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IN YEARS 2000-2010

Warsaw, 2012

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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 in answer to European Commission and International Energy Agency (IEA/OECD) documents. These documents recommended joined actions of Eurostat and Member States, aimed at creation of statistical indicators system to assess trends in the field of energy efficiency and supporting decisions making and coordination of these actions with works carried by International Energy Agency.

Realization of this objective served works carried in frames of European Union projects SAVE I and SAVE II and carry at the present in frames of "Intelligent Energy for Europe" programme.

Presented results show potentiality of system created in the EU and IEA/OECD and are not full analysis of present state and trends of energy intensity of Polish economy.

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 2012

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1. Methodological remarks and definitions of basic concepts

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

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

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

	NACE rev. 1.1	NACE rev. 2
Food	15-16	10-12
Textile	17-19	13-15
Wood	20	16
Paper	21-22	17-18
Chemical	24	20-21
Mineral	26	23
Primary metals	27	24
Machinery	28-32	25-28, 33
Transport equipment	34-35	29-30
Other	25, 33, 36-37	22, 31-32

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

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 primary energy consumption to GDP. **Final energy intensity of GDP** is the ratio of final energy consumption to GDP. **Energy intensity**

[1] www.odyssee-indicators.org

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:

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

where: $t_{śr}(n) = \frac{t_{\min}(n) + t_{maks}(n)}{2}$ - mean outdoor temperature for *n* day, [^{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.

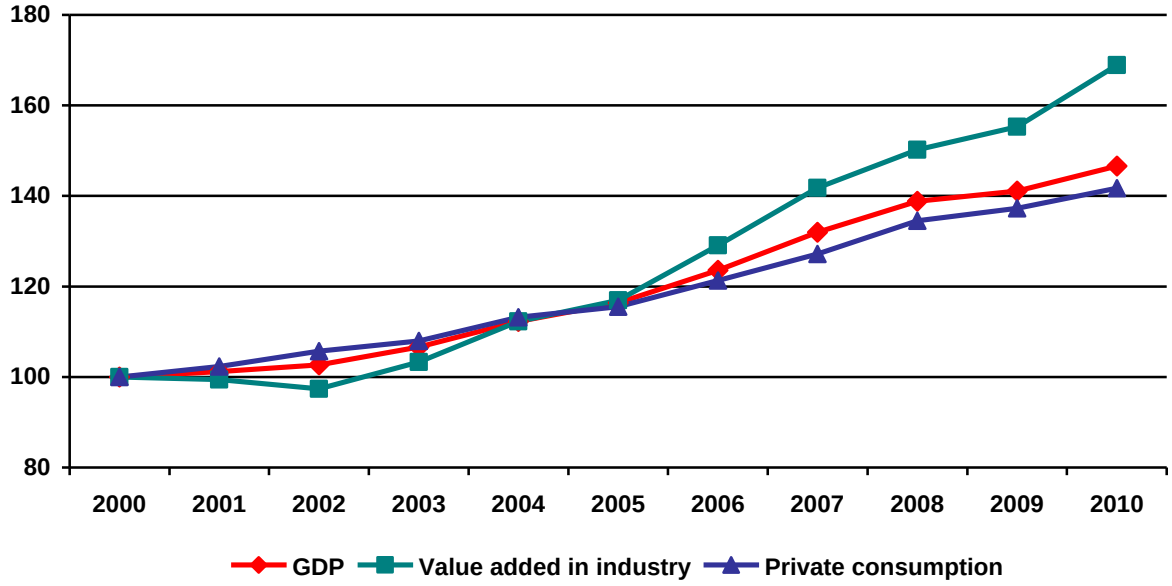
Energy efficiency index (ODEX) is calculated by aggregating the individual changes in energy consumption, observed on certain levels of end-use. ODEX indicator does not show the current level of energy intensity, but the improvement over the base year. ODEX is calculated for each year as the ratio of 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

GDP was constantly increasing in the period 2000-2010 reaching value higher by more than 46% than at the beginning of decade. 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)

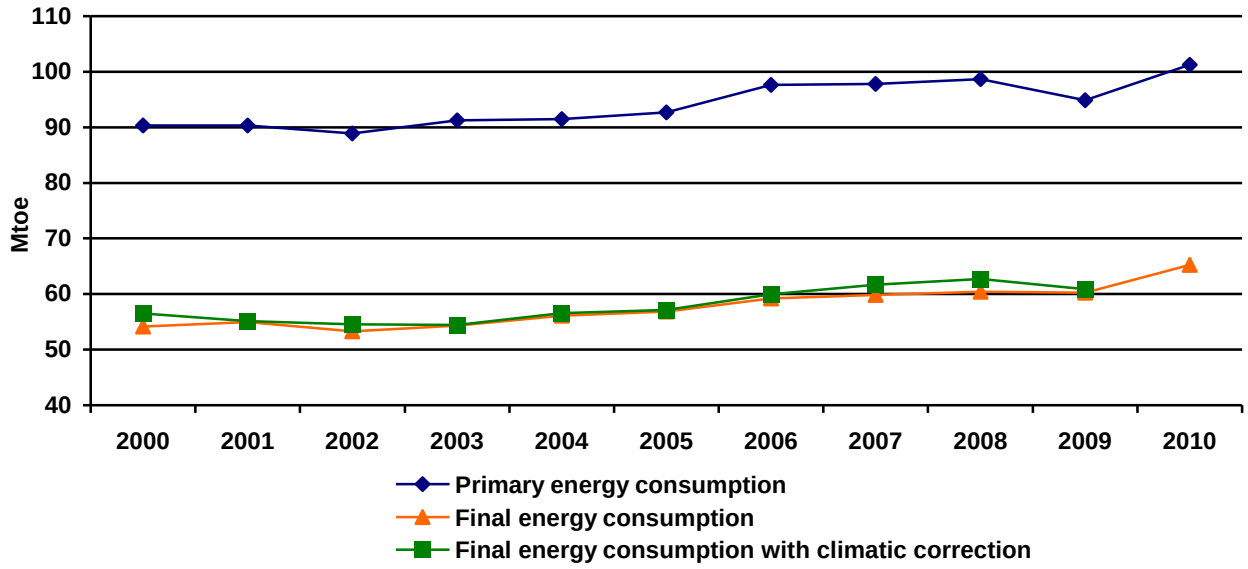


2.2 Energy consumption and prices of energy

Primary energy consumption reached bottom at the level of 89 Mtoe in 2002. Then the slow growth of up to 2009 was observed, when a significant decline occurred. In 2010, there was an increase of consumption to the level of over 101 Mtoe, which was the highest value in this decade. The average increase in of primary energy consumption amounted to 1.1%/year in years 2000-2010. In case of final energy consumption, after slight changes at the beginning of the decade, a slow increase has been observed. The average growth in years 2000-2010 amounted to 1.9%. In case of final energy consumption with climatic correction, that is, taking into account the different weather conditions, the average growth rate of consumption amounted to 0.9% in 2000-2009.

[2] Calculated as geometric mean

Figure 2. Primary and final energy consumption

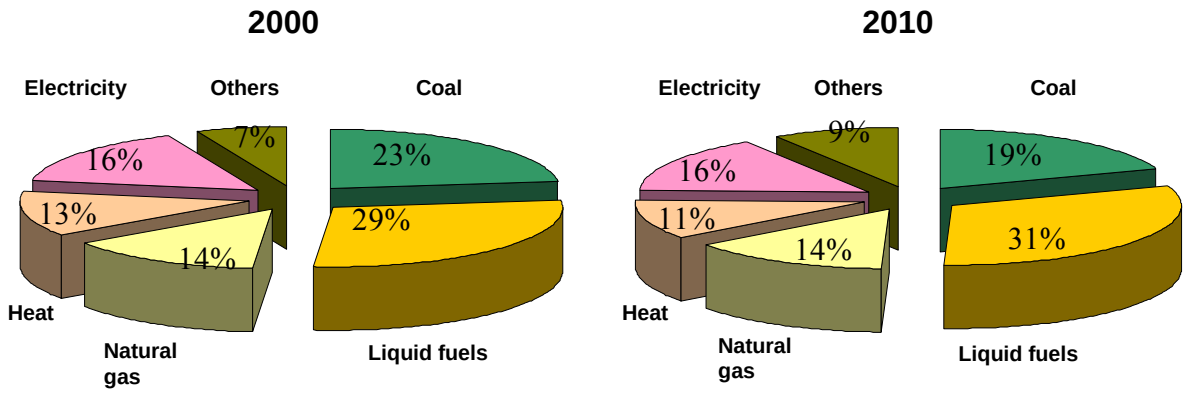


Function of final energy consumption is slightly modified by climatic correction which increases its value for winters characterized by lower degree days value (warmer). Climatic correction concerns households and service sector. Energy consumption with climatic correction describes its theoretical value for a given year, if the weather conditions were similar to long-term average.

Final energy consumption with climatic correction is counted by deducting from final energy consumption the energy consumption in households and service sector and adding energy consumption in these sectors with climatic correction.

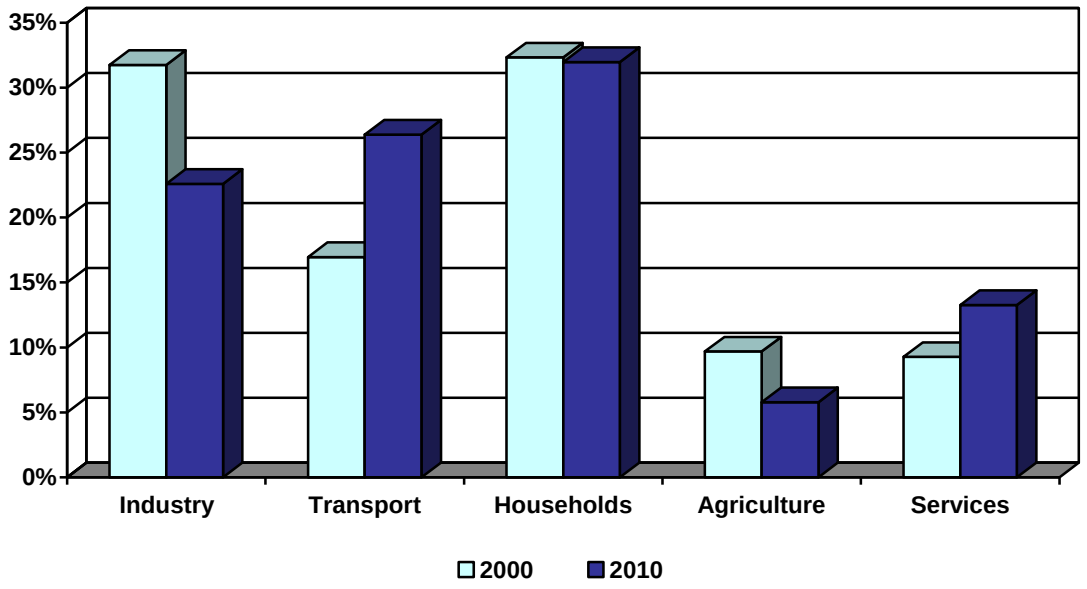
In the energy field, Poland has traditionally been a supply-oriented country with important hard coal and lignite sector. Since the beginning of the 90's the share of liquid fuels in final energy consumption systematically increased, in years 2000-2010 the share of liquid fuels increased from 29 to 31% (Fig. 3). At the same time there was a significant decrease of the share of coal in final energy consumption - from 23% in 2000 to 19% in 2010. A slight increase in comparison with year 2000 occurred in the consumption of other energy carriers, which accounted for 9% of energy consumption in 2010. The share of electricity and gas has not changed, while decrease of the heat was observed.

Figure 3. Final energy consumption by energy carrier



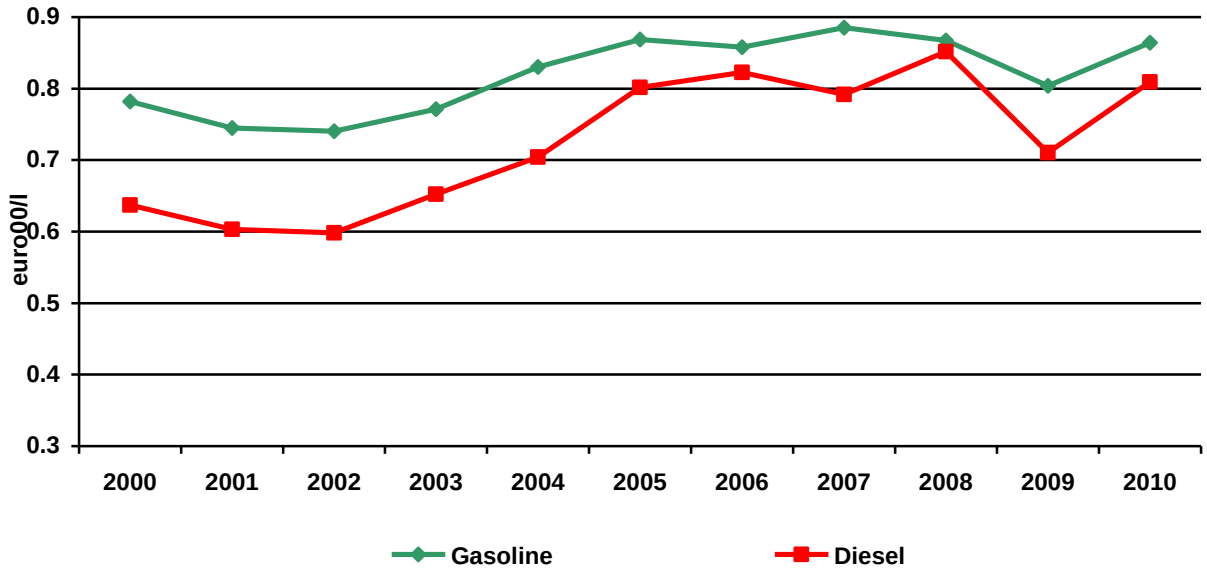
In the structure of final energy consumption by sector it can be seen a significant decline of the share of industry (from 32% to 23%) and increase of the share of transport (from 17% to 26%). In addition, the agriculture sector recorded a decline and service sector growth of the share. Households remained the biggest consumer with market share of 32%. These changes reflect the development trends of the economy (eg increased trade with foreign countries resulting in higher energy consumption in transport), and the activities undertaken in the industrial sector (growth of efficiency associated with rising energy prices) and the results of actions taken by public authorities (eg pro-efficiency programs targeted to households).

