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IN YEARS 2002-2012

Warsaw, 2014

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PREFACE

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 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, July 2014

Contents

List of Figures

List of tables in analytical part

List of tables in tabular part

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.

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**

[1] www.odyssee-indicators.org

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:

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

where: $t_{śr}(n) = \frac{t_{\min}(n) + t_{maks}(n)}{2}$ - mean outdoor temperature for *n* day, [^{o}C]; $t_{\min}(n), t_{maks}(n)$ - minimum and maximum temperature of the *n* day, [^{o}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^{o}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.

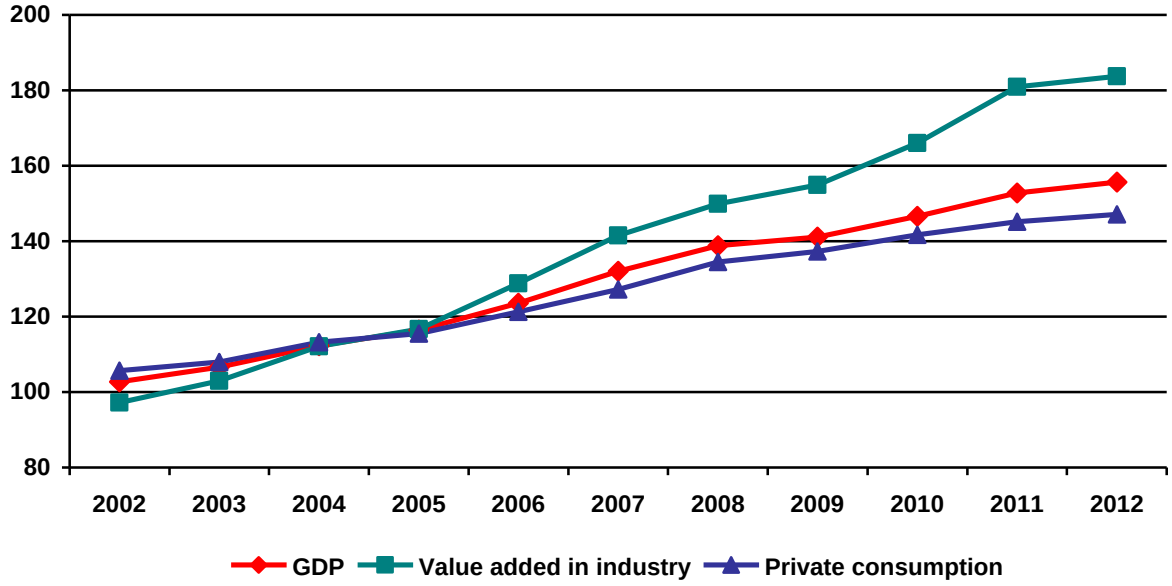
Energy efficiency index (ODEX) is calculated by aggregating the individual changes in energy consumption, observed on certain levels of end-use. ODEX indicator does not show the current level of energy intensity, but the improvement over the base year. ODEX is calculated for each year as the ratio of 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 was constantly increasing in the period 2002-2012 reaching at the end of the period value higher by more than 52% than at the beginning. The fastest rate of growth of value added at constant prices was achieved in the given period in industry sector. Rate of growth[2] of private consumption was little smaller than rate of GDP growth.

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

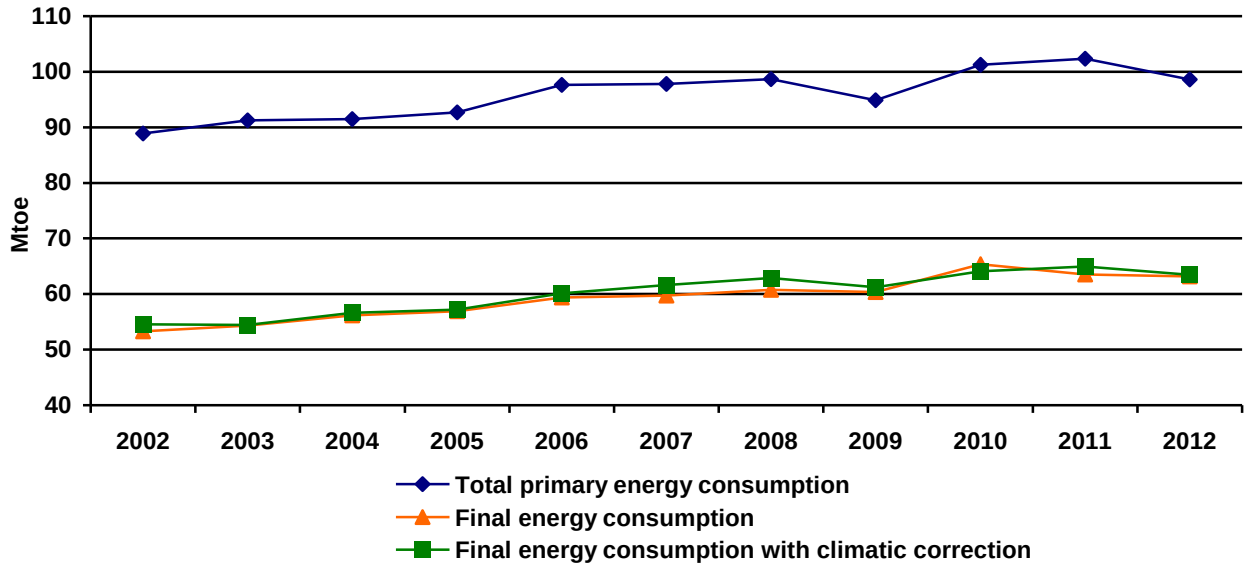


2.2 Energy consumption and prices of energy

Total primary energy consumption increased between 2002-2012 from 89 Mtoe to almost 99 Mtoe (1.0%/year). Decrease in consumption was recorded twice, in 2009 and 2012, ie during periods of low economic growth. In case of final energy consumption average annual growth rate amounted to 1.7% during given period. In absolute terms, this represents an increase from 53 to over 63 Mtoe. In this case, the fall in consumption was observed, in addition to those earlier years, also in year 2011. After taking into account different weather conditions, that is in case of final energy consumption with climatic correction consumption growth rate amounted to 1.5%/year in the period 2002-2012. 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 2012 amounted to 63 Mtoe.

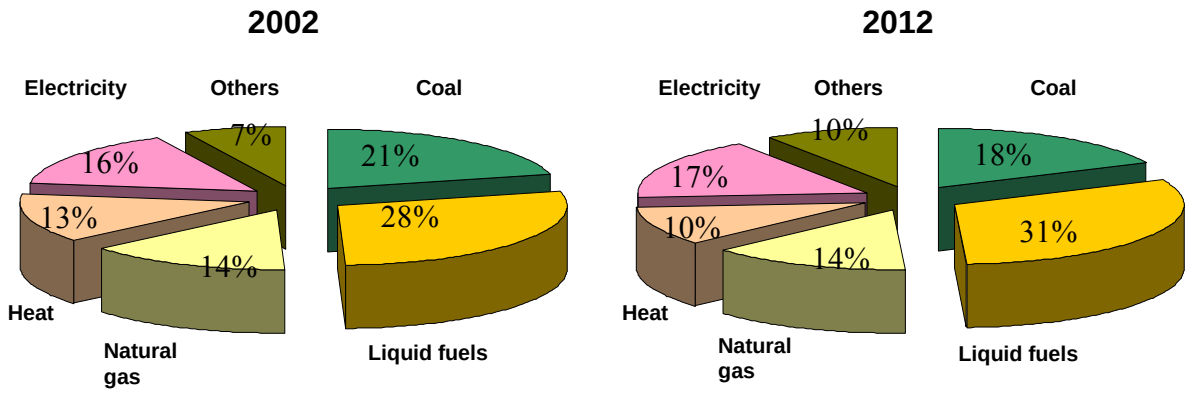
[2] Calculated as geometric mean

Figure 2. Total primary and final energy consumption



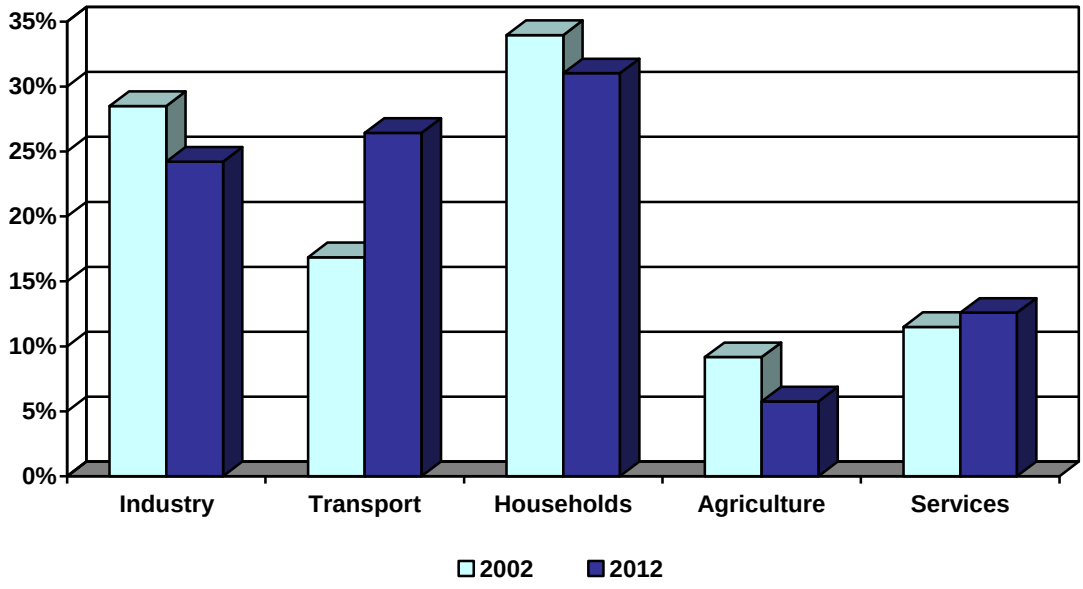
Polish energy sector has traditionally been focused on the use of country natural resources, which also had an impact on the types of energy consumed in other sectors of the economy. The main source of primary energy was and is hard coal and lignite. In case of final energy consumption, it is dominated by liquid fuels, whose share increased over the period 2002-2012 from 28 to 31% (Fig. 3). At the same time there has occurred a decline in the share of coal in final energy consumption - from 21% in 2002 to 18% in 2012. A significant increase compared to year 2002 occurred in the use of other energy sources, which in 2012 reached level of 10% of the final energy consumption. In case of electricity and natural gas share no major change has been observed, while the share of heat declined.

Figure 3. Final energy consumption by energy carrier



Changes in the structure of final energy consumption by energy carrier correspond with changes in the structure of final energy consumption by sector. In the years 2002-2012 the share of transport grew most - from 17 to 26%. Service sector has increased its share as well and accounted for 13% of final consumption. In case of industry, households and agriculture, there has been a decline in the share in total consumption. Households remained the largest consumer with a share of 31%. The growing importance of transport is associated with an increased role of both freight transport and passenger transport carried out in private cars.

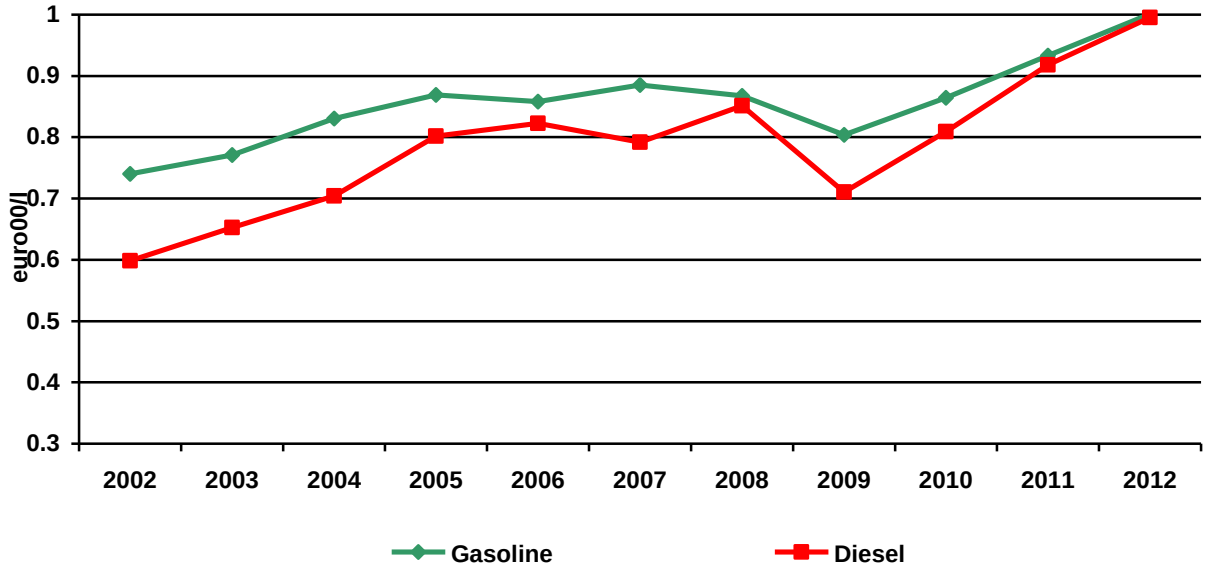
Figure 4. Final energy consumption by sectors



Prices of gasoline and diesel, expressed in constant prices of 2000 were subject to similar changes in 2002-2012. The decrease lasting until 2002 was followed by several years of rising

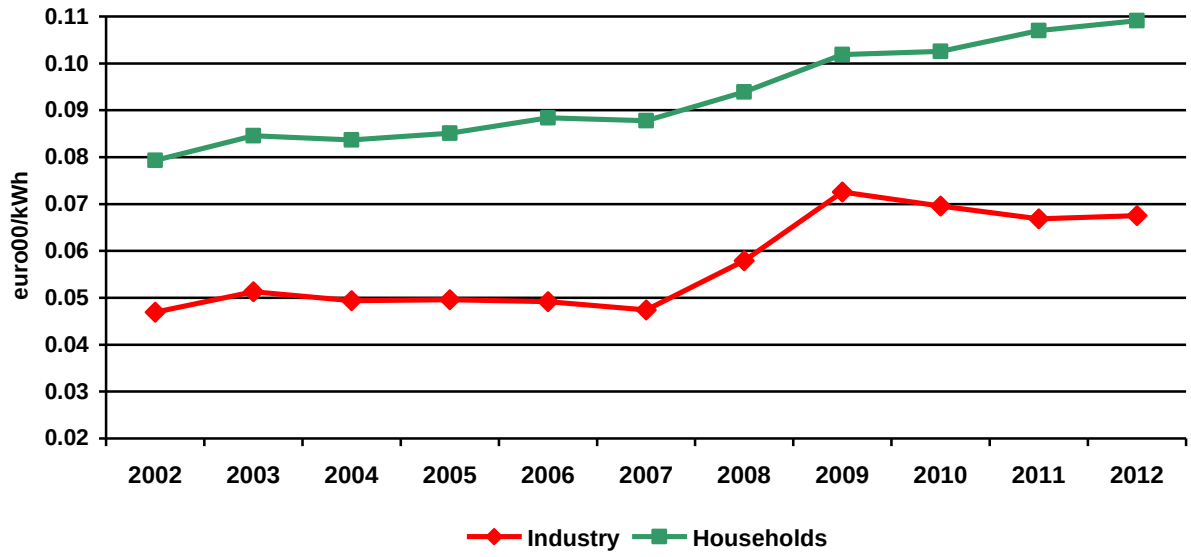
prices, and then a period of low volatility. In 2009, there was a significant drop in prices, particularly diesel oil which plays greater role in economic activity (Fig. 5). Afterwards prices began to grow and in 2012 reached a value of 1.00 euro00/l in case of gasoline and 0.99 euro00/l in case of diesel.

Figure 5. Gasoline and diesel oil prices



Electricity prices for households have increased during 2002-2012 period from 0.08 in 2002 to 0.11 euro00/kWh in 2012, which means in more than 3% average annual growth. The upward trend was clear, only declining years are 2004 and 2007. In case of electricity prices for industry a higher rate of growth was observed - more than 4%/year, but the increase was much less even. The high average annual growth over this period was reached due to high price increase in years 2007-2009, when growth exceeded 50%. In 2009-2011 there was a slight decline in prices while in year 2012 electricity prices for industry grew to almost 0.07 euro00/kWh.

