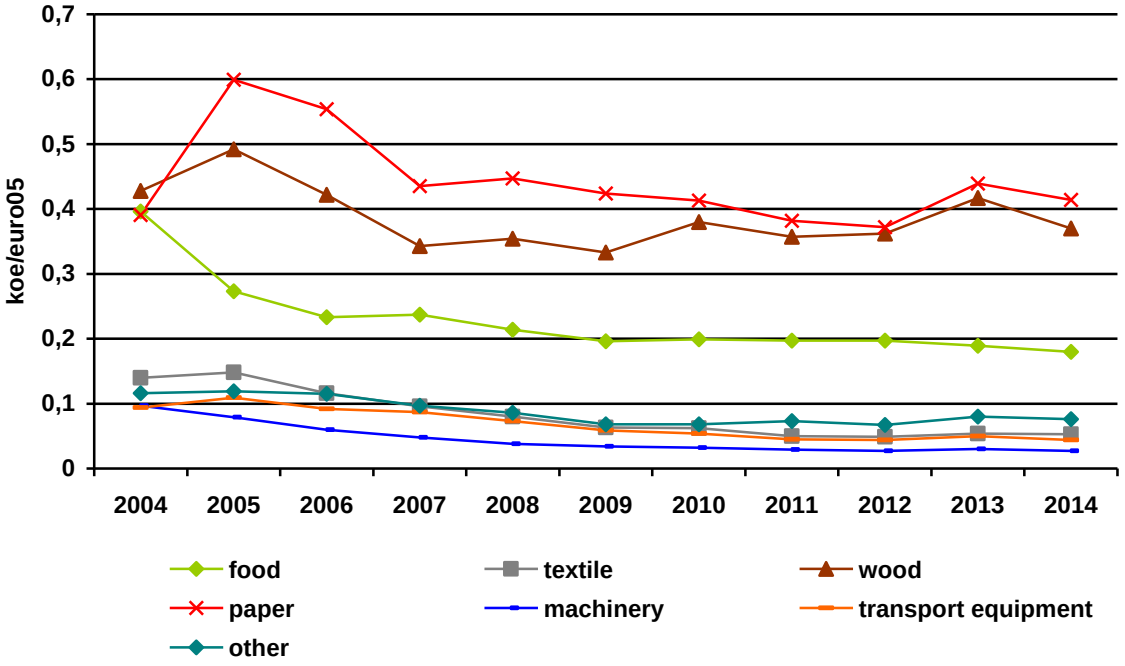


Figure 13. Energy intensity of low energy intensive industry branches



The most dynamic energy efficiency improvements were achieved by: machinery, textile industry and primary metals. The slowest improvement occurred in wood, chemical and other industry. In the paper industry an increase of energy consumption took place.

Overall, the rate of improvement of energy intensity of manufacturing in 2005-2009 was high (Fig. 14 and Table. 2) and amounted on the average to 12.0 %/year. The impact of structural change was positive, but small - contributed to a decline in energy intensity by 1.1 %/year. The energy intensity of manufacturing in constant structure, ie after eliminating the effect of variation of shares of individual sectors in the total volume of manufacturing was decreasing by 11.0 %/year. The situation changed significantly in years 2010-2014 - the rate of decline in energy intensity amounted to 3.6 %/year, and the effect of structural changes amounted to 1.6 %/year.

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

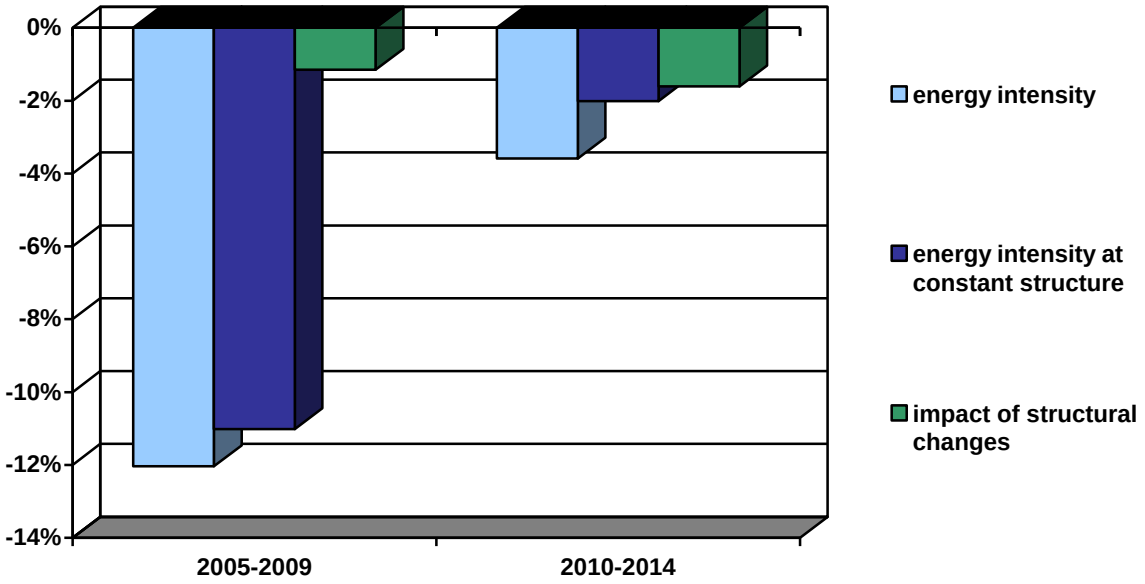


Table 2. Dynamics of energy intensity and impact of structural changes (%/year)

Specification	2005-2009	2010-2014
Energy intensity	-12.04	-3.59
Energy intensity at constant structure	-11.02	-2.01
Impact of structural changes	-1.15	-1.61

Analyzing the energy consumption of industry it should be noted that energy consumption for the production of steel[2], cement[3] and paper[4] accounted for 34% of energy consumption in manufacturing in 2014. Figure 15 presents energy intensity production of these goods in years 2004-2014.

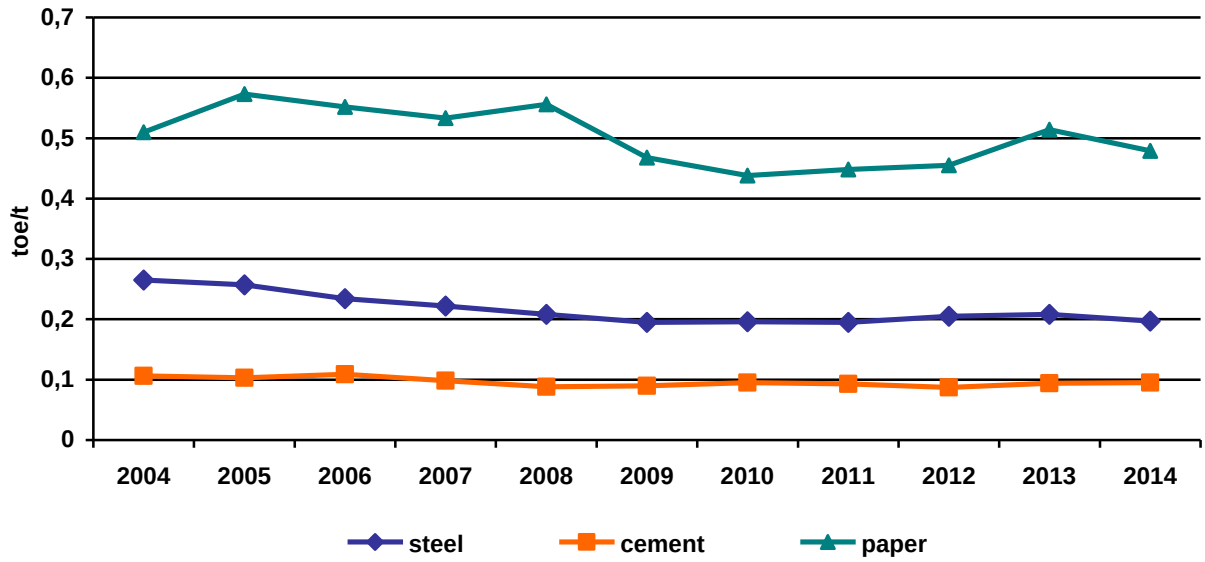
Energy intensity of cement production remained in presented period at a similar level of 0.1 toe/t, which was similar to the European average. The lowest energy intensity was recorded in 2012, when it amounted to 0.087 toe/t. In case of steel production energy intensity was decreasing steadily until 2009, and then stabilized at 0.2 toe/t. Energy intensity of paper industry after an increase in 2005 tended to decrease until 2010, when it reached its lowest

[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

value of 0.44 toe/t. After another growth of energy intensity lasting to year 2013 and the decline following year this figure amounted to 0.48 toe/t in 2014.

In 2014 compared to 2004, energy intensity of crude steel production fell by 25.8% (2.9%/year), paper by 6.1% (0.6%/year), cement by 10.4% (1.1%/year).

Figure 15. Unit consumption of selected industrial products

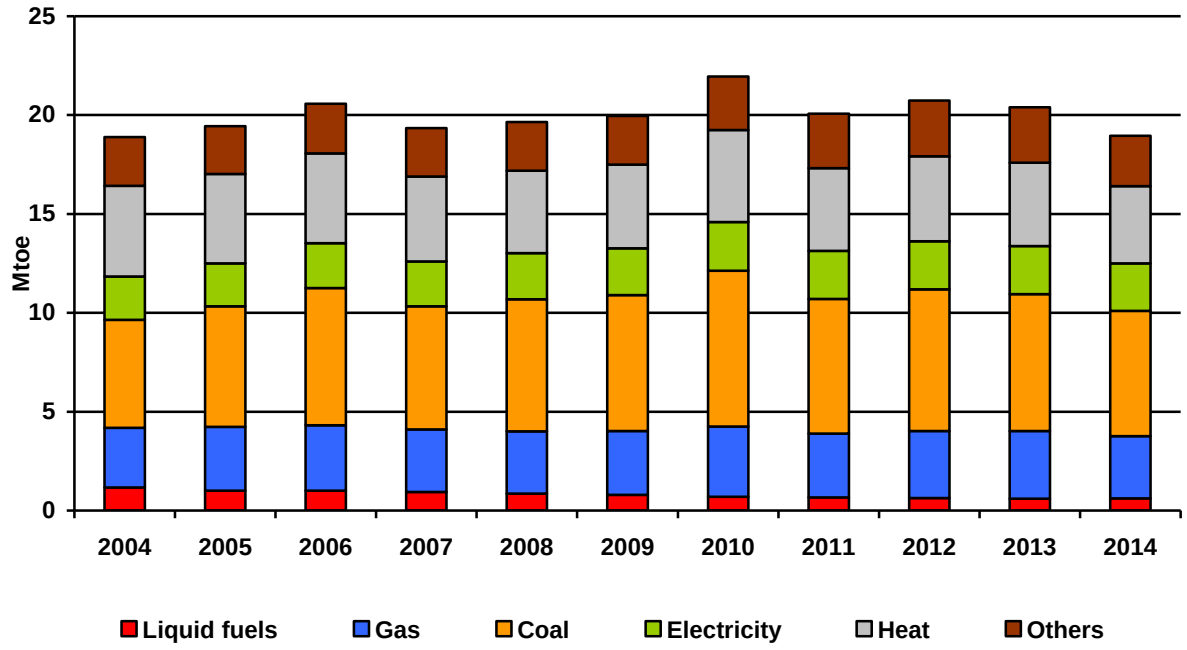


2.5. Households

The share of energy consumption in households in final energy consumption amounted to 31% in 2014.