Figure 4. Final energy consumption by sectors



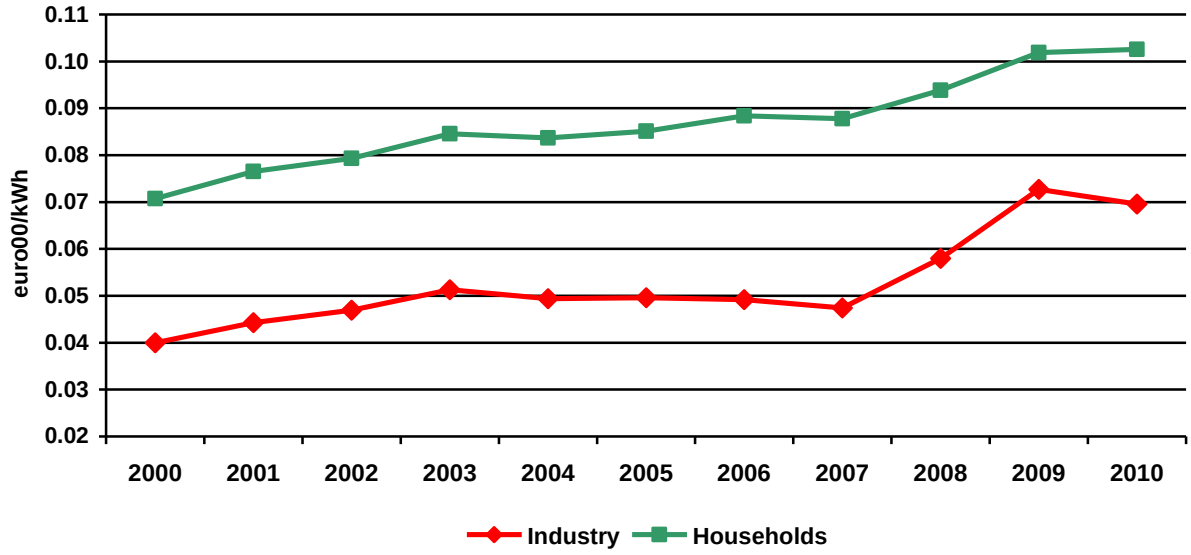
Prices of gasoline and diesel, expressed in constant prices of 2000 were subject to similar changes in 2000-2010. After the decline lasted until 2002, prices have been rising for several years, and then slightly fluctuating. In 2009, there was a significant decline of prices, especially in case of diesel oil, which has more importance for the economic activity (Fig. 5). In 2010, prices rose again and reached a level of 0.86 euro00/l in the case of gasoline and 0.81 euro00/l in case of diesel.

Figure 5. Gasoline and diesel oil prices



Electricity prices for industry (expressed in euro at constant 2000 prices) have grown from 0.04 in 2000 to more than 0.05 euro00/kWh in 2003. After that several years of slow decline occurred. In 2008 steep rise of prices began and prices reached a level above 0.07 euro00/kWh; in 2010 they experienced a slight decline. Electricity prices for households grew fairly steadily during given period, with the exception of two years of decline - 2004 and 2007. Overall, prices rose from 0.07 in 2000 to 0.10 euro00/kWh in 2010, what gave nearly 4% average growth.

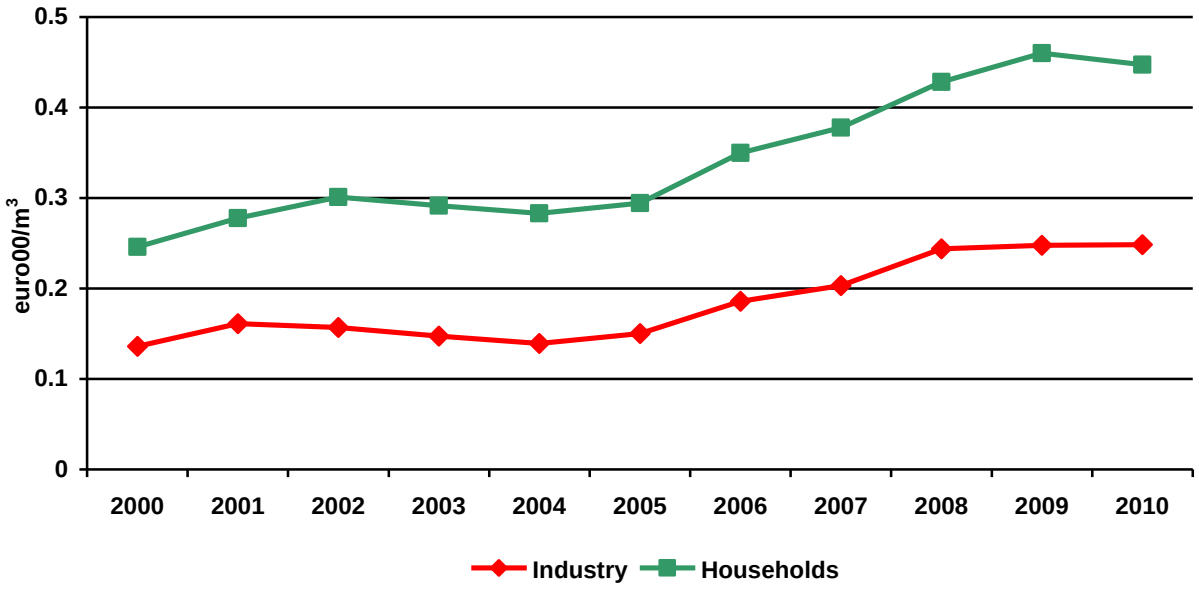
Figure 6. Electricity prices for households and industry



Natural gas prices for households were increasing during the period 2000-2010, with exception of years 2003-2004 and 2010. The growth rate was particularly high after 2005. Overall, the average growth rate of natural gas prices exceeded 6%/year during this period.

Natural gas prices for industry showed similar dynamics, although the growth rate in the first half of the decade was lower. The price of natural gas for industry increased from 0.14 euro00/m^3 in 2000 to 0.25 in 2010 euro00/m^3.

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 2006-2009 the rate of improvement exceeded 5% in case of primary intensity, and amounted to nearly 4% in final energy intensity. In 2010 the energy intensity of Polish intensity grew for the first time since 1993.

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

Growth rate	2000-2006	2006-2009	2009-2010	2000-2010
Primary intensity of GDP……..	-2.21	-5.21	2.76	-2.64
Primary intensity of GDP with climatic correction…….	-2.64	-5.03	.	.
Final intensity of GDP……..	-2.04	-3.76	4.35	-1.94
Final intensity of GDP with climatic correction……..	-2.51	-3.99	.	.

Figure 8. Energy intensity of GDP

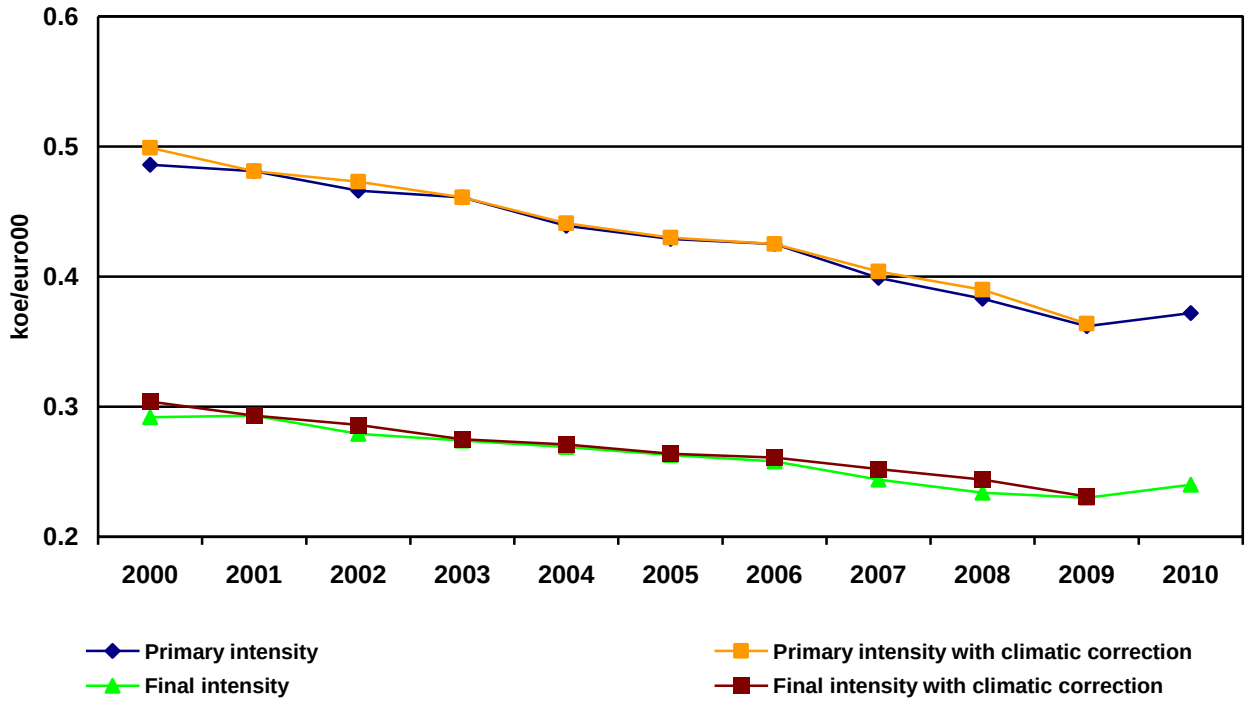
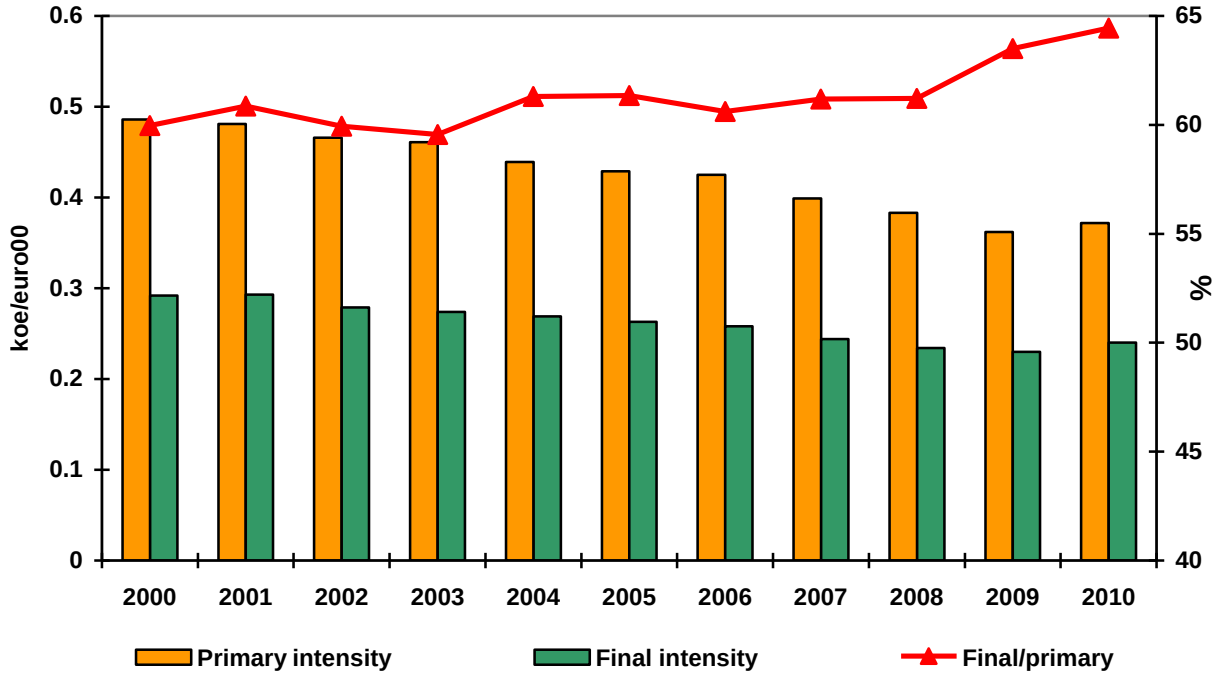


Figure 9. Ratio of final to primary intensity

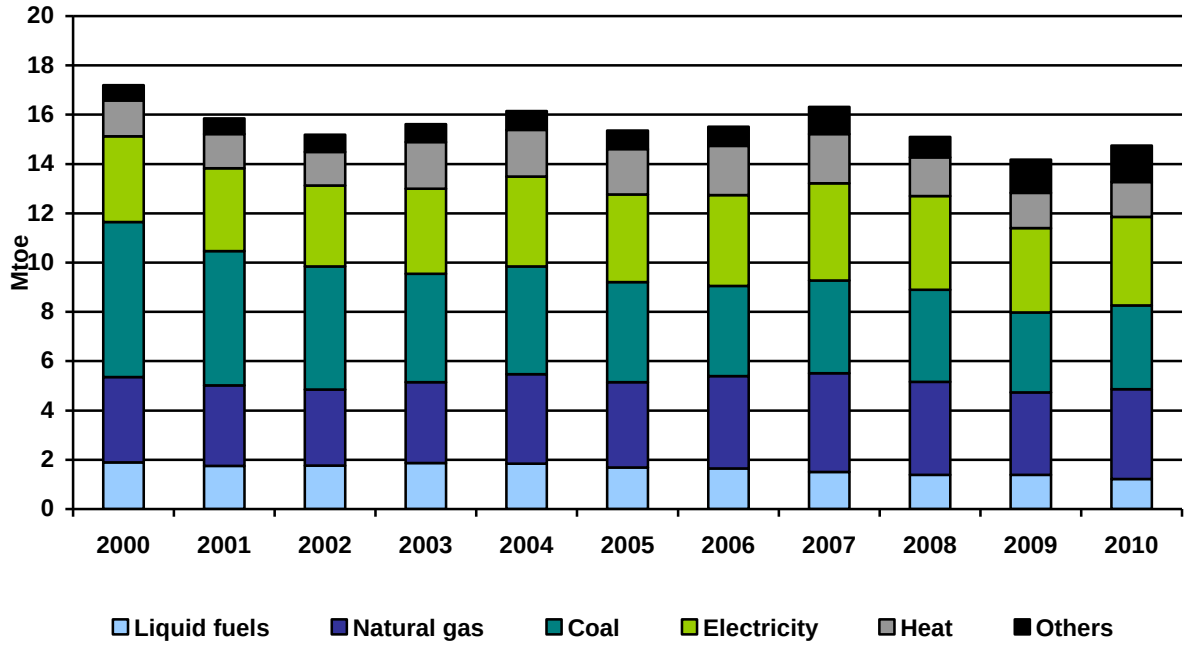


Ratio of final energy consumption in relation to primary energy consumption has remained at a similar level to 2006, when it began a fairly significant increase. In 2010 this indicator reached the highest value in this decade and amounted to 64.4%. Its level is mainly affected by the energy transformation 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