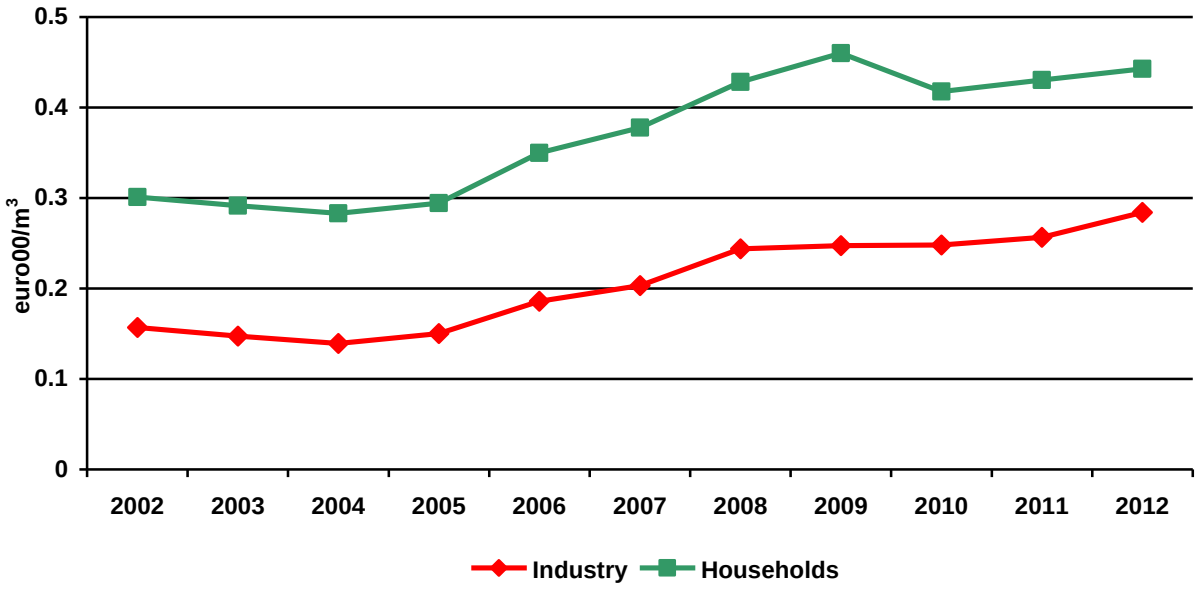
Figure 6. Electricity prices for households and industry



Natural gas prices for households were decreasing until year 2004,. Since then, prices have been steadily growing with exception of year 2010. In total, during the given period average rate of increase of the price of natural gas for households amounted to 3.9%/year.

Natural gas prices for industry decreased in years 2003-2004. Since then, prices tended to rise, in years 2005-2008 dynamically, and in the years to come negligibly. Overall price of natural gas for the industry increased from 0.16 euro00/m^3 in 2002 to 0.28 euro00/m^3 in 2012.

Figure 7. Gas prices for households and industry



2.3. Macro-economic indicators

Growth of GDP faster than the growth in energy consumption resulted in observed decreasing, with the exception of year 2010, primary and final energy intensity of GDP (Figure 8-9, Table. 1). In the first half of the decade, energy intensity decreased by over 2% per year, in years 2007-2009 the rate of improvement exceeded 5% in case of primary intensity, and amounted to nearly 4% in final energy intensity. In years 2010-20112 the rate of improvement reached similar level as during years 2003-2006.

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

Growth rate	2003-2006	2007-2009	2010-2012	2003-2012
Primary intensity of GDP……..	-2.27	-5.22	-2.09	-3.11
Primary intensity of GDP with climatic correction…….	-2.42	-5.19	-2.27	-3.22
Final intensity of GDP……..	-1.93	-3.75	-1.87	-2.46
Final intensity of GDP with climatic correction……..	-2.19	-3.73	-2.16	-2.64

Figure 8. Energy intensity of GDP

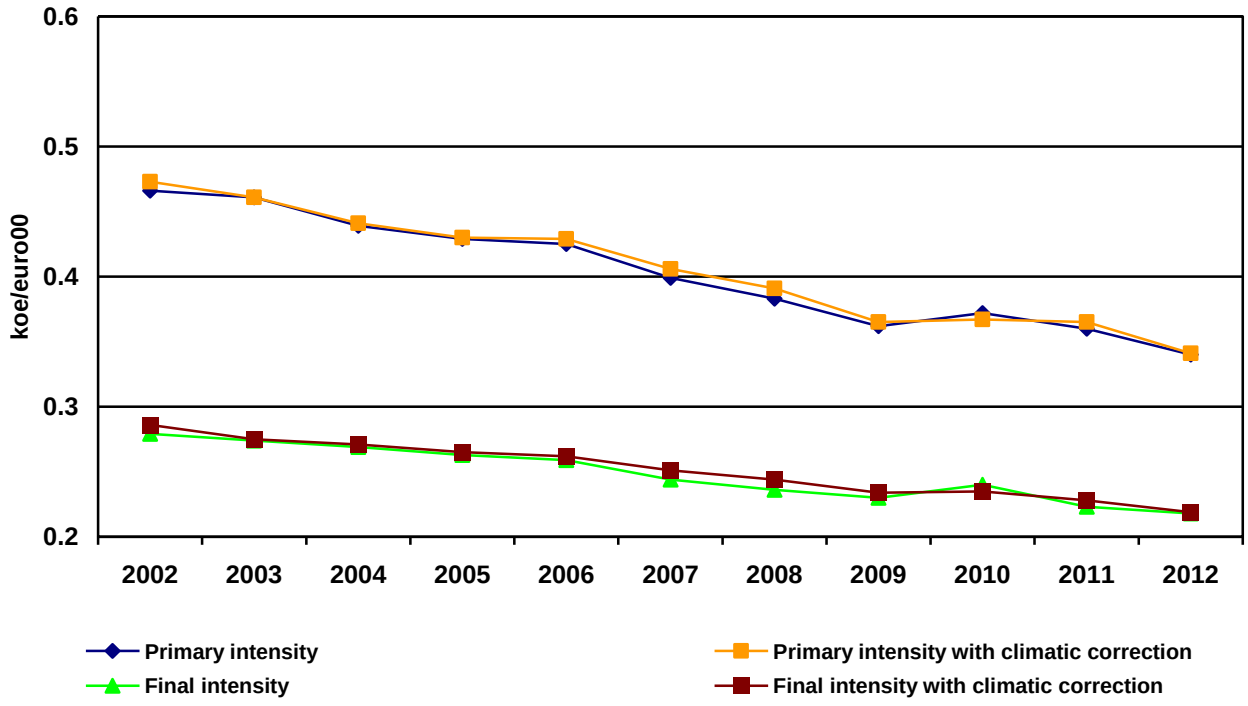
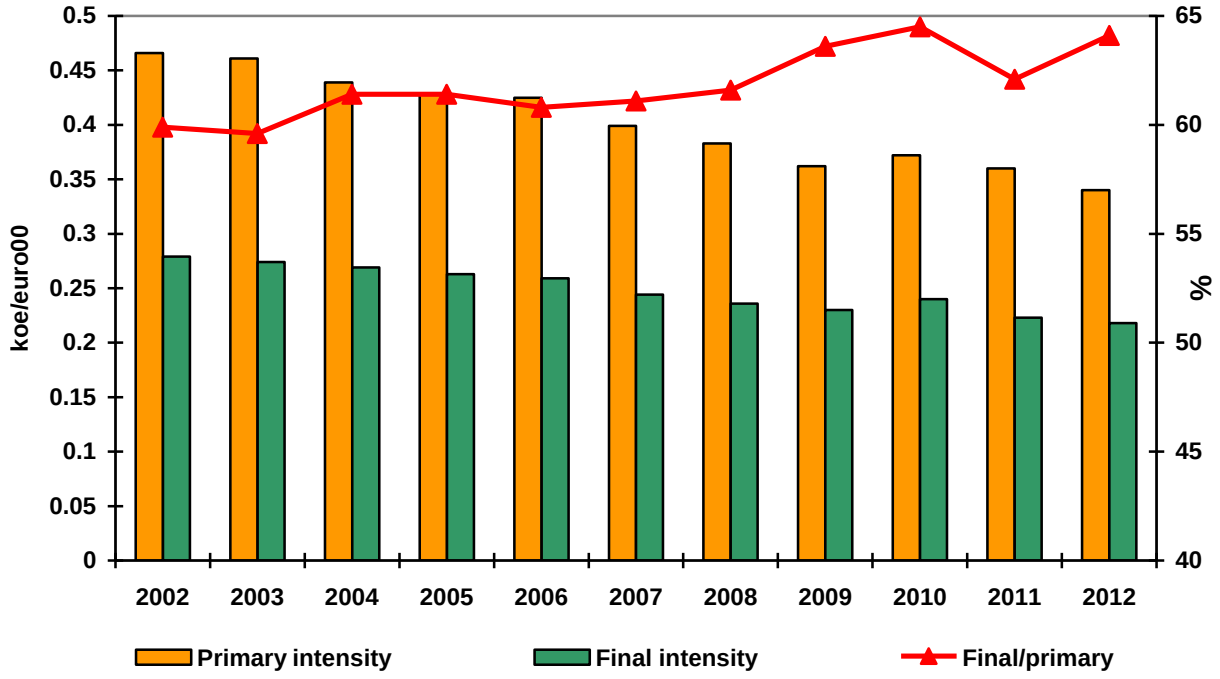


Figure 9. Ratio of final to primary intensity

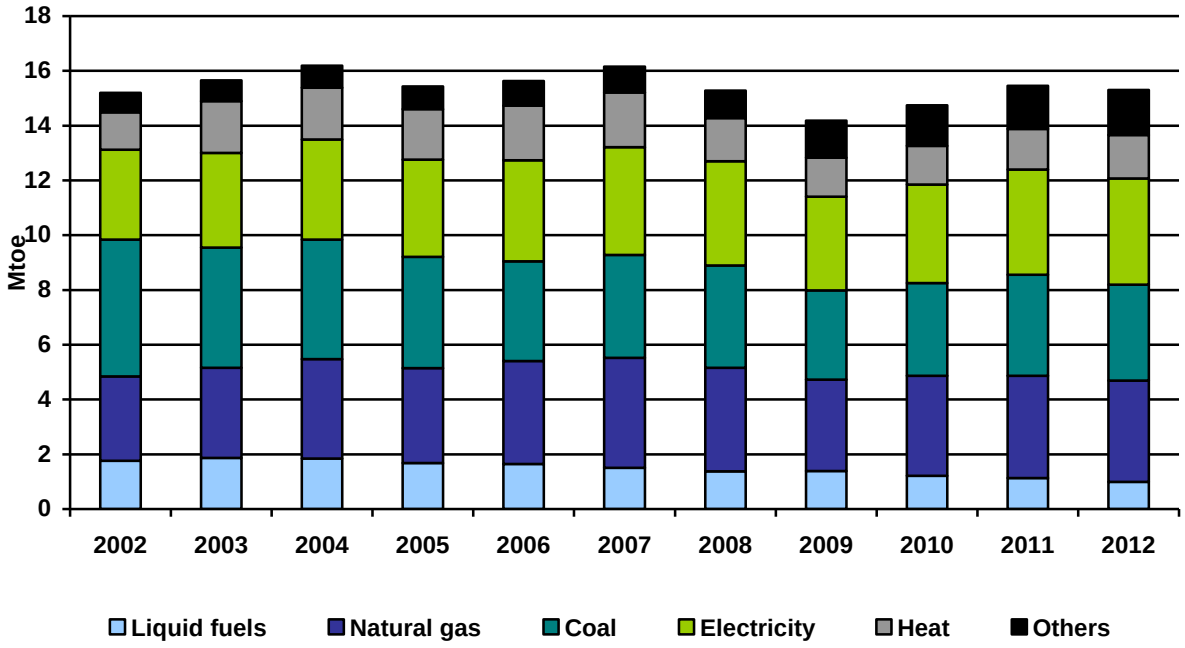


The ratio of final energy consumption to primary energy consumption reached values between 60% and almost 65% in 2010. In 2011, the value decreased to 62.6% and reached 64.1% in 2012. Its level is mainly affected by the energy transformation efficiency (the higher the efficiency the greater the value 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 in the period 2002-2012 was subject to irregular fluctuations. The highest consumption was observed in 2007, then declined to 14 Mtoe in 2009 and grew again to more than 15 Mtoe in 2011. In 2012 energy consumption slightly fell. In terms of energy carriers, a decrease of consumption of coal and liquid fuels can be seen while the use of natural gas, electricity and other energy carriers increased. Heat consumption remained at the same level.

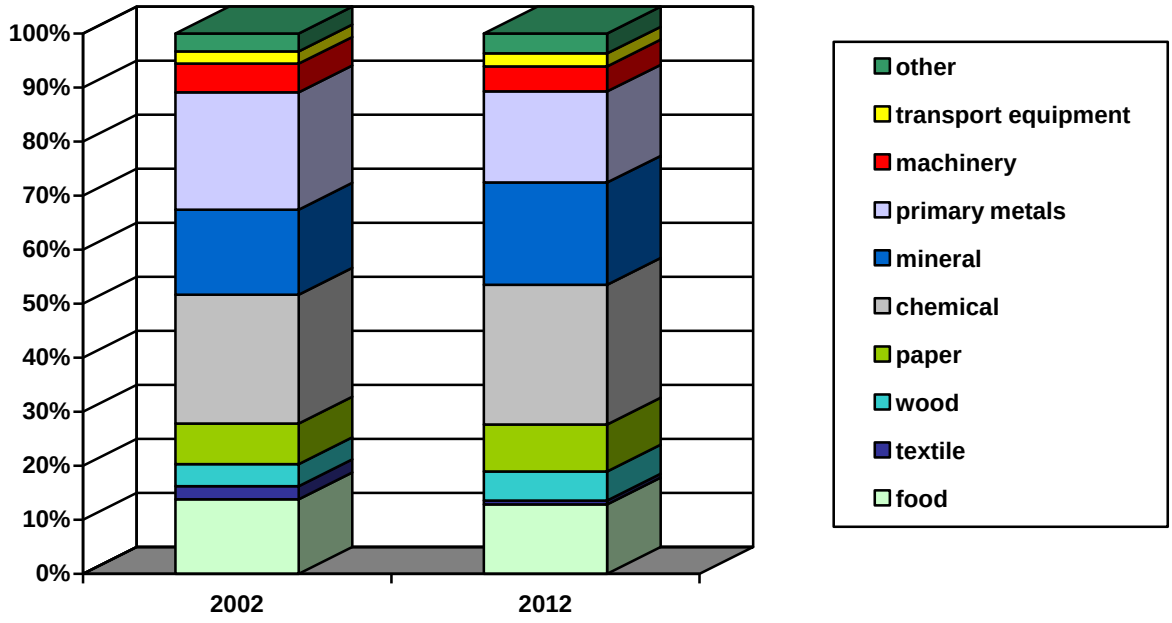
Figure 10. Final energy consumption in industry by energy carrier



Changes in shares of individual industries in total energy consumption in the manufacturing industry is shown in Fig 11. Approximately 60% of energy is consumed by energy-intensive industries: primary metals, chemical and mineral.

The largest decline in comparison with year 2002 which amounted to almost 5 percentage points was achieved by primary metals; food, textile and machinery industries also recorded a decrease in the share of energy consumption. The increase of share of energy consumption was recorded in case of wood, paper, chemical, mineral, transport equipment and other industries. Apart from mineral industry, which share increased by 3 percentage points and chemical industry which achieved an increase of 32percentage points, structural changes are small.

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 2002-2012.

