

**CENTRAL STATISTICAL OFFICE**

**ENERGY**

**EFFICIENCY IN POLAND**

**IN YEARS 1996-2006**

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Warsaw, 2008

**Publisher:** Central Statistical Office, Industry Division  
The Polish National Energy Conservation Agency

**Authors of publication:** dr inż. Figurezard Wnuk, The Polish National Energy Conservation Agency, mgr Grażyna Berent-Kowalska, mgr Szymon Peryt and Employees of the Fuels, Raw materials and Materials Division of the GUS Industry Division

**Computer editorship:** mgr Szymon Peryt

**Cover:** Zakład Wydawnictw Statystycznych

**Print out:** Zakład Wydawnictw Statystycznych  
Al. Niepodległości 208, 00-925 Warsaw

ISSN: 1732-4939

*Publication available on [www.stat.gov.pl](http://www.stat.gov.pl)*

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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 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 aim 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 IAE/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.

Wanda Tkaczyk  
Director of  
Industry Division

Warsaw, June 2008

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# 1. Introduction

The increase of energy efficiency of generation, transmission and use processes is a pillar of sustainable energy policy. It is reflected in the law and actions undertaken by national institutions and international organizations, among them in regulations connected with energy efficiency, including:

- Directives of the European Parliament and of the Council<sup>1</sup> (with the latest 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC),
- Renewed Lisbon Strategy,
- National Coherence Strategy for years 2007-2013.

The main aim of the latest directive is achieving economically reasonable improvement of fuels and energy end-use efficiency in Member States of the European Union through: setting goals, mechanisms and incentives; setting institutional, financial and legal frames to cancel existing market barriers having influence on energy end-use efficiency; promotion of programmes aiming at improving energy efficiency; development of high quality energy services for end users; harmonization of methodology of energy savings calculation and verification.

Above mentioned directive obliges Member States to collect and transmit data required to monitor, assess and plan actions towards energy end-use efficiency improvement.

There are two methods of measuring growth of energy efficiency (energy savings). These are: “top-down” method and “bottom-up” method.

- In method „top-down” aggregated data is used and therefore it is called energy efficiency indicators method. This method enables to set indicators of situation development, but it does not ensure detailed measuring on specific level. Mostly, sections, divisions, groups of economy, groups of devices, and types of transport means are the subjects of calculations. Calculated values of energy consumption or intensity are recalculated with reference to such external factors as number of degree days during heating season, structural changes, production profile, etc.

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<sup>1</sup> See Attachment No. 3

- „Bottom-up” method is more precise way of energy savings calculations resulting from energy efficiency increase. Primary, energy consumption of single end user for instance refrigerator is calculated during defined time period before introducing pro-efficiency action, obtaining base value<sup>2</sup>. Next, the energy consumption in the following period is compared to the consumption during prior period. The difference between results measures energy efficiency increase. If similar calculations are made for all energy devices, and results sum up, precise result of energy efficiency growth is obtained. When making calculations, it should be remembered also in this case to take into account climate corrections and other factors outnumbered in the description of the method „top-down”.

Central Statistical Office and Polish National Energy Conservation Agency take part since few years in successive projects aiming at assessment of energy efficiency trends and description of energy efficiency policy measures. At the moment they participate in 2 - years (2007-2009) project of the Intelligent Energy for Europe programme. “Monitoring of Energy Demand Trends and Energy Efficiency in the EU”.

The project aims at:

- Monitoring of changes (improvement) of energy efficiency (CO<sub>2</sub> emission) in the EU Member States.
- Analysis of energy demand trends.
- Comparison of energy efficiency among various countries.
- Evaluation of share of innovative energy efficient technologies and renewable energy sources in implementation of Lisbon Strategy for increase of economic competitiveness of Europe.
- Evaluation of measures for improvement of energy efficiency in EU Member States.

The above objectives are compliant with requirements concerning energy efficiency measurements of the Directive 2006/32/EC. Under the project two tools will be developed and used: ODYSSEE<sup>3</sup> data base containing data and values of energy efficiency indicators, MURE<sup>4</sup> data base with data concerning measures for improvement of energy efficiency.

The present publication and energy efficiency indicators base on methodology developed during above mentioned projects.

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<sup>2</sup> In calculations „bottom-up”, in case there is no possibility to measure energy consumption earlier, the base level can be reconstructed using parameters of types and share of technologies, which were used when given action was not applied.

<sup>3</sup> [www.odyssee-indicators.org](http://www.odyssee-indicators.org)

<sup>4</sup> [www.mure2.com](http://www.mure2.com)

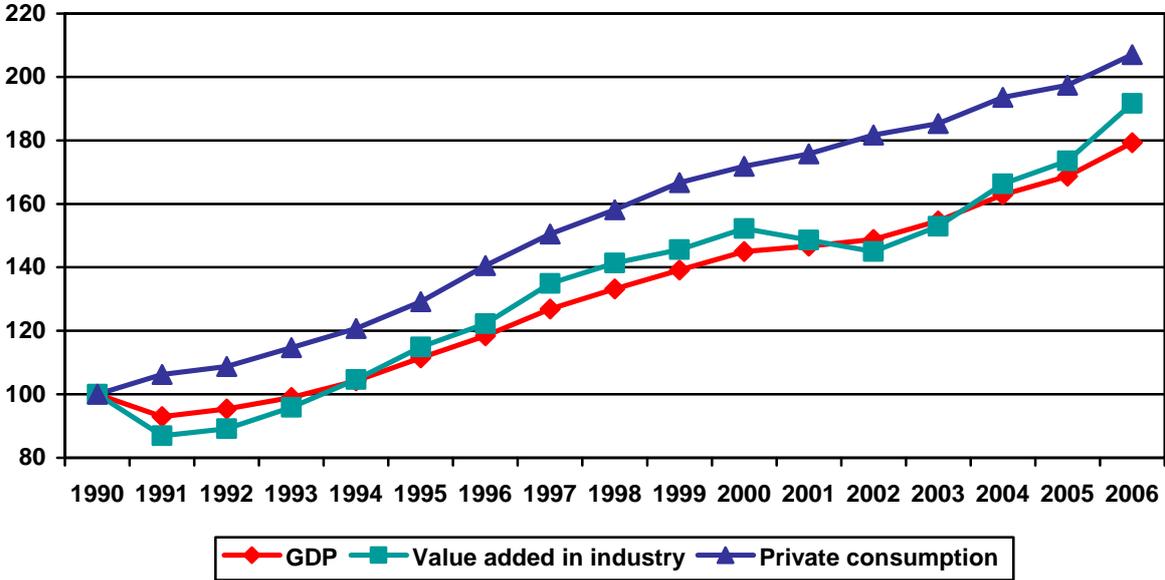
## 2. Energy efficiency indicators for Polish economy and its sectors

Indicators presented below are the result of works carried out in frames of Odyssee-Mure project which is the continuation of the project “Evaluation and Monitoring of Energy Efficiency in the New EU Member Countries and the EU-25” from Intelligent Energy for Europe programme. The indicators were calculated using “top-down” method.

### 2.1. Indicators of economic development dynamics

Since 1992 all the basic economic indicators in Poland have been improving, after drop at the beginning of the 90’s (Figure 1). The fastest rate of growth of value added at constant was achieved in the given period in industry sector though the growth was rather unequal with two declining years (2001 and 2002). Private consumption was increasing at the rate almost similar to the value of GDP (Table 1). The lowest rate of growth was observed in agriculture sector (Figure 2).

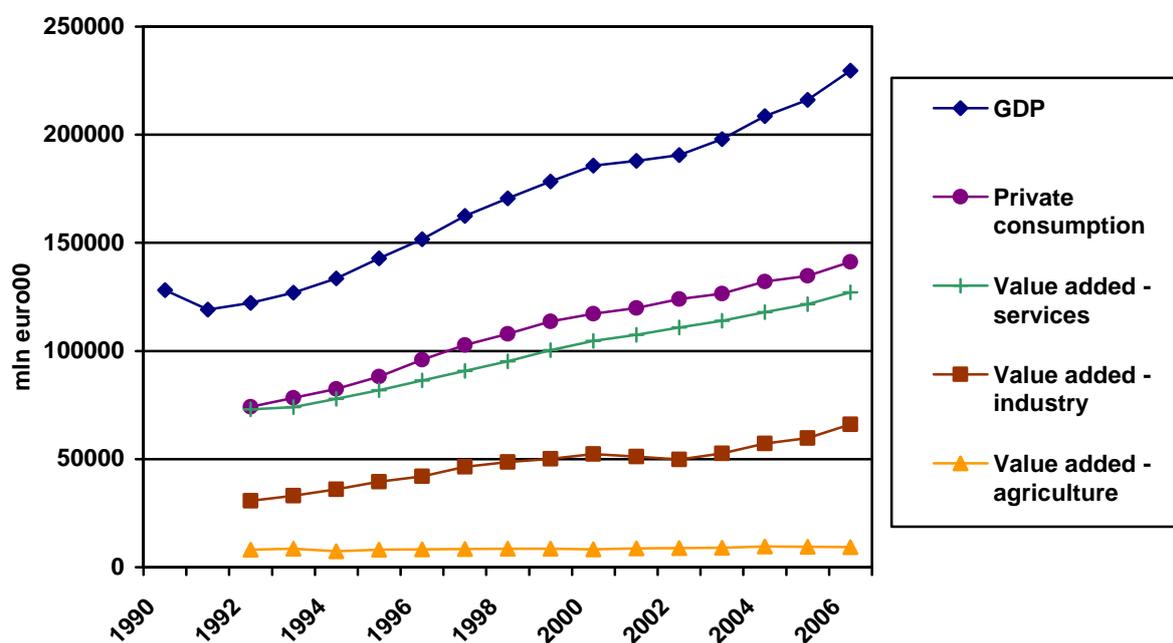
Figure 1. Dynamics of basic macro-economic indicators (1990=100)