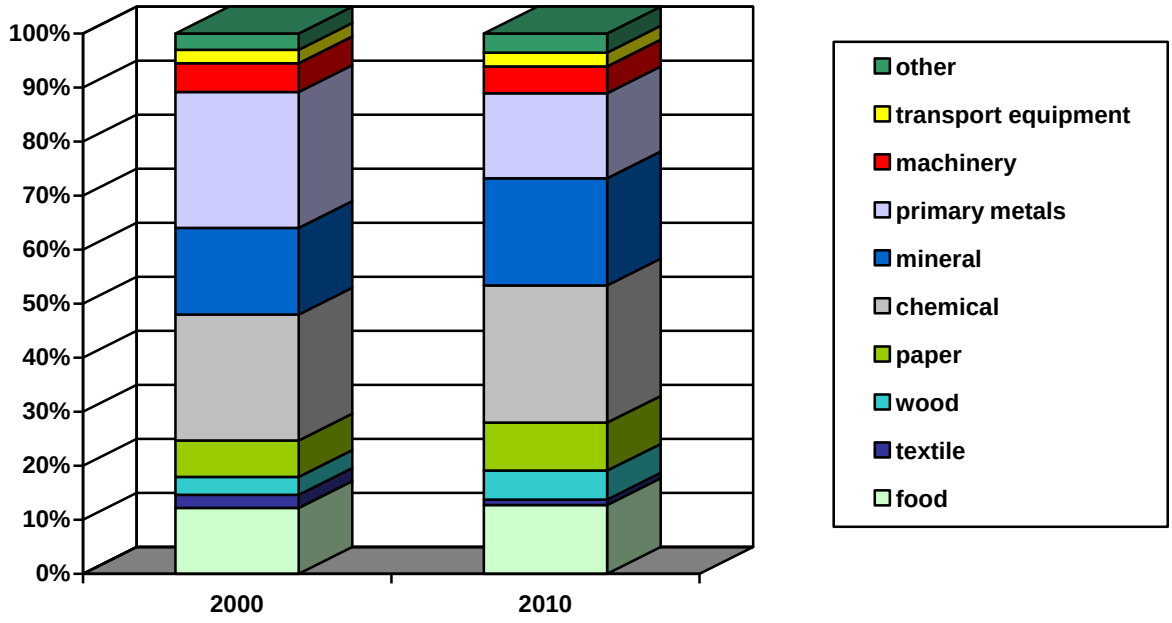
Final energy consumption in industry in the period 2000-2010, was subject to irregular fluctuations with a tendency to decrease. As far as energy carriers go, the consumption of coal and liquid fuels decreased while consumption of natural gas, electricity and other carriers increased. Heat consumption 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 to 2000 which amounted to almost 10 percentage points noted primary metals. The textile and engineering industries have seen a reduction of their share in the energy consumption. Increased share in the consumption of food, wood, paper, chemical, mineral, transport equipment and other industry was recorded. However, structural changes were small and did not exceed a few percentage points.

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 2000-2010.

Figure 12. Energy intensity of energy intensive industry branches

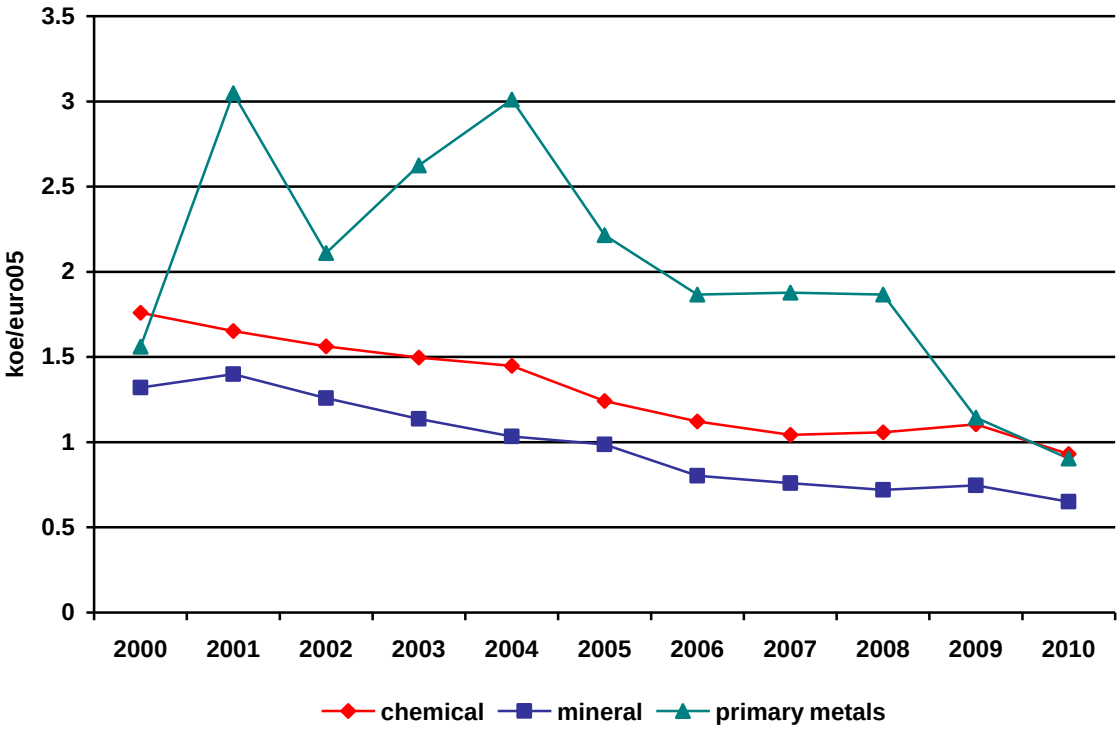
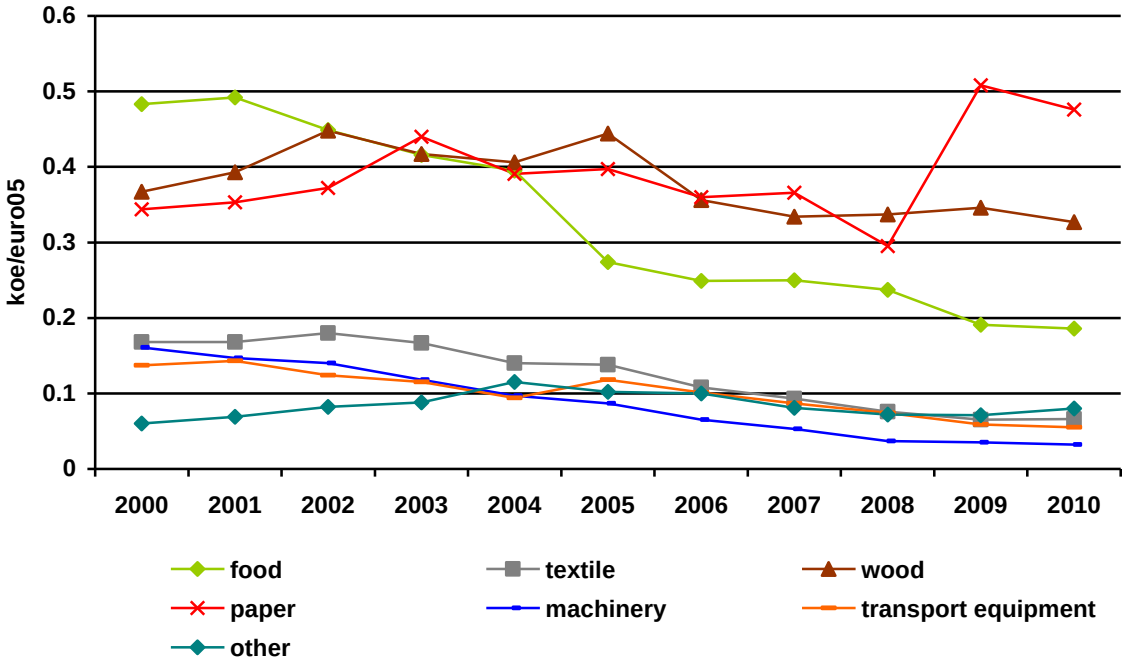


Figure 13. Energy intensity of low energy intensive industry branches



The most dynamic energy efficiency improvements were observed in machinery, as well as food, textile and transport equipment industry. Slowest improvement occurred in the paper industry, wood and others.

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 2000-2008 and averaged to 7.7%/year. Impact of structural change was positive – it contributed to the decline in energy intensity by 3.3%/year. The situation changed in 2010 - energy intensity at constant structure decreased by over 11%, while structural changes have affected the growth of manufacturing energy intensity by more than 3%. Actual intensity decreased by over 8%.

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

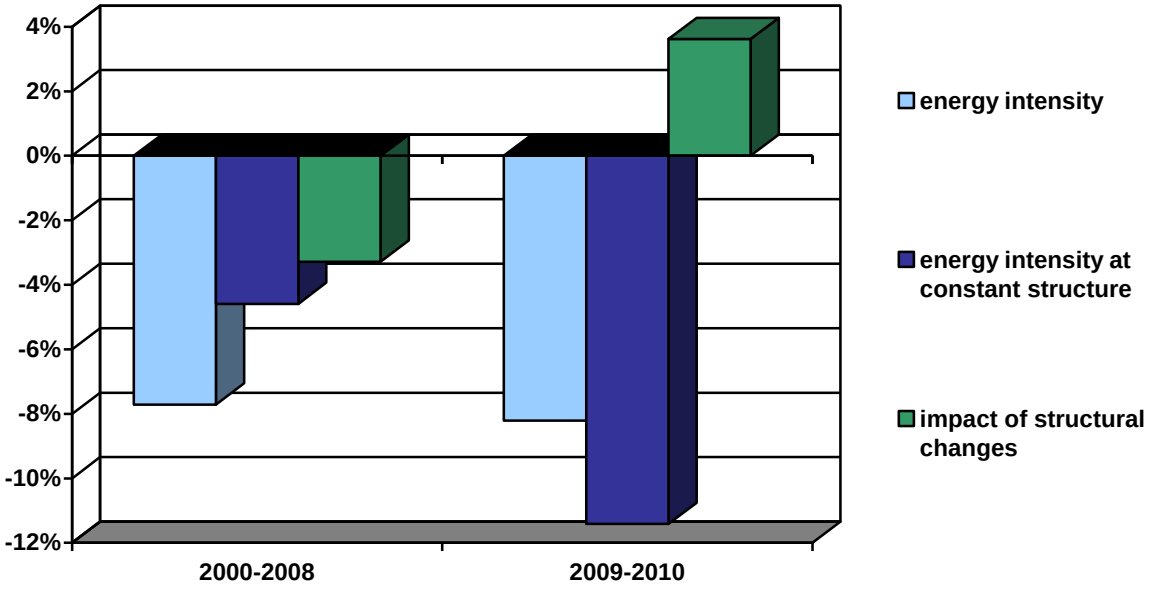


Table 2. Dynamics of energy intensity and impact of structural changes (%/year)

Specification	2000-2008	2009-2010
Energy intensity	-7.71	-8.21
Energy intensity at constant structure	-4.59	-11.41
Impact of structural changes	-3.28	3.62

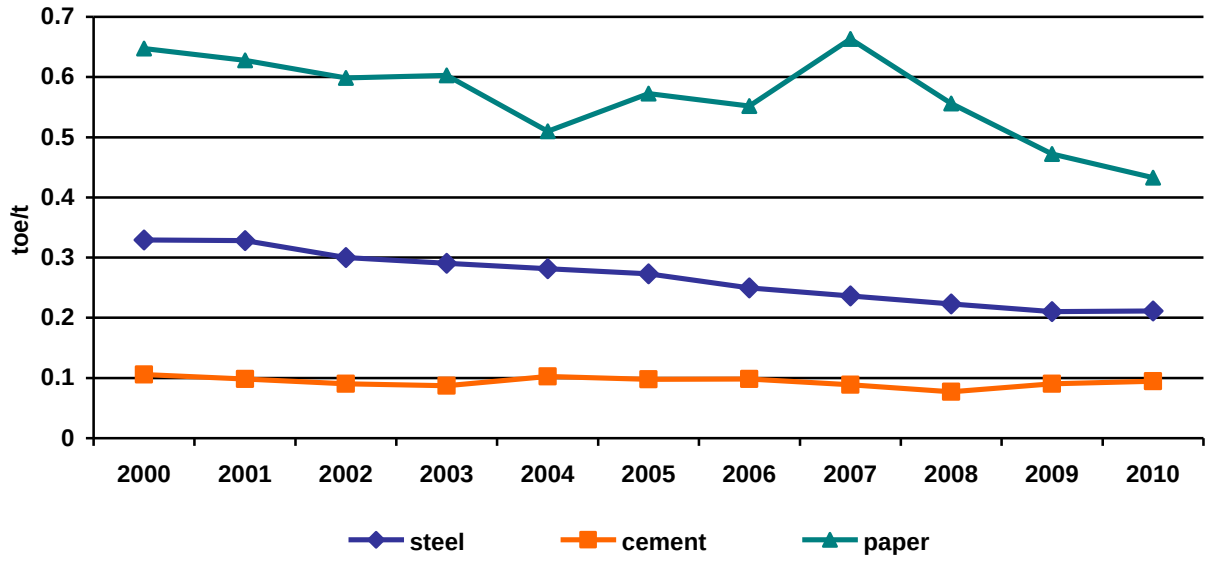
Figure 15 presents energy intensity of steel[3], cement[4] and paper[5] production in years 2000-2010. Energy used to produce these three products amounted to 31% of energy consumption in manufacturing in 2010.

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 2010, when there was a slight increase. Energy consumption of paper industry showed a downward trend in 2000-2010, but between 2004 and 2007 increased from 0.51 to 0.66 toe/t Since then, energy intensity decreased to reach a level of

[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

0.43 toe/t in 2010. In the period 2000-2010, the energy consumption of crude steel production fell by 35.9% (4.3%/year), paper by 33.2% (3.9%/year) and cement by 10.3% (1.1%/year).

Figure 15. Unit consumption of selected industrial products



2.5. Households

The share of energy consumption in households in final energy consumption amounted to 32% in 2010. The structure of consumption by end-use, resulting from surveys carried out by the CSO in 1993, in 2002 and 2009 are shown in Figure 16 and Table 3.