Figure 12. Energy intensity of energy intensive industry branches

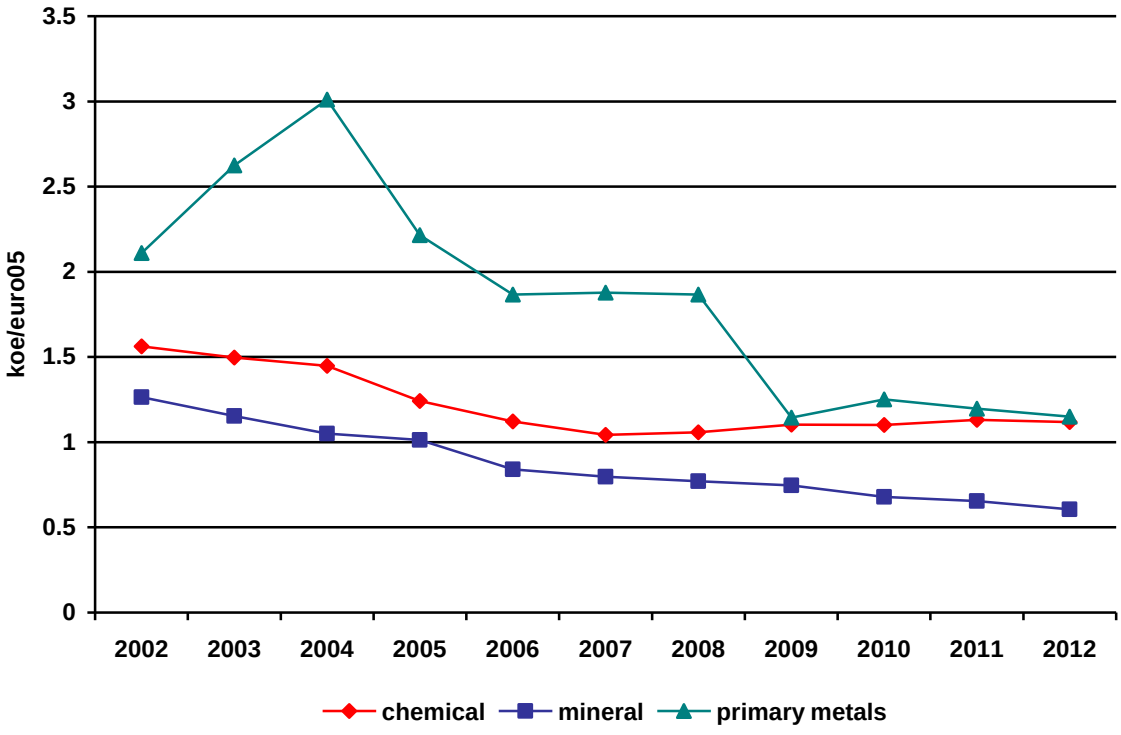
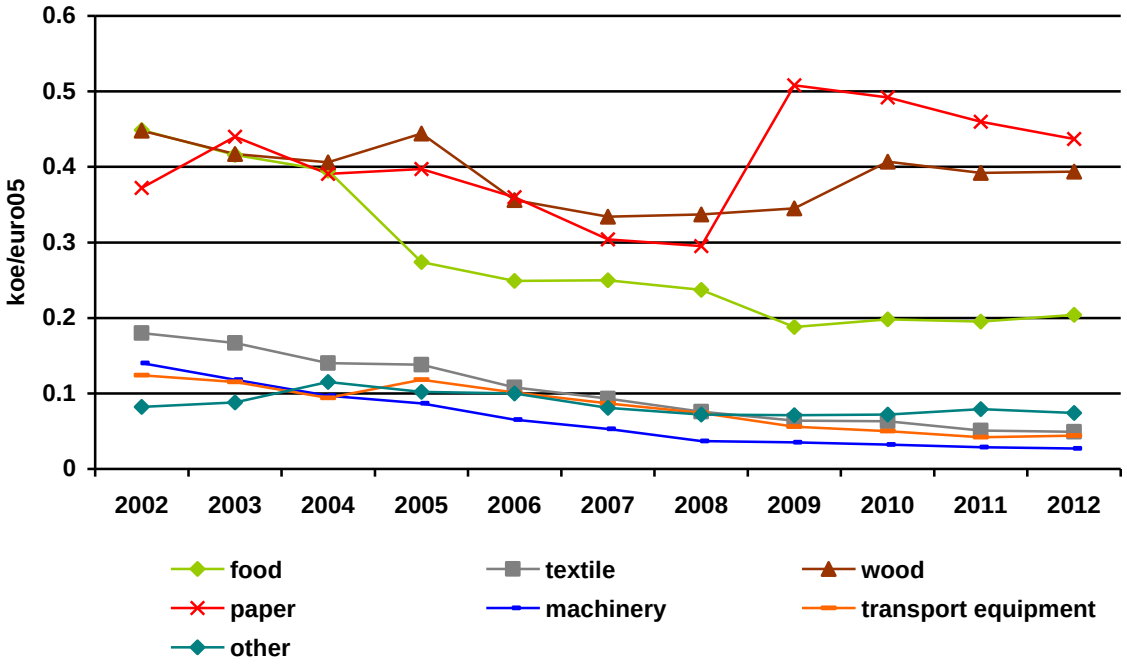


Figure 13. Energy intensity of low energy intensive industry branches



The most dynamic energy efficiency improvements were observed in machinery, as well as food, textile and transport equipment industry. Slowest improvement occurred in wood and other industry. Paper industry noticed worsening of efficiency (it was caused by classification change resulting in this case with incomparability of time series).

Changing shares of individual sectors of manufacturing in the final consumption of energy and value added in the section, that is the changing structure have affected the level of energy consumption in manufacturing.

The rate of improvement of energy intensity of manufacturing industry was high in years 2002-2008 and averaged to 10.2%/year. Impact of structural change was positive – it contributed to the decline in energy intensity by 2.5%/year. The situation changed in years 2010 - 2012 - energy intensity at constant structure decreased by 2.1%, while structural changes have lowered energy intensity of manufacturing by 1.7%/year. Actual intensity decreased by 3.8%/year.

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

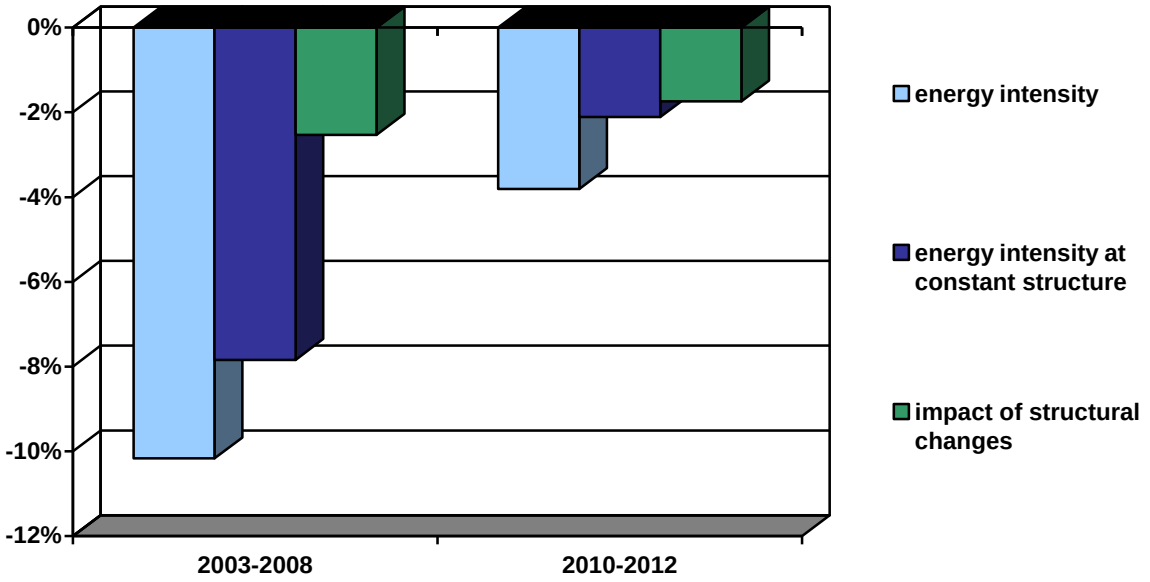


Table 2. Dynamics of energy intensity and impact of structural changes (%/year)

Specification	2003-2008	2010-2012
Energy intensity	-10,17	-3,81
Energy intensity at constant structure	-7,84	-2,11
Impact of structural changes	-2,53	-1,74

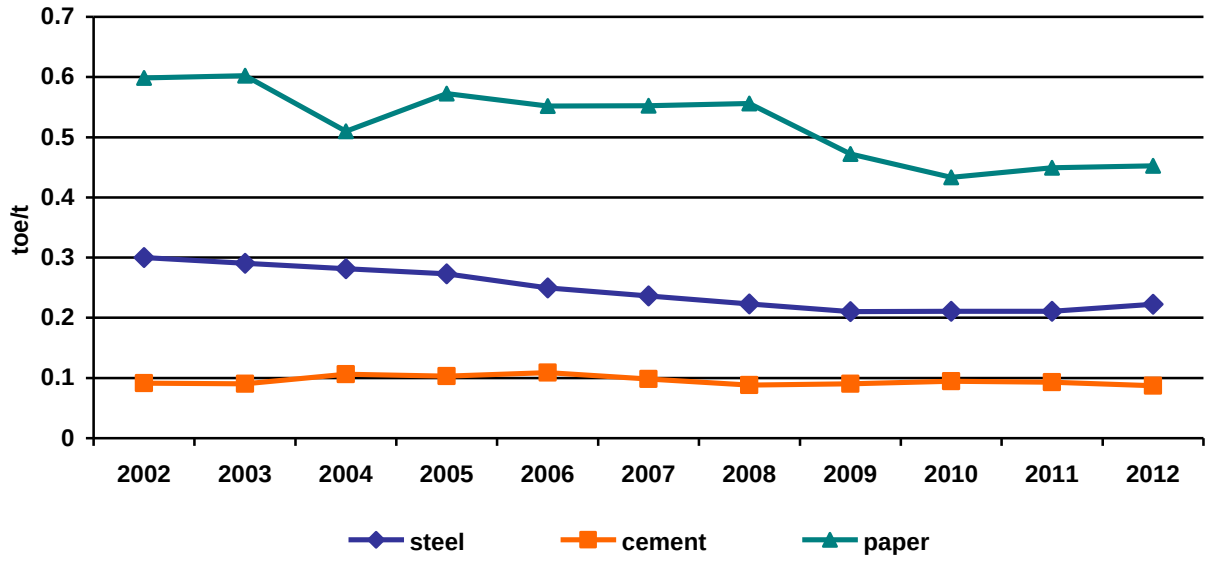
Figure 15 presents energy intensity of steel[3], cement[4] and paper[5] production in years 2002-2012. Energy used to produce these three products amounted to 31% of energy consumption in manufacturing in 2012.

The energy intensity of cement production remained in this decade at a similar level of 0.1 toe/t. This value is close to the European average. In the case of steel production energy intensity decreased steadily until 2009, and then stabilized. Energy consumption of paper industry showed a declining trend in the years 2002-2012, although in some years there has been an increase of energy consumption. In 2012, there was a slight increase in intensity to the level of 0.45 toe / ton.

[3] 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
[4] Calculated as final energy consumption in cement industry (since 2009 in group 23.5 according to NACE Rev. 2) divided by cement production
[5] Calculated as final energy consumption in paper industry (since 2009 in division 17 according to NACE Rev. 2) divided by paper production

In the years 2002-2012 energy consumption of crude steel production fell by 25.9% (3.0%/year), paper by 24.4% (2.8%/year) and cement by 4.4% (0.4%/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 2011. The structure of consumption by end-use, resulting from surveys carried out by the CSO in 1993, in 2002, in 2009 and in 2012 are shown in Figure 16 and Table 3.

The share of energy consumption for heating systematically decreased, which was associated with the installation of more efficient gas and electric appliances; the influence of thermal modernization and more stringent construction standards is also noticeable. 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.

Figure 16. Structure of energy consumption in households by end use

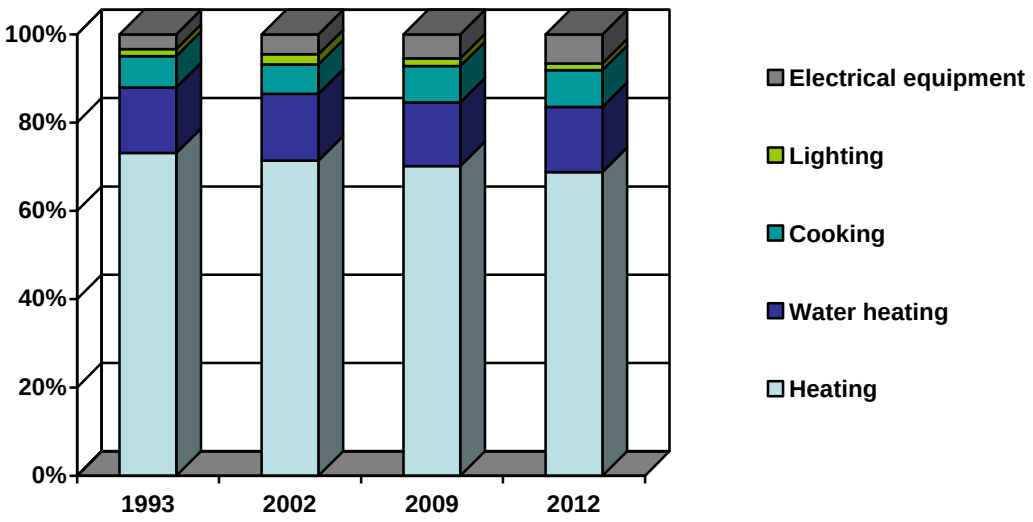


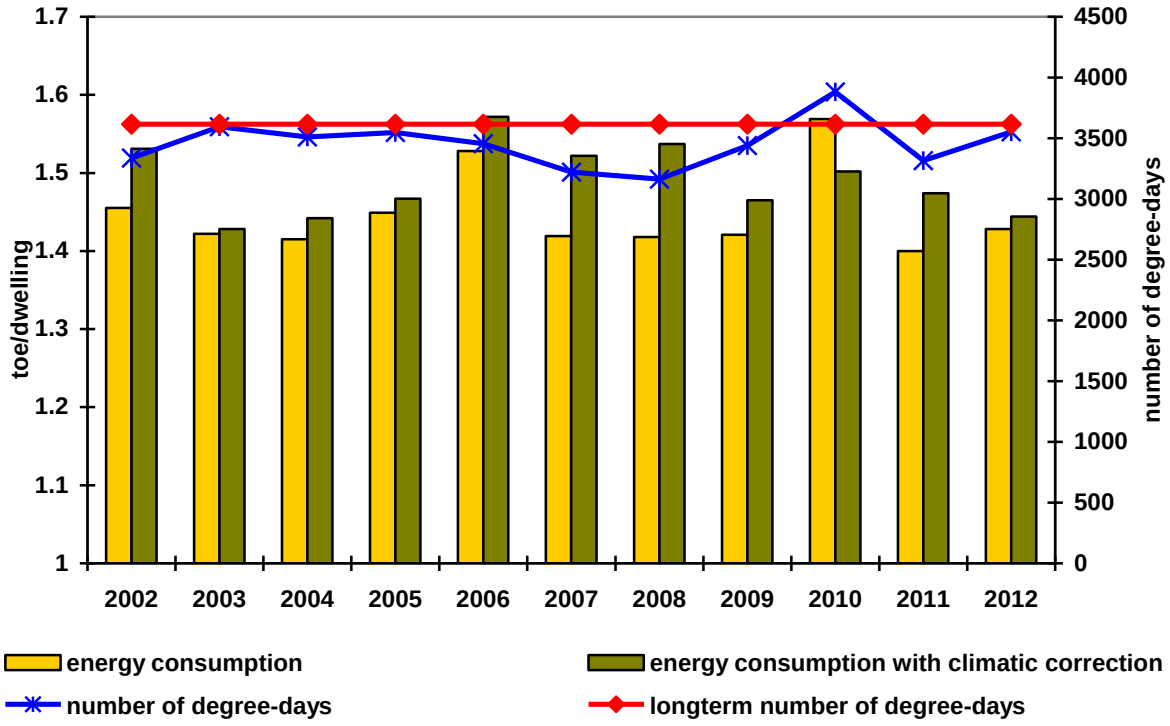
Table 3. Structure of energy consumption in households by end use (%)

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

Figure 17 shows the changes of energy consumption per dwelling. Energy consumption per dwelling was decreasing by 0.2% per year. In 2011 it reached the lowest value during given period. It partly resulted from good weather conditions this year. In year 2012 consumption per dwelling amounted to 1.43 toe/dwelling.

The value of indicator with climatic correction decreased between 2002 and 2012 from 1.53 to 1.44 toe/dwelling, which means the average annual decline of 0.6%. The lowest value was achieved in 2003 followed by several years of growth. Since 2006, the downward trend of energy consumption with climatic correction can be observed.

Figure 17. Energy consumption in households per dwelling



source: Eurostat and Joint Research Center, GUS

Table 4. Heating degree-days in years 1998-2012

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sd - annual	3559	3341	3092	3581	3337	3594	3510	3547	3454	3222	3164	3439	3881	3317	3552

source: Eurostat and Joint Research Center

Trend of energy consumption per m^2 is similar, although the growth rate of improvement is higher by about 1 percentage point, reflecting the gradual increase in the average size of the dwelling. Figure 18 shows the energy consumption in households per m^2.

Electricity consumption in households showed an increasing trend in years 2002-2010, while consumption in years 2011 and 2012 decreased. The growth of electricity consumption in 2003 is due to methodological changes - electricity consumption in households whose main source of income was the income from the use of an individual farm was added.