Energy consumption by energy carrier is presented in Fig. 16. The most often used carrier was coal and other solid fuels, whose share increased from 29% in 2004 to 33% in 2014. The second biggest energy carrier was heat, which share in 2014 amounted to 21% after a decline from 24% in 2004. In 2014, 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



The structure of consumption by end uses changed slightly in recent years. 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 2012.

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

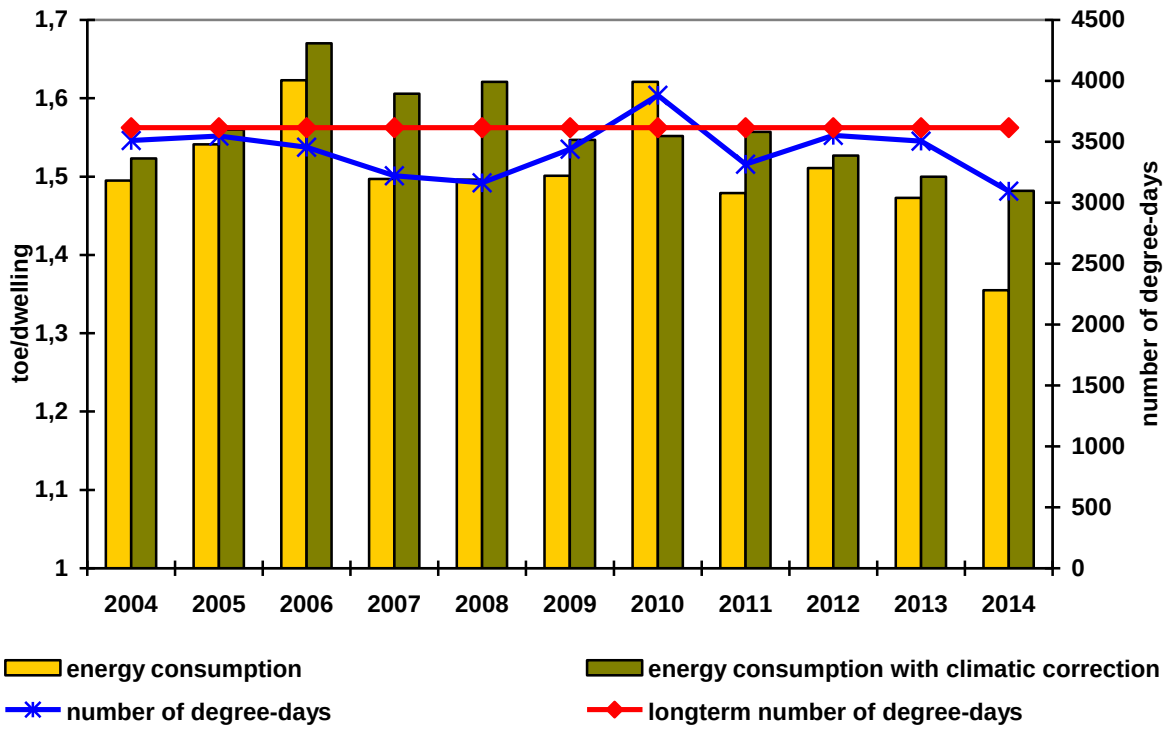
Items	1993	2002	2009	2012
Total	100.0	100.0	100.0	100.0
Heating	73.1	71.3	70.2	68.8
Water heating	14.9	15.0	14.4	14.8
Cooking	7.1	7.1	8.2	8.3
Lighting	1.6	2.3	1.8	1.5
Electrical equipment.....	3.3	4.3	5.4	6.6

Fig. 17 shows energy consumption per 1 dwelling. The energy consumption per dwelling without climatic correction declined in the period 2005-2014 at a rate of 1.0% per year. The

highest consumption was recorded in 2006 and the lowest in 2014, when it amounted to 1.35 toe/dwelling.

The value of this indicator with climatic correction decreased between 2004 and 2014 from 1.52 to 1.48 toe/dwelling, which means an average annual decrease of 0.3%. The lowest value occurred in 2014.

Figure 17. Energy consumption in households per dwelling



source: Eurostat and Joint Research Center, GUS

Table 4. Heating degree-days in years 2000-2014

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sd - annual	3092	3581	3337	3594	3510	3547	3454	3222	3164	3439	3881	3317	3552	3505	3095

source: Eurostat and Joint Research Center

Fig. 18 presents energy consumption in households per m^2. In case of energy consumption a downward trend after 2006 can be observed, more regular after taking into account the climatic correction. In case of total consumption per m^2 improvement of 1.5 %/year was recorded, while taking into account the climatic correction the improvement amounted to 0.8 %/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 declined and in 2014 amounted to 2008 kWh/dwelling and was 0.01% lower compared to year 2004 (Fig. 19).

Figure 18. Energy consumption in households per m^2

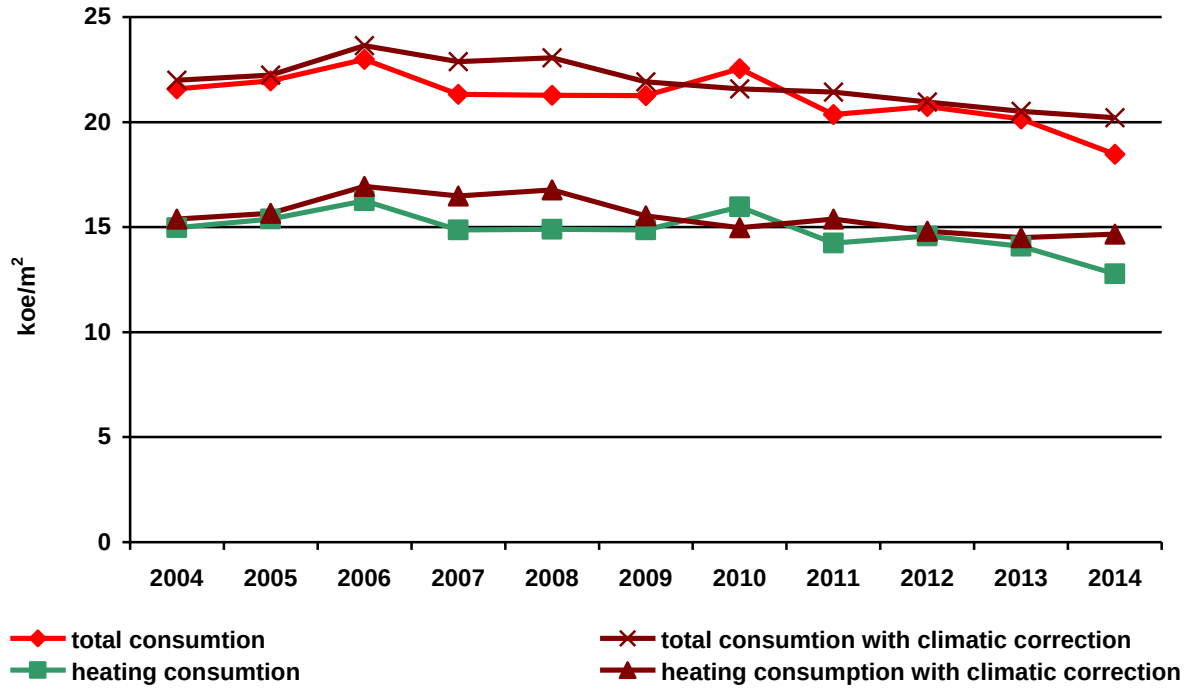
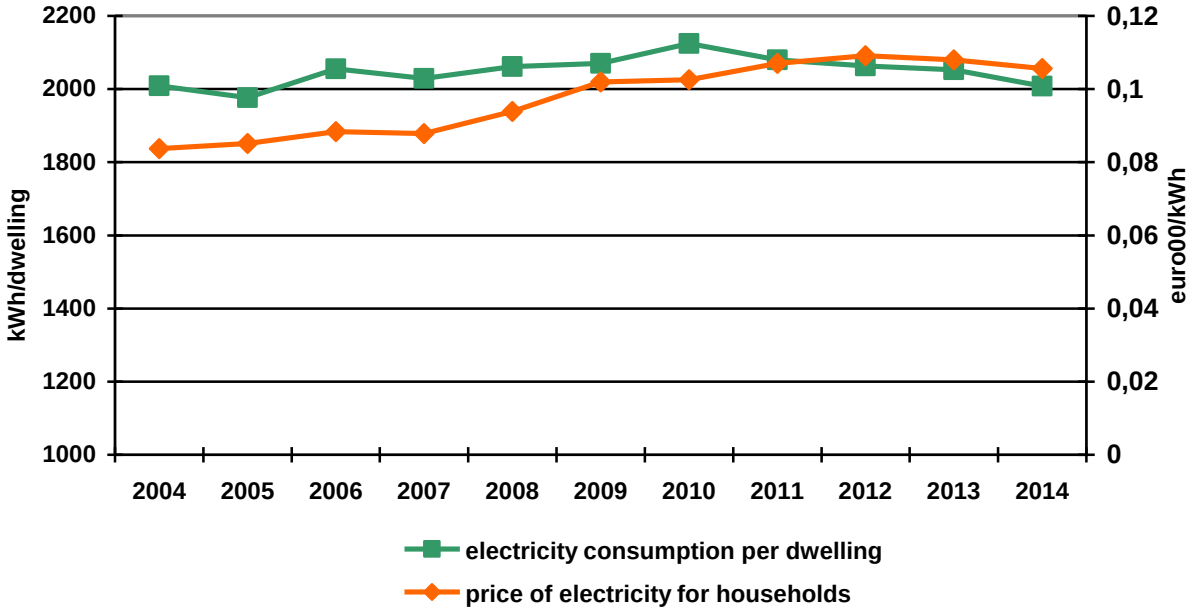


Figure 19. Electricity consumption and price in households per dwelling

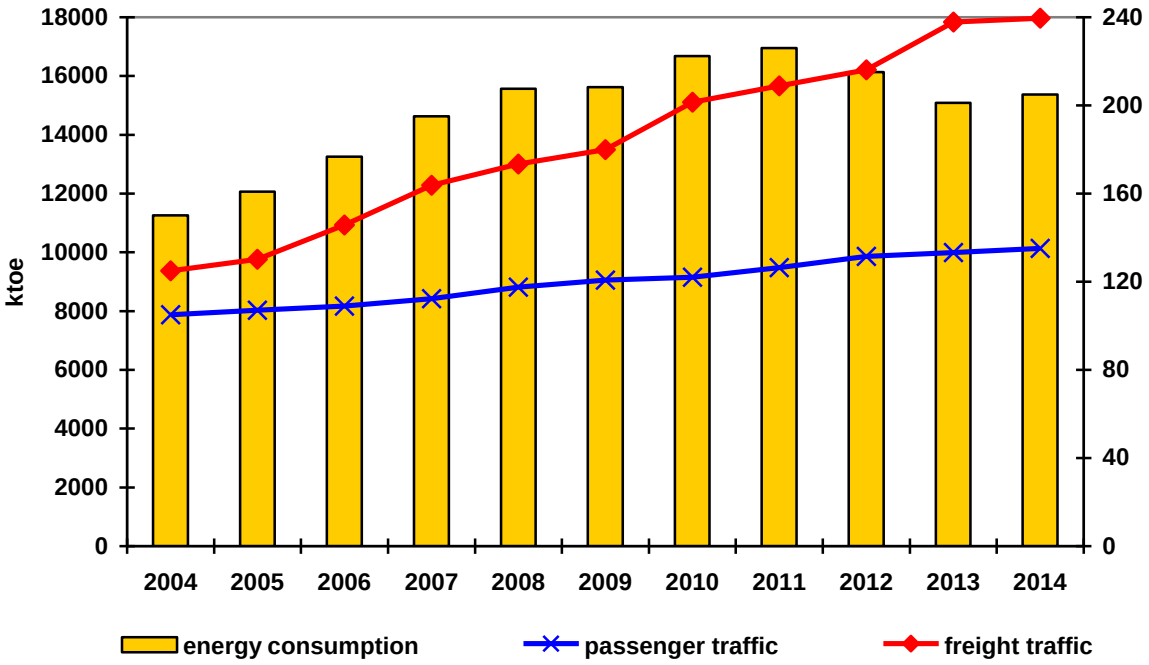


2.6. Transport

In Poland, more than 94% of the energy consumed in transport in 2014 was used in road transport, and more than 2% in rail transport. In addition, more than 3% of the energy was consumed in air transport, and small amounts by the inland and coastal shipping.