The share of energy consumption for heating was steadily decreasing; this was associated with replacing low efficient coal stoves by more efficient gas and electric appliances, the influence of thermal modernization and more stringent construction standards is also noticeable. The increase in electricity consumption is associated with richer home furnishings in electrical equipment and changes in user behavior (eg, changes in the intensity of use of appliances - washing machines, dishwashers, TV, computers).

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

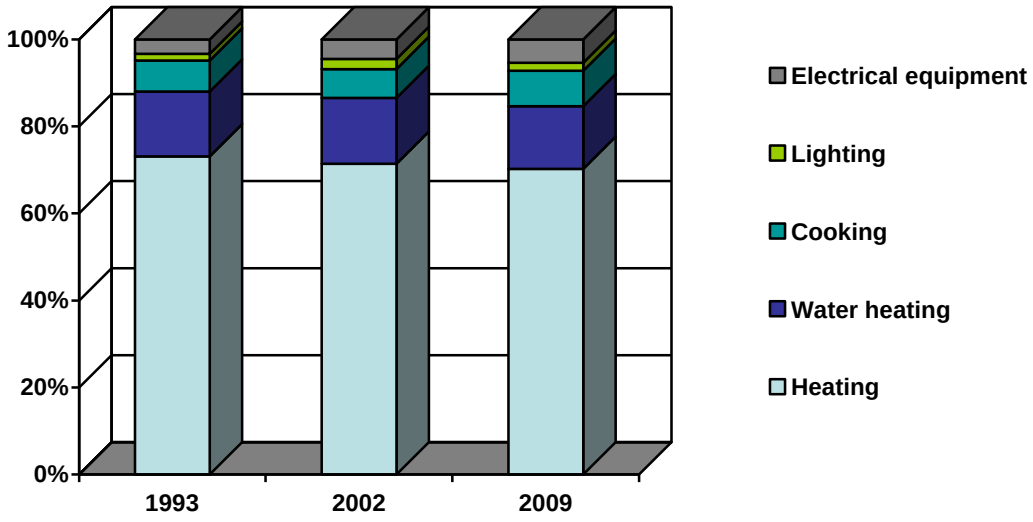


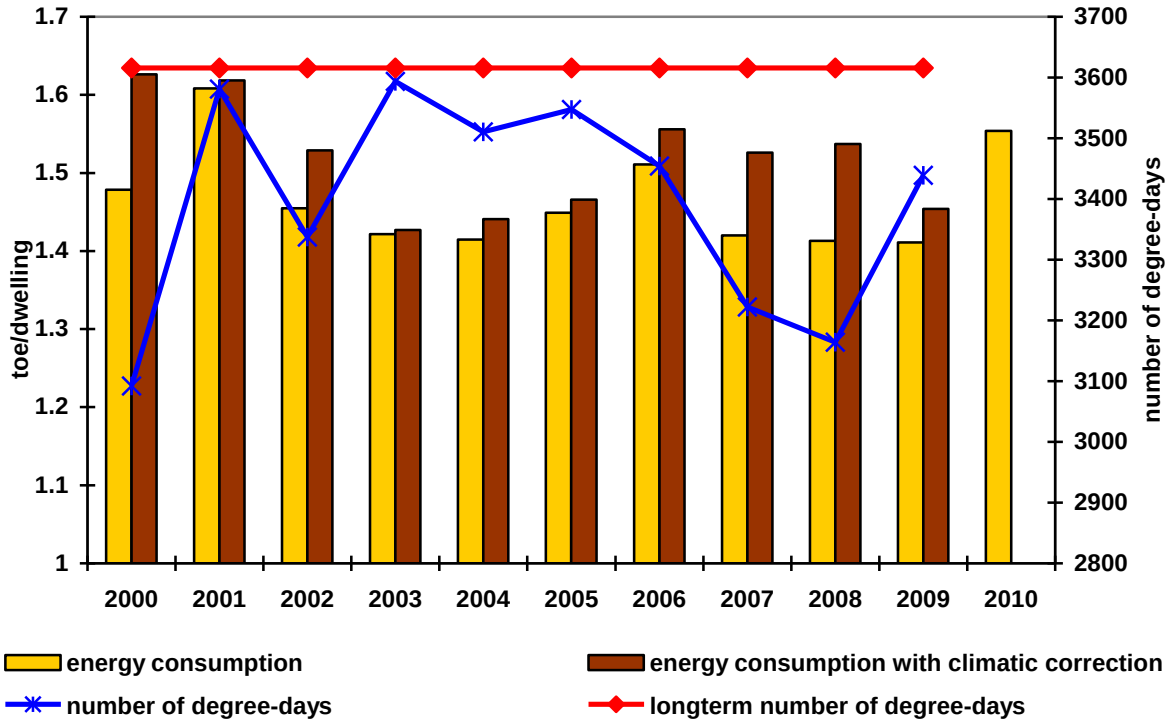
Table 3. Structure of energy consumption in households by end use (%)

Items	1993	2002	2009
Total	100.0	100.0	100.0
Heating	73.1	71.3	70.2
Water heating	14.9	15.0	14.4
Cooking	7.1	7.1	8.2
Lighting	1.6	2.3	1.8
Electrical equipment	3.3	4.3	5.4

Figure 17 shows the changes of energy consumption per dwelling. The indicator with climatic correction declined between 2000 and 2009 with the average annual rate of 1,2%. In the second half of the period consumption has increased.

Energy consumption per house without taking into account climatic adjustment increased by 0.5% per year.

Figure 17. Energy consumption in households per dwelling



source: Eurostat and Joint Research Center, GUS

Table 4. Heating degree-days in years 1995-2009

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Sd - annual	3622	4144	3686	3559	3341	3092	3581	3337	3594	3510	3547	3454	3222	3164	3439

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 2000-2010. 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

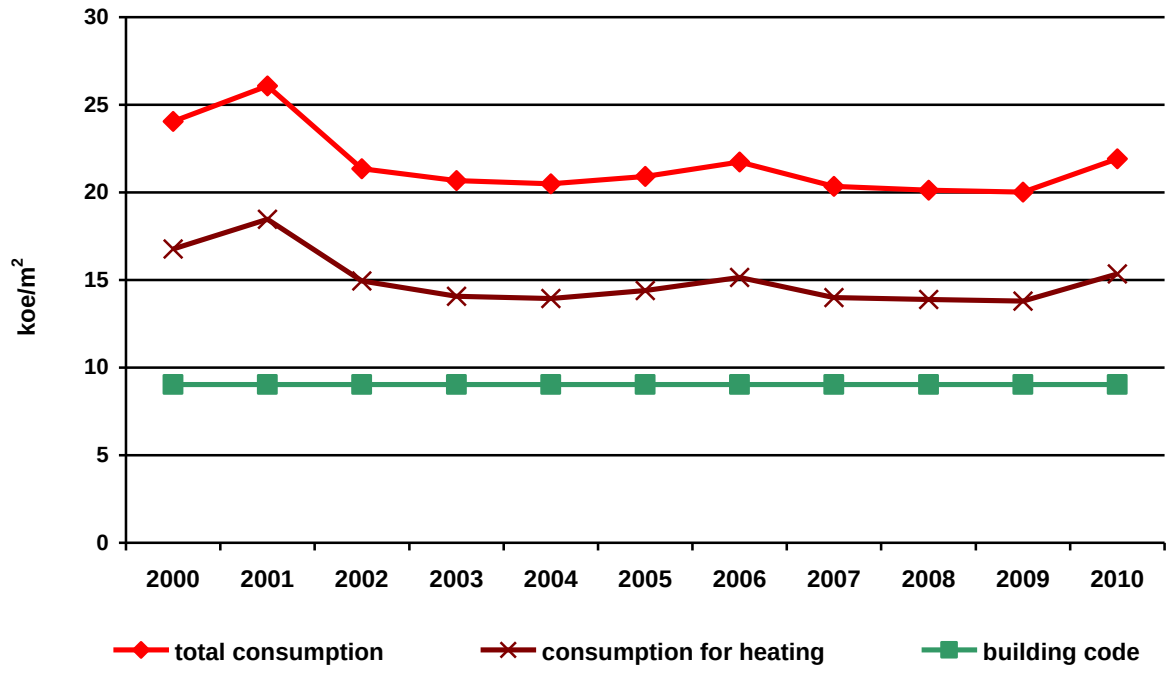
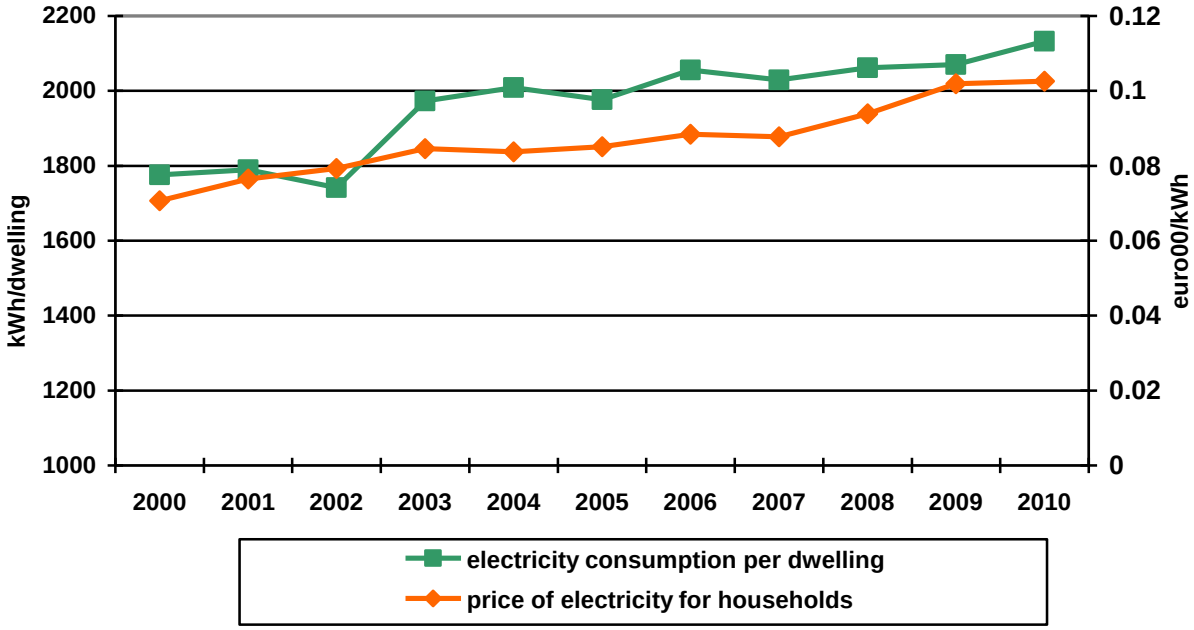


Figure 19. Electricity consumption and price in households per dwelling



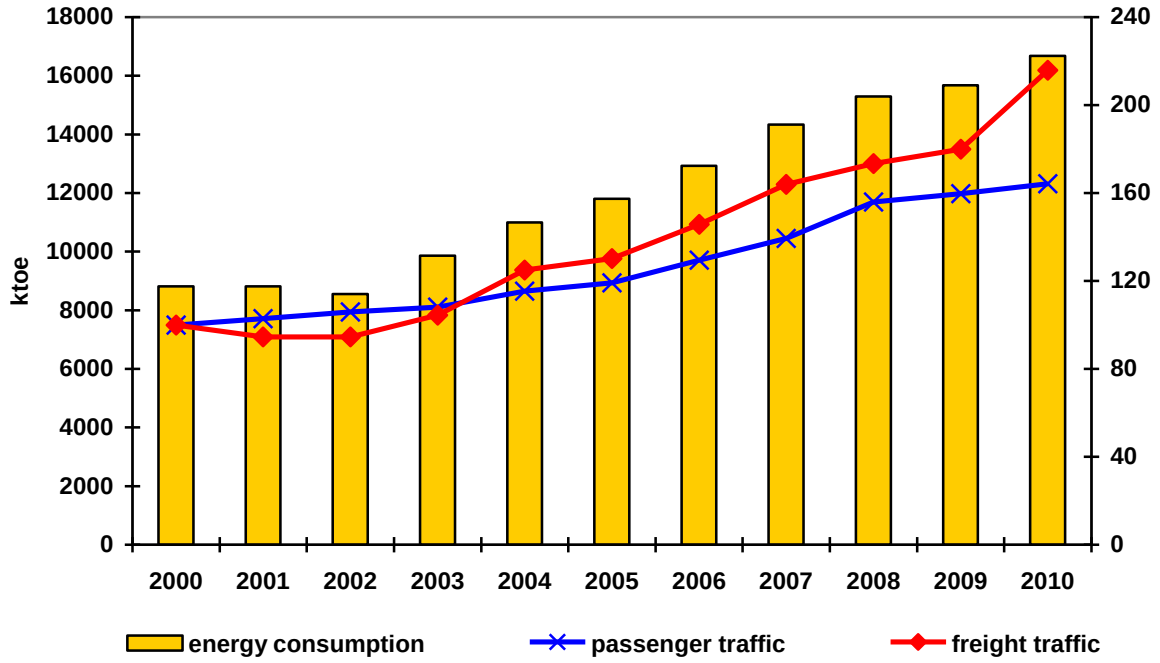
2.6. Transport

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

In the period 2000-2010 average annual growth rate of fuel consumption in road transport amounted to 7%, while energy consumption in rail transport significantly (28%) decreased. Total average annual growth rate of fuel consumption in transport (excluding air transport) amounted to 6.6% in years 2000-2010.

Freight and passenger traffic increased in this period regularly, except for the drop in freight traffic in the early 2000's. In the case of freight traffic an average rate of growth amounted to 8.0%/year, while in the case of passenger transport to 5.1%/year.