Figure 18. Energy consumption in households per m^2

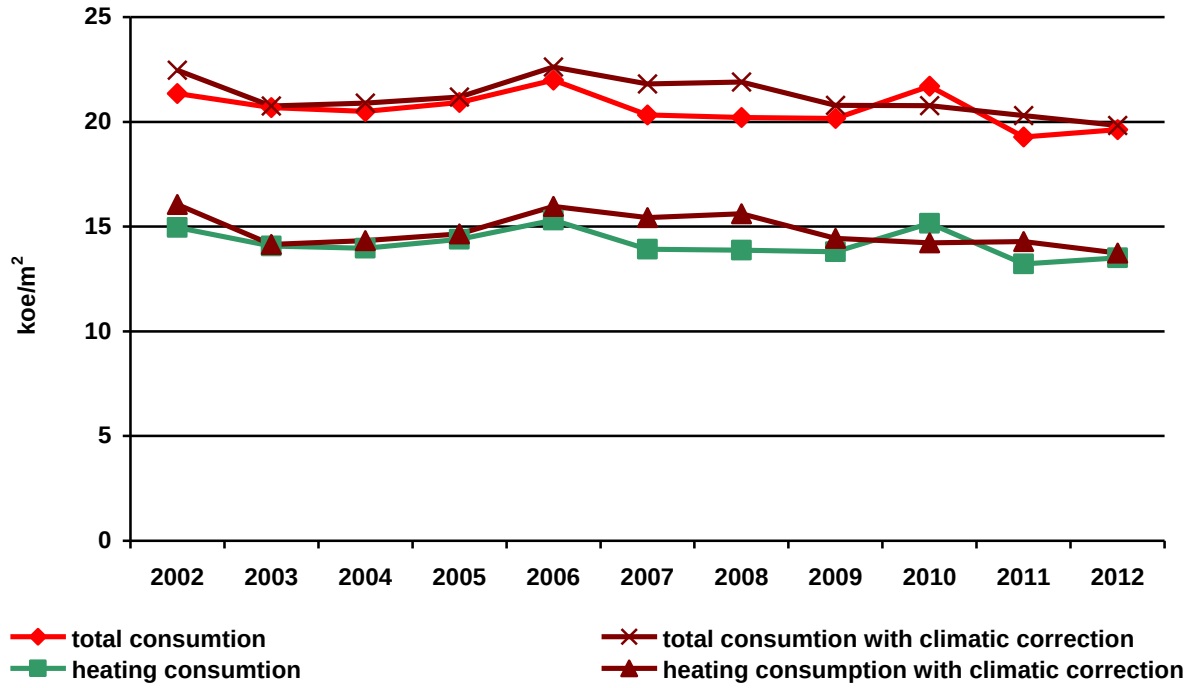
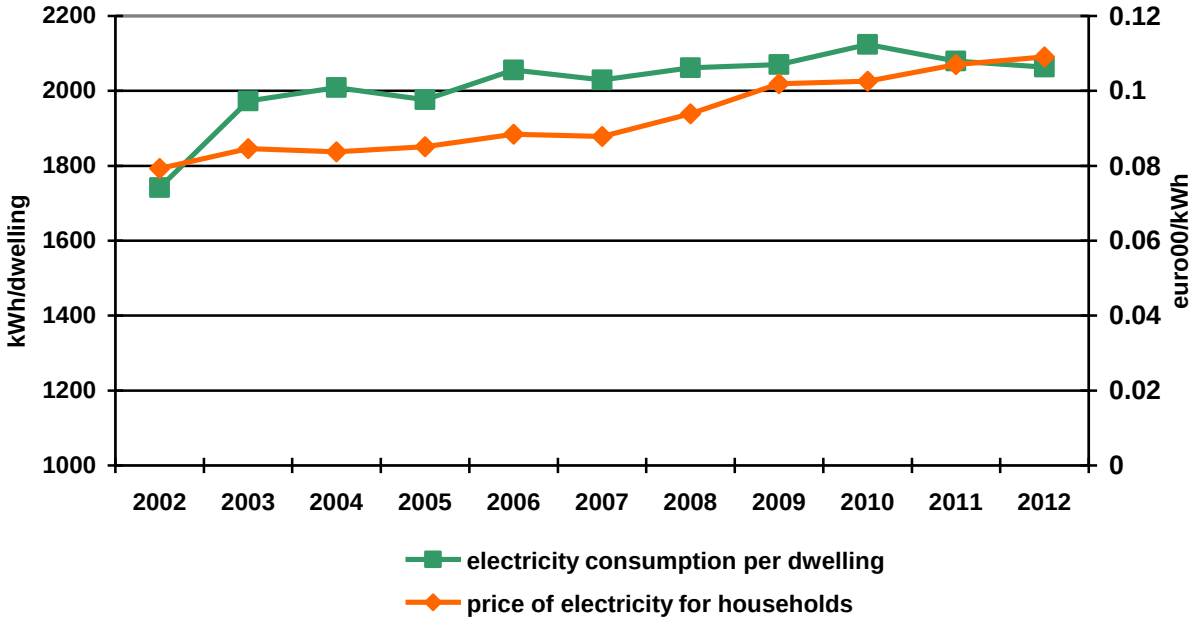


Figure 19. Electricity consumption and price in households per dwelling



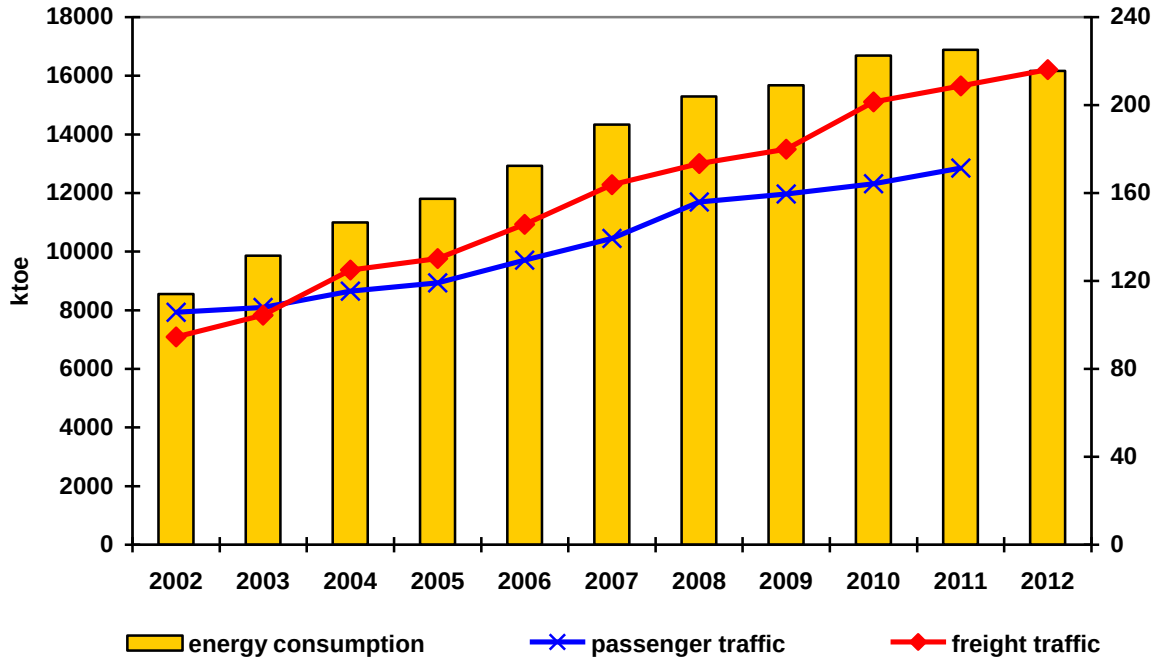
2.6. Transport

In Poland, over 95% of the energy consumed in transport sector is consumed by road transport, and more than 2% in rail transport. In addition, more nearly 3% of energy consumed is by air transport and small amounts by the inland and coastal water transport.

In the years 2003-2012 average annual growth rate of fuel consumption in road transport amounted to 7.0%, while energy consumption in rail transport significantly (by 32%, 3.8%/year) decreased. Total average annual growth rate of fuel consumption in transport (excluding air transport) amounted to 6.6% in years 2003-2012.

Freight and passenger traffic was increasing in this period regularly. In case of freight traffic an average rate of growth amounted to 8.6%/year, while in the case of passenger transport to 5.5%/year (in year 2002-2011).

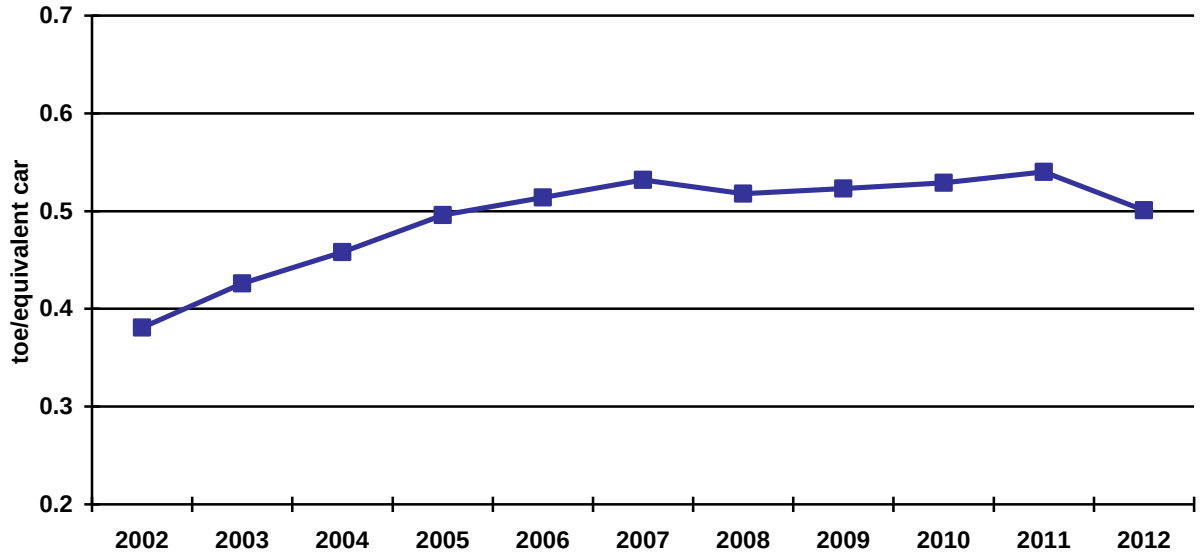
Figure 20. Passenger and freight traffic and energy consumption in transport*



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

Figure 21 shows the evolution of specific fuel consumption per car equivalent. After growth lasting until year 2007 the value of indicator has stabilized at the level above 0.5 toe/ equivalent car. In 2012 the value slightly decreased. The value of this indicator is influenced mainly by the economic situation of the country, variation of fuel prices and the growing efficiency of new cars.

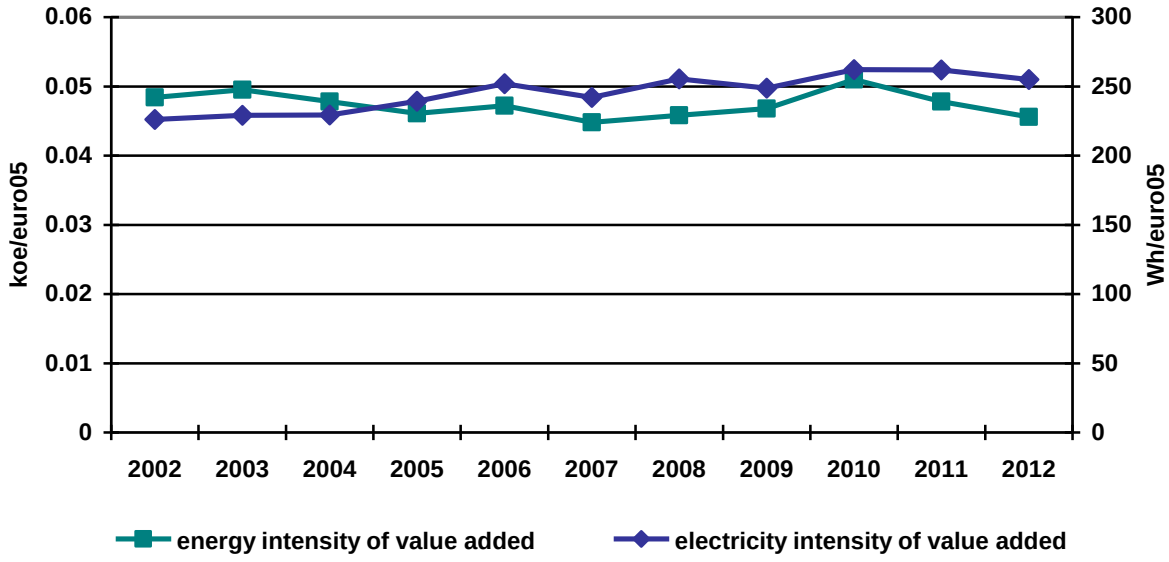
Figure 21. Fuel consumption per equivalent car



2.7. Service sector

The services sector is the most efficient sector. Energy intensity of value added[6] in the services sector was showing slight fluctuations in years 2003-2012. In 2012, energy intensity fell and remained below 0.05 kgoe/euro05. The average annual growth rate amounted to 0.6%. Electricity intensity of value added in the period 2003-2012 increased by an average of 1.2% per year.

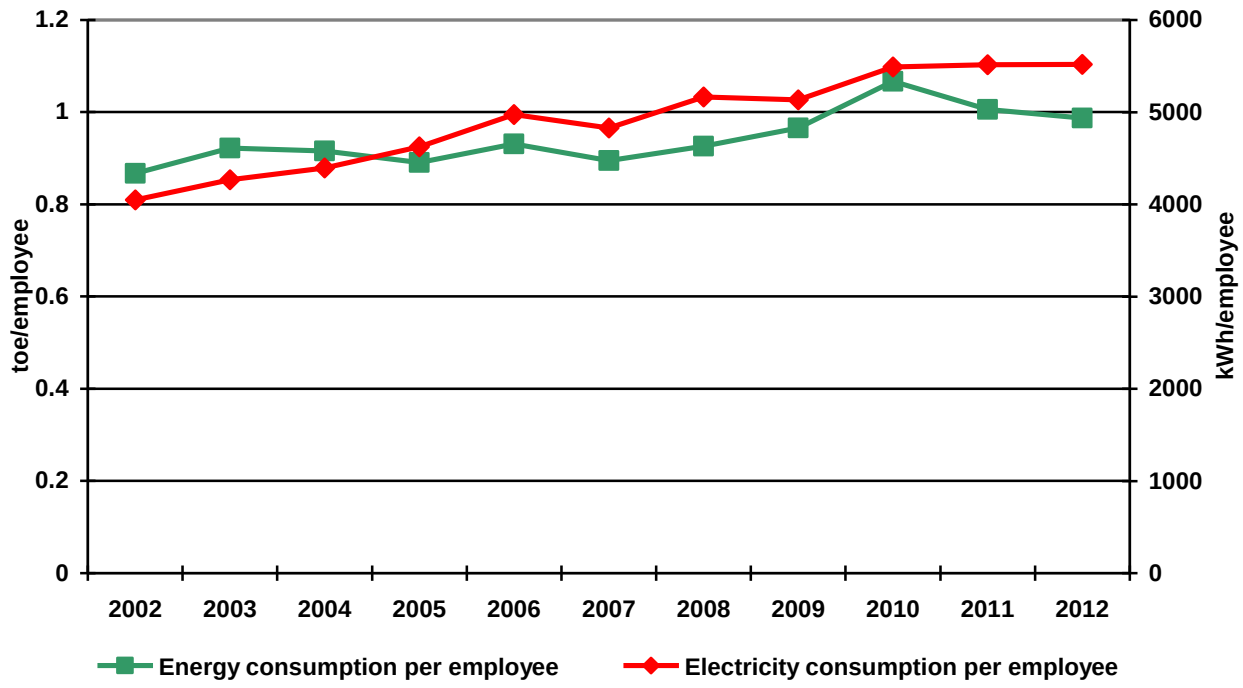
Figure 22. Energy intensity and electricity intensity in service sector



[6] Calculation of this indicator excludes energy consumption of transport but includes value addend of transport. The same procedure concerns electricity intensity indicator.

In case of energy and electricity consumption per employee an irregular trend can be seen in the period 2002-2012 (Fig. 23). Energy consumption has varied in the early years of the period, then came to a strong growth of consumption in years 2008-2010. Since then energy consumption has fallen, in 2012 remained below 1 toe/employee. The average rate of growth of this indicator amounted to 1.3% per year. In the case of electricity consumption per 1 employee growth rate of 3.1% per year.