**Table 1. Dynamics of basic macro-economic development indicators in Poland in 1990-2006 (%/year)**

Specification	1991-2002	2002-2006	1990-2006
GDP	4.37	4.76	3.72
Value added in industry	4.76	7.23	4.15
Private consumption	5.00	3.32	4.65

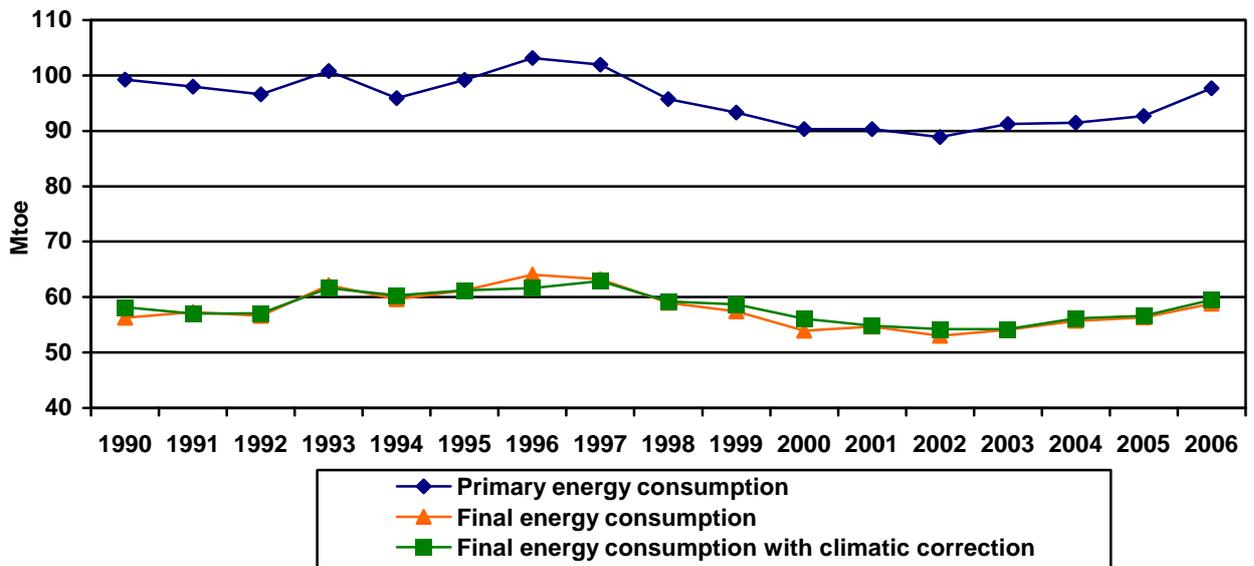
**Figure 2. Changes of GDP, value added in main economy sectors and private consumptions at constant Euro 2000**



After growth in first half of the 90's and reaching top in 1996, total primary and final energy consumption had decreasing trend between 1996-2002 (Figure 3) and slowly rose in subsequent years to jump in year 2006.

Decrease of energy consumption resulted from realization of modernization programmes, restructuring of economy and seasonally lower economic activity. Programmes of energy efficiency improvement and liberalization of energy prices produced also had their share.

**Figure 3. Primary and final energy consumption**



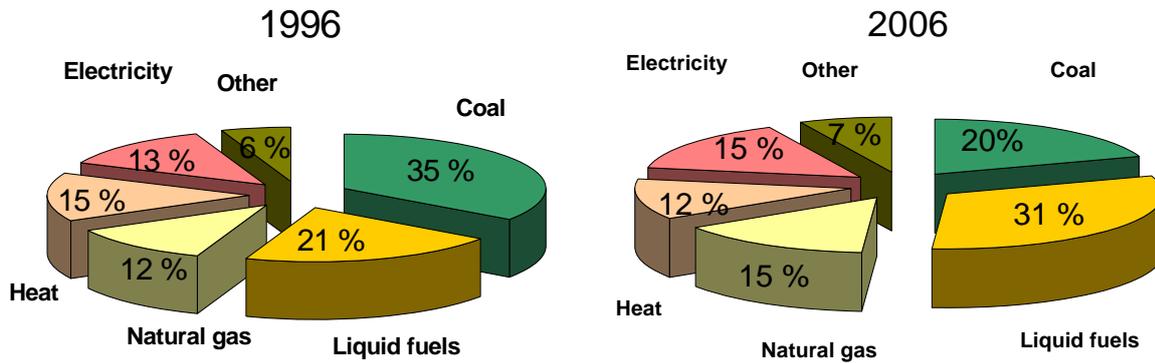
Function of final energy consumption is slightly modified by climatic correction which increases its value for winters characterized by lower degree days value (warmer). Climatic correction concerns households and service sector. Energy consumption with climatic correction describes its theoretical value 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. The same methodology of energy consumption in households and service sector was used in chapter 2.4.

## **2.2 Energy consumption and prices of energy**

In the energy field, Poland has traditionally been a supply-oriented country with important hard coal and lignite sector. However, the share of coal in country energy consumption had decreased systematically from 35% in 1996 to 20% in 2006 (Figure 4). Comparison of final energy consumption by energy carriers between 1996 and 2006 shows the increase role of oil fuels which became dominant in the balance with the share of 31% in 2006. Gas consumption slightly rose and reached 15% of energy consumed in 2006. Similarly, consumption of electricity increased in 1996-2006 and amounted to 15% in 2006.

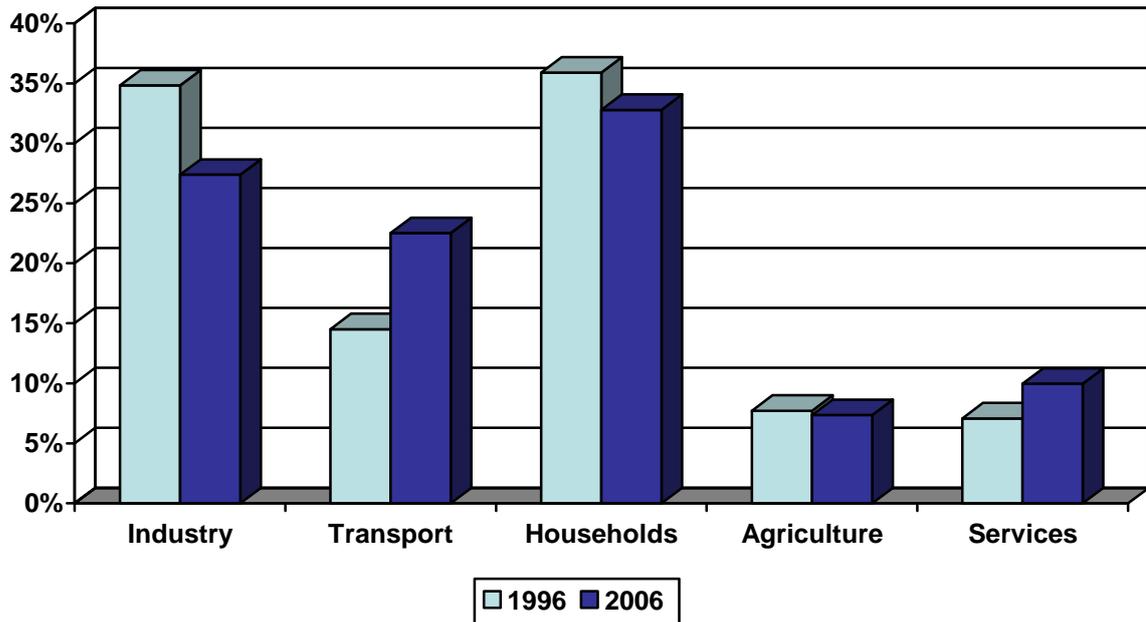
**Figure 4. Final energy consumption by energy carrier in Poland**



Changes of final consumption structure in main sectors of economy (Figure 5) reflect the directions of economy development. Restructuring of industry affected the energy consumption reduction, which was also accompanied by energy saving measures in companies. The development of road transport and services influenced the increase of energy consumption of these sectors. The households experienced the activities as thermo-modernization, improving efficiencies of heating systems and totally obtained 15% reduction of its energy consumption during 1996-2006.

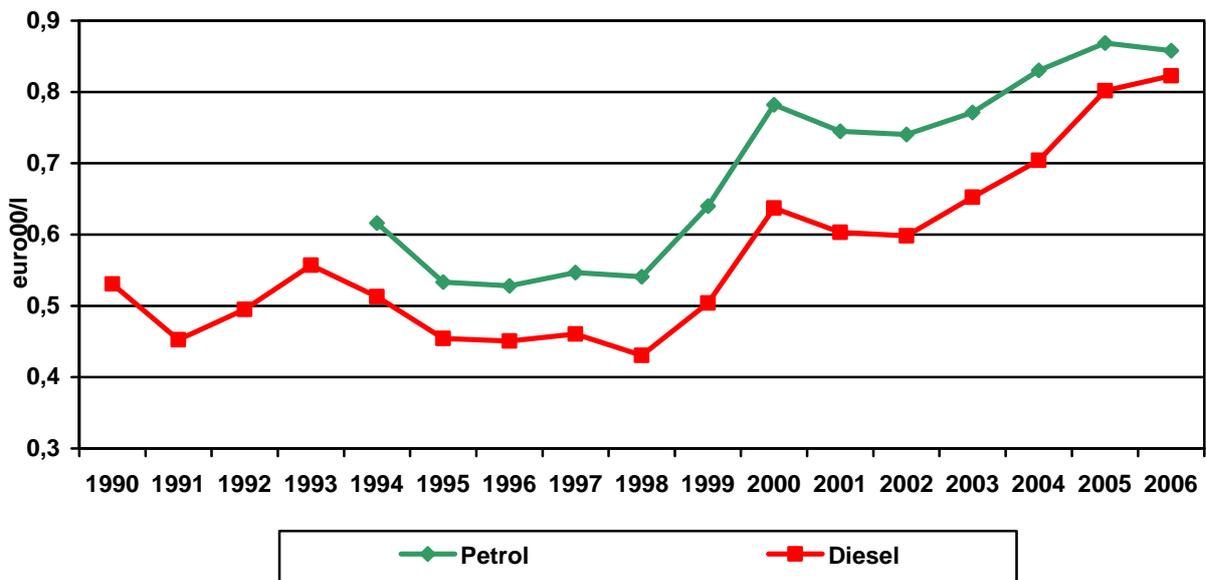
Changes in agriculture sector, consisting in liquidation and privatisation of state-owned agriculture holdings, and building modern large-size farms, did not contribute to save energy, which consumption stays on stable level.