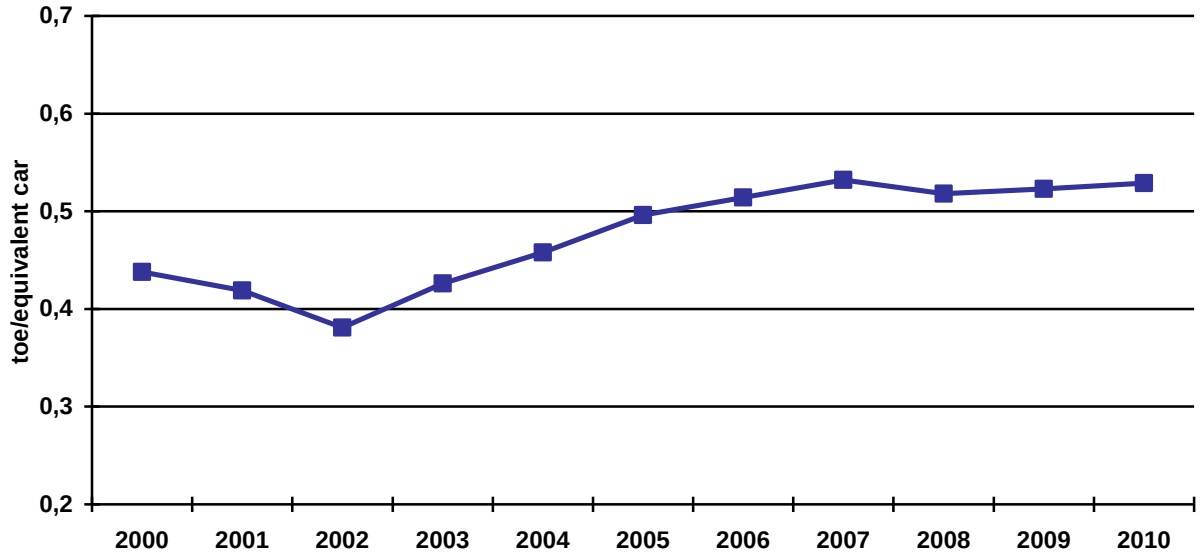
Figure 20. Passenger and freight traffic and energy consumption in transport*



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

Figure 21 shows the evolution of specific fuel consumption per car equivalent. In years 2008-2010 the value of the indicator has stabilized after earlier growth period between 2003 and 2007. 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.

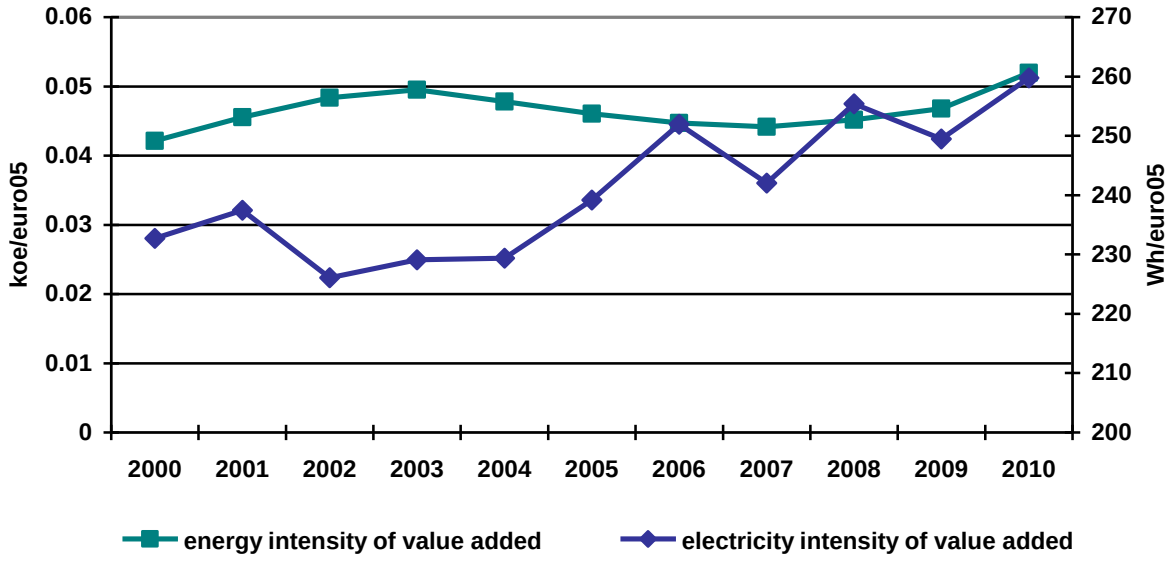
Figure 21. Fuel consumption per equivalent car



2.7. Service sector

Energy intensity of value added[6] in the services sector was showing slight fluctuations and in 2010 it amounted to over 0.05 kgoe/euro05. Energy intensity of service sector was growing by 2.1%/year. At the same time it is the most efficient in terms of energy sector of national product creation. Electricity intensity of value added was increasing in years 2000-2010 by an average of 1.1% per year.

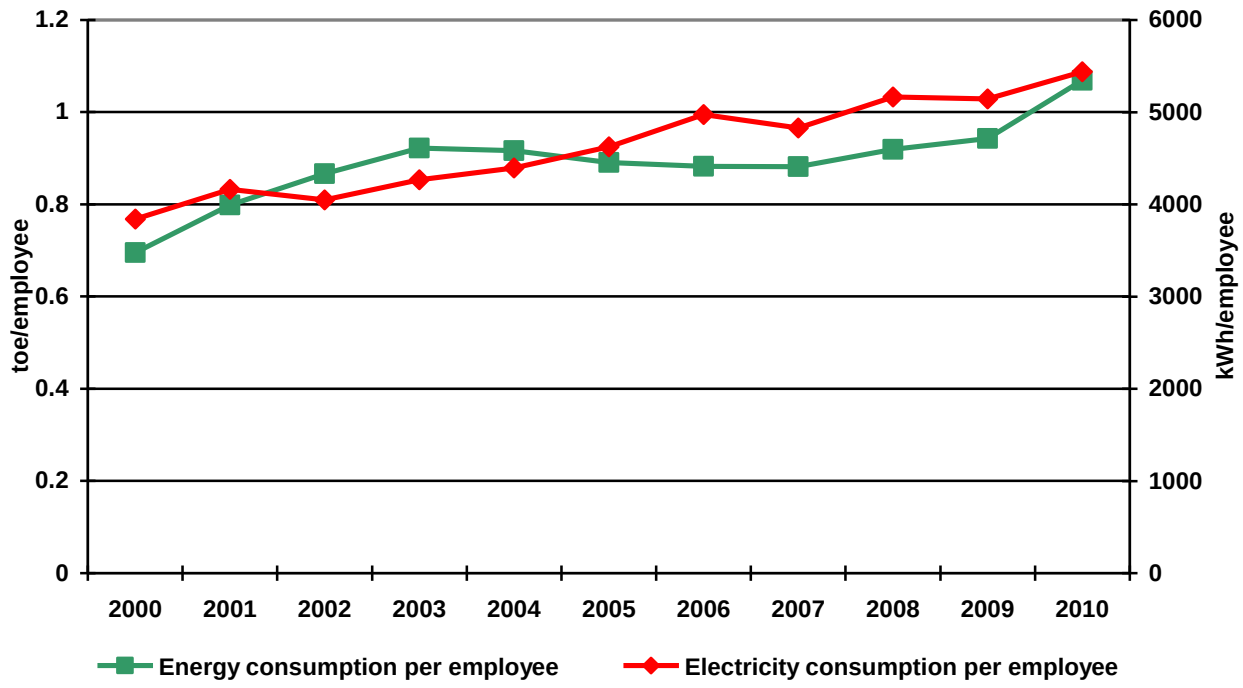
Figure 22. Energy intensity and electricity intensity in service sector



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

In the case of energy and electricity consumption per employee an irregular trend can be seen in the period 2000-2010 (Fig. 23). Energy consumption has increased in the early years of the period, then came to a stabilization of consumption. In 2010 strong growth of consumption occurred. The average growth rate of this indicator amounted to 4.4% per year. In case of electricity consumption per employee the growth was more regular and amounted to 3.5% per year.

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

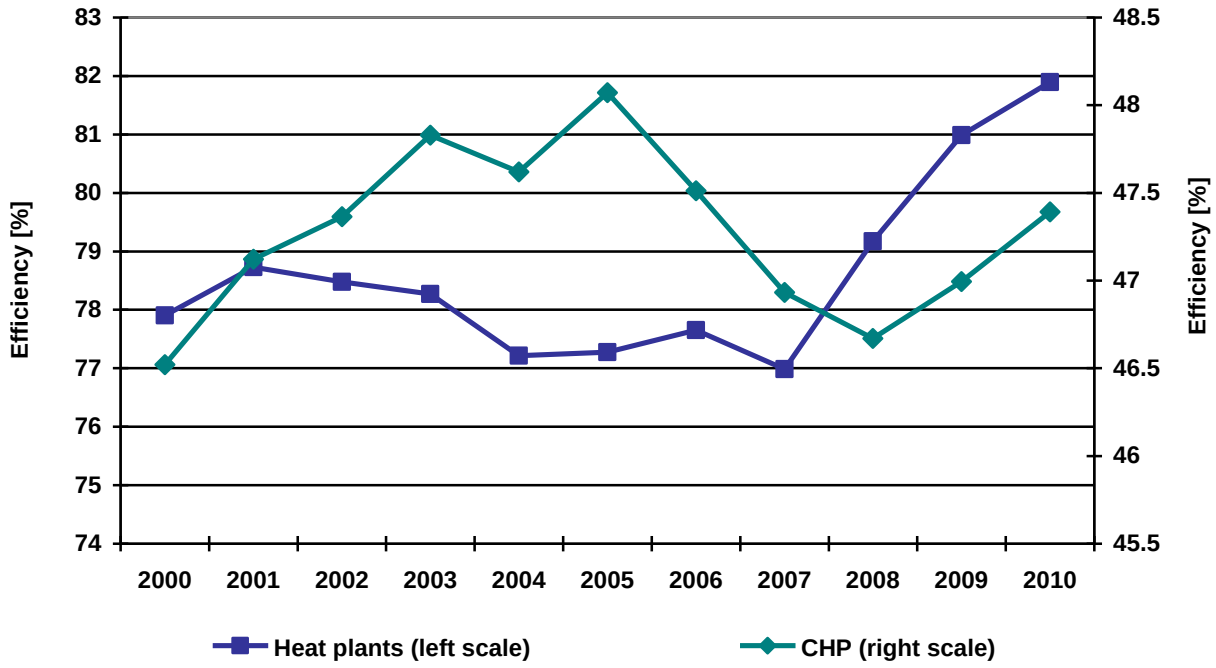


2.8. Heat plants and heat and power generating plants

The efficiency of heat plants producing district heat ranged in years 2000-2007 within the limits of 77-79%, followed by a sharp increase to the level of 82% in 2010.

In case of combined heat and power plants transformation efficiency was increasing until year 2005 and exceeded 48%. In subsequent years efficiency was decreasing. Since 2009 increase in efficiency, which in 2010 amounted to over 47%, has been observed.

Figure 24. Efficiency of heat plants and CHP

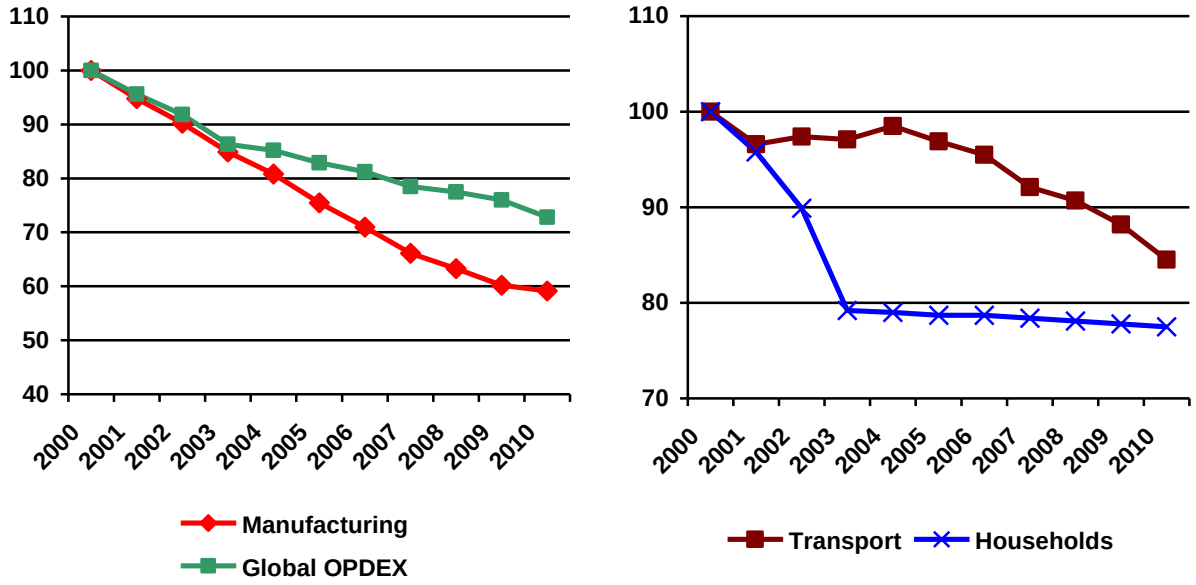


2.9. ODEX indicator and energy savings

ODEX indicator declined in the years 2000-2010 from the level of 100.0 points. to 72.8. The average rate of improvement amounted to 3.1%/year. The fastest rate of improvement (5.1% per year) was achieved by manufacturing. In the household sector ODEX indicator[7] was dynamically falling to 2003, then the rate of improvement was little. The average improvement in years 2000-2010 in this sector amounted to 2.5% per year. In the transport sector value of indicator remained at a similar level to 2004 and then began to decline. Overall, in 2000-2010 the average rate of improvement amounted 1.7%/year[8].