Figure 23. Energy consumption and electricity consumption per employee of the service sector

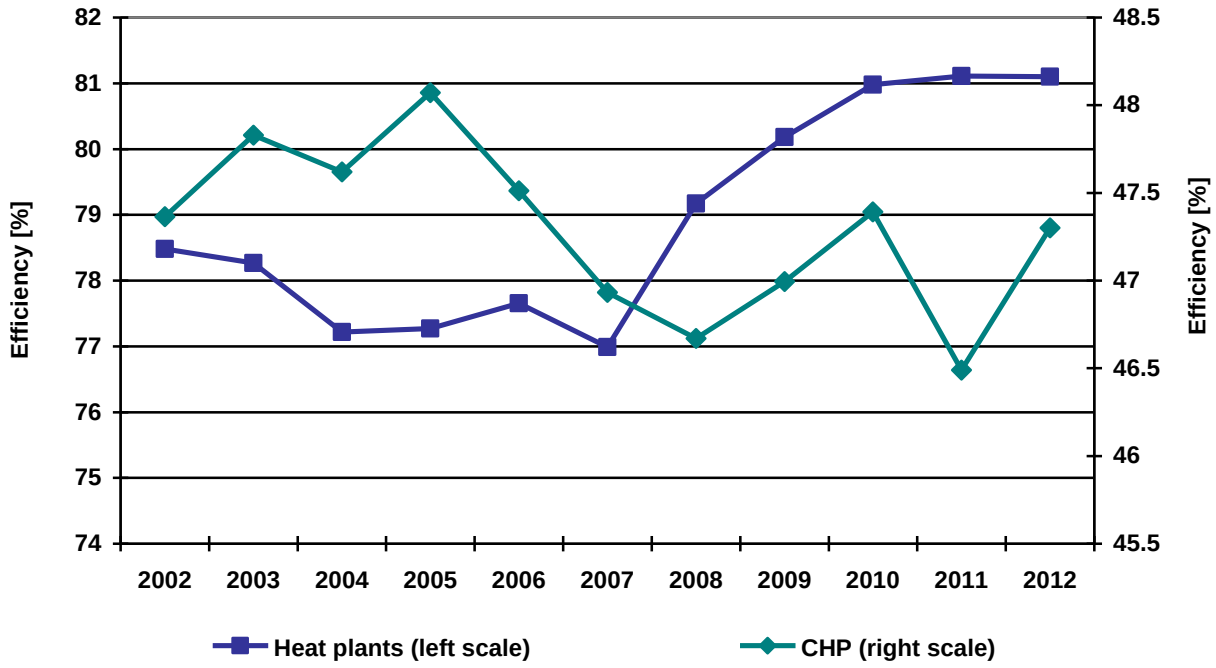


2.8. Heat plants and heat and power generating plants

The efficiency of heat plants producing district heat gradually decreased in years 2002-2007 to the level of 77%, followed by a sharp increase of efficiency. It amounted to 81.1% in 2012.

In case of combined heat and power plants transformation efficiency was increasing until year 2005 and exceeded 48%. In subsequent years, the efficiency of CHP was decreasing until year 2008. Since then efficiency has varied significantly, in 2012 it reached a value of 47.3%.

Figure 24. Efficiency of heat plants and CHP

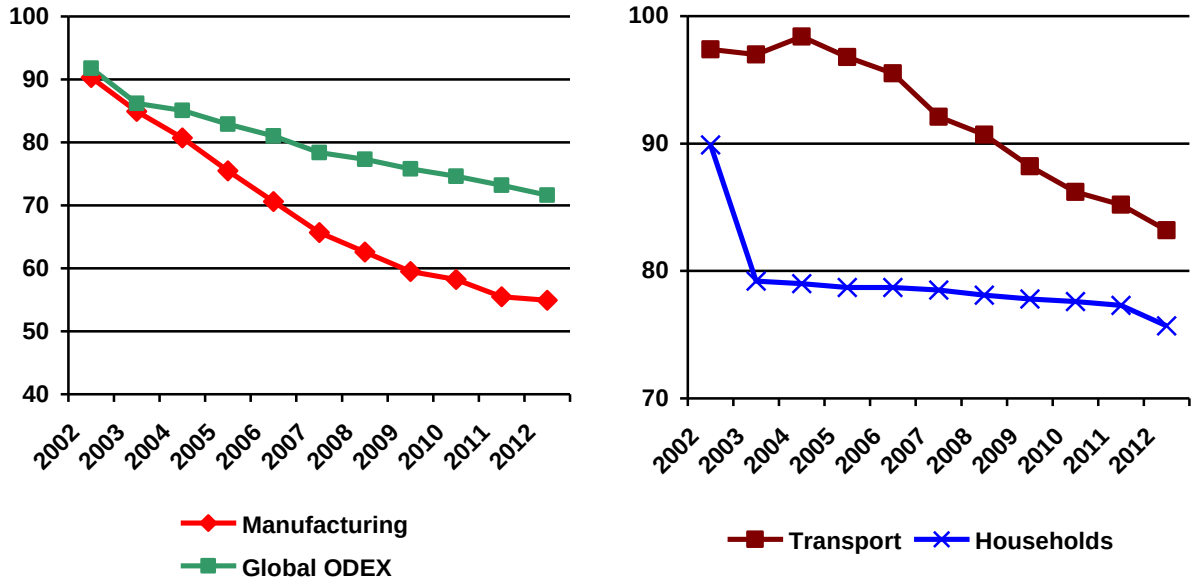


2.9. ODEX indicator and energy savings

ODEX indicator calculated on the basis 2000=100 declined in years 2002-2012 from 91.8 to 71.6 points. The average rate of improvement amounted to 2.5% / year. The fastest rate of improvement (4.8% annually) was achieved by manufacturing. In the household sector ODEX indicator[7] was dynamically falling until year 2003, then the rate of improvement was little. Average annual improvement in the years 2003-2012 in this sector amounted to 1.7%. In the transport sector, the indicator remained at similar level to 2004 and then began to decline. Overall in the years 2003-2012 the average rate of improvement amounted to 1.6%/year[8].

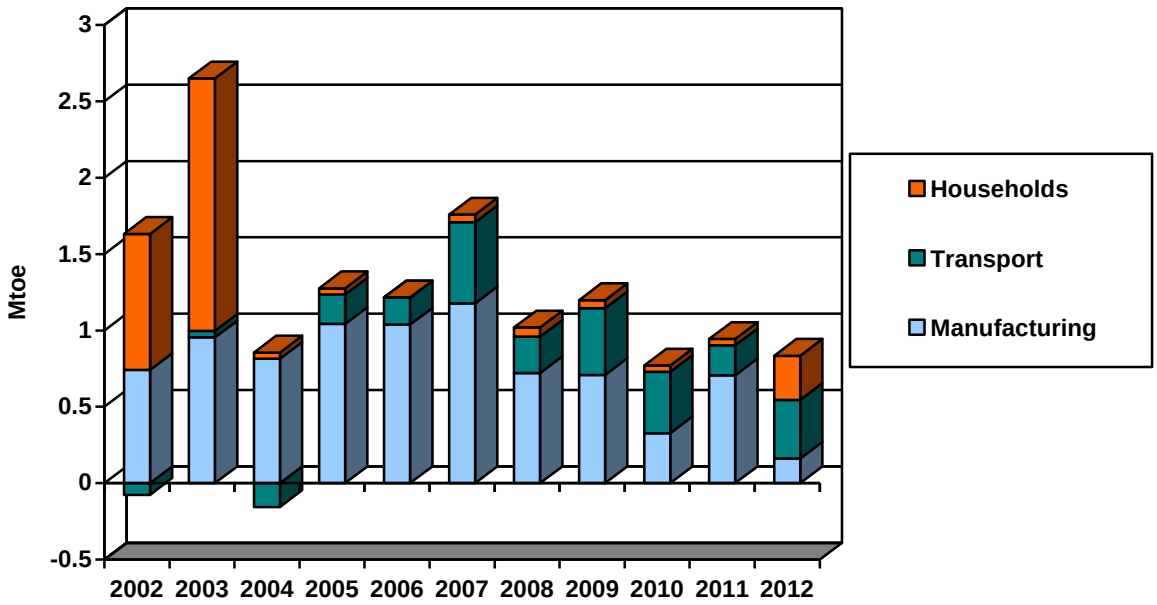
[7] For household sector technical ODEX was calculated, that is basing on the technical parameters of buildings.
[8] Because of lack of official data on specific consumption of different types of transport, calculation of indicator for transport is based on estimated and constant parameters and therefore can be burdened with an error.

Figure 25. ODEX indicator



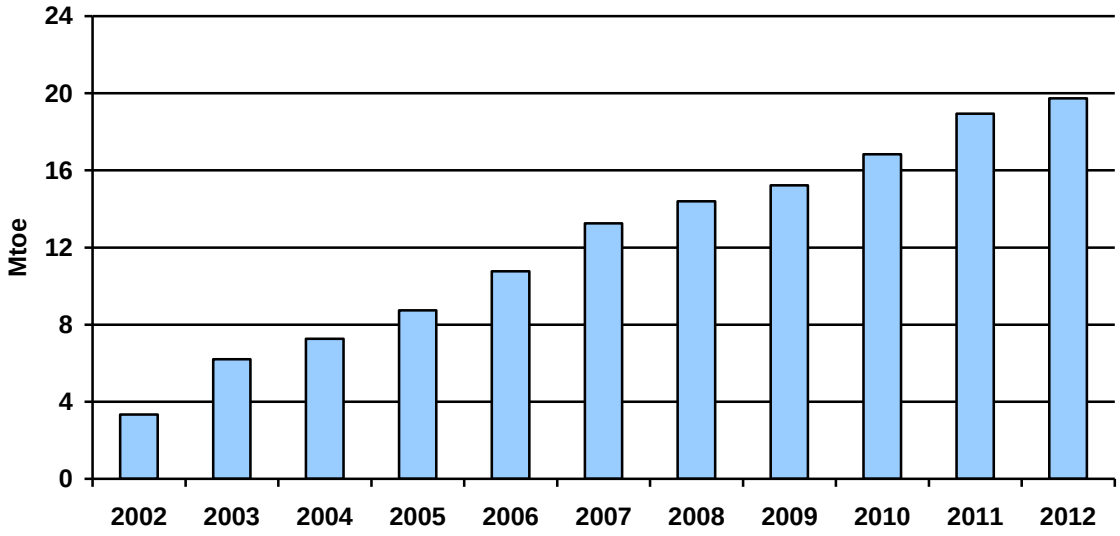
The chart below shows energy savings achieved in subsequent years in manufacturing, households and transport sector after 2000 calculated using ODEX indicators.

Figure 26. Annual energy savings



The cumulative energy savings since 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 2012 to 19.7 Mtoe. This result takes into account also the savings achieved by the sectors covered by the European Emissions Trading Scheme (ETS).

Figure 27. Energy savings since year 2000

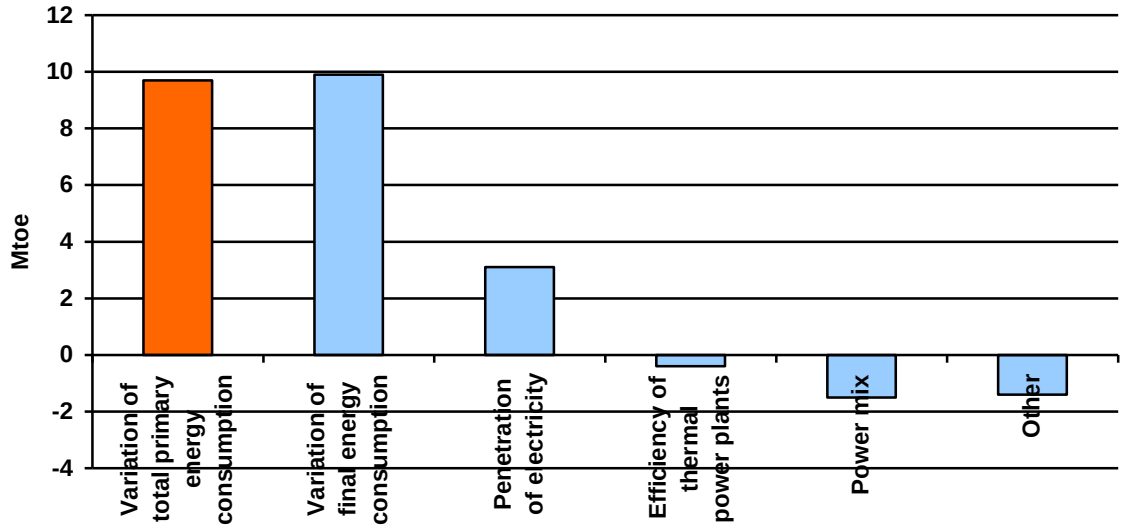


2.10. Decomposition

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 transformations including the non-energy use.

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

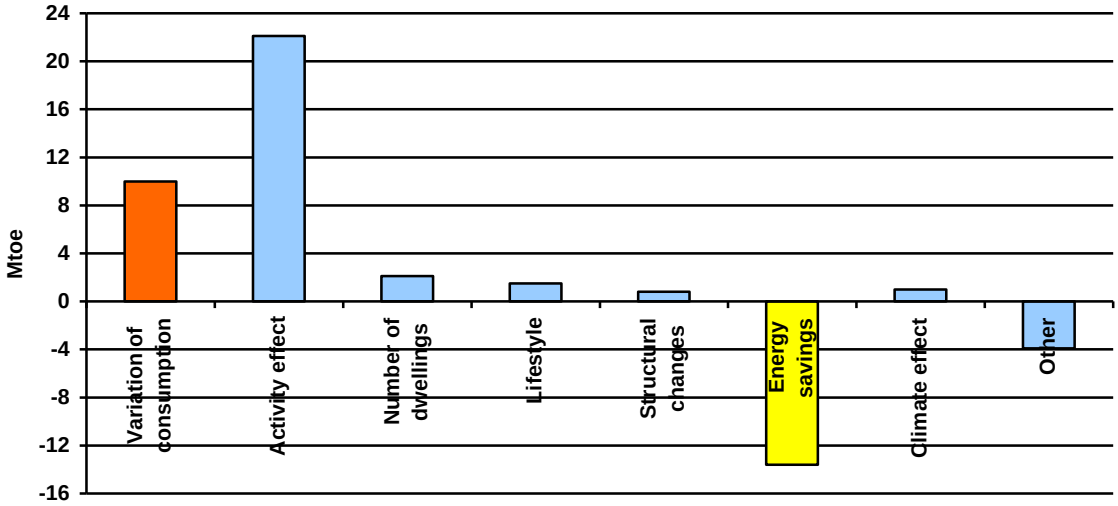
Figure 28. Impact of selected factors on total primary energy consumption in years 2002-2012



In the years 2002-2012 the total primary energy consumption has increased by almost 10 Mtoe. This growth was influenced by: the demand for final energy, which increased by the similar amount, increase of electricity production, while the reduction of the demand for primary energy was achieved by improvement of the efficiency of thermal power plants, increase of the use of renewable energy and decrease of the demand for non-energy needs and increase efficiency of other transformations.