**Figure 5. Final energy consumption by sectors**



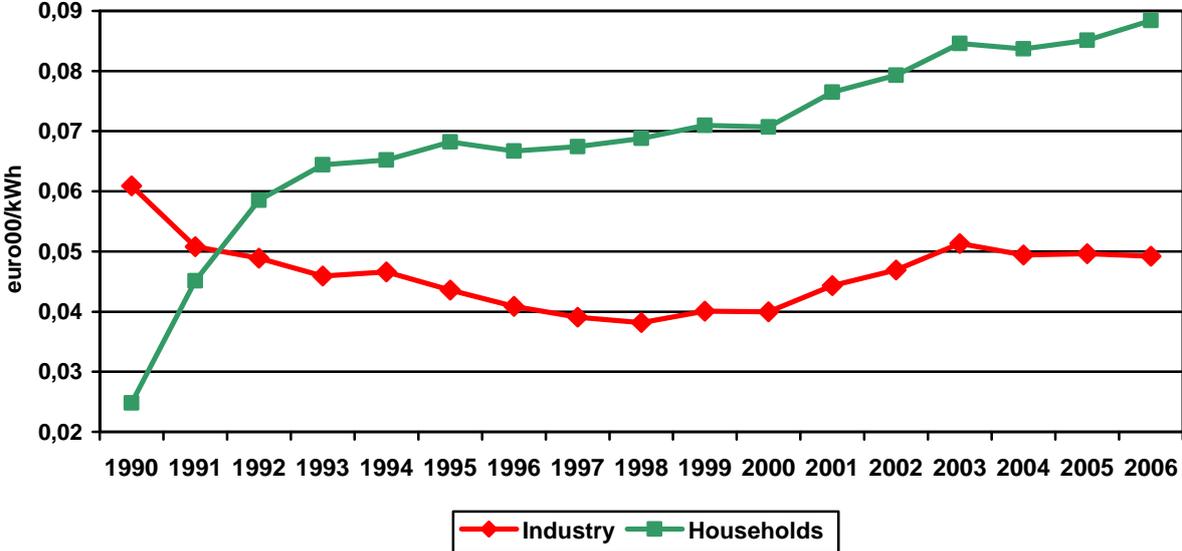
Prices of gasoline and diesel expressed in constant of 2000 have dynamically grown since 1998 with the periodical corrections of the trend (Figure 6). The main factors influencing level of these prices is the level of tax contained in fuel prices (significant increased of excise tax took place at the end of the 90's) and prices of crude oil on world markets (oil prices have been growing since 1999).

**Figure 6. Changes of gasoline and diesel oil prices**



Poland has completed the difficult task of cross subsidies in the electricity sector elimination, which has been achieved by increasing the tariff for household from 0.0248 for 1kWh in 1990 up to 0.0664 in 1993: 160% of growth expressed in Euro in constant. And also for next years 1993-1999 the price of household electricity has been increasing slowly and more sharp growth again is observed for 2001-2003. Price of electricity for industry has been decreasing during the years 1990-2000 (4.1%/year) - Figure 7. In years 2001-2003 the prices increased by 28% and then, in case of industry became stable. The prices for households were further growing.

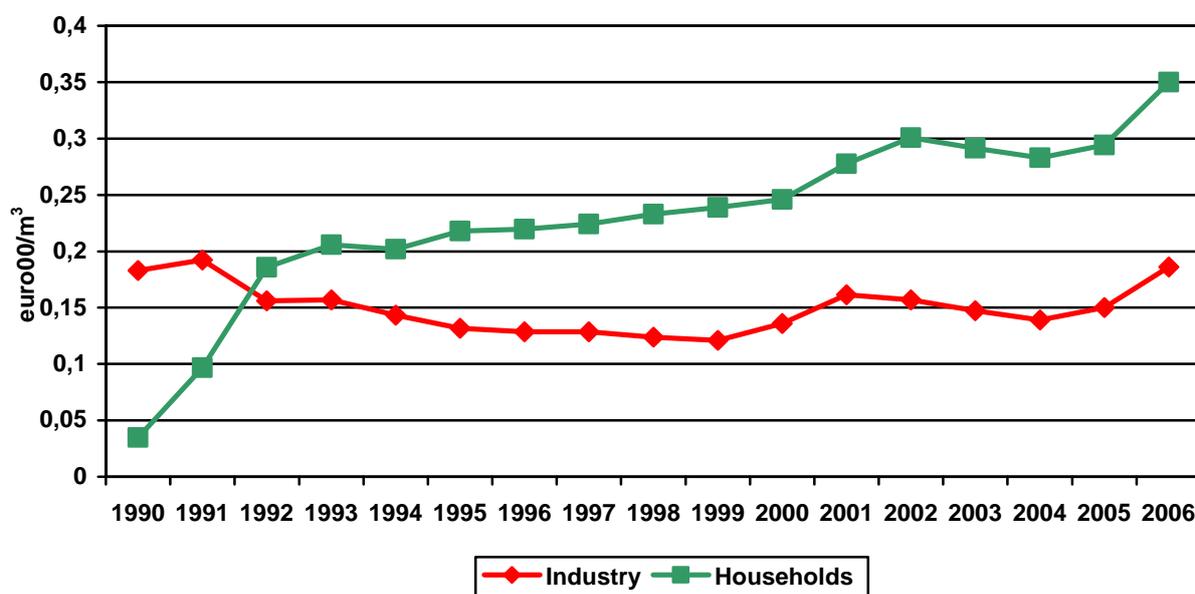
**Figure 7. Changes of electricity prices for households and industry**



The price of gas reflected the tendencies observed for electricity prices. In case of gas price the growth for households expressed in constant Euro 2000 was much sharper: from 0.0349 in 1990 up to 0.2058 in 1993 (490% of growth at constant Euro 2000 (Figure 8) and up to year 2000 price was steadily growing. In 2001 and 2002 gas price jumped and next years the prices fluctuated. In 2004 prices returned to increasing trend which fastened in 2006.

In years 1990-1999 gas price for industry declined systematically, then it jumped in 2000-2001. After decreasing until 2004, prices began to grow.

**Figure 8. Changes of gas prices for households and industry**



Stable level of energy consumption and increasing value of Gross Domestic Product caused decrease of primary and final energy intensity of GDP (Figure. 9-11, table 2). Initial growth of intensity until year 1993, was followed by the period of dynamic improvement which lasted until year 2000. Since that time, gradual improvement of intensity at the rate of 2% per year has taken place.

**Table 2. An average annual rate of changes in GDP energy intensity indicators (%/year)**

Rate of change	1990-1993	1993-2000	2000-2006	1993-2006	1990-2006
Final intensity of GDP	3.71	-7.21	-2.07	-4.87	-3.32
Primary intensity of GDP	0.84	-6.77	-2.22	-4.69	-3.68