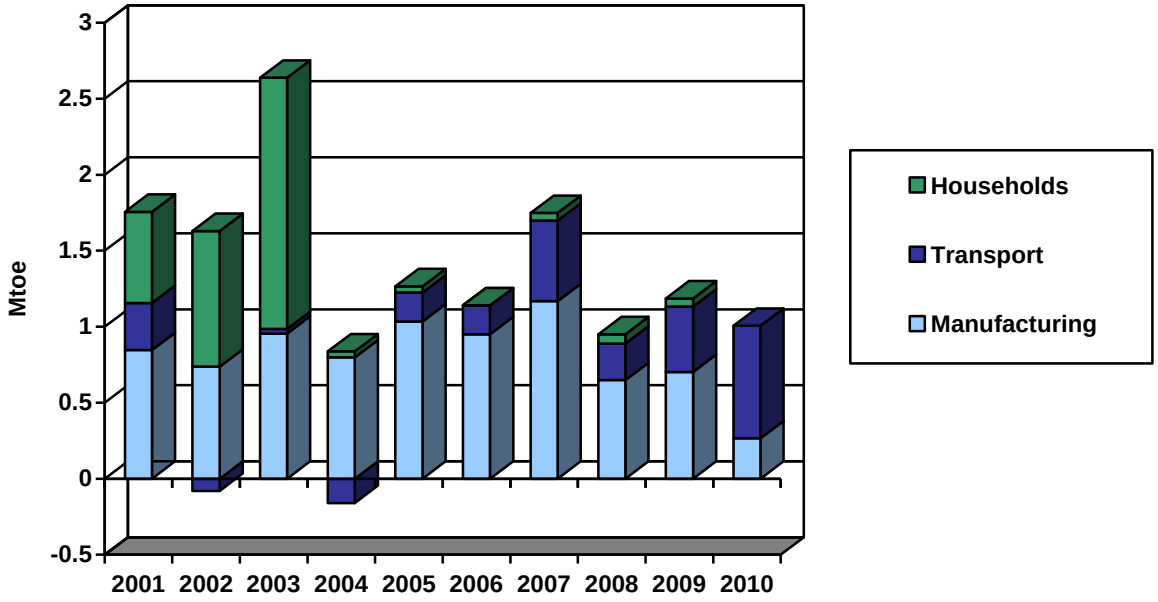
[7] For household sector technical ODEX was calculated, that is basing on the technical parameters of buildings.
[8] Because of lack of official data on specific consumption of different types of transport, calculation of indicator for transport is based on estimated and constant parameters and therefore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

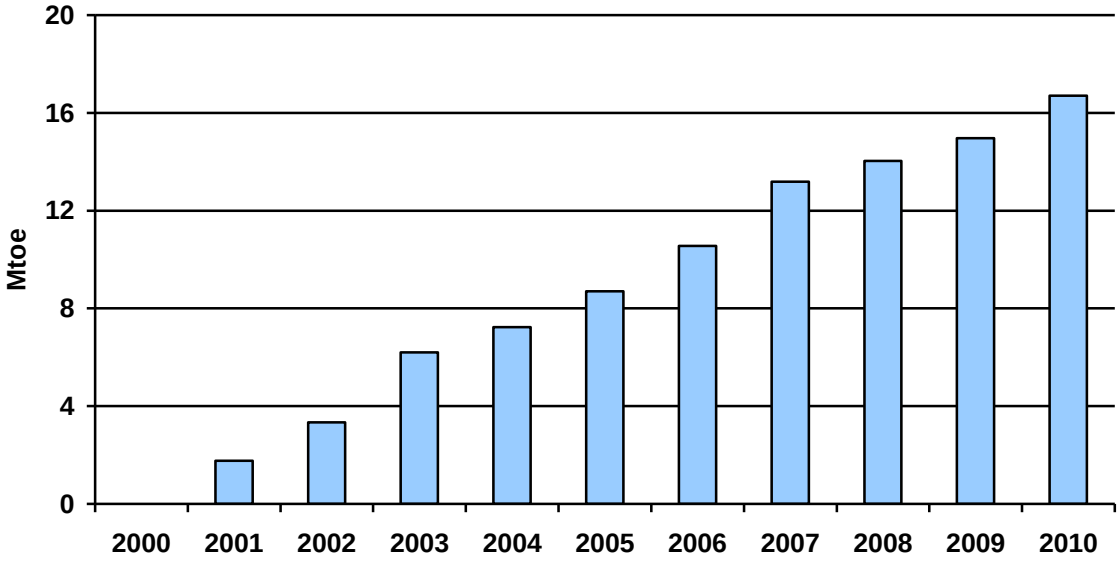
Figure 26. Annual energy savings



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 2010, 16.7 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

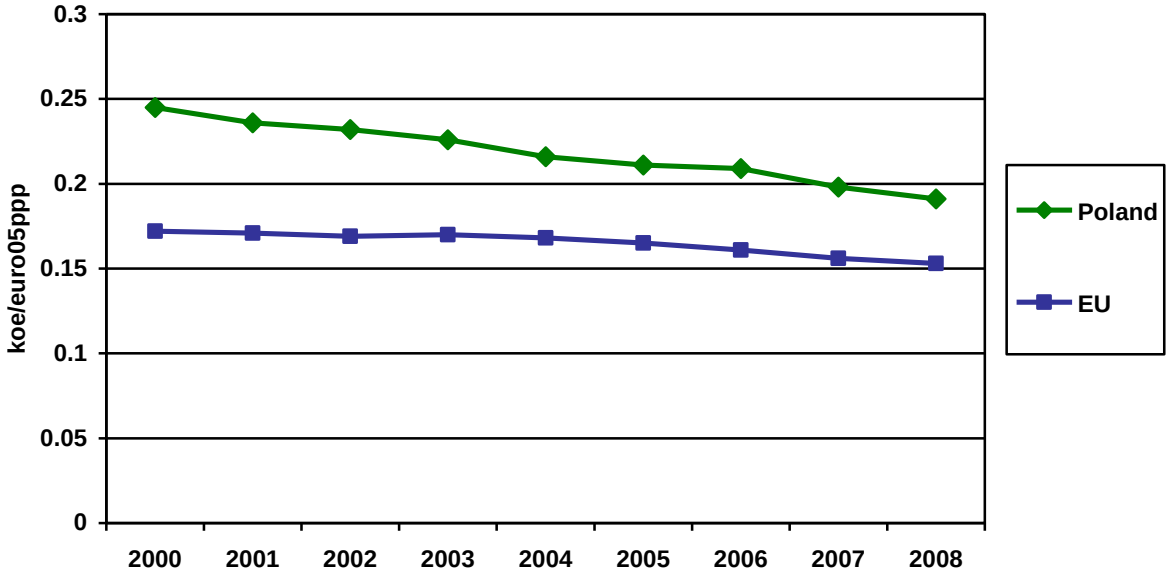


2.10. Poland against a background of other EU countries[9]

Primary intensity of GDP at constant prices and purchasing power parity (base year 2005) amounted in Poland in 2008 to 0.191 koe/euro05ppp and was 25% higher than European average. This difference fell by 17 percentage points. compared to the year 2000. The rate of improvement of energy intensity was in Poland in 2000-2008 twice higher than in the European Union. Among the countries showing a similar level of primary energy consumption can be found Romania, Belgium and Slovakia.

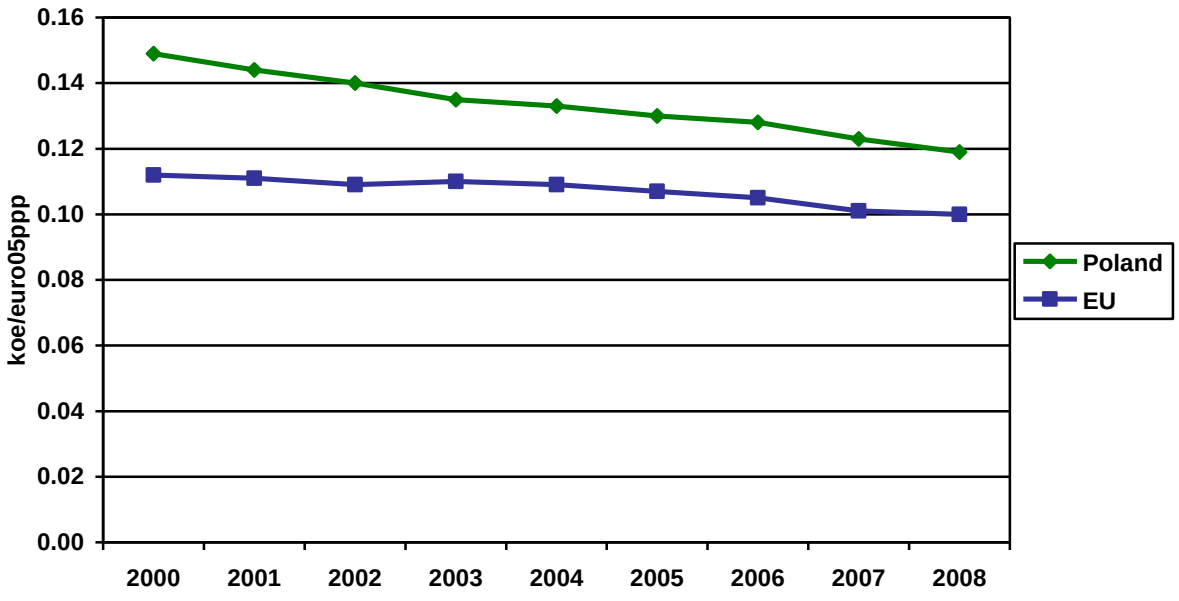
[9] Data comes from Odyssee database

Figure 28. Primary intensity of GDP (euro05, ppp)



In case of final energy intensity difference is smaller and amounts to 19% between Poland (0.119) and EU average (0.100). It is the result of the fact, that ratio of final to primary energy consumption is lower in Poland than in Europe.

Figure 29. Final intensity of GDP (euro05, ppp)



For the purpose of monitoring of the Strategy 2020 currently is used indicator of "Energy intensity" which is defined as the ratio of gross inland consumption to gross domestic product

at constant prices of 2000. Values for the Polish and the EU in accordance with the data calculated by Eurostat are presented in the following table.

Table 5. Energy intensity of Poland and the EU (kgoe/1000 euro00)

Specification	**2006**	**2007**	**2008**	**2009**	**2010**
Poland.....	426.3	397.4	384.1	363.8	373.9
EU.....	175.7	169.1	167.6	165.7	168.0

Source: Eurostat

This indicator does not reflect the actual disparity between the energy efficiency of the Polish economy and the EU due to differences in purchasing power, which means that the price levels of goods and market and non-market services in different countries vary (euro's purchasing power in Poland is higher than in the EU).

3. Energy Efficiency Policy and actions towards its improvement

3.1. Energy Efficiency in „Poland Energy Policy until 2030”[10]

The issue of energy efficiency is prioritised in Poland's energy policy, and advances in this area will be the key to realize all the aims of this policy.

The main aims of energy efficiency in the energy policy are:

- Pursuing a „zero-energy” economic growth, economic growth without an increase of demand for primary energy;
- Consequentially, decreasing the energy intensity of the Polish economy to UE-15 levels.

Particular aims in energy efficiency field are:

- Increasing the efficiency of electricity generation, through construction of high efficiency units;
- Doubling electric energy production in high efficiency cogeneration technologies until 2020, compared to production in 2006;
- Decreasing loss ratios in transmission and distribution by modernizing current and building new networks, replacing low efficiency transformers and developing distributed generation;
- Increasing energy end-use efficiency;
- Increasing the relation between annual electricity demand and maximal load-peak electricity demand, which allows decreasing the total costs of supplying the electricity demand.

The actions for improving energy efficiency outlined in the above mentioned document cover:

- Establishing a national target for energy efficiency increase;
- Introducing a systematic support mechanism for actions used to achieve the national energy efficiency increase target;
- Stimulating developments of cogeneration, including cogeneration from sources below 1 MW, through support mechanisms, and adequate regional policies;
- Using mandatory energy performance certificates for buildings and apartments introduced to the market or rented;

[10] Approved by the Council of Ministries on 10th November, 2009

- Labelling the energy consuming appliances and products and introducing minimal standards for energy using products;
- Obliging the public sector to play a model role in sustainable energy management;
- Supporting energy saving investments through preferential loans and grants from national and European funds, as part of legislation on supporting thermo modernizations and renovations, Infrastructure and Environment Operational Program, regional operational programmes, and funds of the National Fund for Environmental Protection and Water Management;
- Supporting scientific work in developing new solutions and technologies decreasing energy use in all areas of its transformation and use;
- Implementing Demand Side Management, stimulated through, among other, different daily distribution rates and energy prices based upon reference prices resulting from a day-by-day market as well as passing the price signal to the consumer through remote, two way communication with electronic meters;
- Information and educational campaigns, promoting rational energy use.

3.2. First National Energy Efficiency Action Plan and energy efficiency legislation

Poland realizes the indicative target resulting from the 2006/32/EC Directive of the European Parliament from the 5th of April 2006, on energy end-use efficiency of and repealing directive 93/76/EWG which is achieving energy savings of 9% in relation to average final energy consumption from 2001 to 2005 (53 452 GWh), defined in the first National Action Plan on energy efficiency.

The 2006/32/EC Directive imposed a duty on Poland, of taking up actions leading to decreasing final energy consumption by end users in the next nine years of its validity, beginning from the 1st of January 2007. Carrying out article 14, act 2 of the Directive the Ministry of Economy developed the first National Energy Efficiency Action Plan in 2007. The document defined the indicative target in energy saving until 2016 according to article 4 of the directive. A national intermediate target of 2% energy savings by 2010 was also defined, creating a path for achieving the 2016 target as well as evaluating the realization of the target. Additionally the document presented an outline of resources and the resulting

actions, realized or planned on a national level, used to achieve the national indicated target in the expected period.

The main difficulties in exploitation of potential for improving energy efficiency and realizing the first National Energy Efficiency Action Plan (2007) are:

- to little interest on energy saving solutions by energy companies,
- lack of encouragement in the form of tariffs favouring users who use energy sustainably,
- to little support for actions increasing energy savings taken up by the society,
- financial barriers (e.g. lack of a defined budget, limited support resources),
- weak effect of energy saving action taken up by households,
- little knowledge and low awareness of the energy user (e.g. no familiarity with sources of information on energy efficiency).

Until now Poland did not have regulations which would ensure the implementation of programmes and actions improving essentially energy efficiency to achieving the required energy savings. No strong encouragement market mechanisms for implementing energy efficiency actions were in place. New regulation accepted on the 15th of April 2011, Law on energy efficiency (Law Gazette No. 94, pos. 551), is meant to cause developments of mechanisms stimulating energy efficiency improvements. The Law introduces the obligation to acquire an appropriate number of energy efficiency certificates, called White Certificates, by energy companies selling electricity, heat or natural gas to end users connected to the network on the territory of the Republic of Poland.

The system will work similarly to the existing green certificates for energy from renewable energy sources and red certificates for electricity generated by CHP. Certificates can be given to among others, companies who decreased their energy use by investing in new technologies. The issuing body will be the President of the Energy Regulatory Office (URE). Income from substitute fees, monetary penalties for failure to comply with the obligations of possessing white certificates and presentation them for redemption to the President of URE, failure to pay the substitute fees, as well as failure to carry out other responsibilities resulting from the energy efficiency law will be gathered, in a National Fund for Environmental Protection and Water Management (NFOŚiGW) bank account. They will be used as funding for programmes supporting improvements in energy efficiency, including high efficiency CHP, supporting

development of renewable energy sources and building or improving networks used to connect to these sources.