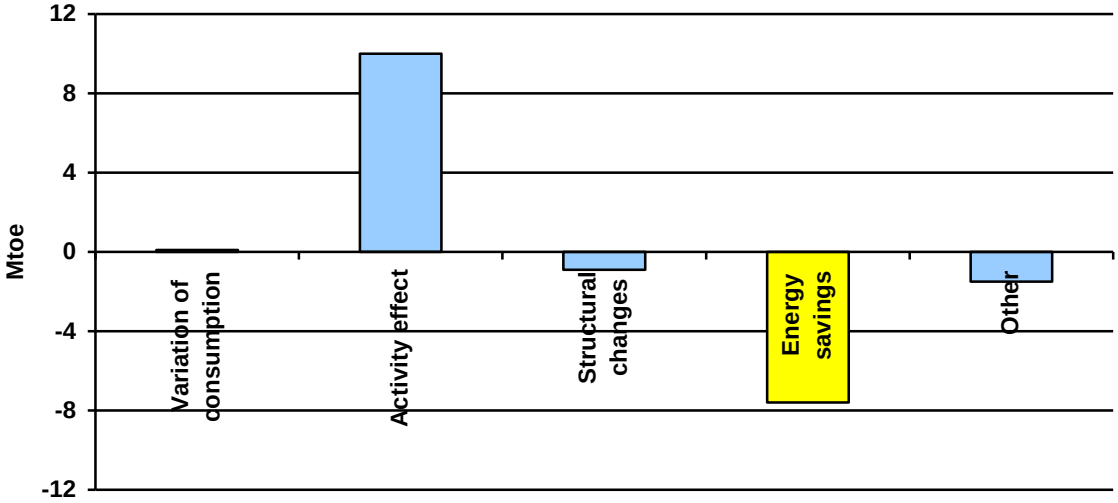
In case of final consumption, the factors that have an impact on consumption in different sectors were selected. These are: activity, housing resources, lifestyle, structural changes, energy savings resulting from efficiency improvement of end-users, weather conditions and other factors. Pooled results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

Figure 29. Impact of selected factors on final energy consumption in years 2002-2012



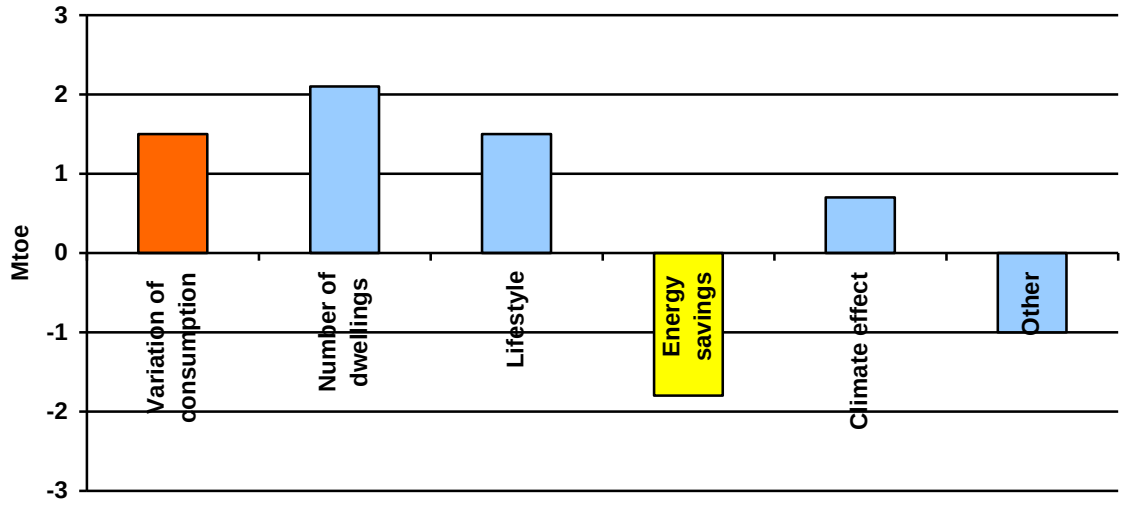
In case of industry sector, consumption growth was low, while the activity of the industry significantly increased. The impact of activity on consumption was offset by a rapidly improving energy efficiency. Also, the structural changes have contributed to the decline in consumption, as well as other factors (mainly the difference between the increase in activity measured by value added or production index).

Figure 30. Impact of selected factors on final energy consumption in industry in years 2002-2012



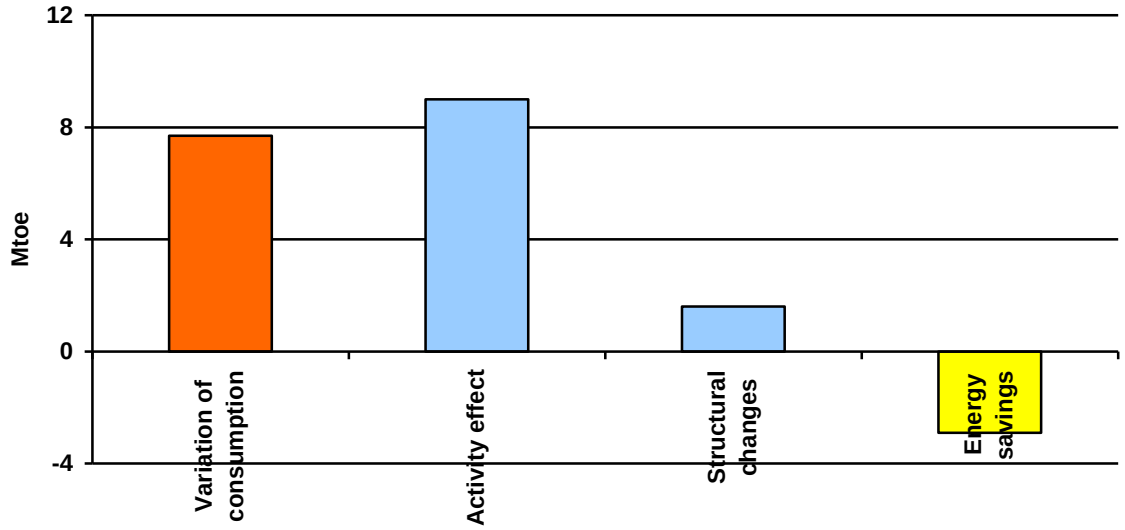
In households an increase in energy consumption by 1.5 Mtoe in the years 2002-2012 was observed. The increase in consumption was caused by: an increase in the number of dwellings, lifestyle change (larger apartments), weather conditions (year 2012 was cooler than 2002). Reduction of energy consumption was achieved by improving energy efficiency and other factors.

Figure 31. Impact of selected factors on final energy consumption in households in years 2002-2012



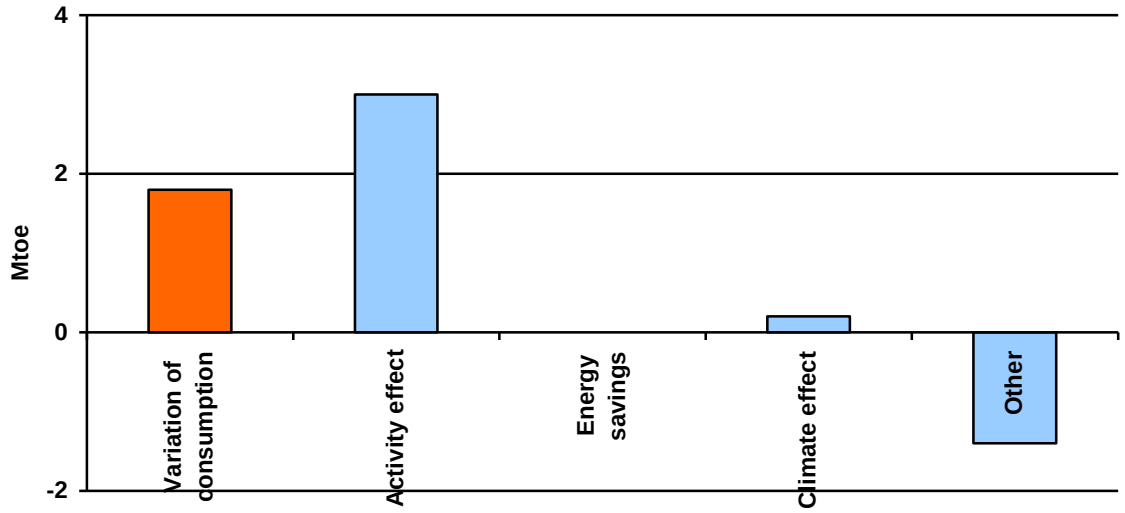
The highest increase of energy consumption was observed in transport sector. This was fueled by increase of activity and structural changes (increase in the share of road transport). Energy savings have reduced consumption by nearly 3 Mtoe.

Figure 32. Impact of selected factors on final energy consumption in transport in years 2002-2012



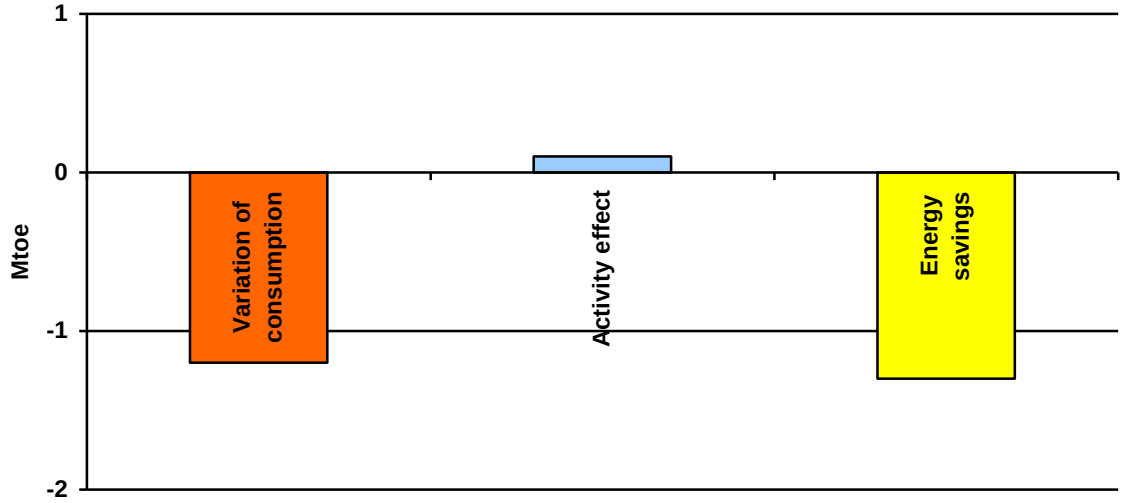
In service sector it was increased activity and weather conditions that contributed to increase of energy consumption. There was no improvement in energy efficiency. Increase of productivity (value added per capita) of working staff in this sector reduced energy consumption.

Figure 33. Impact of selected factors on final energy consumption in services in years 2002-2012



In the agricultural sector, a decrease in consumption resulted from energy savings, a slight increase in activity increased consumption by 0.1 Mtoe.

Figure 34. Impact of selected factors on final energy consumption in agriculture in years 2002-2012



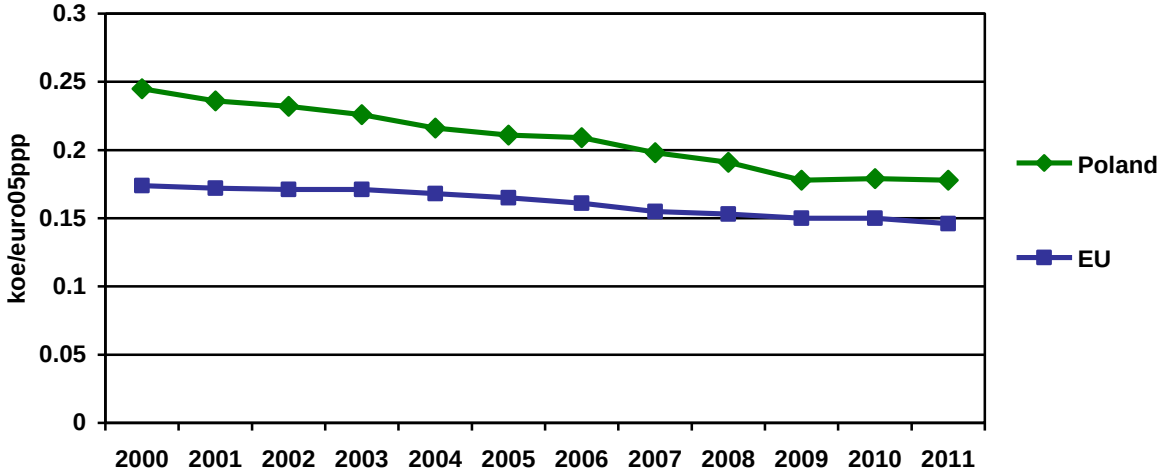
Summary data are presented in tabular part.

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 2011 to 0.178 koe/euro05ppp and was 18% higher than European average. This difference fell by 25 percentage points. compared to the year 2000. The rate of improvement of energy intensity was in Poland in years 2000-2011 more than twice higher

than in the European Union. Among the countries showing a similar level of primary energy intensity can be found Romania, Hungary and Latvia.

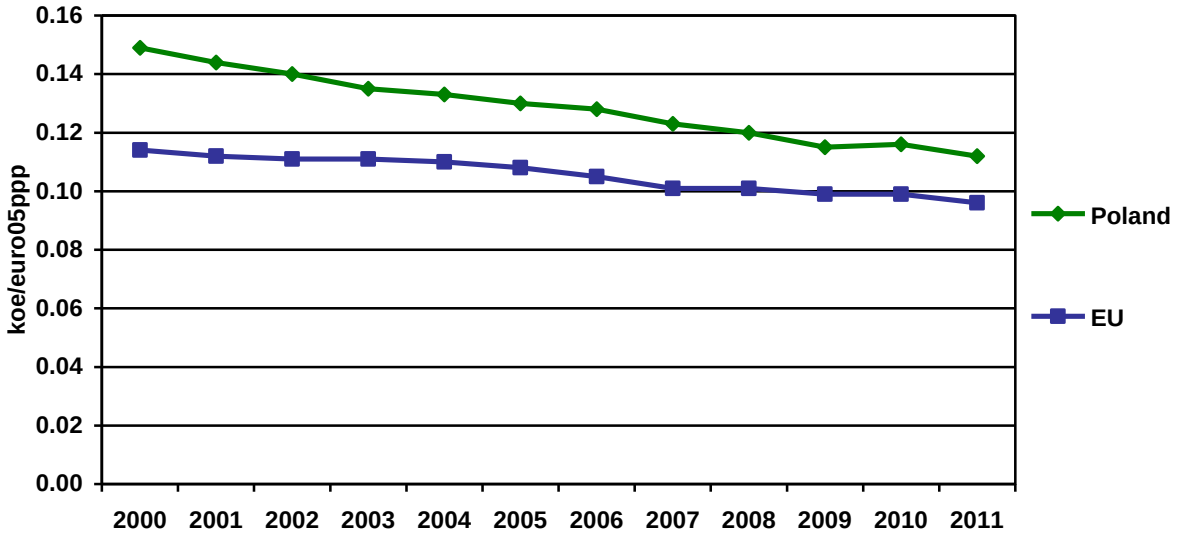
Figure 35. Primary intensity of GDP with climatic correction (euro05, ppp)



Source: Odyssee database, www.odyssee-indicators.org

In case of final energy intensity difference is smaller and amounts to 14% between Poland (0.112) and EU average (0.096). It is the result of the fact, that ratio of final to primary energy consumption is lower in Poland than in Europe.

Figure 36. Final intensity of GDP with climatic correction (euro05, ppp)

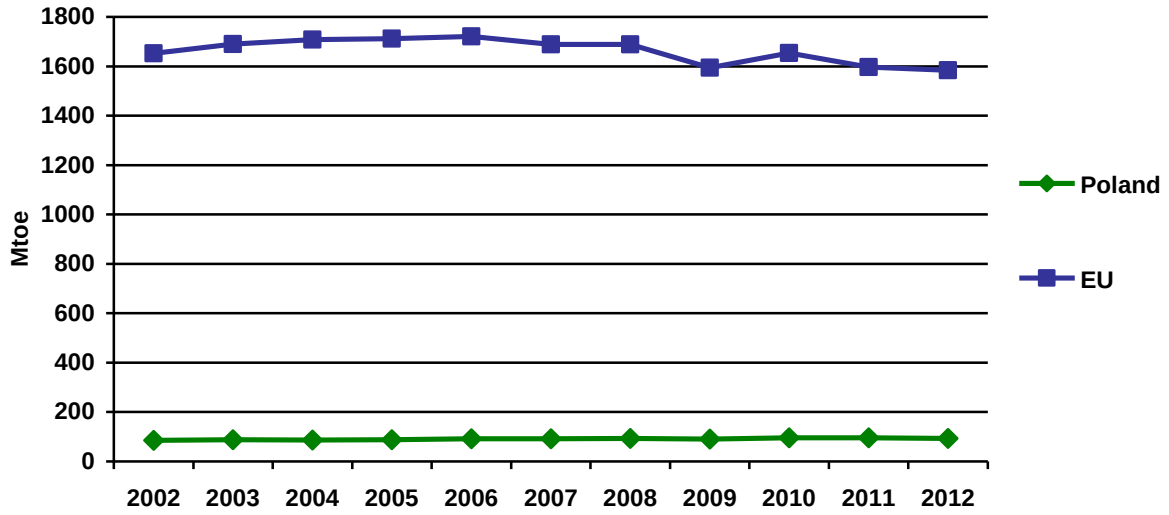


Source: Odyssee database, www.odyssee-indicators.org

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 2012 amounted to 93.3 Mtoe.

Fig. 37. 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 achieving the objectives of the **energy and climate package** published in January 2008, according to which the Member States are required to:

- reduce CO_2 emissions in 2020 by 20% compared to 1990;
- increase the EU's consumption of energy from renewable energy sources by 20% by the year 2020; the target for Poland is set at 15%;
- increase energy efficiency in 2020 by 20% compared to 2005.