Figure 9. Changes of GDP energy intensities indicator

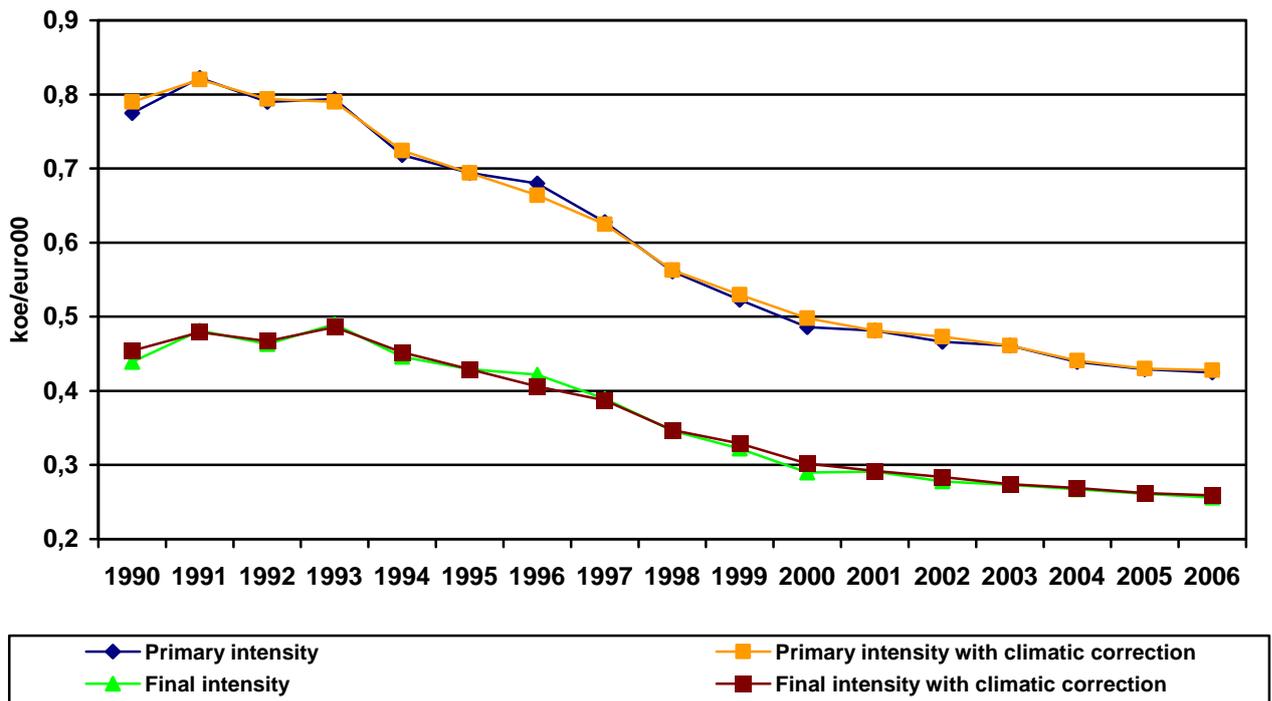
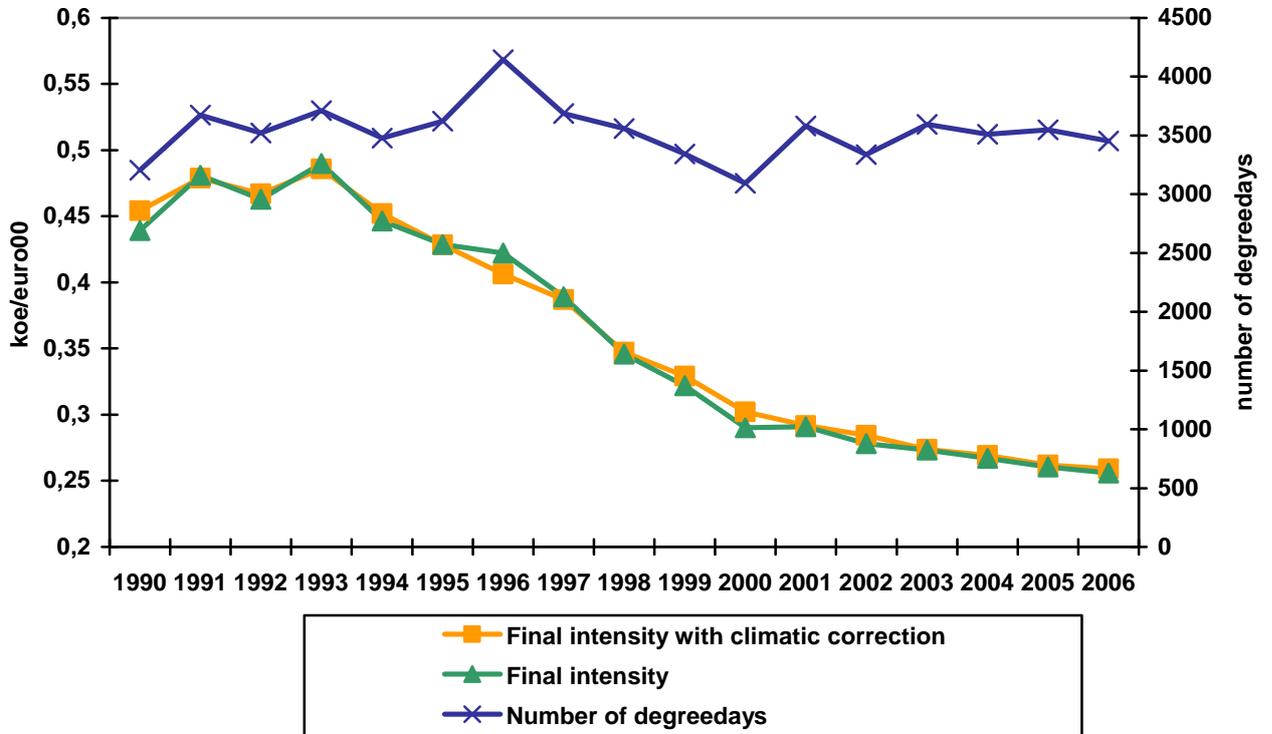
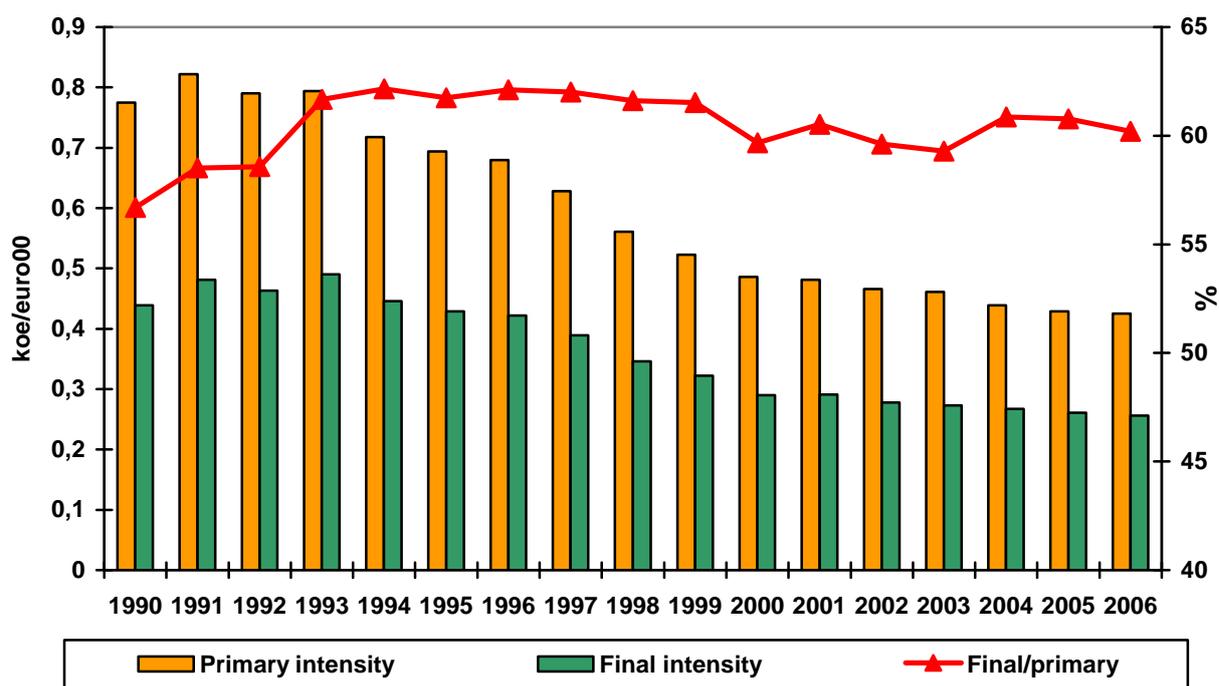


Figure 10. Changes of GDP final energy intensities indicator



**Figure 11. Ratio of final energy GDP indicator to primary energy GDP indicator**

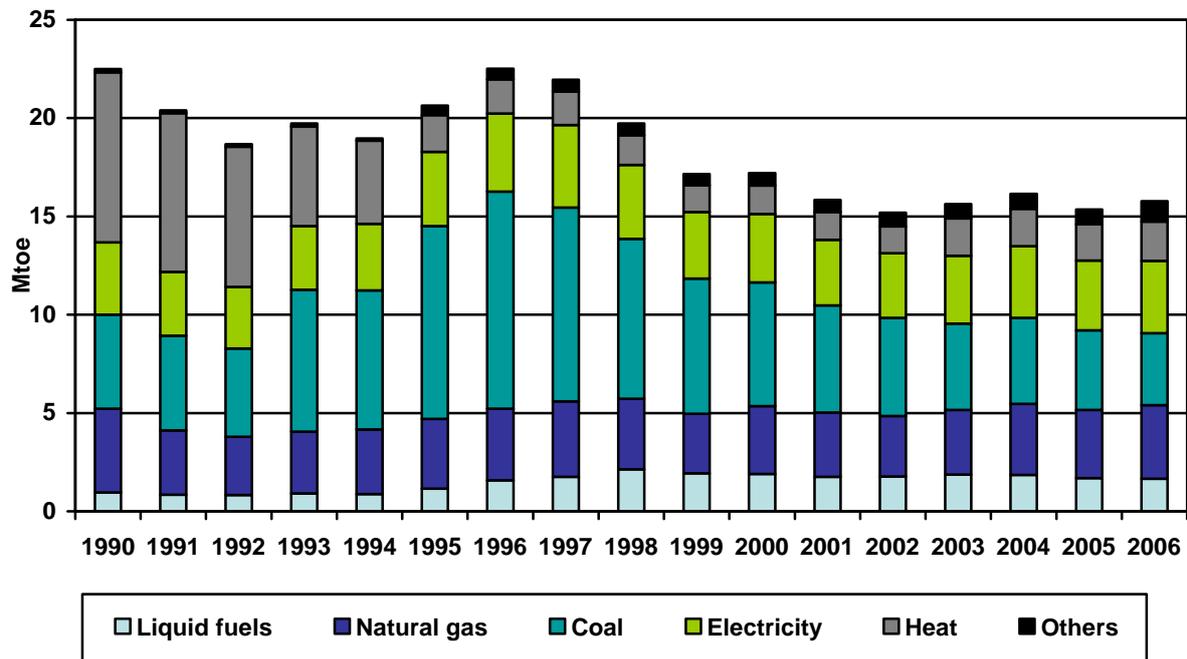


While analysing changes in energy intensities, it is necessary to bear in mind the specific situation before 1990s in the Central European countries, including Poland. In those countries of the central planning, energy prices were very low, which resulted in energy wastage reaching in extreme cases even 60 to 70% of the energy consumed. This caused a habit of excessive energy consumption, difficult to overcome but creating the possibilities to save. Drop of energy intensity was caused partly by use of these simple reserves.