The Law introduces obligations for the public sector to play the exemplary role in energy saving. Government and local authorities are obliged to, while realizing their roles, utilise at least 2 measures of energy efficiency improving, from the list in the Law. Additionally the regulation outlines the rules for conducting energy efficiency audits.

After conducting analysis of existing programmes and resources of improving energy efficiency as well as those planed as part of national policies, additional priority and further actions for improving energy efficiency for 2011-2016 as part of a second National Action Plan, which will allow reaching the national sustainable energy management target.

3.3. Second National Energy Efficiency Action Plan

The Second National Energy Efficiency Action Plan (April 2012_ - NEEAP2 was prepared to fulfil the obligation of submitting reports on the 2006/32/EC Directive (Journal of Law L 114 from 27 April 2006, page 64) as well as the directive on energy performance in buildings, 2010/31/EC (Journal of Law L 153 from 18 June 2010, page 13). The document was developed based on art. 6 section 1 from the 15th of April 2011 on energy efficiency (Journal of Law No. 94, pos. 551), implementing regulations of directive 2006/32/EC.

NEEAP2 contains descriptions of energy efficiency improving measures aimed at end energy use and calculations on current energy savings achieved in the period 2008-2009 and expectations until 2016 according to the requirements of the directive.

The document was prepared by the Ministry of Economy, with involvement from the Ministry of Transport, Construction and Marine Economy, Central Statistical Office (GUS) and the Polish National Energy Conservation Agency (KAPE S.A.).

The document contains detailed descriptions of planned measures for improving energy efficiency defining actions aimed at improving energy efficiency in the different areas of the economy, essential to achieving the national target for sustainable energy management for year 2016, which is to be achieved in nine years from 2008 according to art. 4 of the directive.

While developing NEEAP2 the following assumptions were taken into account:

- the proposed measures will be maximally based on market mechanisms and in minimally on the state budget.

- goals will be accomplished according to lowest cost rules with maximal use of existing mechanisms and organizational infrastructure,
- participation of all parties in exploitation of the total national energy efficiency potential.

The document also contains the report required by the 2010/31/EC directive on building energy performance in which the European Commission is presented with information needed by the directive, a list of current and planned measures and instruments including financial and supporting actions on energy saving in buildings (article 10 of directive 2010/31/EC).

Realized (2009) and projected (2016) final energy savings based on directive 2006/32/EC was considered in two ways. Based on data from statistical surveys and evaluation models, a total final energy saving for the entire national economy was defined with distinction for each sector of end use.

Additionally the final energy savings are defined for each measure by the bottom-up method. This method allows to show a direct relationship between these measures and the implementation of national energy policy. Measures monitored by a bottom-up method cover a large part of the total final energy savings, that is more than 30% of the total energy savings which, in accordance with Directive 2006/32/EC should be determined by the bottom-up method.

The NEEAP2 on energy efficiency defines the following measures of increasing efficiency:

1. Measures in residential housing (households)
    a. Fund for Modernization and Renovation (continued).
2. Measures in the public sector
    a. System of green investments (Part 1) – management of energy in public use buildings (new).
    b. System of green investments (Part 5) – management of energy in buildings of chosen public finance sector entities (new).
    c. Operational Program “Energy saving and promotion of renewable energy sources” for use of financial resources as part of the EOG Financial Mechanism and the Norwegian Financial Mechanism in 2012-2017 (new, under preparation).
    d. Operational Program Infrastructure and Environment (POIiŚ) – Action 9.3 Thermo-modernization of public buildings (continued).
3. Measures in industry and small and medium companies (SMEs)

a. Effective energy use (Part 1) – Additional financing of energy and electricity audits (new).
b. Effective energy use (Part 2) – Financing investments leading to energy savings or energy efficiency improvements in companies (new).
c. Access to financial instruments for the SME sector (PolSEFF) (new).
d. Priority Program Intelligent energy networks (new, from 2012).
e. Operational Program Infrastructure and Environment (POIiŚ) – Action 9.2 Effective energy distribution (continued).
f. Operational Program Infrastructure and Environment (POIiŚ) – Action 9.1 High efficiency energy generation (continued).

4. Measures in the transport sector
   a. Systems of traffic management and optimization of freight transport (continued).
   b. Replacing the fleet in city transport departments and eco-driving promotion (new, from 2012).
5. Horizontal measures
   a. System of energy efficiency certificates – white certificates (new).
   b. Informational campaigns, workshops and education in improving energy efficiency (continued).

3.4. National Targets in energy efficiency and achieving energy savings

In the first National Energy Efficiency Action Plan in 2007 indicative targets for energy efficiency for 2010 and 2016 were defined. For 2010 it is 2% of the average national final energy consumption, with the average taking into account years 2001-2005, and for 2016 9% of said energy consumption. These targets are maintained in the NEEAP2.

Table 6 shows targets in energy savings realized as part of the 2006/32/EC directive, shown in NEEAP1, achieved and planned energy savings in 2009 and 2016 respectively. Due to availability of data the savings of final energy until 2009 were calculated.

Table 6. Targets in energy savings and achieved final energy savings

Year	Target		Energy saving achieved (2009) and predicted (2016)	
	GWh	%*)	GWh	%*)
2010……	11 878	2	35 320	5.9
2016……	53 452	9	67 211	11

*) with respect to average use 2001-2005

Table 6 shows that both realized and planned energy savings will exceed the targets set by directive 2006/32/EC and NEEAP1.

Table 7 shows the achieved final energy savings divided by sector in 2009, calculated by the top-down method presented below.

Table 7. Final energy savings divided into sectors (calculated using the top-down method for 2009 with respect to 2007)

Sector	Achieved energy savings GWh
Households……..…….……	13 816
Services…….……	-
Industry…….…….	11 851
Transport……...	9 653
Total……...	**35 320**

Calculation of energy savings (top-down method)

Presented below is the method used to calculate the final energy savings for the NEEAP2. The calculations were done for year 2009. The calculations were done using the top-down method, according to the methodology published by the European Commission *Recommendations on measurement and verification methods in the framework of directive 2006/32/EC on energy end-use efficiency and energy services*. Year 2007 was recommended by the European Commission as the base year.

Based on analysis of available data the following indicators are possible apply, with regard to each sector of the economy

	Economy Sector	Indicator
1.	Housing	*P*1
2.	Service	*M*3, *M*4
3.	Transport	*P*9
4.	Industry	*P*14

*) definitions and labels of the indicators accordingly to the methodology published by the European Commission as above.

Indicator *P*1 defines the energy consumption of households for space heating per floor area in m² adjusted for climatic conditions. Indicator *P*1 is described with the relationship:

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

Energy savings in year *t* with respect to the recommended base year 2007, are calculated from the formula:

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

in the above:

$E_{2007}^{H_{SH}}$, $E_t^{H_{SH}}$ - Energy consumption of households for space heating, in year 2007 and year *t* respectively;

$MDD_{25}^{heating}$ - Mean heating degree days over the last 25 years;

$ADD_{2007}^{heating}$, $ADD_t^{heating}$ - Actual heating degree days in year 2007 and in year *t*;

F_{2007}, F_t - Total floor area in m² of permanently occupied dwellings in year 2007 and year *t*

Indicator M3 defines non-electricity consumption of the service sector per employee in full time equivalent adjusted for climatic conditions. Indicator *M3* is defined as follows:

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

Energy savings are calculated from the formula:

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

where:

$E_{2007}^{S_{NON-EL}}$, $E_t^{S_{NON-EL}}$ - Non-electricity energy consumption of the service sector in 2007 and in year *t*;

$em_{2007}^{S^{fte}}, em_t^{S^{fte}}$ - Total number of employee in the service sector (in full time equivalent) in 2007 and in year *t*

Indicator *M4* defines electricity consumption of the service sector per employee. Indicator *M*4 is calculated in the relationship:

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

and energy savings in calculation year *t* with regard to base year 2007, from the formula:

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

where:

$E_{2007}^{S_{EL}}, E_t^{S_{EL}}$ - Total number of employee in the service sector (in full time equivalent) in 2007 and in year *t* respectively.

Savings calculations based on indicators *M3* and *M4* for year 2009, with respect to base year 2009, showed no savings.

Indicator P9 is defined as the energy consumption of trucks and light vehicles in kgoe per ton-km. *P*9 is defined from the formula:

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

and energy savings from the formula:

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

where:

$E_{2007}^{TLV}, E_t^{TLV}$ - Energy consumption of trucks and light vehicles in 2007 and in year *t*

$T_{2007}^{TLV}, T_t^{TLV}$ - Total traffic of trucks and light vehicles in ton-km in 2007 and in year *t*.

Indicator *P14* is the energy consumption of industrial sub-sector per unit of production. For its calculation, according to recommendations of the European Commission, knowledge of ETS installations share in energy consumption of a each sub-sector is necessary.

Indicator *P14* recommended by the Commission includes 13 sub-sectors of industry (acc. NACE Rev. 1):

- Mining and quarrying (non-energy) (NACE 13-14)
- Manufacture of food products, beverages and tobacco (NACE 15-16)
- Manufacture of textiles and textile products (NACE 17-19)
- Manufacture of wood and of products of wood and cork, except furniture (NACE 20)
- Manufacture of pulp, paper and paper products; publishing and printing (NACE 21-22)
- Manufacture of chemicals and chemical products (NACE 24)
- Manufacture of other non-metallic mineral products (NACE 26), including cement (NACE 26.51)
- Manufacture of basic iron and steel and of ferro-alloys (NACE 27.1)
- Manufacture of non-ferrous metals (NACE 27.2)
- Manufacture of machinery and equipment (NACE 28-32)
- Manufacture of transport equipment (NACE 34-35)
- Other (NACE 25, 33, 36-37)
- Construction (NACE 45)

Indicator *P*14 is the energy use in the industry sub-sector with regard to the production index, calculated from the formula:

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

while energy savings are calculated from the formula:

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

where:

$E_{2007}^{I^X}, E_t^{I^X}$ - energy consumption of industrial sub-sector *x* in 2007 and in the year *t* respectively;

$IPI_{2007}^{I^X}, IPI_t^{I^X}$ - industrial production index of industry sub-sector *x* in 2007 and in the year *t* respectively;

$K_{2007}^{I^X}$ - share of energy consumption of industrial sub-sector *x* falling under the scope of Directive 2006/32/EC in 2007.

3.5. Description of selected measures for improving energy efficiency

Exemplary role of the public sector

Fulfilling a model role by the public administration is realized by the proper implementation of the energy efficiency law regulations, which defines the actions of the public sector in energy efficiency. In light of art. 10 section 1 and 2 of the law, a public sector entity realizes it's tasks by implementing at least two of five listed measures for improving energy efficiency, and an energy audit according to the regulation of the law from the 21st of November 2008 on supporting thermo-modernizations and renovations. In the energy audit, it is advised to carry out action shown in the audit with regard for their economic feasibility. These actions can be financed from public funds available from the National Fund for Environmental Protection and Water Management.

According to art 13 of the directive 2010/31/EC of the European Parliament and Council from the 19th of May 2010 on energy performance of buildings, all government buildings with an area above 500 m^2 should, until 2013, have a clearly visible energy performance certificate. In 2015 this obligation will also include buildings with an area above 250 m^2.

Among main aims of ongoing action were shown:

- increasing the consideration of environmental aspects in public tenders,
- developing the market for environmentally friendly products and increasing the market for technologies of the environmental protection industry and environmental services,
- promoting sustainable standards of production and consumption.

The public administration is also realizing its exemplary role through implementing and promoting near-zero emission buildings. It is assumed that, financing from the EU for public buildings – e.g. schools, hospitals etc. will be given primarily (and after 2015 exclusively) to buildings of higher energy efficiency, and above all of near-zero energy use. Promotion of demonstrational and pilot projects on nearly zero energy public buildings is also planned. Additionally with regard to the pilot character of these actions, the funding for these projects should be higher than for conventional actions connected to building thermo-modernization. Development of example building projects of near-zero energy, which should be and inspiration for everyone realizing such projects is planned.

Access to information and advice

Information on measures improving energy efficiency and financing mechanisms is available to market participants, including final users.

The Polish National Energy Conservation Agency leads the National Contact Point as part of the Competitiveness and Innovation Framework Programme 2007-2013 (CIP) for beneficiaries of the Intelligent Energy – Europe Programme (IEE II). As part of the National Contact Point for the IEE Programme the following actions are ongoing:

- Providing potential beneficiaries information on the IEE Programme;
- organizing National Information Days with relation to proposal calls published by the European Commission;
- organizing trainings for institution interested in participating in the programme;
- participating in trainings, conferences and workshops organized by other institutions;
- translating work documents;
- preparing and distributing materials on the IEE programme;
- preparing and updating www.cip.gov.pl website (CIP - Competitiveness and Innovation Framework Programme);
- preparing reports on participation on polish entities in invitation to proposal submissions and realizing projects as part of the IEE programme;
- help with preparing proposal applications.

The Poland-Japan Energy Conservation Technology Centre (PJCEE) conducts actions aiming to improve energy management in industry, mainly through trainings of energy auditors and management staff in industry and conducting industrial energy audits.

Additionally other organizations, associations and institution as part of their service offer information and advice on promoting issues of energy conservation, such as: the National Agency for Energy Conservation (NAPE), Fund for Effective Energy Use (FEWE), regional energy agencies (e.g. the Baltic Agency for Energy Conservation – BAPE, Regional Agency for Energy Conservation in Torun (RAPE), the Mazovian Energy Agency (MAE), Podkarpackie Energy Agency (PAE), the Institute for Eco Development and other industry organizations.

Due to actions on promoting energy efficiency buildings an appointment of advisory group is planned, whose members will consist of representatives of the public administration, local governing bodies, companies working in the construction industry and non-government organizations. As part of actions of the group, developing a diagnosis of the state of building

energy efficiency with regard to the developer sector and thermo-modernization process is planned. The basis of the diagnosis will be information on the current energy standard for buildings. The aim of this report is the necessity to adapt existing support instruments to a changing economic situation.
Additionally creating a national ESCO contact point is planned. The work of this contact point will include, among others, helping entities in the public finance sector, including local territorial governing bodies, planning to save energy in the ESCO formula.