The priority attitude to energy efficiency increase is expressed in the subsequent communication and directives of the EU.

One of the key directives relating to energy efficiency was D**irective 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. Directive 2006/32/EC required the member states to take measures to reduce final energy consumption by end-users by 9% (an indicative target) in the nine-year application period of the directive, i.e. from 1 January 2008 to 31 December 2016. Directive 2006/32/EC also required Member States to submit National Energy Efficiency Action Plans. The objective of the directive was to unlock the energy efficiency increase potential, contribute to improved security of energy supply, increase the competitiveness of the European economy and contribute to sustainable development. This was to be done through the development of several areas of business activity beneficial to both households and enterprises, such as new energy services, energy audits, smart metering of energy consumption, more informative invoicing systems and a range of financial instruments and support programmes.

In 2011, the European Commission reviewed the possibility of achieving the 3x20% targets of the energy and climate package. In view of a threat to achieving, by 2020, the target of energy efficiency increase by 20% compared to the forecasted scenario, a new directive on energy efficiency was drawn up. On 14 November 2012, in the Official Journal of the European Union, the **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, was published. Pursuant to paragraph 2 of the preamble to the new directive, the conclusions of the European Council of 4 February 2011 emphasized that the target of energy efficiency increase by 20% up to the year 2020,

adopted by the European Council in June 2010, had not been sufficiently pursued to-date but still had to be achieved. According to forecasts developed in 2007, primary energy consumption in 2020 is going to amount to 1842 Mtoe. A reduction by 20% would translate into primary energy consumption of 1474 Mtoe in 2020, i.e. a reduction of 368 Mtoe compared to the forecasts. Adequately, final energy consumption in 2020 would be 1078 Mtoe.

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. When doing so, they shall also express those targets in terms of an absolute level 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 shall ensure that energy distributors and/or retail energy sales companies that are designated as obligated parties operating in each Member State's territory, achieve a cumulative end-use energy savings target by 31 December 2020 Each Member State shall set up an energy efficiency obligation scheme. That scheme shall ensure that energy distributors and/or retail energy sales companies that are designated as obligated parties under paragraph 4 operating in each Member State's territory achieve a cumulative end-use energy savings target by 31 December 2020.

Pursuant to 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.

The implementation deadline for the energy efficiency Directive 2012/27/EU has been set on 5 June 2014. By 30 June 2014 the Commission shall review and assess the progress in achieving the 20% energy efficiency improvement. If the measures referred to in the Directive turn out to be insufficient to achieve the targets set for 2020, the Commission may propose additional legislation.

3.2. Energy efficiency policy in Poland

The key documents that define energy efficiency policy in Poland are:

- Energy Policy of Poland until 2030;
- National Energy Efficiency Action Plans (the plans nos. 1, 2 and 3, drawn up respectively in 2007, 2012 and 2014); the drawing up of the plans is required by Directive 2006/32/EC.

Energy Policy of Poland until 2030

Since 2010 Poland has been implementing the "Energy Policy of Poland until 2030". The policy, developed pursuant to the Act of 10 April 1997 - Energy Law (Journal of Laws of 2012, item 1059, as amended) aims at tackling the main challenges facing the Polish energy sector both in the short term perspective and in the long-term perspective until 2030.

Energy Policy of Poland is aimed at increasing energy efficiency of the country's economy which translates into a reduction of its energy intensity. The policy is implemented with the following goals in mind:

- the planning of activities which to the largest possible extent are based on market mechanisms and to the lowest possible extent make use of public funding;
- pursue the goals in accordance with the principle of cost effectiveness, inter alia through the maximum use of existing mechanisms and organizational infrastructure;
- make use of the national potential in the field of energy efficiency improvement;
- take into account technological requirements relating to energy generation, transmission or distribution.

The Energy Policy of Poland sets out the following measures to improve energy efficiency:

- Setting the national energy efficiency increase target;
- Introducing a systemic mechanism to support measures aimed at attaining the national energy efficiency improvement target;
- Stimulating development of cogeneration through support mechanisms taking into account cogeneration sources up to 1 MW as well as adequate policy of municipalities;
- Using mandatory *energy performance certificates* for buildings and apartments upon their marketing or renting;
- Determining energy intensity of devices and energy consuming products, as well as introducing minimum standards for energy-consuming products;

- Committing the public sector to serve as a role model in the field of economical consumption of energy;
- Providing support to energy saving investments, through preferential loans and grants from domestic and European funds, including funds available under the Act on supporting thermal modernisation and renovation, the Operational Programme Infrastructure and Environment, and the National Fund for Environmental Protection and Water Management;
- Supporting research and development work on new solutions and technologies reducing energy consumption in all fields of energy processing and use;
- Applying Demand Side Management techniques stimulated e.g. by diversification of distribution fees within a day and of electricity prices, based on reference prices resulting from the introduction of an intra-day market, and sending price signals to customers through remote two-way communication via smart meters;
- Informational and educational campaigns promoting efficient energy consumption.

The above mentioned measures were improved and updated with time and their implementation was evaluated in the subsequent National Energy Efficiency Action Plans.

First and Second Energy Efficiency Action Plans

Pursuant to Article 14 paragraph 2 of Directive 2006/32/EC, in 2007 the Polish Ministry of Economy developed the first National Energy Efficiency Action Plan (NEEAP). The document determined the final energy saving target for the year 2016. The target was set as no less than 9% of average annual energy consumption in the period 2001 - 2005 (i.e. about 53 452 GWh). The target was of indicative nature. Also, an interim national energy saving target was determined for the year 2010 in the amount of 2%. The interim target was a stage on the path of achieving the 2016 target and helped to assess the progress in its achievement. The Energy Efficiency Action Plan also outlined the measures and activities implemented and planned at the national level with the aim to achieve the national indicative targets in the period in question.

The main difficulties in developing the energy efficiency improvement measures and the implementation of the first National Energy Efficiency Action Plan (2007) were:

- too little interest in the energy efficiency improvement measures on the side of energy companies;

- lack of incentives in the form of preferential tariffs for consumers who rationally use energy;
- too little support for measures taken by citizens in order to increase energy savings;
- financial obstacles (e.g. lack of predetermined budget, limited assistance funds);
- small-scale effects of energy saving measures taken by households;
- limited knowledge and low awareness of energy consumers (e.g. lack of knowledge of sources of information on energy efficiency).

In Poland until 2011 there was no legislation that would ensure the implementation of energy efficiency improvement programmes and measures necessary to achieve the required savings. Neither there existed sufficiently strong market mechanisms to encourage the implementation of energy saving measures. Therefore, a new legal regulation entitled **Energy Efficiency Act** (Journal of Laws No. 94, item 551) was adopted on 15 April 2011, with the aim to develop mechanisms to stimulate energy efficiency improvement. The Act introduced the obligation to obtain a sufficient number of energy efficiency certificates (so-called white certificates) by energy sales companies selling electricity, heat or natural gas to final customers connected to the grid or network within the territory of Poland.

The second National Energy Efficiency Action Plan was developed in connection with the obligation to submit reports to the European Commission, pursuant to Directive 2006/32/EC on energy end-use efficiency and energy services (OJ L 114, 27.04.2006, p 64) and Directive 2010/31/EC on the energy performance of buildings (OJ L 153, 18.06.2010, p 13). The Action Plan document was also developed in consistency with Article 6 paragraph 1 of the Act of 15 April 2011 - Energy Efficiency Law (Journal of Laws No. 94, item. 551), which implemented the provisions of Directive 2006/32/EC.
The second National Action Plan included a description of energy efficiency improvement measures relating to final energy consumption, as well as calculations of energy savings achieved in 2008-2009 and expected by 2016 in accordance with the requirements of the above mentioned directives.
The document was developed by the Ministry of Economy, in cooperation with: the Ministry of Transport, Construction and Maritime Economy; the Central Statistical Office (GUS), and the National Energy Conservation Agency (KAPE).

The document contained, in particular, a description of the planned measures to improve energy efficiency in the individual sectors of the economy in order to achieve the national energy saving target for the year 2016.

The second national Action Plan also included a report required under Directive 2010/31/EC on the energy performance of buildings. The European Commission was presented the information required under the said directive, i.e. a list of existing and planned measures and instruments, including financial ones, aimed at supporting energy saving measures in buildings (Article 10 of Directive 2010/31/EC).

The third National Energy Efficiency Action Plan (2014), which is currently at the approval stage, summarises the achieved energy efficiency improvement targets, sets up the targets for 2020 and updates already undertaken and planned actions and measures. Many of the measures set out in the document (in section 3.4) were already mentioned in the second NEEAP and have been described in the previous publication "Energy Consumption Efficiency in 2001-2011".

3.3. National energy efficiency targets and energy savings achieved

Pursuant to Article 3 paragraph 1 of Directive 2012/27/EU, a national energy efficiency target for 2020 was set, as presented in Table 5. The target is understood as the achievement in the years 2010-2020 of primary energy consumption reduction by 13.6 Mtoe, which in the conditions of economic growth also means an improvement of energy efficiency of the country's economy. The target was also expressed in terms of an absolute level of primary energy consumption and final energy consumption in 2020. The energy efficiency target for 2020 was set up based on data developed as a result of the analyses and forecasts carried out for the needs of the governmental document "Energy Policy of Poland until 2030". The analyses indicate that the reduction of primary energy consumption will result from a number of already implemented projects as well as the implementation of energy efficiency improvement measures provided for under the country's energy policy.

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[9]

Table 6 presents final energy saving targets (final energy consumption) calculated in accordance with Directive 2006/32/EC (the 2% intermediate target for 2010, and the target for 2016: 9% of the average national energy consumption in 2001-2005), as well as energy savings achieved.

The energy savings have been calculated in accordance with the European Commission recommendations contained in the document *Recommendations on Measurement and Verification Methods in the Framework of Directive 2006/32/EC on Energy End-Use Efficiency and Energy Services*.

Table 6. Final energy saving targets and final energy savings achieved

Item	Final energy saving targets		Final energy savings achieved in 2010 and savings planned to be achieved in 2016	
	in GWh	In %, in relation to the average consumption in 2001-2005	in GWh	In %, in relation to the average consumption in 2001-2005
2010	11 878	2	54 957	9,3
2016	53 452	9	82 398	13,9

[9]) According to the reference values for Poland, included in the forecast developed for the European Commission (PRIMES - Baseline 2007), the forecasted primary energy consumption level for 2020 is 110 Mtoe. Thus, taking into account energy consumption decrease by 13.6 Mtoe, we get:
110 Mtoe - 13.6 Mtoe = 96.4 Mtoe

Table 7 presents final energy savings achieved in the years 2010-2012, broken down by final energy consumption sectors.

Table 7. Achieved final energy savings by sectors

Sector	Achieved final energy savings (GWh)		
	2010	2011	2012
Households	16 960	13 867	21 669
Services	0	0	0
Industry	20 261	25 413	26 943
Transport	17 735	14 504	25 141
Total	54 956	53 783	73 753

Poland has made a significant progress on the way to meeting its national target in the field of rational energy management, i.e. achieving, by 2016, the final energy savings of no less than 9% of the average national final energy consumption in 2001-2005. As a result of GDP growth being faster than the growth in energy consumption, primary energy intensity and final energy intensity decreased (with the exception of the year 2010). In 2006-2009, the improvement rate exceeded 5% for primary energy consumption intensity, and amounted to nearly 4% for final energy consumption intensity. The sector with the largest demand for final energy was industry, although its demand dropped from approximately 38% in 2000 to 30.5% in 2011. Energy-intensive industries (steel industry, chemical industry and mineral industry) consumed about 60% of the overall industrial energy consumption. At the same time, a significant increase in energy demand, from 16.8% to 25.4%, occurred in the transport sector. The share of household sector consumption was 27%-29%, and the share of agricultural sector consumption dropped from 7.7% to 5.2%. Poland's distance to the average European values of key energy efficiency indicators decreased to over ten percent but compared to the most efficient economies it still remains significant[10)].

[10) According to information and statistical analyses contained in the Central Statistical Office publication "Energy efficiency in 2001-2011", Warsaw, 2013.

3.4. Energy efficiency improvement measures

The draft *Third National Energy Efficiency Action Plan* of 14 May 2014 provides for the following energy efficiency improvement measures:

Horizontal measures:

- the obligatory energy efficiency improvement scheme (white certificates);
- support for entrepreneurs - energy audits of companies;
- the priority programme "Smart Power Grids";
- information and education campaigns.

Measures in the field of energy performance of buildings:

- Thermal modernisation fund;
- Green Investment Scheme (Part 1) - Energy management in buildings of selected public sector entities;

Energy efficiency measures in public institutions:

- Operational Programme PL04 "Saving energy and promoting renewable energy sources" (area no. 5 - energy efficiency);
- Green Investment Scheme (Part 5) - Energy management in buildings of selected public sector entities;
- Efficient use of energy (Part 4 - LEMUR) - Energy-efficient public utility buildings;
- Operational Programme Infrastructure and Environment (Measure 9.3) – Thermal modernisation of public utility buildings;
- Efficient use of energy (Part 6 – SOWA) – Energy-efficient street lighting systems.

Energy efficiency measures in industry:

- Support to entrepreneurs focused on low-emission economy - energy efficiency increase;
- Access to financial instruments dedicated to SMEs (PolSEFF);
- Operational Programme Infrastructure and Environment (Measure 9.1) - Highly efficient power generation;
- Operational Programme Infrastructure and Environment (Measure 9.2) - Efficient energy distribution.

Energy efficiency measures in transport:

- Traffic management systems, freight transport optimisation systems and fleet replacement programmes for urban transport companies;
- Green Investment Scheme (Part 7 - Gazela) - Low-emission urban transport.

Energy efficiency improvement measures in selected sectors of the economy are specified and described below.

Horizontal measures

The energy efficiency obligation scheme

Article 7 of Directive 2012/27/EU requires EU Member States Each Member to set up an energy efficiency obligation scheme or to apply alternative policy measures in order to achieve the required target amount of energy savings among final customers. The energy savings to be achieved under the energy efficiency obligation scheme or through alternative policy measures applied in accordance with Article 7 paragraph 9 of Directive 2012/27/EU have to be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the years 2010-2012.

As a result of analyses carried out, it was decided to implement the standard program i.e. 1.5% per year until 2020, i.e. 10.5%, pursuant to Article 7 paragraph 1 of Directive 2012/27/EU. This corresponds to achieving in 2020 final energy savings in the amount of 154 128 TJ (3.68 Mtoe).

The energy efficiency obligation scheme in the form of energy efficiency 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, within the meaning of the Act of 26 October 2000 on commodity exchanges

(Journal of Laws of 2014, item 197), and are thus tradeable on 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 tenders 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 might 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 devices 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 (Dz. U. [Journal of Laws], item 1039).

Energy audits and energy management systems

Pursuant to Article 8 paragraph 4 of Directive 2012/27/EU, large enterprises that are not small and medium enterprises (SMEs) are subject to energy audits.

Energy audit of an enterprise has to be carried out by an independent entity with expertise and experience in conducting such audits. In the case an energy audit of an enterprise is carried out by experts of the audited enterprise, they may not be directly involved in the audited activity of the enterprise. Energy audit of an enterprise has to include detailed and verified calculations relating to the proposed energy efficiency improvement projects, as well as deliver information on potential energy savings.

Support to the industrial sector enterprises (i.e. enterprises with cumulative electricity and heat consumption exceeding 20 GWh/year) in the implementation of energy audits is provided under a special programme implemented by the National Fund for Environmental

Protection and Water Management. The programme, covering the period 01.01.2011-31.12.2017, has a budget of 32 million PLN coming from the National Fund resources.

Power meters and power cost settlements

The Act of 26 July 2013, amending the Act on Energy Law and other acts (Journal of Laws, item 984) introduced regulations concerning the planning, by distribution companies, of projects in the field of collection, transmission and processing of measurement data from remote-reading meters, and introduced provisions requiring energy companies to ensure appropriate security level of data obtained from remote meter readings. Within the Smart Grid programme co-financed by the National Fund for Environmental Protection and Water Management co-funding is available to: promotional and educational activities; implementation (in the pilot areas) of smart metering and information transmission networks; works relating to electricity use balancing and optimisation (measurement and feedback activities); implementation (in pilot areas) of distributed renewable energy sources, energy storage facilities and smart lighting systems using energy-efficient light sources; development works; development of IT systems, and specification of standards. The programme, with a budget of PLN 171.8 million, is to be implemented in the period 2014-2017.

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 the society, and aimed at developing pro-environmental attitudes through presenting possible energy saving measures.