### 2.3. Industry

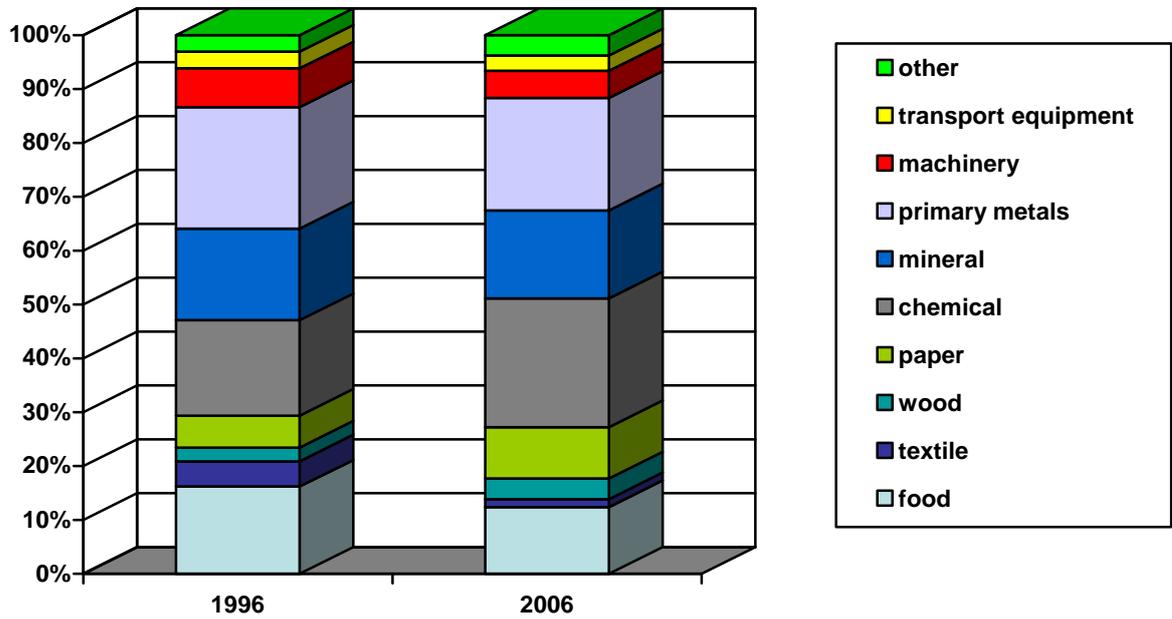
Final energy consumption in industry varied similar to total final consumption. In second half on the 90's began decrease of consumption which reached the bottom at the level of 15 Mtoe in year 2002. Since then consumption has been slightly growing.

**Figure 12. Final energy consumption in industry by energy carrier**



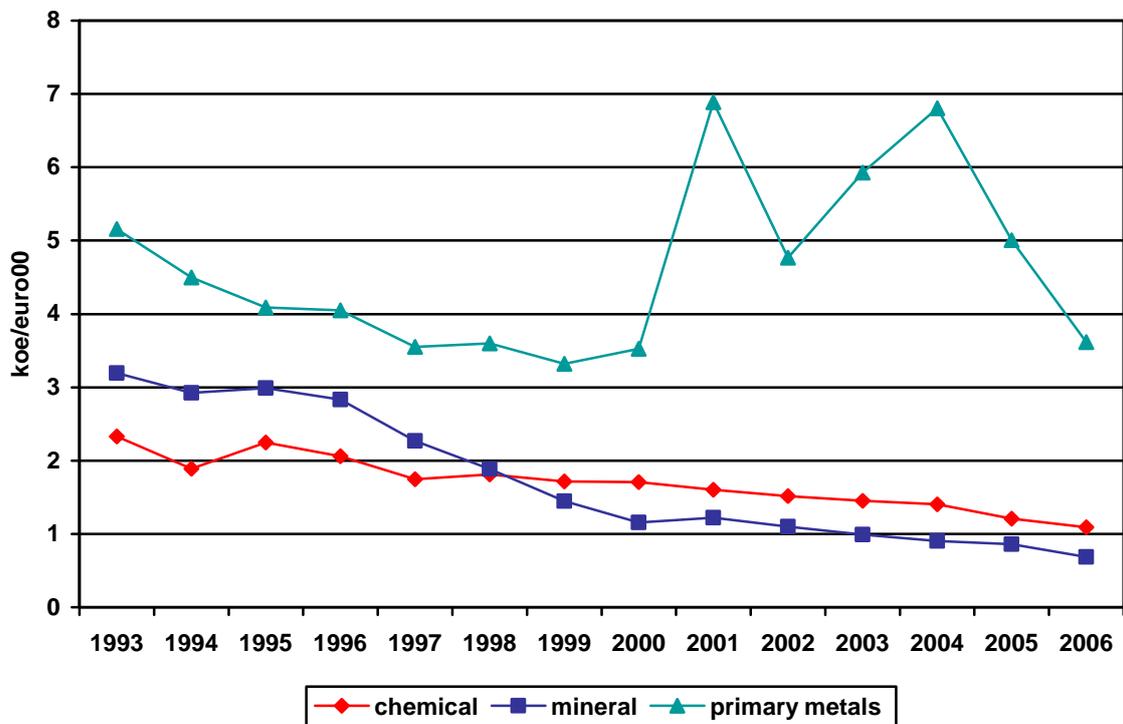
Energy consumption of manufacturing by branch presents Figure 13. About 60% of energy is consumed by following industrial branches: primary metals (iron and non-ironic metals), chemicals and minerals, their share did not change much during 10 years. Chemical and paper industry increased their share. Consumption of energy by food, textile and machinery industry slightly declines. Significant drop of energy consumed was observed in case of steel industry. The drops are caused mainly by limiting production (steel, sulphur), and not by modernization of enterprises aiming at reduction of energy consumption. Structural changes are rather small and do not exceed few percentage points.

**Figure 13. Energy consumption in manufacturing by branch**

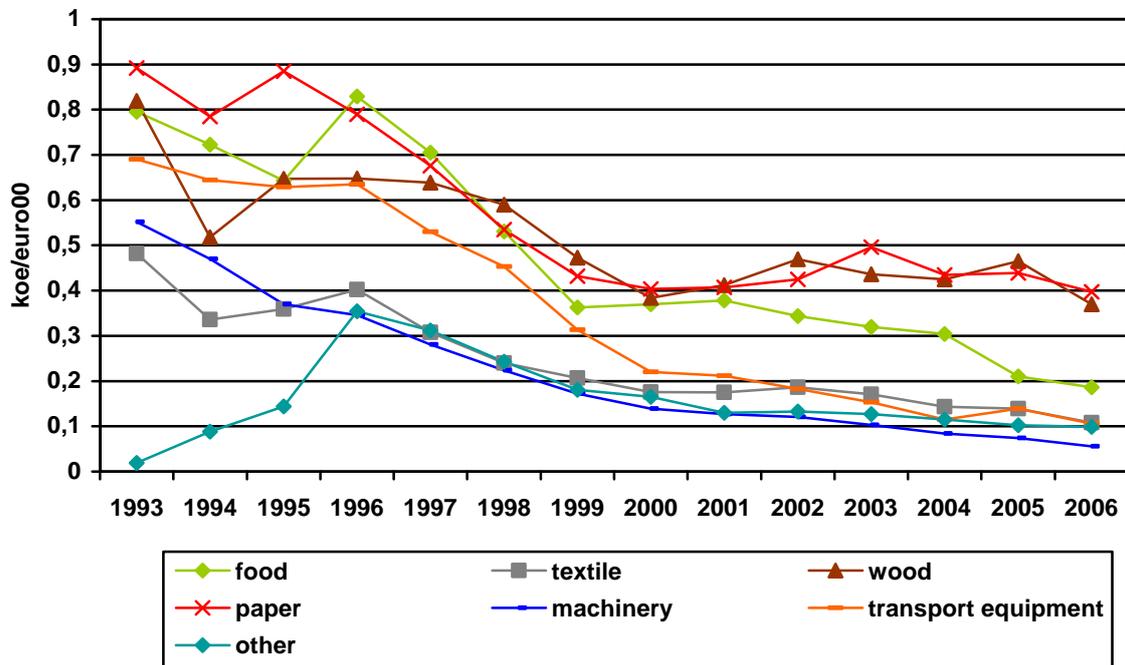


Figures 14 and 15 present energy intensity (final energy consumption/value added) of selected industrial branches in years 1993-2006.