In years 2005-2014 fuel consumption in road transport increased by 43% (annual growth rate of 4.3%), while significant (by 35%, 4.2 %/year) decline in energy consumption in rail transport. Total average annual growth rate of fuel consumption in transport (excluding air transport) amounted to 3.2% in the period from 2005 to 2014 and increased in 2014 by 37% compared with 2004.

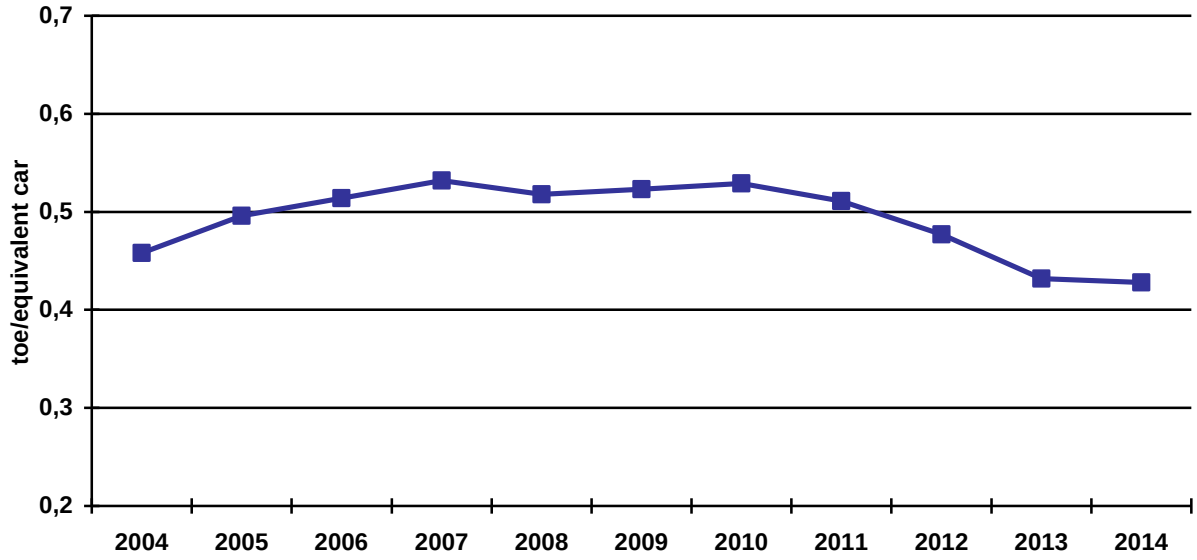
Figure 20. Passenger and freight traffic and energy consumption in transport*



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

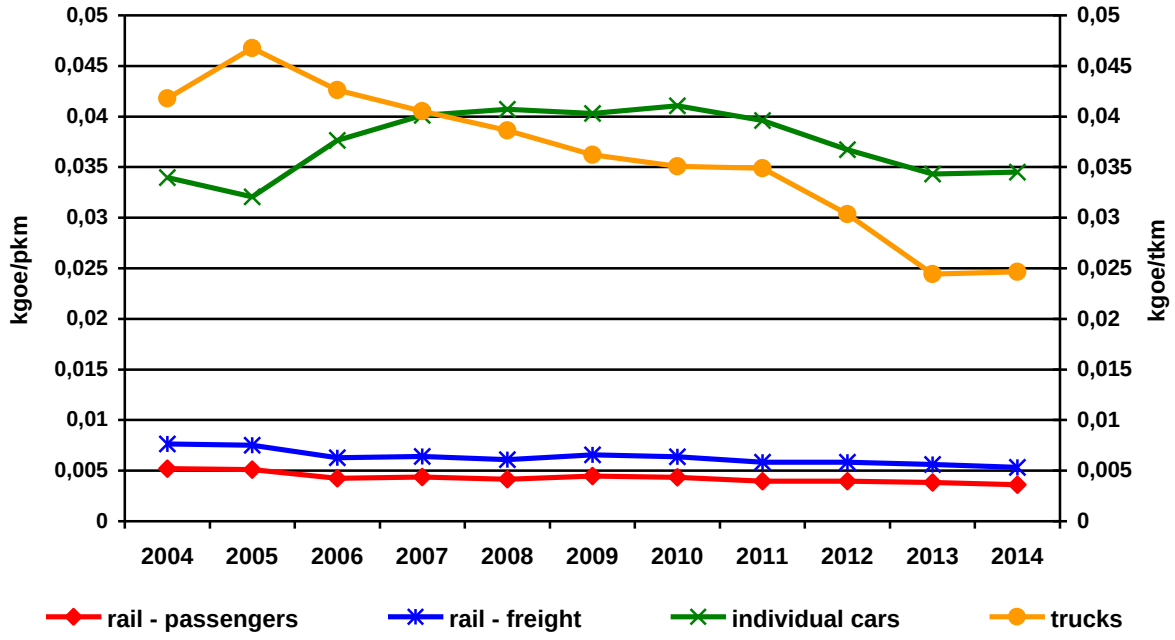
Fuel consumption per equivalent car was increasing until 2007, then slightly fluctuated above 0.5 toe/equivalent car (Fig. 21). After 2010 the decline in the value of the indicator is observed. In 2014, it amounted to 0.428 toe/equivalent car. The value of this indicator is mainly influenced by the economic 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 5.1 %/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 0.2 %/year was observed, especially in years 2005-2010. 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.

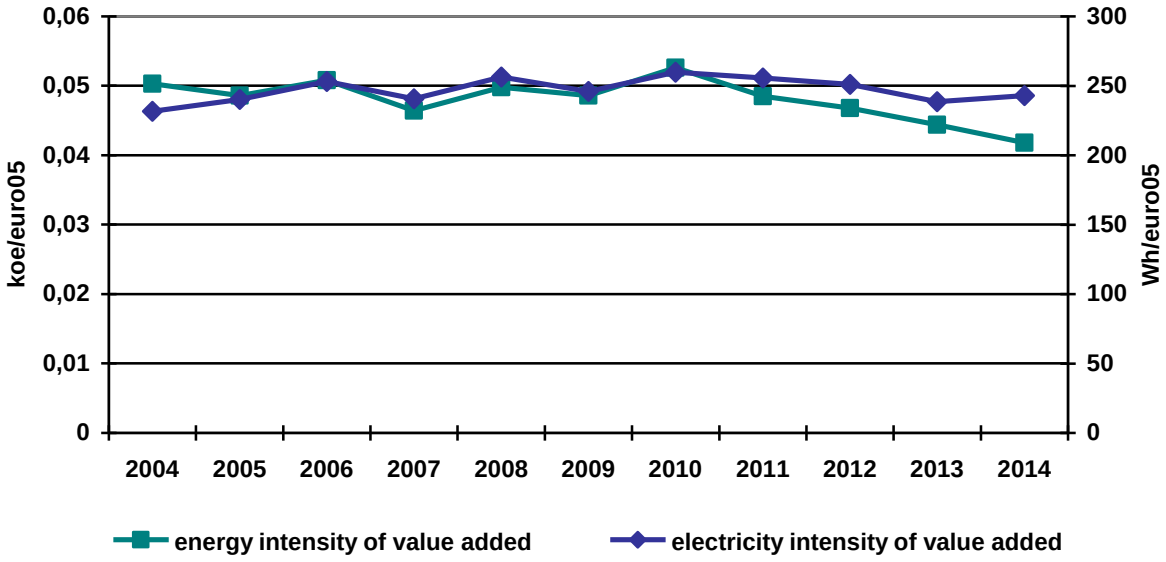
Figure 22. Energy intensity in transport



2.7. Service sector

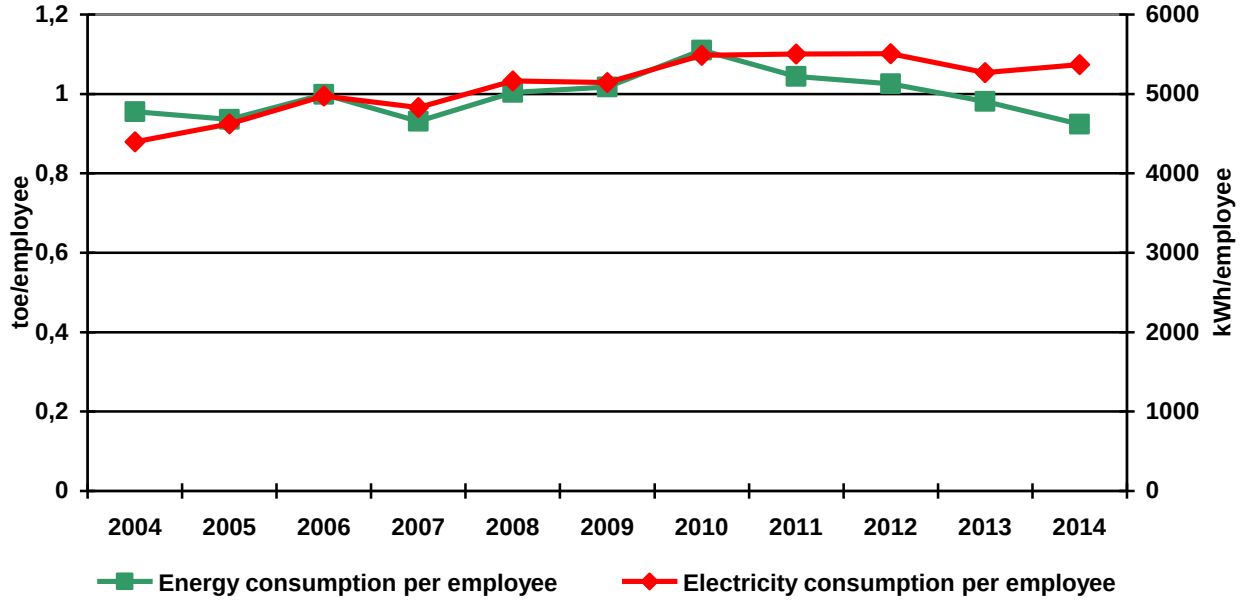
The service sector is characterized by the lowest energy intensity of added value in comparison to other sectors. It showed slight fluctuations in 2004-2010, after which, the trend downward. In 2014, energy intensity decreased and amounted to 0.042 kgoe/euro05. The average annual rate of decline in energy intensity in this period amounted to 1.8%. In case of electricity intensity of added value irregular fluctuations in the value of the indicator, which grew on average by 0.5% per year can be observed.