Market for energy services

Aiming to stimulate the market for companies providing energy services, such as ESCO type energy saving companies, the law from the 15th of April 2011 on energy efficiency includes regulation on joining tender by these entities as means to achieving energy efficiency certificates (white certificates). ESCO type energy saving companies will be the beneficiaries of the white certificates system, thanks to the possibility of aggregating energy savings and joining the tender representing other entities, which realized actions aimed at improving energy efficiency, achieving a total savings of 10 toe, which is included in the regulation.
Additionally, entities of the public sector which will be obliged to use measures of improving energy efficiency by the regulation will be able to sign contracts which will include realization and financing of investments of measures aimed at improving energy efficiency, with companies such as ESCO type energy saving companies. This will lead to an increase in the market for services of these entities, which offer various forms of out-of-budget financing, e.g. third party financing, or agreement on improving energy efficiency, upon which the investment is financed based on the energy saving specified in the agreement.
In 2012 other actions for developing the energy services market will also be taken up. These actions will concern, above all, facilitating agreements with companies working in the ESCO formula. The main facilitation in agreements on improving energy efficiency and out-of-budget financing by ESCO type companies would be causing the acquired financial resources to be treated as own resources when applying and realizing projects on energy efficiency, co-financed or credited from EU resources in a new financial perspective from resources of the NFOŚiGW, WFOŚiGW and the Norwegian Mechanism. Appropriate changes to the proper regulations on acquiring these resources are being prepared by the Ministry of Regional Development and the Ministry of Environment with cooperation with other departments. Example Specifications of Important Order Conditions will be published on the Ministry of

Economy website along with model agreements on different categories of services guaranteeing energy efficiency improvements.

3.6. Measures of improving energy efficiency presented in the MURE database

Undertaken or planned actions and measures for improving energy efficiency in all of the European countries, including Poland, are presented in the MURE (*Mesures d'Utilisation Rationnelle de l'Energie*, http://www.mure2.com/) database. The MURE database was created as part of the SAVE Intelligent Energy Europe by a team of European experts and coordinated by ISIS (Institute of Studies for the Integration of Systems, Italy), Fraunhofer Institute for Systems and Innovation Research ISI (Germany). The MURE database presents descriptions of undertaken, planned or completed action in improving energy efficiency as well as their quantitative and qualitative evaluation. Involvement of EU countries guarantees constant updating of the database, which also includes certain statistical data and general presentation of issues regarding energy efficiency in the different countries. The database consists of five sections classifying the information on the energy efficiency improvement programmes with respect to four primary sectors of economy: industry, households, transport and services as well as with regard to horizontal measures (regarding the whole economy).

The number of measures presented in the MURE database on energy efficiency improving actions, with regard to all European countries and Poland is illustrated below (as of the 20th of June 2012).

Fig. 30. Number of energy efficiency improving measures implemented or planned in European countries described in the MURE database

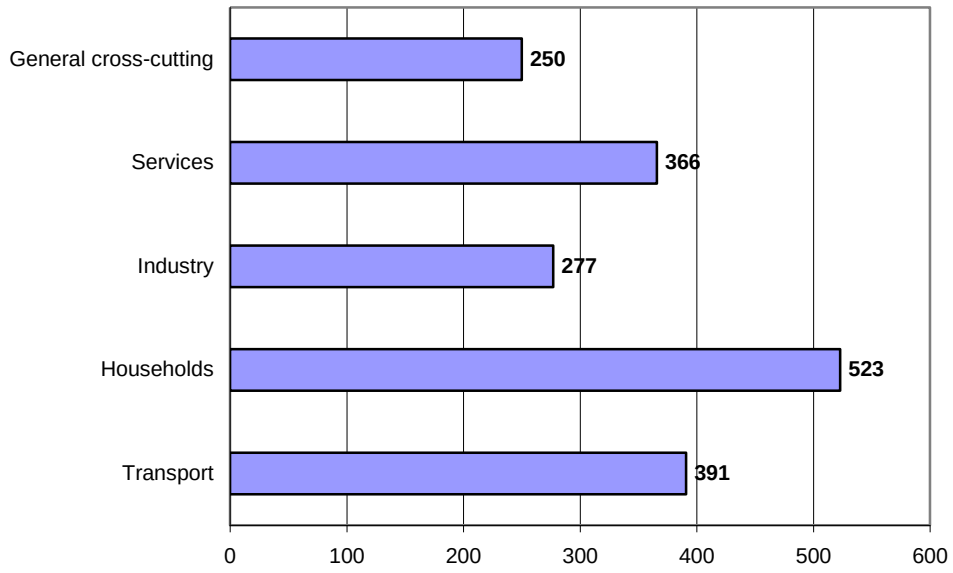
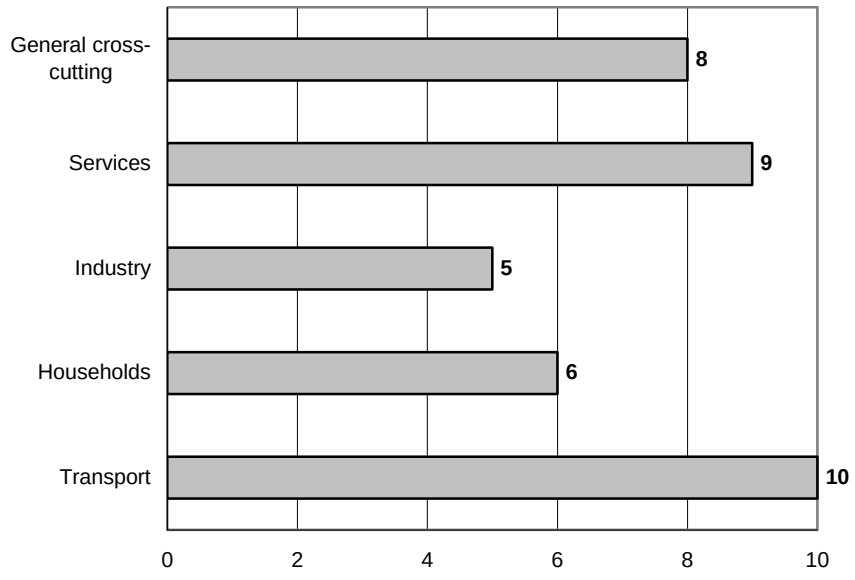


Fig. 31. Number of energy efficiency improving measures implemented or planned in Poland described in the MURE database



The measures improving energy efficiency, presented in the MURE database are in detailed described, including their quantitative and ecological effects.

4. Summary

Increasing the energy efficiency of generation, transmission and use of energy is the pillar of conducting a sustainable energy policy. It finds its expression in legislation and actions taken up by national and European institutions. Poland, as a member of the European Union, actively participates in creating a common energy policy and legislation on energy efficiency, as well as its implementation in national circumstances, taking into account protecting the interests of consumers, available energy resources and the technological conditions of generating and transmitting energy. Improving energy efficiency is one of the priorities of the EU energy policy, with an aim of decreasing energy use by 20% by 2020 compared to the "business as usual" scenario. Poland pursues the indicative target set by Directive 2006/32/EC of the European Parliament and Council from the 5th of April 2006 on effective end use of energy and energy services, repealing Directive 93/76/EWG of the council, which is achieving 9% of energy savings compared to 2001-2005 average use of final energy. According to the directive, energy saving should be counted as a absolute decrease in energy use as a result of organizational actions as well as achieved by undertaking set investment projects or renovations. Up to 2009 Poland achieved important progress in this regard.

An effect of a GDP increasing faster than the increase of energy consumption is an observed decrease of primary and final energy intensity of GDP, with the exception of year 2010. In the first half of the decade energy intensity decreased by 2% annually, and between 2007 and 2009 the rate amounted to 5% for primary energy intensity of GDP and almost 4% in the case of final energy intensity of GDP. However in 2010 the energy intensity of the Polish economy increased for the first time since 1993. The fastest rate of improving energy efficiency was noted in the industry sector, while the slowest in the services sector.

The necessity of monitoring effects of actions towards energy efficiency improvement, described in Directive 2006/32/EC, endeavour to harmonization and making international comparisons possible, force to introduce changes in respect of collection of statistical data i.e. enlarge subject and object scope of surveys, as well as to supplement administrative data bases (administrative sources).

TABLES

Table 1. Energy consumption and intensity of GDP

#	Specification	Unit	2000	2001	2002
1	Primary energy consumption ……..…..	Mtoe	90,3	90,3	88,9
2	Final energy consumption ……..	Mtoe	54,2	55,0	53,3
3	Final energy consumption with climatic correction…….	Mtoe	56,5	55,1	54,5
4	Primary energy intensity of GDP……...	kgoe/euro00	0,486	0,481	0,466
5	Final energy intensity of GDP…..……	kgoe/euro00	0,292	0,293	0,279
6	Final energy intensity of GDP with climatic correction……...	kgoe/euro00	0,304	0,293	0,286

Table 2. Energy intensity of industry branches

#	Specification	Unit	2000	2001	2002
1	Food.....	kgoe/euro05	0,483	0,492	0,449
2	Textile.....	kgoe/euro05	0,168	0,168	0,180
3	Wood.....	kgoe/euro05	0,367	0,393	0,448
4	Paper.....	kgoe/euro05	0,344	0,353	0,372
5	Chemical.....	kgoe/euro05	1,760	1,653	1,563
6	Mineral.....	kgoe/euro05	1,321	1,400	1,258
7	Primary metals.....	kgoe/euro05	1,560	3,048	2,110
8	Machinery.....	kgoe/euro05	0,161	0,147	0,140
9	Transport equipment.....	kgoe/euro05	0,137	0,143	0,124
10	Other.....	kgoe/euro05	0,060	0,069	0,082

Table 3. Energy intensity of production

#	Specification	Unit	2000	2001	2002
1	Steel……	toe/t	0,329	0,328	0,300
2	Cement..……..	toe/t	0,105	0,098	0,090
3	Paper..…….	toe/t	0,647	0,628	0,598

2003	2004	2005	2006	2007	2008	2009	2010	#
91,2	91,5	92,7	97,7	97,8	98,7	94,9	101,3	1
54,3	56,1	56,9	59,2	59,8	60,4	60,2	65,3	2
54,4	56,6	57,2	60,0	61,7	62,7	60,9	.	3
0,461	0,439	0,429	0,425	0,399	0,383	0,362	0,372	4
0,274	0,269	0,263	0,258	0,244	0,234	0,230	0,240	5
0,275	0,271	0,264	0,261	0,252	0,244	0,231	.	6

2003	2004	2005	2006	2007	2008	2009	2010	#
0,416	0,395	0,274	0,249	0,250	0,237	0,188	0,183	1
0,167	0,140	0,138	0,108	0,093	0,076	0,064	0,065	2
0,417	0,406	0,444	0,356	0,334	0,337	0,345	0,327	3
0,440	0,391	0,397	0,360	0,366	0,295	0,508	0,476	4
1,497	1,448	1,242	1,121	1,042	1,058	1,103	0,930	5
1,136	1,034	0,986	0,802	0,760	0,721	0,747	0,652	6
2,624	3,011	2,215	1,867	1,877	1,866	1,145	0,904	7
0,118	0,097	0,087	0,065	0,053	0,037	0,035	0,032	8
0,115	0,094	0,118	0,101	0,087	0,074	0,056	0,055	9
0,088	0,115	0,102	0,100	0,081	0,072	0,071	0,079	10

2003	2004	2005	2006	2007	2008	2009	2010	#
0,290	0,281	0,273	0,250	0,237	0,223	0,210	0,211	1
0,087	0,102	0,098	0,098	0,089	0,077	0,090	0,095	2
0,603	0,510	0,572	0,552	0,664	0,556	0,472	0,433	3

Table 4. Energy efficiency indicators in households sector

#	Specification	Unit	2000	2001	2002
1	Energy consumption per dwelling.....	toe/dwel.	1,479	1,609	1,455
2	Energy consumption per dwelling with climatic correction.....	toe/dwel.	1,626	1,618	1,529
3	Energy consumption per m^2.....	kgoe/m^2	24,1	26,1	21,4
4	Energy consumption for heating per m^2.....	kgoe/m^2	16,8	18,5	14,9
5	Electricity consumption per dwelling.....	kWh/dwel.	1775,8	1789,4	1741,4

Table 5. Energy efficiency indicators in service sector

#	Specification	Unit	2000	2001	2002
1	Energy intensity.....	kgoe/euro05	0,042	0,046	0,048
2	Electricity intensity.....	Wh/euro05	232,7	237,4	226,1
3	Energy consumption per employee.....	toe/emp.	0,695	0,799	0,867
4	Electricity consumption per employee.....	kWh/emp.	3841,7	4162,4	4050,1

Table 6. Energy efficiency indicators in transport and energy sector

#	Specification	Unit	2000	2001	2002
1	Fuels consumption per equivalent car.....	toe/eq. car	0,438	0,419	0,381
2	Heat plants efficiency.....	%	77,9	78,7	78,5
3	CHP efficiency.....	%	46,5	47,1	47,4

Table 7. ODEX indicator

#	Specification	Unit	2000	2001	2002
1	Manufacturing.....	2000=100	100,0	94,8	90,2
2	Transport.....	2000=100	100,0	96,6	97,4
3	Households.....	2000=100	100,0	95,8	89,9
4	Global ODEX.....	2000=100	100,0	95,6	91,8

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

2003	2004	2005	2006	2007	2008	2009	2010	#
1,422	1,415	1,449	1,511	1,420	1,413	1,411	1,554	1
1,427	1,441	1,466	1,556	1,526	1,537	1,454	.	2
20,7	20,5	20,9	21,7	20,3	20,1	20,0	21,9	3
14,1	14,0	14,4	15,2	14,0	13,9	13,8	15,4	4
1973,0[b)]	2008,6	1976,6	2055,4	2029,4	2061,9	2069,9	2132,7	5

2003	2004	2005	2006	2007	2008	2009	2010	#
0,050	0,048	0,046	0,045	0,044	0,045	0,047	0,052	1
229,1	229,4	239,2	251,9	242,0	255,4	249,5	259,8	2
0,922	0,916	0,891	0,883	0,882	0,919	0,943	1,069	3
4265,9	4396,5	4625,3	4973,4	4829,9	5165,6	5144,5	5437,8	4

2003	2004	2005	2006	2007	2008	2009	2010	#
0,426	0,458	0,496	0,514	0,532	0,518	0,523	0,529	1
78,3	77,2	77,3	77,7	77,0	79,2	81,0	81,9	2
47,8	47,6	48,1	47,5	46,9	46,7	47,0	47,4	3

2003	2004	2005	2006	2007	2008	2009	2010	#
84,9	80,8	75,5	71,0	66,1	63,3	60,2	59,1	1
97,1	98,5	96,9	95,5	92,1	90,7	88,2	84,5	2
79,2	79,0	78,7	78,7	78,4	78,1	77,8	77,5	3
86,3	85,2	82,9	81,2	78,5	77,5	76,0	72,8[c)]	4

source of income was profit from individual farming, c) excluding households

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.*