**Figure 14. Changes of energy intensity indicators in energy intensive industry branches**



**Figure 15. Changes of energy intensity indicators in low energy intensive industry branches**

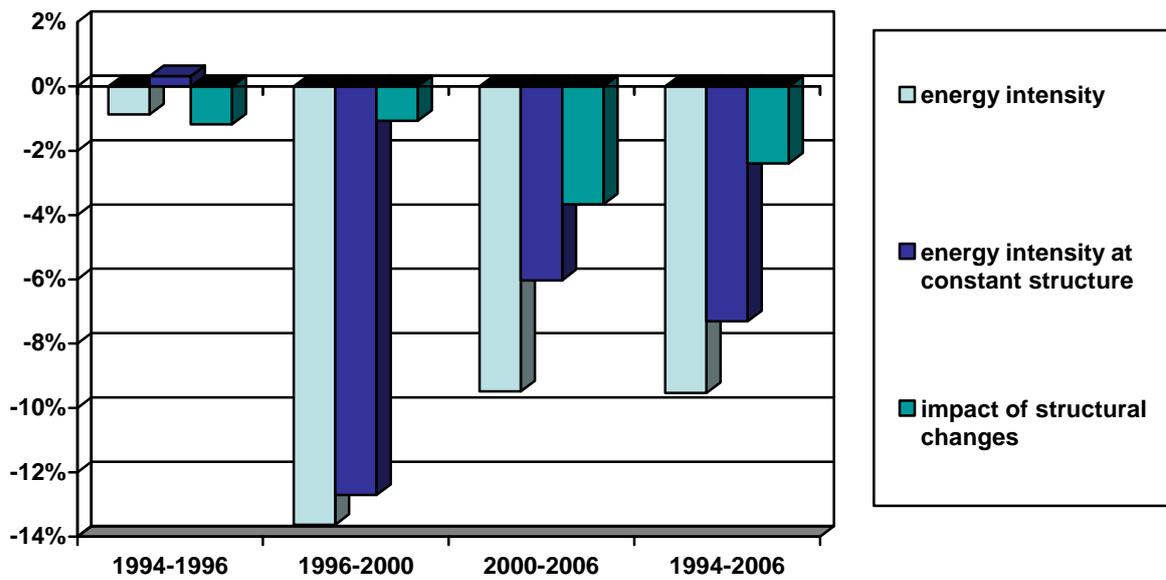


The highest dynamic of improvement was achieved by machinery and transport equipment industry, as well as food and textile industry. The slowest improvement took place in primary metals, paper, wood and chemical industry.

Changing shares of manufacturing divisions in final energy consumption and value added, i.e. changing structure has impact on intensity of manufacturing. Values presented below assessing impact of structural changes in manufacturing on level of energy intensity were obtained using DIVISIA method.

Intensity of manufacturing was improving the fastest between 1996 and 2000, when the dynamic of improvement reached 13.6% (tab. 3). After year 2000, rate of improvement fell to 9.5%. The impact of structural changes was little before year 2000, its importance grew after 2000. In years 1994-2006 structural changes caused fall of energy intensity by 2.4% on average annually.

**Figure 16. Changes of energy intensity of manufacturing - role of structural changes**

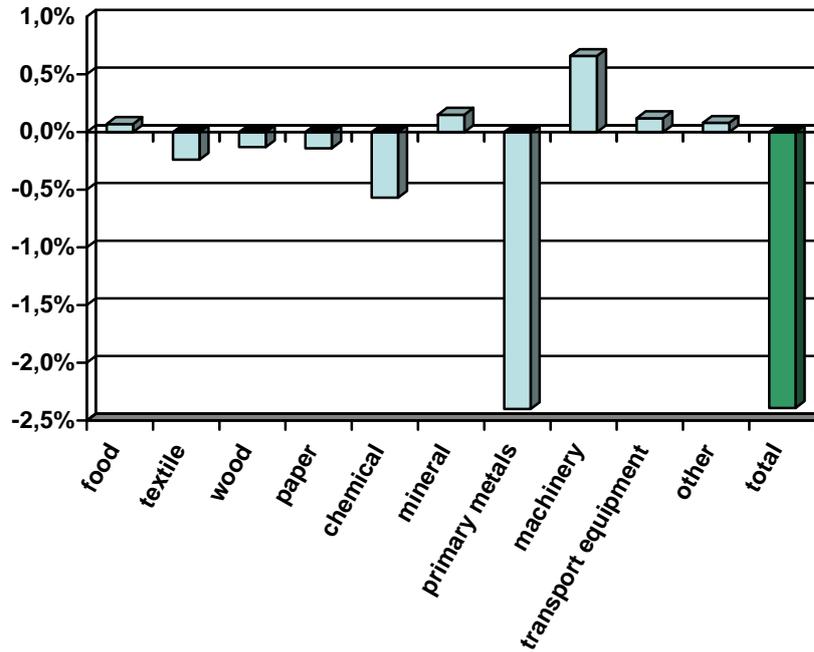


**Table 3. Dynamics of changes of energy intensity and impact of structural changes**  
(%/year)

Specification	1994-1996	1996-2000	2000-2006	1994-2006
Energy intensity	-0.87	-13.63	-9.48	-9.53
Energy intensity at constant structure	0.32	-12.70	-6.03	-7.30
Impact of structural changes	-1.18	-1.07	-3.67	-2.40

Effect of structural changes was influenced strongest by primary metals. It was result of drop of importance of division which parallel did not improve its energy efficiency. On the other hand constant development of machinery industry and increasing importance of this branch caused positive impact on structural changes.

**Figure 17. Structural changes – impact of manufacturing branches**



Impact of primary metals on effect of structural changes was strongest after year 2000.

**Figure 18. Structural changes – impact of manufacturing branches by period**

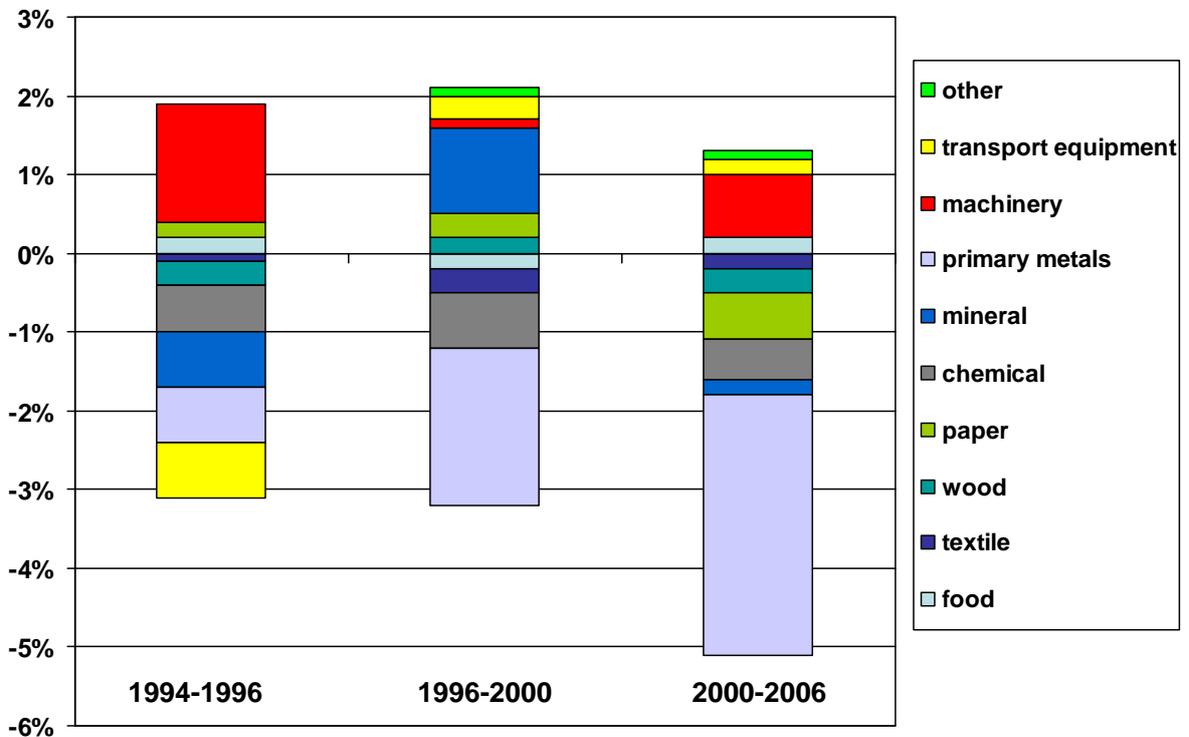
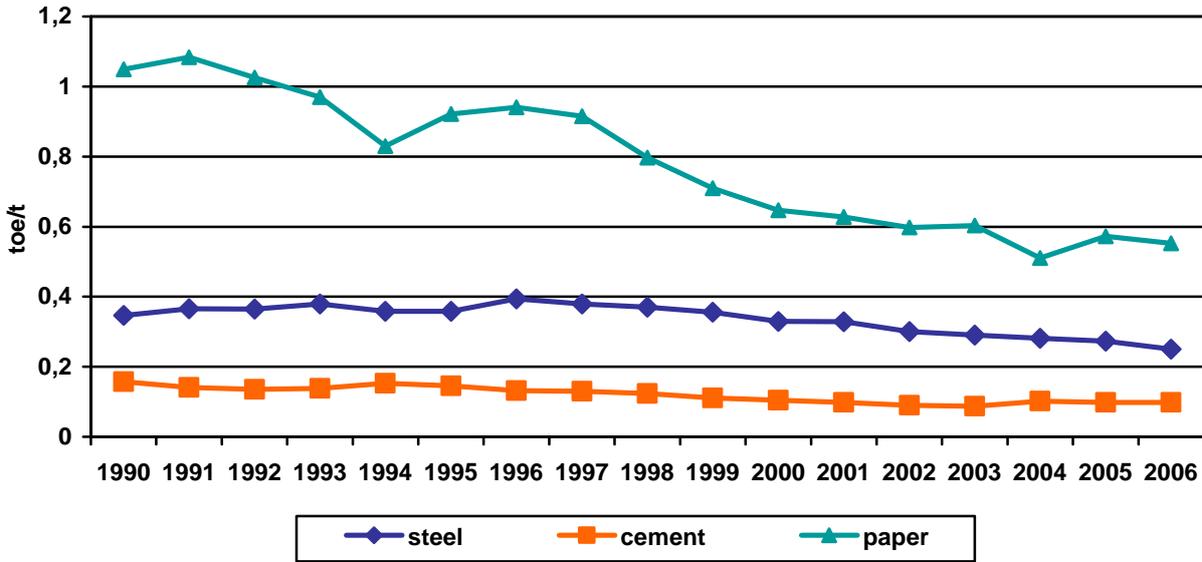


Figure 19 presents energy intensity of steel<sup>5</sup>, cement<sup>6</sup> and paper<sup>7</sup> production in years 1990-2006. Energy intensity of cement production declines systematically. Old-fashioned wet method of production was abandoned what resulted in decline of energy intensity below 0.1 toe/t i.e. value close to European average. Little decline of energy intensity of steel production results from delays in privatisation process and modern technologies implementing. Paper industry was thoroughly modernized after privatisation, which resulted in further decrease of intensity to level of 0.55 toe/t in 2006. In years 1990-2006 energy intensity of crude steel production declined by 28.04% (2.04%/year), paper production by 47.37% (3.93%/year) and cement production by 37.39% (2.88%/year).