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). From that moment, this ratio tended to decline, especially in years 2013 and 2014. Energy consumption per 1 employee in 2014 amounted to 0.92 toe, and the average rate of decline in the reporting period amounted to 0.3% per year. In case of electricity consumption per 1 employee growth rate amounted to 2.0% per year. Electricity consumption was increasing irregularly until 2010, then stabilized around 5500 kWh/employee.

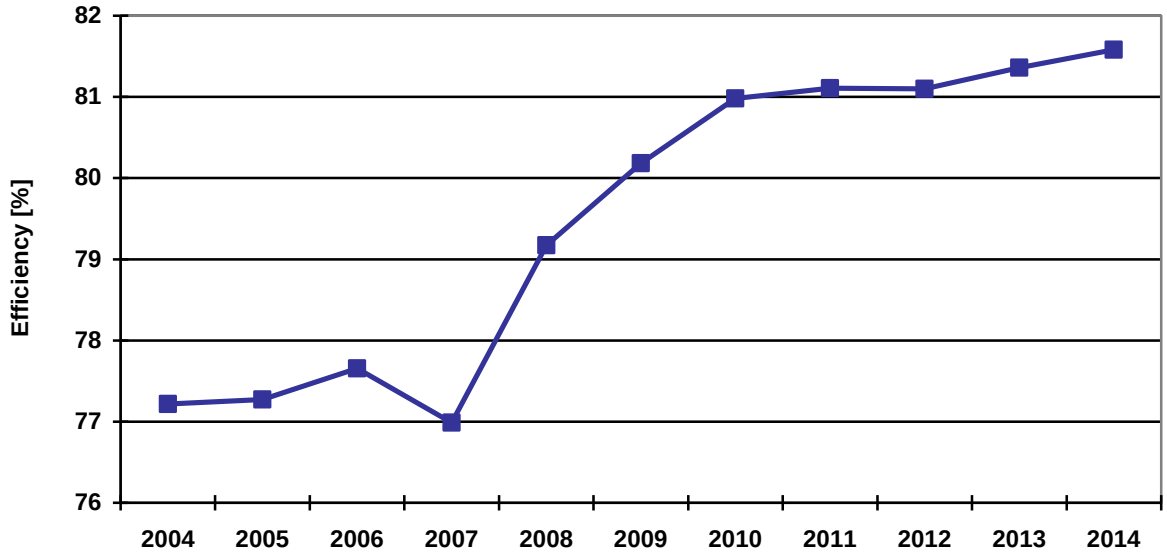
Figure 24. Energy consumption and electricity consumption per employee of the service sector



2.8. Heat plants

The efficiency of heat plants producing district heat was increasing systematically, except for year 2007. In 2014 efficiency of heat plants amounted to 81.6%.

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 2004-2014 from 85.8 to 68.1 points. The average rate of improvement amounted to 2.3 %/year. The fastest rate (4.3%/year) was recorded by manufacturing. The slowest pace of improvement was achieved in household sector, where the annual improvement in the period 2005-2014 amounted to 0.6%. In the transport sector the average rate of improvement amounted to 2.6 %/year[5].

Figure 26. ODEX indicators

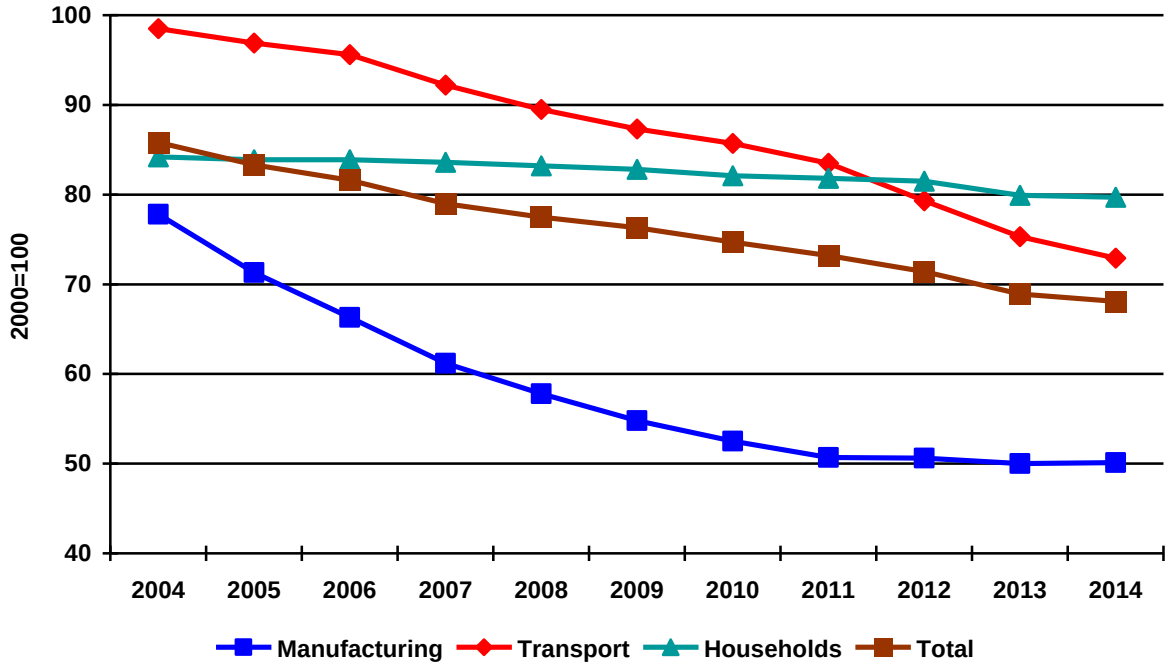
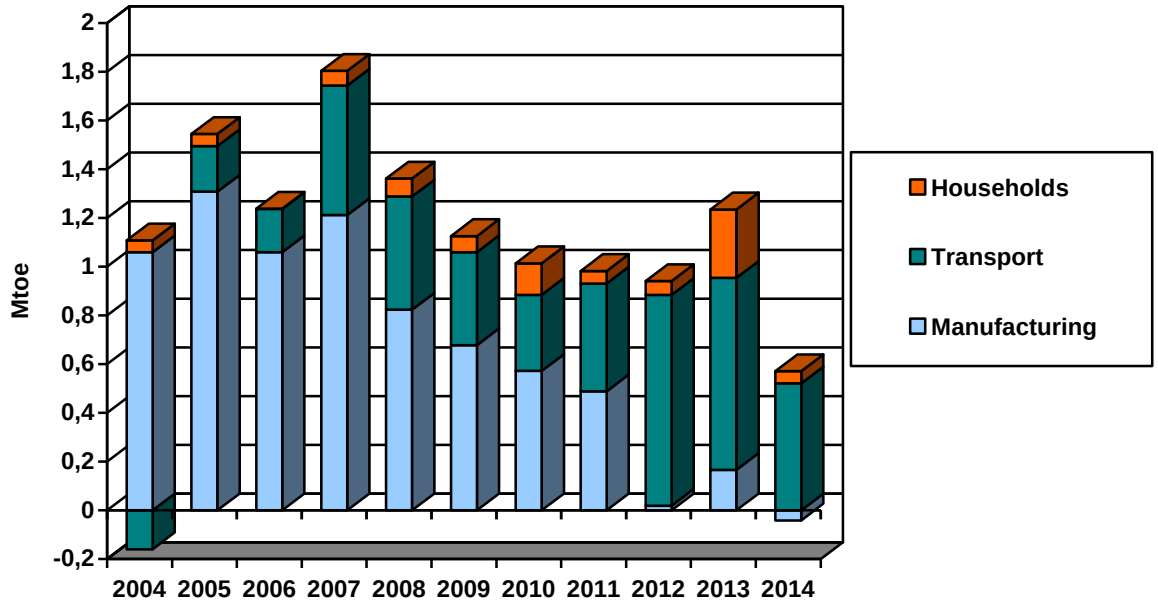


Figure 27 shows energy savings achieved in subsequent years in manufacturing, households and transport sector after 2000 calculated using ODEX indicators. Energy savings were achieved in all three sectors each year except for transport sector in 2004 and manufacturing in 2014. The sum of energy savings amounted usually around 1 Mtoe, with small tendency to decrease.

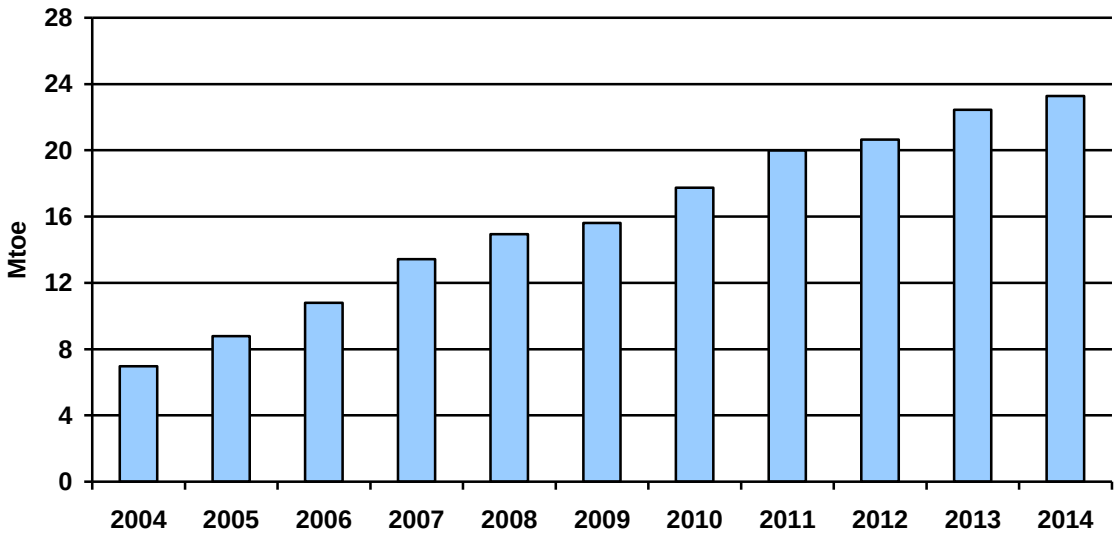
[5] Because of lack of official data on specific consumption of different types of transport, calculation of indicator for transport is based on estimated and constant parameters and therefore can be burdened with an error.