In 2012 – 2014, such information campaigns were conducted by:

- the Ministry of Economy which uses, inter alia, the form of campaigns to meet its obligation to carry out informational and educational activities required under the Energy Efficiency Act,
- the Ministry of Environment which carries out its duties under the Act of 27 April 2001 - The Environmental Protection Law (Journal of Laws of 2013, items 1232 and 1238, and of 2014, items 40, 47 and 457).

To-date the following information and education campaigns have been carried out:

- ***Time to save energy***

  An information campaign conducted by the Ministry of Economy with the aim to promote rational use of energy under the slogan "time to save energy." The campaign presents specific energy efficiency measures and their profitability, as well as informs the Polish society of relevant issues, in accordance with the responsibilities of the Minister of Economy in the field of increasing energy efficiency of the Polish economy.

- ***Switch off the power - turn on savings*****; and *Poles save heat even more***

  The campaigns were conducted by the Ministry of Environment in 2012 and were dedicated to energy savings in households. Within the campaigns, the largest national television channels broadcast advertising spots in which famous people (actors, scientists and publicly respected persons) encouraged people to take simple, everyday activities which translate into energy savings and help reduce energy bills.

- ***Unleash your energy! Protect the environment!***

  TV spots produced by the Energy Regulatory Office and broadcast over a period of 14 days. The spots were viewed by over 15 million TV viewers. The campaign began on 17 June 2012 on TVP channels as a part of the broader "Information and education campaign to promote effective and efficient use of energy for the benefit of the environment and household budgets." The aim of the campaign was to inform consumers of their rights as well as benefits they may get if they are aware and active participants of the energy market.

Access to the qualification, accreditation and certification systems

Currently the 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, to 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, within the meaning of the Act of 21 November 2008 on support to thermal modernisation and renovation of buildings (Dz. U. [Journal of Laws] No. 223, item 1459, as amended[11)]), 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 to apply for co-financing of a thermal modernisation project. The aim of such a project is to reduce 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 projects 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 using the

[11)] The amendments to the Act were published in Dz. U. [Journals of Laws] of: 2010, No. 157, item 1241; 2010, No. 76, item 493; 2011, No. 106, item 622; and 2012, items 951 and 1342.

building, as well as a specification of possible works which may improve the cost-effectiveness of the different energy-consuming systems in the building.

Energy services market

In order to stimulate the market for energy service companies such as energy saving companies (ESCO), the Act contains provisions relating to participation in tender procedures by such companies with the aim to obtain energy efficiency certificates (white certificates). ESCOs may be beneficiaries of the white certificates scheme. According to the Act, they may aggregate energy savings and make use of these savings while participating in tenders on behalf of other entities which have completed energy efficiency improvement projects and achieved a cumulative energy saving of at least 10 toe. Also, public sector entities which are under the obligation to implement energy efficiency improvement measures provided for under the Act, may conclude agreements on the implementation and financing of energy efficiency improvement projects with entities such as energy saving companies (ESCOs).

The website of the Ministry of Economy contains the text of a document developed by KAPE S.A., entitled „Time to save energy. A guidebook for public sector entities". The document discusses, inter alia, standard contract forms relating to various types of energy efficiency improvement services. It also contains a list of providers of different energy efficiency improvement services[12)].

Measures in the field of energy performance of buildings

Building renovation strategy

Pursuant to Article 4 of Directive 2012/27/EU, the Ministry of Infrastructure and Development developed a strategy for renovation of buildings. The document is entitled „Promoting investments in the modernisation of buildings".

Additional measures relating to energy performance of buildings

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

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

The Thermal Modernisation and Renovation Fund, with resources coming from the state budget, is a programme of support to thermal modernisation and related renovation works carried out in old multi-family residential buildings. The programme in its current form has been implemented since 2009. The Fund's resources are allocated to partial re-financing of the costs of thermal modernisation and renovation projects aimed at improving technical condition of the existing housing stock and reducing its heat demand. The re-financing is available in the form of so-called thermal modernisation premiums or so-called renovation premiums.

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 the field of energy efficiency of buildings, including residential buildings, activities have been undertaken to establish minimum energy saving requirements and thermal insulation requirements, as well as the path of achieving compliance with the requirements to be met in 2021 when all newly constructed buildings will have to be nearly zero-energy buildings (the Regulation of the Minister of Transport, Construction and Maritime Economy of 5 July 2013 amending Regulation on technical conditions to be met by buildings and their location (Dz, U. [Journal of Laws] item 926).

Energy efficiency measures in public institutions

The National Fund for Environmental Protection and Water Management implements the following programmes improving energy efficiency in public utility buildings:

- Operational Programme PL 04 - Saving energy and promoting renewable energy sources (area No. 5 - energy efficiency).
- Green Investment Scheme (Part 5) - Energy management in buildings of selected public sector entities.
- Efficient use of energy (Part 4 - LEMUR) - Energy-efficient public buildings.
- Operational Programme Infrastructure and Environment (Measure 9.3) - thermal modernisation of public utility buildings.
- Efficient use of energy (Part 6 - SOWA) – Energy-efficient street lighting systems

Energy efficiency measures in the transport sector

Energy efficiency improvement projects were implemented under the Operational Programme Infrastructure and Environment (Measure 7.3 - Urban transport in metropolitan areas, and Measure 8.3 - Increasing the application scope of Smart Transport Systems). In addition, the National Fund for Environmental Protection and Water Management implements the Low Emission Urban Transport programme under the Green Investment Scheme (GIS), Part 7. The programme aims to reduce or avoid carbon dioxide emissions by co-funding projects involving reduction of energy and fuel consumption in urban transport. The programme includes activities such as: purchase of new hybrid buses fuelled with compressed natural gas (CNG); training for public transport vehicle drivers who drive low-emission vehicles; infrastructure and management training related to modernisation or construction of refuelling stations for public transport vehicles, and adjusting those stations to hybrid buses fuelled with CNG; modernisation or construction of cycling lanes; modernisation or construction of bus lanes; modernisation or construction of „Park and Ride" car parks; implementation of urban transport management systems; implementation of urban cycling systems.

Energy efficiency measures in the field of energy supply

Article 24 paragraph 2 of Directive 2012/27/EU and section 2.2 of Annex XIV thereto require Member States to submit specific information on all energy efficiency measures that serve the purpose of implementing the key components of the Directive. This section provides information on energy efficiency measures relating to electricity and heat supplies.

In 2007-2012 Poland had a support system for producers of electricity from high-efficiency cogeneration (PES> 10%). In 2014 the system has been re-launched and will remain in use until the end of 2018. Producers of electricity from high-efficiency cogeneration obtain certificates of origin (the certificates) and then dispose of property rights arising from the certificates – either on the power exchange or through bilateral contracts. The Act - Energy Law indicates specific entities required to redeem the certificates purchased on the power exchange or through bilateral contracts. The Act also determines the size of such obligations for subsequent years.

There are also other legal instruments supporting producers of electricity from high-efficiency cogeneration:

- the power system operator, within the area of its operation, is required to ensure to all entities priority in the provision of transmission or distribution services for electricity

produced in high-efficiency cogeneration, at the same time maintaining the reliability and security of the national power system;

- the power system operator, within the area of its operation, is required to purchase electricity produced in high-efficiency cogeneration sources that are located in the territory of Poland and are directly connected to the operator's grid;
- for installations or facilities with planned peak thermal capacity of no less than 50 kW the requirement has been introduced to have a connection to an existing district heating network, or to have its own renewable heat source or cogeneration heat source or waste heat source. This requirement does not apply if the price of district heat is equal to or higher than the average price of heat produced in a non-cogeneration source, taking into account the same type of fuel.

In addition to the legislative instruments there are support programmes for investments into the construction of new high-efficiency cogeneration units and modernisation of power and heat networks. The support is granted on individual basis, upon submission of a relevant application and fulfilment of requirements set out in the programme description. Such programmes are available in Poland, among others, within the Operational Programme Infrastructure and Environment and are serviced by the National Fund for Environmental Protection and Water Management.

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. Most recent Directive 2012/27/EU of 25 October 2012 on energy efficiency is a continuation and stresses the importance of policies to improve the efficiency of the European Union. The Directive obliges EU Member States to introduce measures to improve energy efficiency for achieving the target of 20% primary energy savings by 2020.

Poland actively participates in the creation of common energy policy and legislation on energy efficiency and makes its implementation in national conditions, taking into account the protection of the interests of customers, owned energy resources and technological conditions of production and transmission of energy. Poland pursues indicative target resulting from the Directive 2006/32/EC of the European Parliament and of the Council. By 2012, Poland has completed most of the assumed energy savings.

The effect of GDP growth faster than the rate of energy consumption is decreasing primary energy consumption, which decreased by over 3% per year in the period of 2002-2012 and the final energy consumption, which decreased at a rate of over 2% per year. The fastest rate of energy efficiency improvement was recorded in the industrial sector, while the slowest in the service sector. The most important factors affecting the change in the volume of energy consumption are economic activity and energy savings resulting from energy efficiency improvements. Among other influencing factors are: number of dwellings, lifestyle, structural changes, weather conditions.

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	2002	2003	2004
1	Primary energy consumption ……..…..	Mtoe	88.9	91.2	91.5
2	Final energy consumption ……..	Mtoe	53.3	54.3	56.2
3	Final energy consumption with climatic correction…….	Mtoe	54.6	54.4	56.6
4	Primary energy intensity of GDP……...	kgoe/euro00	0.466	0.461	0.439
5	Final energy intensity of GDP…..……	kgoe/euro00	0.279	0.274	0.269
6	Final energy intensity of GDP with climatic correction……...	kgoe/euro00	0.286	0.275	0.271

Table 2. Energy intensity of industry branches

No.	Specification	Unit	2002	2003	2004
1	Food.....	kgoe/euro05	0.449	0.416	0.395
2	Textile.....	kgoe/euro05	0.180	0.167	0.140
3	Wood.....	kgoe/euro05	0.448	0.417	0.406
4	Paper.....	kgoe/euro05	0.372	0.440	0.391
5	Chemical.....	kgoe/euro05	1.563	1.497	1.448
6	Mineral.....	kgoe/euro05	1.264	1.153	1.051
7	Primary metals.....	kgoe/euro05	2.110	2.624	3.011
8	Machinery.....	kgoe/euro05	0.140	0.118	0.097
9	Transport equipment.....	kgoe/euro05	0.124	0.115	0.094
10	Other.....	kgoe/euro05	0.082	0.088	0.115

Table 3. Energy intensity of production

No.	Specification	Unit	2002	2003	2004
1	Steel……	toe/t	0.300	0.290	0.281
2	Cement..……..	toe/t	0.091	0.090	0.106
3	Paper..…….	toe/t	0.598	0.603	0.510

2005	2006	2007	2008	2009	2010	2011	2012	No.
92.7	97.7	97.8	98.7	94.9	101.3	102.4	98.6	1
56.9	59.4	59.8	60.7	60.4	65.4	63.6	63.2	2
57.2	60.1	61.6	62.9	61.2	64.1	65.0	63.5	3
0.429	0.425	0.399	0.383	0.362	0.372	0.360	0.340	4
0.263	0.259	0.244	0.236	0.230	0.240	0.223	0.218	5
0.265	0.262	0.251	0.244	0.234	0.235	0.228	0.219	6

2005	2006	2007	2008	2009	2010	2011	2012	No.
0.274	0.249	0.250	0.237	0.188	0.198	0.195	0.204	1
0.138	0.108	0.093	0.076	0.064	0.063	0.051	0.049	2
0.444	0.356	0.334	0.337	0.345	0.407	0.392	0.394	3
0.397	0.360	0.304	0.295	0.508	0.492	0.460	0.437	4
1.242	1.121	1.042	1.058	1.103	1.101	1.131	1.118	5
1.012	0.841	0.798	0.770	0.747	0.679	0.654	0.605	6
2.215	1.867	1.877	1.866	1.145	1.252	1.197	1.150	7
0.087	0.065	0.053	0.037	0.035	0.032	0.029	0.027	8
0.118	0.101	0.087	0.074	0.056	0.050	0.042	0.044	9
0.102	0.100	0.081	0.072	0.071	0.072	0.079	0.074	10

2005	2006	2007	2008	2009	2010	2011	2012	No.
0.273	0.250	0.237	0.223	0.210	0.211	0.211	0.223	1
0.103	0.109	0.098	0.088	0.090	0.095	0.093	0.087	2
0.572	0.552	0.552	0.556	0.472	0.433	0.449	0.452	3

Table 4. Energy efficiency indicators in households sector

No.	Specification	Unit	2002	2003	2004
1	Energy consumption per dwelling.....	toe/dwel.	1.455	1.422	1.415
2	Energy consumption per dwelling with climatic correction.....	toe/dwel.	1.531	1.428	1.442
3	Energy consumption per m^2.....	kgoe/m^2	21.4	20.7	20.5
4	Energy consumption for heating per m^2.....	kgoe/m^2	15.0	14.1	14.0
5	Electricity consumption per dwelling.....	kWh/dwel.	1741.4	1973[b)]	2008.6

Table 5. Energy efficiency indicators in service sector

No.	Specification	Unit	2002	2003	2004
1	Energy intensity.....	kgoe/euro05	0.048	0.050	0.048
2	Electricity intensity.....	Wh/euro05	226.1	229.1	229.4
3	Energy consumption per employee.....	toe/emp.	0.867	0.922	0.916
4	Electricity consumption per employee.....	kWh/emp.	4050.1	4265.9	4396.5

Table 6. Energy efficiency indicators in transport and energy sector

No.	Specification	Unit	2002	2003	2004
1	Fuels consumption per equivalent car.....	toe/eq. car	0.381	0.426	0.458
2	Heat plants efficiency.....	%	78.5	78.3	77.2
3	CHP efficiency.....	%	47.4	47.8	47.6

Table 7. ODEX indicator

No.	Specification	Unit	2002	2003	2004
1	Manufacturing.....	2000=100	90.3	84.9	80.7
2	Transport.....	2000=100	97.4	97.0	98.4
3	Households.....	2000=100	89.9	79.2	79.0
4	Global ODEX.....	2000=100	91.8	86.2	85.1

a) data estimated, b) since 2003 including electricity consumption in households, whose primary

2005	2006	2007	2008	2009	2010	2011	2012	No.
1.449	1.528	1.419	1.418	1.421	1.569	1.400	1.428	1
1.467	1.572	1.522	1.537	1.465	1.502	1.474	1.444	2
20.9	22.0	20.3	20.2	20.2	21.7	19.3	19.6	3
14.4	15.3	13.9	13.9	13.8	15.2	13.2	13.5	4
1976.6	2055.4	2029.4	2061.9	2069.9	2124.3	2079.8	2063.5	5

2005	2006	2007	2008	2009	2010	2011	2012	No.
0.046	0.047	0.045	0.046	0.047	0.051	0.048	0.046	1
239.2	251.9	242.0	255.4	248.8	262.2	261.8	255.1	2
0.891	0.931	0.895	0.926	0.966	1.067	1.006	0.987	3
4625.3	4973.4	4829.9	5165.6	5134.5	5489.3	5515.1	5516.8	4

2005	2006	2007	2008	2009	2010	2011	2012	No.
0.496	0.514	0.532	0.518	0.523	0.529	0.540	0.501	1
77.3	77.7	77.0	79.2	80.2	81.0	81.1	81.1	2
48.1	47.5	46.9	46.7	47.0	47.4	46.5	47.3	3

2005	2006	2007	2008	2009	2010	2011	2012	No.
75.5	70.6	65.7	62.6	59.5	58.2	55.5	54.9	1
96.8	95.5	92.1	90.7	88.2	86.2	85.2	83.2	2
78.7	78.7	78.5	78.1	77.8	77.6	77.3	75.7	3
82.9	81.0	78.4	77.3	75.8	74.6	73.2	71.6	4

source of income was profit from individual farming

Table 8. Impact of selected factors on variation of final energy consumption in years 2002-2012 (Mtoe)

Specification	Industry	Households	Transport	Services	Agriculture	Total
Variation of final consumption……..	0,1	1,5	7,7	1,8	-1,2	9,9
FACTORS						
Activity…….....	10,0	–	9,0	3,0	0,1	22,1
Number of dwellings…….....	–	2,1	–	–	–	2,1
Lifestyle..……...	–	1,5	–	–	–	1,5
Structural changes..	-0,9	–	1,6	–	–	0,8
Energy savings…..	-7,6	-1,8	-2,9	0,0	-1,3	-13,6
Climate effect…….	–	0,7	–	0,2	–	1,0
Other……..	-1,5	-1,0	–	-1,4	–	-3,9

Attachment. List of legal acts

EU documents concerning issues related to energy efficiency are as follows:

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) *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.*
15) *Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics.*

Directives and regulations concerning energy efficiency of appliances:

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.*