**Figure 19. Changes of energy intensity indicators in production for selected industrial products**



**2.4. Households**

Share of energy consumption in households in final energy consumption amounts to 32-33% and tends to grow. The structure of consumption by end use, surveyed by CSO in 1993 and 2002 presents Figure 20 and Table 4. Decreasing share of energy consumption for heating and cooking results from replacing low-efficient coal with gas and electric ovens. Growth of

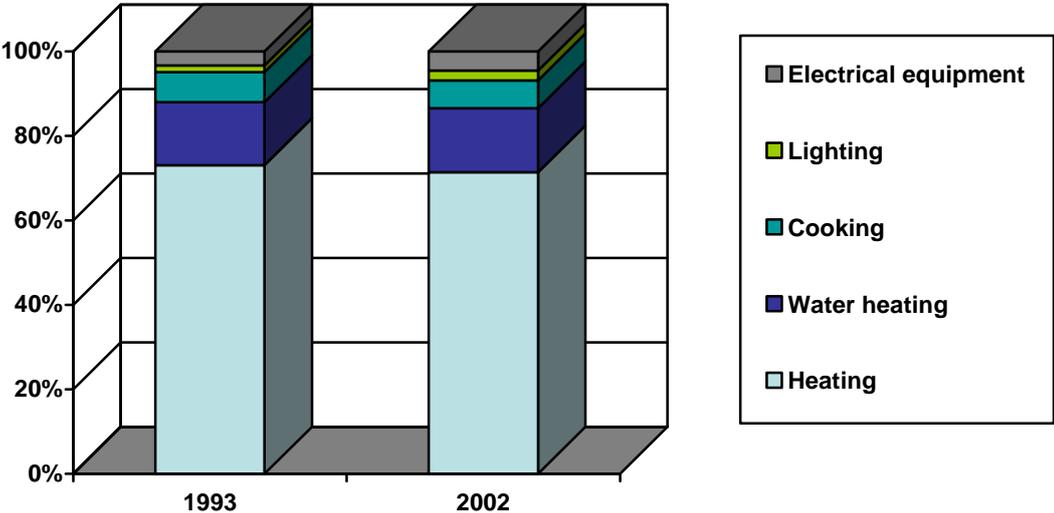
<sup>5</sup> Calculated as final energy consumption in groups 27.1, 27.2, 27.3 and classes 27.51 and 27.52 divided by steel production

<sup>6</sup> Calculated as final energy consumption in group 25.6 divided by cement production

<sup>7</sup> Calculated as final energy consumption in group 25.6 divided by paper production

consumption by electrical appliances and lighting is connected with richer equipment of households in electrical appliances and behaviour changes (e.g. changes in intensity of appliances use - washing machines, dish washers, TVs, computers).

**Figure 20. Structure of energy consumption in households by end use**

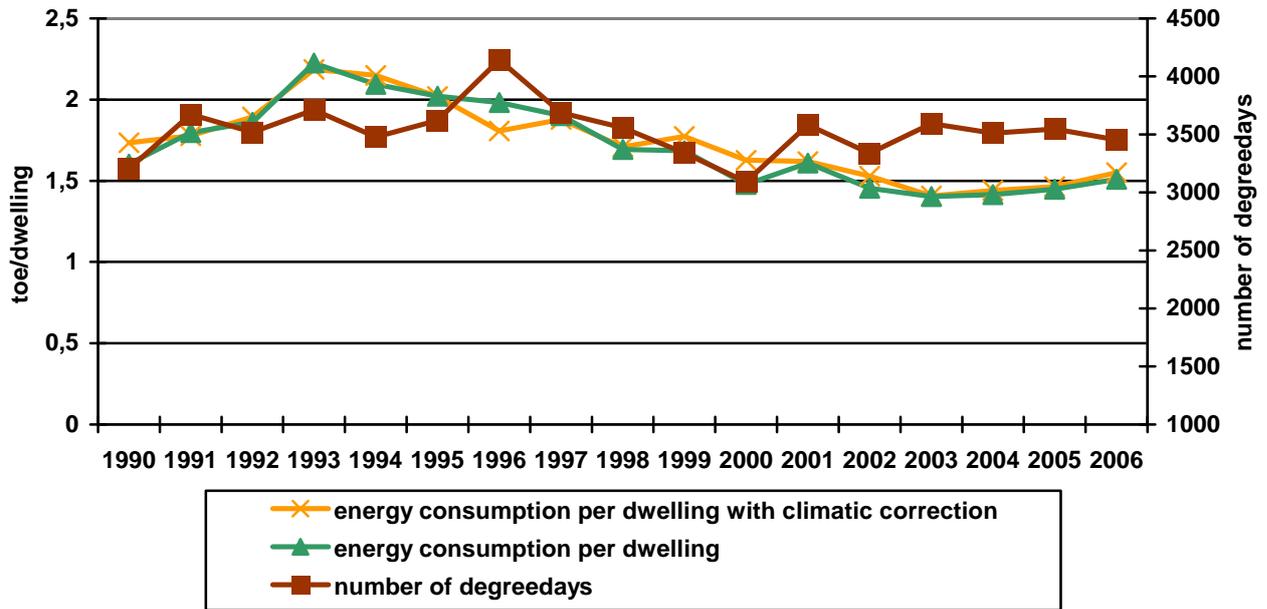


**Table 4. Changes in structure of energy consumption in households by end use**

Items	1993	2002
Total	100.0	100.0
Heating	73.1	71.2
Water heating	14.9	15.1
Cooking	7.1	6.6
Lighting	1.6	2.3
Electrical equipment	3.3	4.5

Figure 21 presents changes of energy consumption per dwelling. The value of indicator with climatic correction tends to decrease with annual decrease rate of 1.5% since 1996. Decrease of unit energy consumption in dwellings is related to buildings thermo modernization, reduction of losses in central heating systems, improvement of efficiency of newly installed devices.

**Figure 21. Changes in indicator of energy consumption in households per dwelling**



The method for the climatic correction of final energy consumption 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  $ZFF^{kk}$  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,  $\alpha$  - heating share in total energy consumption in dwelling sector.

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

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

where:  $t_{sr}(n) = \frac{t_{\min}(n) + t_{\max}(n)}{2}$  - mean outdoor temperature for  $n$  day, [ $^{\circ}\text{C}$ ];  $t_{\min}(n)$ ,  $t_{\max}(n)$

- minimum and maximum temperature of the  $n$  day, [ $^{\circ}\text{C}$ ];  $N$  - number of days per year.

According to formula and the Eurostat assumption, the mean outdoor temperature of the heating day should be less than  $15^{\circ}\text{C}$ .

The values of heating degree days ( $SD$ ) for 1992-2006 are presented in the table below (long-term average calculated for years 1980-2004 amounts to 3615.77).

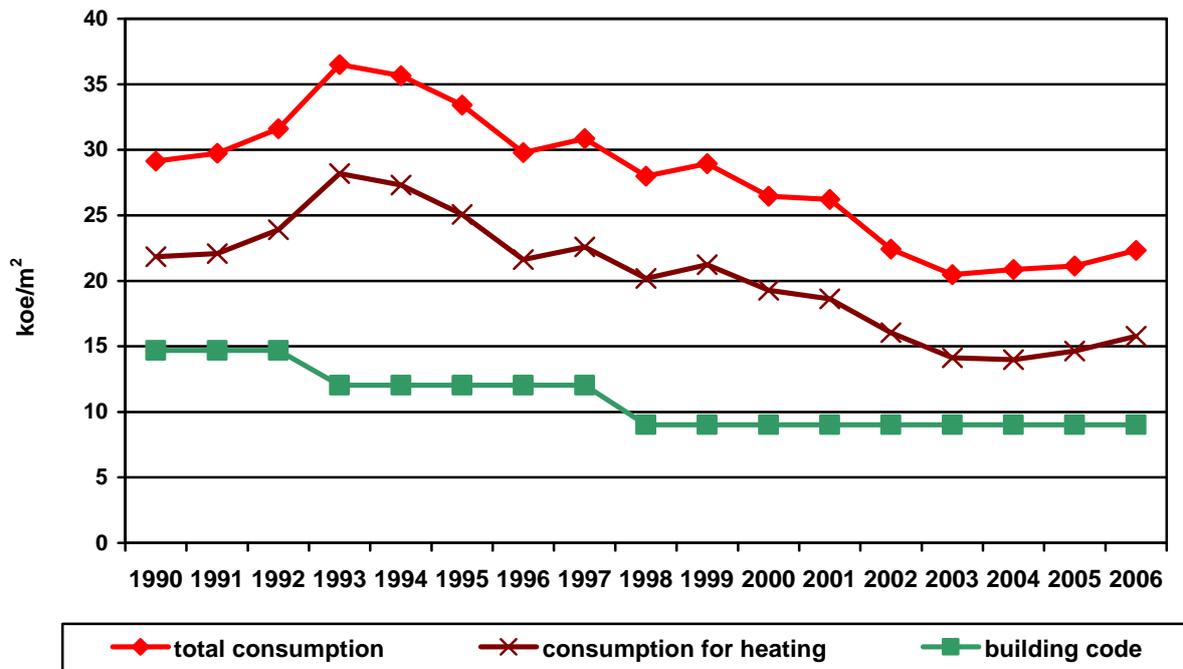
**Table 5. Heating degree-days in years 1992-2006**