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 2014 to 23.3 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

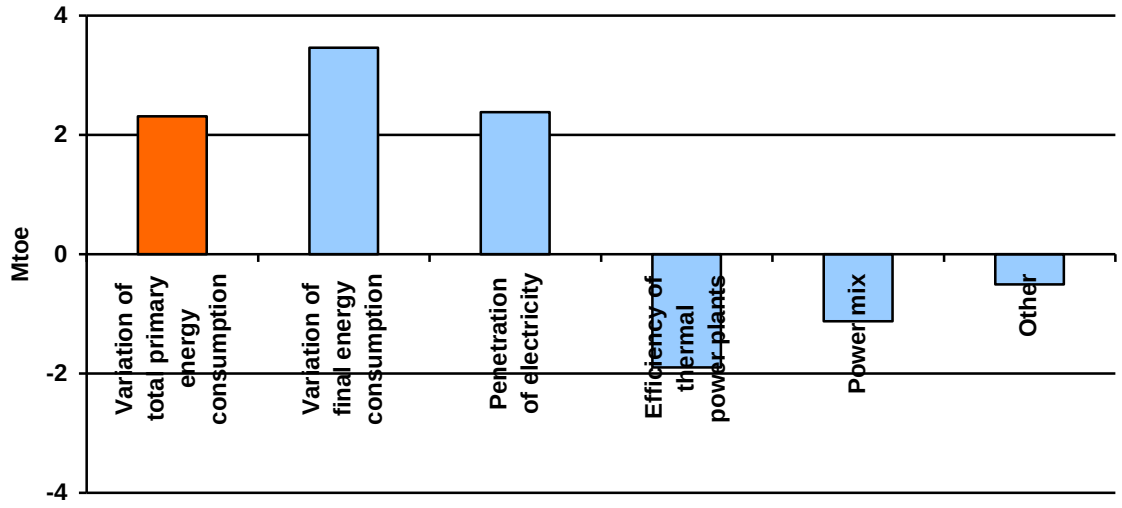


2.10. Decomposition

The most important factors affecting the size of primary energy consumption are: final energy consumption, penetration of electricity (electricity consumption growth also affects the demand for primary energy due to transformation losses), the efficiency of thermal power plants (increased efficiency reduces the demand for primary energy), power mix (renewable energy sources operating at 100% efficiency cause a decrease in demand) and other (including other transformations and non-energy use).

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

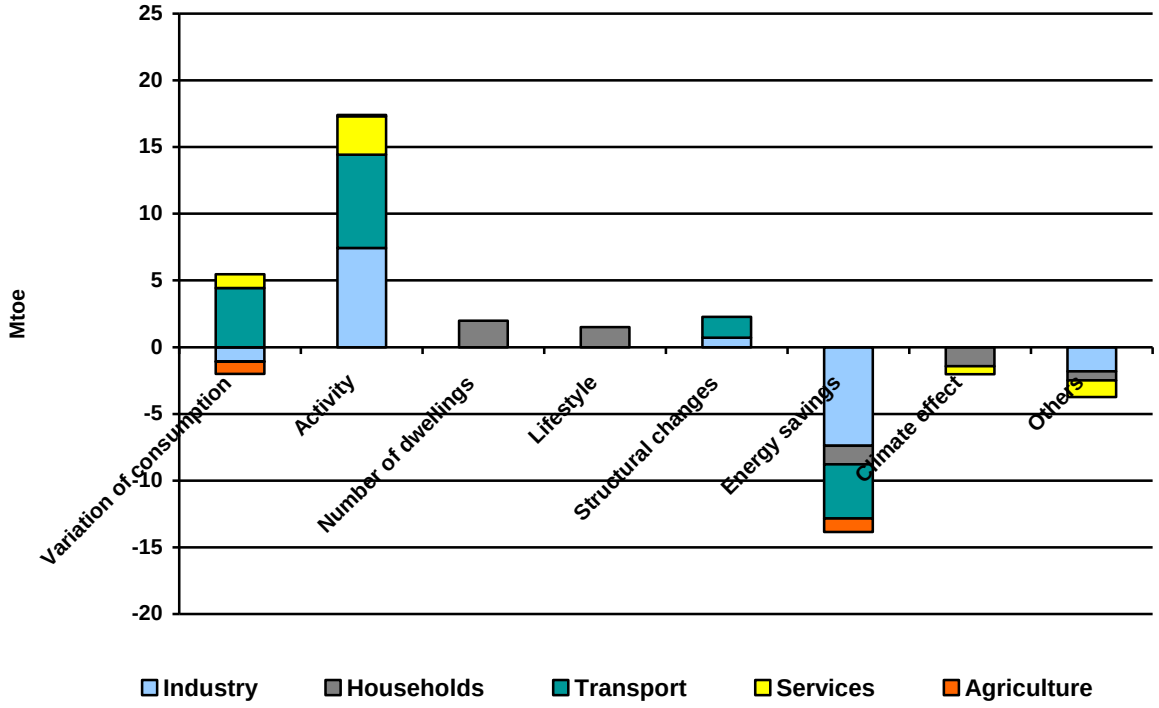
Figure 29. Impact of selected factors on total primary energy consumption in years 2004-2014



In the years 2004-2014 the total primary energy consumption increased by 2.3 Mtoe. This increased consumption was influenced by: an increase in final energy consumption by 3.5 Mtoe and increased electricity production by 3.2%, which caused an increase in primary energy demand of 2.4 Mtoe. In contrast, a reduction in primary energy demand was caused by improvement of the efficiency of thermal power plants (down by 1.9 Mtoe), increasing use of renewable energy (down by 1.1 Mtoe) and other factors, including increased efficiency of other transformations (a decrease of 0.5 Mtoe).

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 2004-2014



Energy consumption in industry slightly decreased between 2004 and 2014. The activity of the industry significantly increased, while its impact on the energy consumption growth was offset by rapidly improving energy efficiency (both values amounted to 7.4 Mtoe). Structural changes contributed to the growth of consumption and other factors on the decline (mainly the difference between the increase in activity measured by value added and production index).

In households, there was no change in energy consumption between years 2004 and 2014. The increase in stock of dwellings and lifestyle change (larger apartments) affected the increase in consumption. Weather conditions (2014 was warmer than 2004) contributed to a significant reduction in energy consumption in this sector. In addition, a reduction in consumption was affected by the improvement of energy efficiency and other factors.

In the transport sector the greatest increase in energy consumption (4.4 Mtoe) occurred. Increase in activity and structural changes (increase in the share of road transport) have contributed to that growth. Energy savings have reduced consumption by more than 4 Mtoe.

In the services sector an increase in activity influenced positively the growth of consumption. There was no improvement in energy efficiency. Increase in productivity (value added per capita) employed in this sector and weather conditions were reducing energy consumption.

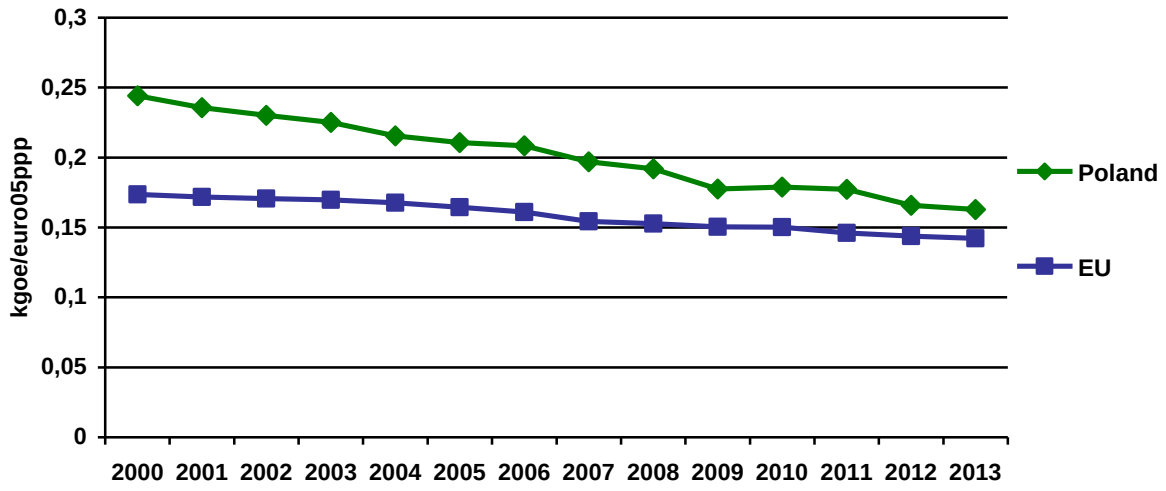
In the agricultural sector decline in consumption was due to the energy savings, higher activity increased consumption by 0.1 Mtoe.

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 2013 to 0.163 koe/euro05ppp and was 15% higher than European average. This difference fell by 27 percentage points compared to the year 2000. The rate of improvement of energy intensity was in Poland in years 2000-2013 more than twice higher than in the European Union.

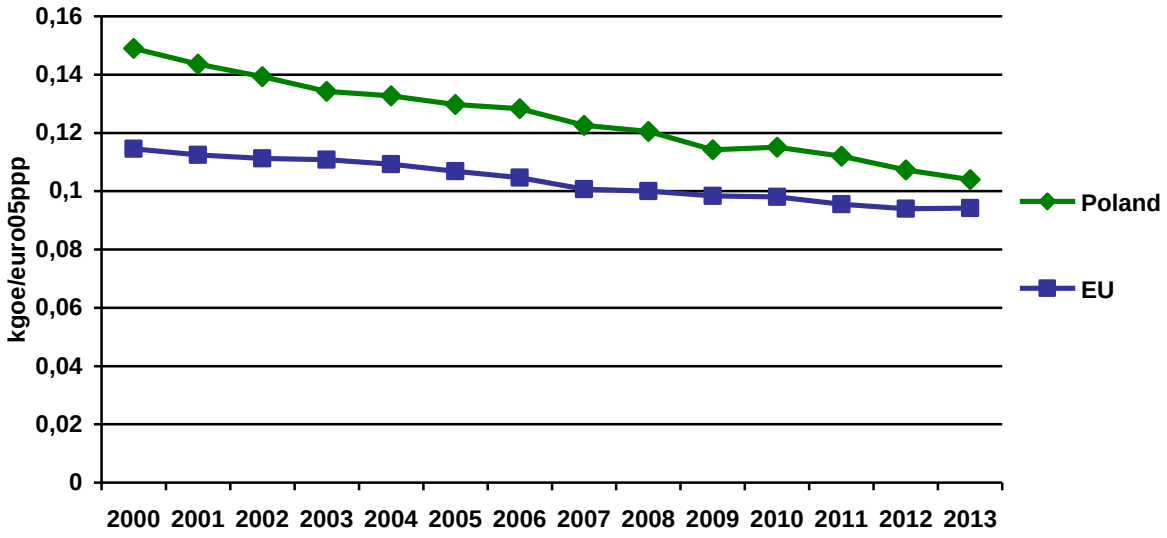
Figure 31. Primary intensity of GDP with climatic correction (euro05, ppp)



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

In case of final energy intensity difference is smaller and amounted in 2013 to 11% between Poland (0.104) and EU average (0.094). The difference between rate of improvement which amounted in year 2000-2013 to 2.7%/year for Poland and 1.5%/year for European average is also smaller in comparison with primary intensity achievements.

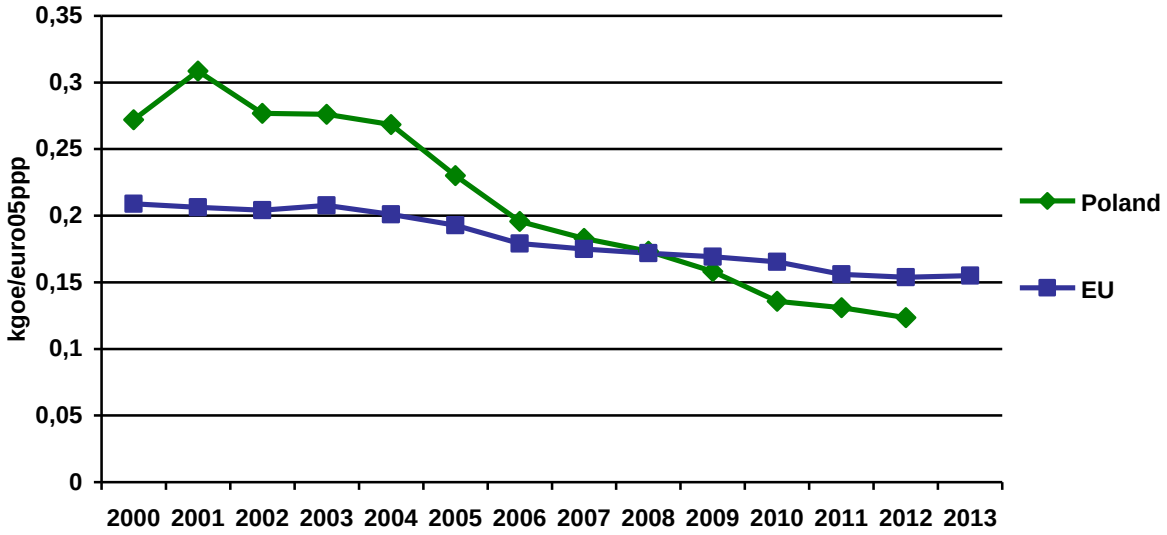
Figure 32. Final intensity of GDP with climatic correction (euro05, ppp)



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 6.4%/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)

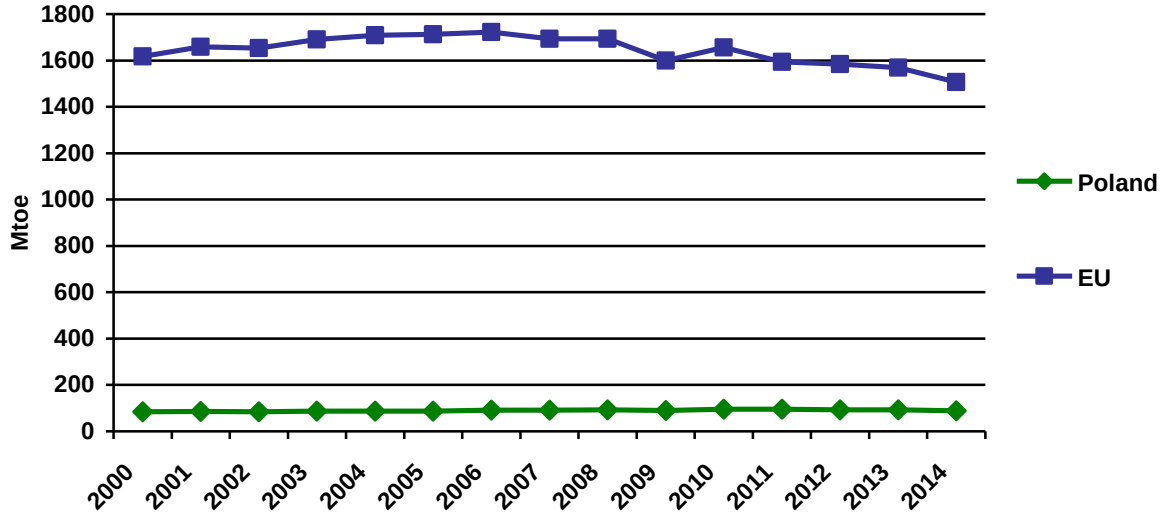


Source: Odyssee database, www.odyssee-mure.eu

For the purpose of monitoring of the Strategy 2020 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 2014 amounted to 89.1 Mtoe.

Figure 34. Primary energy consumption



Source: Eurostat

3. Energy efficiency policy and measures towards its improvement

3.1. Energy Efficiency Policy of the European Union

The European Union is consistently implementing the January 2008 energy and climate package, 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 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.

In accordance with Article 7 paragraph 9 of Directive 2012/27/EU, as an alternative to setting up an energy efficiency obligation scheme, Member States may opt to take other policy measures (e.g. taxes, standards, regulations, labelling schemes or voluntary agreements) to

achieve energy savings among final customers, provided those policy measures meet applicable criteria and generate the required new energy savings.

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 and 3, were drawn up in 2007, 2012 and 2014 respectively); drawing up plans was required by Directive 2006/32/EC.

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. These measures are presented in the subsequent editions of the following publications.

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 above Act 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 fully implements directive 2012/27/UE of the European Parliament and of the Council into the Polish legislative framework.

The Act defines the rules for developing the so called National Energy Efficiency Action Plan and of conducting an energy efficiency audit of a company. The Act also includes public sector objectives for improving energy efficiency.

Minister of Energy develops a national action plan every three years. The plan has to include description of energy efficiency improvement programs in each economic sector, define the national energy efficiency target, information on energy savings in transmission or distribution, delivery, and energy final consumption. Additionally the plan should also contain a strategy for supporting investments in building renovations. For the first time the Minister of Energy should present the plan to the European Commission until 30 April 2017.

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 will be required to purchase and use energy efficient energy products and services. They will also be 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 2011. New regulations assume gradual removal of the substitute fee for refraining from energy efficiency improving investments.

The Act comes into force on 1 October 2016.

3.3 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	
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

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

a) Introduction

Calculations were based on official statistic data – 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.

b) Calculation of final energy savings by top-down method

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

Table 7 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. 7. 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%	5.13	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.

The values of the achieved saving in final energy consumptions between 2010 and 2016 presented in the tables are different from those presented in 3 NEEAP and the "Efficient usage of energy in years 2002-2012" publication on account of adjustment made using data from 2010-2013.

Table 8 present final energy savings achieved up to 2014 divided by energy end-use sector. Presented energy savings are related to the base year, 2007.

Table. 8. Overview on achieved final energy savings by sectors (Mtoe)

Economy sector	2010	2011	2012	2013	2014
Households……	1.773	1.153	1.842	2.175	1.828
Services……...	0	0	0	0	
Industry…….....	2.195	2.928	3.114	2.931	3.416
Transport……	1.165	1.334	3.078	5.417	5.387
Total…….	**5.133**	**5.415**	**8.033**	**10.522**	**10.631**

The table shows that savings of total final energy consumption in the years 2010 - 2014 were increased more than doubled.

c) Calculations of energy savings with use of ODEX indicators

Energy efficiency indicators ODEX are used as a measure of energy savings. ODEX indicators have been developed in order to achieve an understandable and comparable indicator for showing progress in terms of energy efficiency.

Taking 2010 as the base year, energy savings calculated using the ODEX indicator is shown in table 9.

Table. 9. Overview on achieved final energy savings based on ODEX indicator, regarding to 2010 (Mtoe)

Economy sector	2011	2012	2013	2014
Households……..	0.063	0.218	0.374	0.510
Services……	0.000	0.000	0.000	0.000
Industry……	0.836	1.114	1.349	1.441
Transport……	0.474	1.368	2.211	2.862
Total……	**1.374**	**2.701**	**3.933**	**4.813**

3.5 Activities for improving energy efficiency in the 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 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)

3.6 Activities for improving energy efficiency in Poland

The measures for improving energy efficiency in Poland present in the MURE database are presented in third National Energy Efficiency Action Plan on energy efficiency (3 NEEAP). Support from the EU under the Operational Programme Infrastructure and Environment (OPIE) and the Regional Operational Programmes (ROP), are presented in the next section,

followed by national programs of the National Fund for Environmental Protection and Water Management (NFOŚiGW).

a) Horizontal measures

The main horizontal measures are presented below.

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

The energy efficiency obligation scheme was introduced under the Energy Efficiency Act of 15 April 2011 (Journals of Laws: 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 tradeable on commodity exchanges, as understood under the Act of 26 October 2000 on commodity exchanges (Journal of Laws of 2014, item 197), and are thus tradeable at the Power Exchange. Energy efficiency certificates may only be obtained for projects characterised by the highest economic efficiency. The projects are selected by way of tender organised by the President of ERO. The successful winners are those entities which declare the largest energy savings compared to the value of energy efficiency certificates obtained.

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 (Law Gazette, item 1039).

Until 19 January 2015 three 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.

Information and consultancy programmes for customers

The Polish National Energy Conservation Agency (KAPE S.A.) provides information and advisory services in the field of energy saving measures and their promotion. In Poland, there are also other organisations, associations and institutions operating in this area. In particular, they include: the National Agency for Energy Conservation - „NAPE"; the Foundation for Efficient Energy Consumption - „FEWE"; regional energy agencies (e.g. the Baltic Energy Conservation Agency - „BAPE", Regional Energy Conservation Agency in Toruń - „RAPE", Mazowsze Regional Energy Agency - „MAE", Podkarpackie Regional Energy Agency – „PAE"); the Institute for Sustainable Development, and other sectoral organisations.

An important role in promoting energy efficiency improvement measures is also played by information campaigns addressed to society, and aimed at developing pro-environmental attitudes through presenting possible energy saving measures.

The Ministry of Economy, in cooperation with the National Fund for Environmental Protection and Water Management, is planning to realize a nationwide advisory program on energy efficiency (including RES), including advisory services for enterprises. The program will be implemented between 2015 and 2023. It will be an indispensable element of support in the development of a low-emission economy in Poland, concerning low-emission economy plans prepared by municipalities from among other funds of the Operational Programme Infrastructure and Environment.

The initiative aims to develop an advisory system on regional low-emission economies, based on regional and local advisory services for local government entities, enterprises, individuals, and community and housing associations.

The program's goals will be:

- increasing social awareness on energy efficiency and RES through enabling information exchange on the local and regional levels, and good practices on implementing directive 2010/21/UE and 2012/27/UE (for example creating uniform standards and guidelines);
- supporting preparations of local low-emission economy plans and the resulting projects utilizing energy efficiency and RES;
- creating incentive for creating posts for energy advisors promoting energy efficiency within local government entities;
- creating training systems improving the qualifications of municipal energy specialists.

The nationwide energy efficiency and RES advisory program will implement the assumptions of Directive 2012/27/UE (article 12 and article 17) and Directive 2009/28/EC (article 14 paragraph 6).

The program's implementation will be funded from the Cohesion Fund of the Operational Programme Infrastructure and Environment 2014-2020.

Access to the qualification, accreditation and certification systems

Currently, Polish legislation provides for three main categories of documents which help those interested in energy efficiency improvement to assess energy consumption of buildings, equipment and installations, identify the sources of potential energy savings and to determine the costs of implementing energy saving solutions. These document categories are:

- **Energy Audit**

  Energy audit, defined by the Act of 21 November 2008 on support for the thermal modernisation and renovation of buildings (Law Gazette No. 223, item 1459, as amended[6)]), is an expert opinion determining the scope, as well as technical and economic parameters of a thermal modernisation project. An energy audit document indicates the optimum energy saving solution in terms of implementation costs and energy savings potential. The energy audit document is required in applications for co-financing of a thermal modernisation project. The aim of such a project is reducing the consumption of energy used to heat the building space and to produce domestic hot water, and thus to reduce the costs of ensuring appropriate comfort conditions inside the building.

- **Energy efficiency audit**

  Energy efficiency audit, within the meaning of the Act, is an analytical document containing an analysis of energy consumption of the building/structure/technical device or installation in question and of its technical condition. The document contains a list of measures aimed at improving energy efficiency of the building/structure/technical device or installation, as well as an analysis of their cost-effectiveness and possible energy savings. An energy efficiency audit has to be carried out in order to obtain support in the form of white certificates.

- **Building's energy performance certificate**

  Building's energy performance certificate, within the meaning of the Act of 7 July 1994 - Construction Law (Journal of Laws of 2013, item 1409, and of 2014, item 40) is a document which determines the amount of energy (expressed in kWh/m2/year) which has to be ensured to meet the different energy needs connected with the use of the building, as well as a specification of possible measures which may improve the cost-effectiveness of the different energy-consuming systems in the building.

- **Market for energy services**

  Aiming to stimulate the market for energy services enterprises, such as energy saving enterprises (ESCO), the Act introduced regulations concerning the ability of such entities to enter into tenders for obtaining energy efficiency certificates (white certificates). ESCOs can be beneficiaries of the white certificates scheme in place of other entities, as the Act allows the aggregation of energy savings and bundling them

[6)] The amendments to the Act were published in Law Gazette 2010, No. 157, item 1241; 2010, No. 76, item 493; 2011, No. 106, item 622; and 2012, items 951 and 1342.

for tenders, as long as the realized enterprise leads to energy efficiency improvements, achieving a cumulative energy saving of at least 10 toe. Furthermore, public sector entities, while are obliged to use the energy efficiency improvement measures provided in the Act can sign agreements, which aim to realize and fund enterprises improving energy efficiency, with entities such as ESCOs.

The Polish National Energy Conservation Agency elaboration titled "Time for energy saving. Textbook directed to units of public sector" has been made available on the Ministry of Economy's website. The publication describes model agreements in various services categories which guarantee improvements of energy efficiency and a specified a list of available energy services providers[21)].

b) Measures in scope of energy efficiency in **buildings**

Building renovation strategy

The Ministry of Infrastructure and Development's strategy for buildings renovations "Supporting Investments in Building Modernisation", which was based on article 4 of directive 2012/27/UE, was present as attachment 4 in NEEAP 3.

Additional measures relating to the energy performance of buildings

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

The Thermal Modernisation and Renovation Fund, funded from the state budget, is a support programme for thermal modernisations and related renovation works carried out in old multi-family residential buildings. In its current form the programme is being implemented since 2009. The Fund's resources are 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.

In 2012, the Thermal Modernisation and Renovation Fund allocated the overall amount of 139.42 million PLN to the implementation of 2859 thermal modernisation projects with a total value of 1018.8 million PLN. It also allocated 31.79 million PLN to the implementation of 658 renovation projects with a total value of 226.2 million PLN.

In buildings energy efficiency, 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.

3.7 Support for energy efficiency within the Infrastructure and Environment Program 2014 - 2020 - Priority Axis 1 - reducing the emission of the economy

Presented below are measures executed within the Infrastructure and Environment Program and dedicated to reducing the emission of the economy.

a) Activities 1.1

Target: supporting production and distribution of energy from renewable sources.

Indicators of direct result list:

- Estimated annual decrease of greenhouse gas emissions;
- Production of electricity from newly built / new power generating installations using renewable energy sources;
- Production of thermal energy from the newly built / new power generating installations using renewable energy sources.

Types of projects:

- Building, rebuilding installations, increasing the installed capacity of land wind farms;
- Building, rebuilding installations, increasing the installed capacity of biomass installation;
- Building, rebuilding installations, increasing the installed capacity of biogas installation;
- Building, rebuilding installations, increasing power the installed capacity of water or solar energy or geothermal energy installation;

b) Activities 1.2

Target: promoting energy efficiency and the use of renewable energy sources in enterprises, increased energy efficiency in enterprises.

Indicators of direct result list:

- Estimated annual decrease of greenhouse gas emissions;
- Reduction of final energy consumption;
- Reduction of primary energy consumption;
- The amount of electricity saved;
- The amount of heat energy saved

Types of projects:

- The enterprises supported, in accordance with the Ordinance of the Minister of Economy of 21 December 2012 on the detailed list of measures improving energy efficiency, the activities resulting from an energy audit aimed at improving energy efficiency, as well as efforts towards technological changes in existing facilities, installation and technical devices, including:
- Reconstruction of the production lines to increase energy efficiency;
- Deep, complex modernization of the energy performance in business buildings;
- The implementation of energy efficient technologies in enterprises, through rebuilding or replacement of energy intensive equipment and installations, lighting, and transportation routes for production lines;
- Building or rebuilding of local heating sources (including replacing existing source with installations utilizing renewable energy sources);
- The implementation of energy recovery technology with a system of utilizing waste heat energy in enterprise.

c) Activities 1.3

Target: promotion of energy efficiency in buildings, increasing energy efficiency in multi-family residential buildings and public buildings.

Indicators of direct result list:

- Estimated annual decrease in greenhouse gas emissions;
- Reduction of annual primary energy consumption in public buildings;
- Reduction of final energy consumption;
- The amount of electricity saved;
- The amount of saved heat energy;

- Reduction of primary energy consumption.

Types of projects:

- Support for investment projects relating to deep, comprehensive energy modernization of public buildings;
- Support for project relating to deep, comprehensive energy modernization of public art schools in Poland;
- Support for investment projects relating to deep, comprehensive energy modernization of multi-family residential buildings;

d) Activities 1.4

Target: Developing and implementing smart distribution systems operating at low and medium voltages.

Indicators of direct result list:

- Number of additional energy users connected to smart grids;
- Reduction of primary energy consumption;
- The amount of saved electricity.

Types of projects:

- Construction or rebuilding of medium and low voltage distribution systems related to the implementation of smart grid technologies dedicated to reducing energy consumption and/or increasing connection capabilities for renewable energy sources, e.g.: replacing transformers and as integral part of the project, intelligent measuring system;
- A comprehensive pilot and demonstration projects implementing intelligent solutions, aimed at energy efficiency and/or optimization of the use of energy produced from renewable energy sources;
- Support within the activities relating to the dissemination of knowledge and the promotion of intelligent systems in industry and energy distribution.

e) Activities 1.5

Target: efficient distribution of heat and cold.

Indicators of direct result list:

- Estimated annual decrease in greenhouse gas emissions;
- Reduction of primary energy consumption.

Types of projects:

- Rebuilding existing heating systems and cooling networks in order to reduce transmission losses and distribution;
- Building connection to existing buildings and installation of individual nodes leading to the removal of group nodes;
- Building new sections of the heating network with connections and heat distribution nodes to eliminate existing local heat sources using solid fuel;
- Connecting buildings to the district heating network with the goal of eliminating individual and collective low-emission sources.

f) Activities 1.6

Target: promoting the use of high-efficiency cogeneration of heat and electricity based on need for heat and the increased use of electricity and heat production processes in high efficiency cogeneration.

Indicators of direct result list:

- Estimated annual decrease in greenhouse gas emissions;
- Reduction of primary energy consumption.

Types of projects:

- With regard to combustion installations utilizing fuel with a rated thermal input exceeding 20 MW: construction, reconstruction to cogeneration units and reconstruction of existing units into units of high-efficiency cogeneration using biomass as fuel;
- Implementation of complex projects for building new or remodelling existing units into high-efficiency cogeneration with heating networks or cooling networks, which would permit the use of heat / cold formed at the installation.
- Building of heating or cooling networks (including connections) allowing the use of thermal energy generated at sources of high-efficiency cogeneration;

- Use of waste heat produced in high efficiency cogeneration systems as part of development / construction projects of district heating networks;
- Building heating or cooling networks which enable the use of the heat generated in high-efficiency cogeneration, waste heat, heat from RES installations, as well as increasing the use of heat produced in such installations.

g) Activities 1.7

Target: comprehensive elimination of low emissions in the śląsko - dąbrowski conurbation.

Indicators of direct result list:

- Estimated annual decrease in greenhouse gas emissions;
- Reduction of primary energy consumption.

Types of projects:

- Support for investment projects related to deep, comprehensive energy modernizations of multi-family residential buildings;
- Building of heating or cooling networks (including connections) allowing the use of thermal energy generated in cogeneration sources
- Use of waste heat produced in high efficiency cogeneration systems as part of development / construction projects of district heating networks;
- Building heating or cooling networks that enable the use of the heat generated in high-efficiency cogeneration, waste heat, heat from RES installations, as well as increasing the use of heat produced in such installations.

3.8 Support for energy efficiency within Regional Operational Programs

Set out below is a description of the priority axis actions concerning energy efficiency and low-emission economic within the Regional Operational Programs. The axis described below is increasing efficiency energy and transitioning to a low-emission economy.

a) priority axis – Improving energy efficiency in enterprises

Types of projects:

- Deep thermo-modernisation of objects in enterprises;
- Energy reclamation technologies along with system utilizing waste heat energy within enterprise;
- Energy management systems (as a project's element)
- Projects concerning the reduction of energy, heat, water, loss, including the reclamation and utilization of waste heat;
- Projects concerning the implementation of energy-efficient (electric energy, heat, cold, water) production technologies and energy consumption;
- Construction and rebuild RES installation (if it is the result of an energy audit);
- Rebuilding production lines to increase energy efficient.

b) Priority axis - Energy efficiency of the public sector

Types of projects:

- Deep thermo-modernization of public facilities, including those belonging to Local Government entities (e.g. hospitals, schools);
- Replacing the equipment of the above objects with devices of the highest, economically justified, energy efficiency class (e.g. facility heating, replacement of doors and windows, upgrading heating systems, including the replacement of heating source using RES (excluding individual sources of heat), modernization of systems (ventilation, air conditioning), inclusion of energy management systems;
- Distributed generation, improving the efficiency of heating through replacing heating sources with high-efficiency cogeneration unit (as part of the comprehensive deep thermal modernization of buildings).

c) Priority axis - The energy efficiency of the housing sector

Types of projects:

- Deep thermo-modernization of multi-family residential buildings;
- Replacing the equipment of the above objects with devices of the highest, economically justified, energy efficiency class (e.g. facility heating, replacement of doors and windows, upgrading heating systems, including the replacement of heating source using RES (excluding individual sources of heat), modernization of systems (ventilation, air conditioning), inclusion of energy management systems;
- Distributed generation, improving the efficiency of heating through replacing heating sources with high-efficiency cogeneration unit (as part of the comprehensive deep thermal modernization of buildings).

d) Priority axis- Support the transition to a low carbon economy in all sectors

Types of projects:

- The development of renewable energy sources;
- Energy efficiency and renewable energy sources in enterprises;
- Energy efficiency in buildings;
- Smart energy networks;
- Low-emission strategies, including urban transport and heating networks;
- Cogeneration of heat and electricity.

3.9 National Fund for Environmental Protection and Water Management (NFEPWM) programs for years 2016-2020

3.9.1 Improvement of air quality

Presented below are programs by the National Fund for Environmental Protection and Water Management (NFEPWM) for years 2016 – 2020 within the context of the priority program Air Quality Improvement.

The priority program's goal is increasing air quality through limiting or avoiding CO_2 emissions by increasing the production of energy from renewable energy sources and reducing the energy consumption of buildings.

a) Part 1 Energy use of geothermal resources

The aim of the program is: constructing of new, expansion or modernization of existing geothermal heating/power plants, modernization or expansion of existing geothermal sources through the construction of geothermal heating/power plants, or drilling new or restructuring wells, provided they do not qualify for exploratory drilling.

Indicators of target acquiring:

- amount of energy produced from RES (MWh/year);
- reduction of primary energy consumption (PE);
- reduction of carbon dioxide emissions (CO_2).

b) Part 2 Reducing energy consumption in civil engineering

The purpose of the program is the implementation of thermal modernization in terms of replacing the equipment of the objects to devices with the highest, economically justified, energy efficiency standards directly related to the conducted thermal modernization of facilities, such as: museums, hospitals, medical care, nursing care, hospices, historic buildings, religious buildings along with accompanying facilities, dormitories, and other objects designed for the needs of culture, religious worship, education, care, upbringing and education.

Indicators of target acquiring:

- amount of energy produced from RES (MWh/year);
- reduction of primary energy consumption (PE);
- reduction of carbon dioxide emissions CO_2.

c) Part 3 BOCIAN – dispersed, renewable energy sources

The purpose of the program is reducing or avoiding CO_2 emissions by increasing the production of energy from renewable energy power plants.

Indicators of target acquiring:

- Planned production of electricity from renewable sources, at least, 430 000 MWh/year,
- Planned production of heat from renewable sources, at least, 990 000 GJ/year;
- Reduction or avoidance CO_2 emissions, at least, 400 000 Mg/year.

d) Part 4 Lemur

The purpose of the program is reducing energy consumption and therefore reducing or avoiding CO_2 emissions by designing and building low energy public buildings and multifamily buildings.

Indicators of target acquirement:

- Reduction of primary energy consumption, at least, 23 000 MWh/year;
- Reduction or avoidance CO_2 emissions, 4 600 Mg/year.

3.9.2 SYSTEM – support of activities for environmental protection and water management carried out by external partners.

a) KAWKA

The purpose of the program is to eliminate low-emission, supporting the growth of energy efficiency and the development of distributed renewable energy sources.

b) Ryś

The purpose of the program is to support the thermo-modernization of single-family houses. Reducing CO_2 emissions and dust resulting from improved energy efficiency in existing single-family residential buildings.

Indicators of target acquirement:

- A reduction in final energy consumption: the planned achieved value of the index is at least 300 000 GJ/year;
- Reduction of CO_2 emissions: the planned achieved value of the index is at least 25 000 Mg/year;
- Reduction of emissions of particulate matter with a diameter less than 10 microns (PM10): the planned achieved value of the index is at least 50 Mg/year;
- Reduction of emissions of particulate matter with a diameter less than 2.5 micrometres (PM2.5): the planned achieved value of the index is at least 45 Mg/year.

c) PROSUMENT - financing for the purchase and installation of micro-installations using renewable energy sources

The purpose of the program is to reduce or avoid CO_2 emissions by increasing energy production from renewable sources, through the purchase and installation of small plants or micro-installations using renewable energy sources to produce electricity or heat for individual and community housing.

Indicators for target acquirement:

- Reduction of CO_2 emissions;
- The amount of energy produced from renewable sources, at least, 90 thousand. Mg/year.

3.9.3 Support for innovations favorable to a resource saving and low-emission economy

a) **Sokół** – implementing innovative environmental technologies

The aim of the programme is the implementation of innovative technologies which reduce the effect of plants/installations/equipment on the environment, as well as the use or production of technologies complying with the National Smart Specialization Strategy (RIS3 strategies)

Indicators for target acquirement:

- Number of enterprises supported in conducting R & D,
- Number of implemented innovative environmental technologies.

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 2004-2014 consistent improvement of energy efficiency took place. Primary and final energy consumption were decreasing in this period by more than 3% per year. The fastest rate of energy efficiency improvement was recorded in the industrial sector, but in the second half of this period the pace of improvement significantly dropped.

The most important factor influencing the increase in energy demand was rising economic activity in all sectors, while improving energy efficiency had strongest impact on reduction of demand.

In comparison with the results achieved in the European Union it can be seen that the rate of energy efficiency improvement in Poland exceeds the European average rate, while the level of energy intensity of economy is above the European average.

The achieved results allow to exceed indicative target under Directive of the European Parliament and of the Council 2006/32/EC. Achieved until year 2014 savings exceeded objectives for the whole duration of the Directive.

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	2004	2005	2006
1	Primary energy consumption ……..…..	Mtoe	91.2	92.0	96.9
2	Final energy consumption ……..	Mtoe	57.0	58.0	60.6
3	Final energy consumption with climatic correction…….	Mtoe	57.2	57.9	60.9
4	Primary energy intensity of GDP……..	kgoe/euro00	0.435	0.424	0.421
5	Final energy intensity of GDP…..……	kgoe/euro00	0.272	0.267	0.263
6	Final energy intensity of GDP with climatic correction……...	kgoe/euro00	0.273	0.267	0.265

Table 2. Energy intensity of industry branches

No.	Specification	Unit	2004	2005	2006
1	Food.....	kgoe/euro05	0.396	0.273	0.233
2	Textile.....	kgoe/euro05	0.140	0.148	0.116
3	Wood.....	kgoe/euro05	0.428	0.492	0.422
4	Paper.....	kgoe/euro05	0.391	0.599	0.554
5	Chemical.....	kgoe/euro05	1.203	1.088	0.949
6	Mineral.....	kgoe/euro05	1.062	0.948	0.792
7	Primary metals.....	kgoe/euro05	2.784	1.964	1.618
8	Machinery.....	kgoe/euro05	0.097	0.079	0.060
9	Transport equipment.....	kgoe/euro05	0.094	0.109	0.092
10	Other.....	kgoe/euro05	0.116	0.119	0.115

Table 3. Energy intensity of production

No.	Specification	Unit	2004	2005	2006
1	Steel……	toe/t	0.265	0.257	0.234
2	Cement..……..	toe/t	0.106	0.103	0.109
3	Paper..…….…….	toe/t	0.510	0.573	0.552

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
97.1	98.1	94.3	100.5	101.5	98.1	97.7	93.8	1
60.4	61.6	60.6	65.3	63.8	63.3	62.0	60.5	2
62.0	63.3	61.1	63.6	65.0	63.6	62.5	63.0	3
0.393	0.383	0.358	0.368	0.354	0.337	0.332	0.308	4
0.245	0.240	0.230	0.239	0.223	0.217	0.210	0.199	5
0.251	0.247	0.232	0.233	0.227	0.218	0.212	0.207	6

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
0.237	0.214	0.196	0.199	0.197	0.197	0.189	0.180	1
0.096	0.080	0.063	0.062	0.050	0.049	0.054	0.053	2
0.343	0.354	0.333	0.380	0.357	0.362	0.417	0.370	3
0.435	0.447	0.424	0.413	0.382	0.372	0.439	0.414	4
0.887	0.838	0.816	0.811	0.860	0.812	0.871	0.805	5
0.815	0.765	0.734	0.657	0.638	0.617	0.590	0.522	6
1.595	1.589	0.997	1.057	1.034	1.027	1.114	1.023	7
0.048	0.038	0.034	0.032	0.029	0.027	0.030	0.027	8
0.087	0.073	0.059	0.054	0.045	0.044	0.050	0.044	9
0.097	0.086	0.068	0.068	0.073	0.067	0.080	0.076	10

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
0.222	0.208	0.195	0.196	0.195	0.205	0.208	0.197	1
0.098	0.088	0.090	0.095	0.093	0.087	0.094	0.095	2
0.533	0.556	0.468	0.438	0.448	0.455	0.514	0.479	3

Table 4. Energy efficiency indicators in households sector

No.	Specification	Unit	2004	2005	2006
1	Energy consumption per dwelling.....	toe/dwelling	1.495	1.541	1.623
2	Energy consumption per dwelling with climatic correction.....	toe/dwelling	1.518	1.540	1.643
3	Energy consumption per m^2.....	kgoe/m^2	21.6	22.0	23.0
4	Energy consumption for heating per $m^{2\ a)}$.....	kgoe/m^2	15.0	15.4	16.3
5	Electricity consumption per dwelling.....	kWh/dwelling	2008.6	1976.6	2055.4

Table 5. Energy efficiency indicators in service sector

No.	Specification	Unit	2004	2005	2006
1	Energy intensity.....	kgoe/euro05	0.050	0.049	0.051
2	Electricity intensity.....	Wh/euro05	231.6	240.2	253.1
3	Energy consumption per employee.....	toe/emp.	0.955	0.936	0.999
4	Electricity consumption per employee.....	kWh/emp.	4396.5	4625.3	4973.4

Table 6. Energy efficiency indicators in transport and energy sector

No.	Specification	Unit	2004	2005	2006
1	Fuels consumption per equivalent car.....	toe/eq. car	0.458	0.496	0.514
2	Heat plants efficiency.....	%	77.2	77.3	77.7

Table 7. ODEX indicator

No.	Specification	Unit	2004	2005	2006
1	Manufacturing.....	2000=100	77.8	71.3	66.3
2	Transport.....	2000=100	98.5	96.9	95.6
3	Households.....	2000=100	84.2	83.9	83.9
4	Global ODEX.....	2000=100	85.8	83.3	81.6

a) Data estimated

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
1.497	1.496	1.501	1.621	1.479	1.511	1.473	1.355	1
1.606	1.621	1.547	1.552	1.557	1.527	1.500	1.482	2
21.3	21.3	21.3	22.5	20.4	20.7	20.1	18.5	3
14.9	14.9	14.9	16.0	14.2	14.6	14.1	12.8	4
2029.4	2061.9	2069.9	2124.3	2079.8	2063.5	2053.1	2008.4	5

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
0.046	0.050	0.049	0.053	0.049	0.047	0.044	0.042	1
240.9	256.7	245.7	259.9	255.7	251.1	238.3	242.9	2
0.931	1.003	1.017	1.110	1.044	1.025	0.981	0.924	3
4829.9	5165.6	5134.5	5489.3	5502.1	5506.6	5266.3	5369.5	4

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
0.532	0.518	0.523	0.529	0.511	0.477	0.432	0.428	1
77.0	79.2	80.2	81.0	81.1	81.1	81.4	81.6	2

2007	2008	2009	2010	2011	2012	2013	2014	Lp.
61.2	57.8	54.8	52.5	50.7	50.6	50.0	50.1	1
92.2	89.5	87.3	85.7	83.5	79.3	75.3	72.9	2
83.6	83.2	82.8	82.1	81.8	81.5	79.9	79.7	3
79.0	77.5	76.3	74.7	73.2	71.4	68.9	68.1	4

Table 8. Impact of selected factors on variation of final energy consumption in years 2004-2014 (Mtoe)

Specification	Industry	Households	Transport	Services	Agriculture	Total
Variation of final consumption……..	-1.1	0.0	4.4	1.0	-0.9	3.5
FACTORS						
Activity…….....	7.4	–	7.0	2.9	0.1	17.4
Number of dwellings…….....	–	2.0	–	–	–	2.0
Lifestyle..……...	–	1.5	–	–	–	1.5
Structural changes..	0.7	–	1.6	–	–	2.3
Energy savings…..	-7.4	-1.4	-4.0	0.0	-1.0	-13.8
Climate effect…….	–	-1.4	–	-0.6	–	-2.0
Other……..	-1.8	-0.7	–	-1.2	–	-3.8

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. *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.*