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Sd - annual	3520	3711	3477	3622	4144	3686	3559	3341	3092	3581	3337	3594	3510	3547	3454

source: Eurostat and Joint Research Center

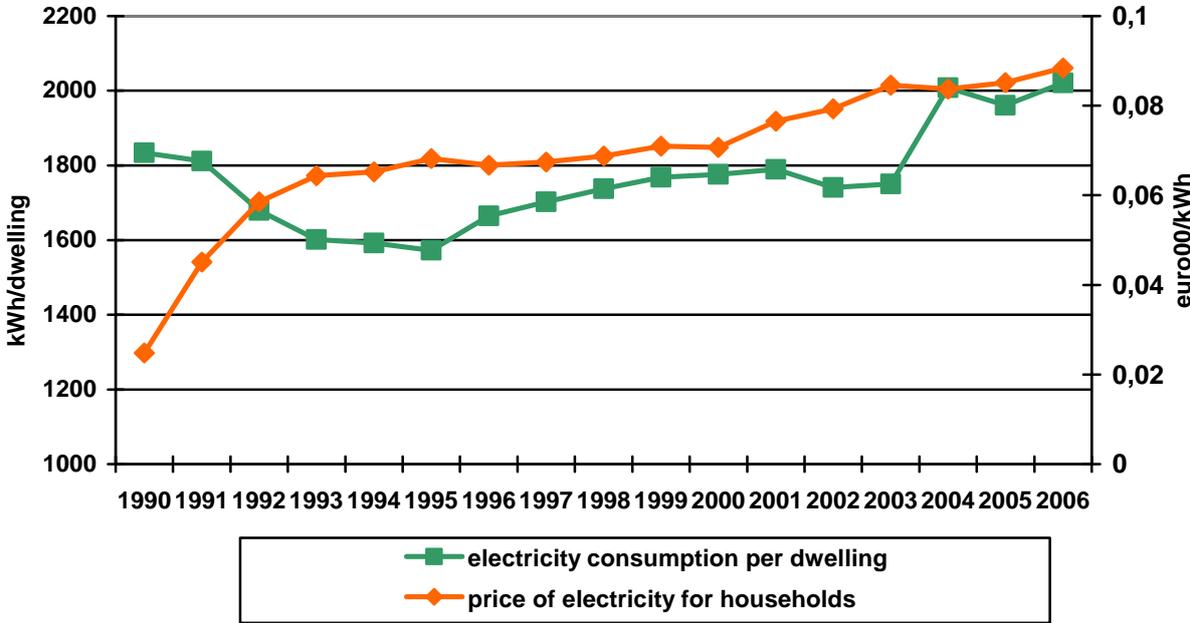
Trend of energy consumption per  $\text{m}^2$  looks similar, however dynamic of improvement is higher by 1%, what results from increasing average floor space. Although building code for new buildings allows for twice lower use of energy than present use, the impact of this factor on energy efficiency improvement in whole buildings is little. Figure below presents energy consumption in household dwellings per  $\text{m}^2$ .

**Figure 22. Energy consumption in households per  $\text{m}^2$**



Energy consumption by the households is shaped by various factors. The most significant are price level and economic situation of households which is reflected in so called behaviour changes resulting *inter alia* in different intensity of household appliances. Increase of prices at the beginning of the 90's resulted in sudden drop of electricity consumption which was compensated thanks to increasing incomes of population at the beginning of the next decade. Subsequent increases contributed to another limitation of electricity use. After growth in 2004 consumption of electricity stabilized.

**Figure 23. Changes of prices and indicator of electricity consumption in households per dwelling**



**2.5. Transport**

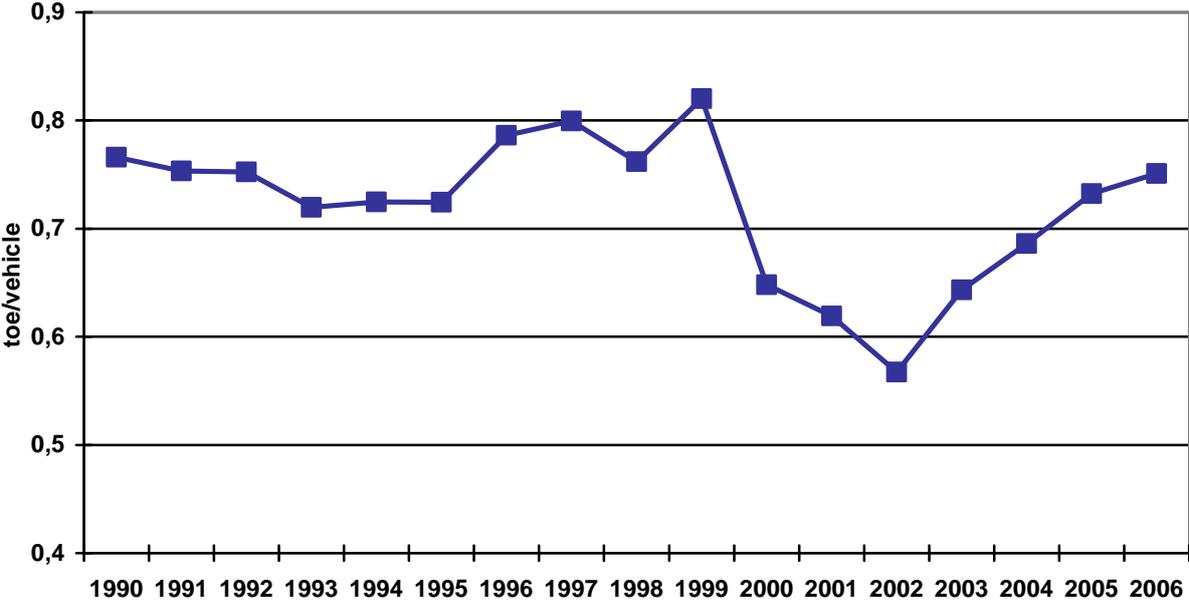
In Poland almost 94% of energy consumed in transport consumes road transport, around 3% rail transport. Another 3% is consumed by airplanes and the rest is consumed by inland and inshore water transport.

In years 1990-2006 growth of fuel consumption in road transport (4.8% annually) is observed, accompanied by significant drop of energy consumption by rail transport. It is the result of

transport modal shift from rail transport to road transport. Since 1990 road traffic has tripled while rail transport decreased by 50%.

Figure 24 presents unit consumption of fuels by vehicle. The indicator is influenced mainly by country economical situation and increasing efficiency of new cars.

**Figure 24. Changes in indicator of fuel consumption per vehicle**



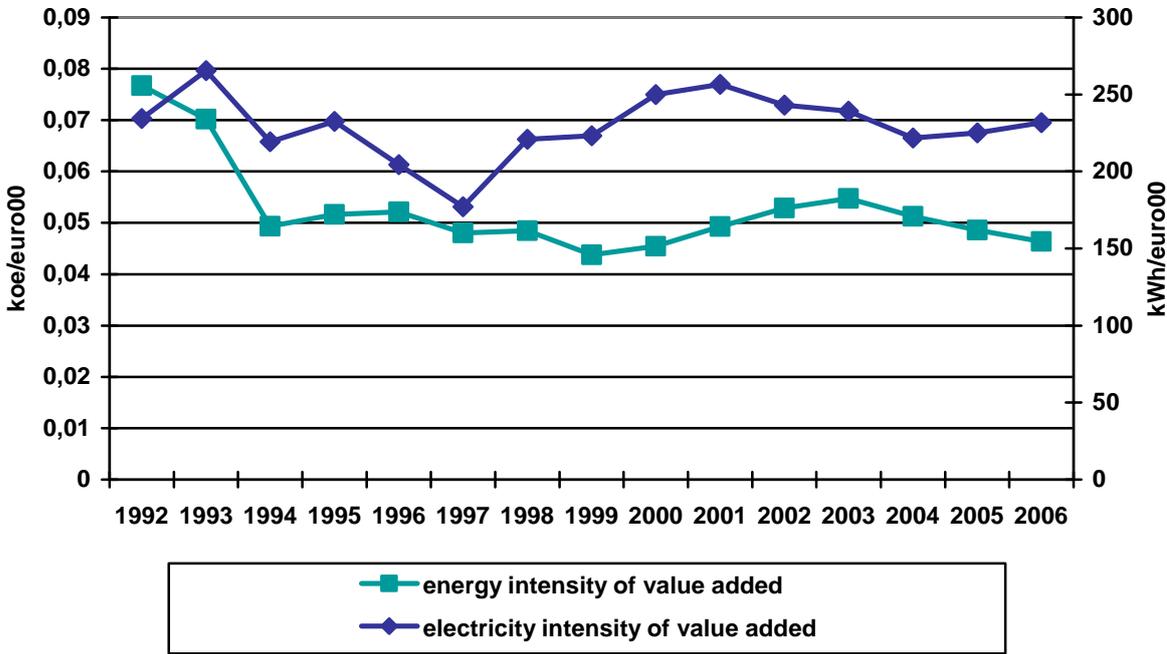
**2.6. Services**

Service sector has the most stable energy efficiency indicators. Value added energy intensity<sup>8</sup>, after drop at the beginning of the 90’s shows slight fluctuation and in 2005 it has the same value as in 1994. Improvement rate is lower than the global value and is significantly lower than improvement e.g. in industry but at the same time it is the sector of national income creation that is the most efficient in respect of energy. The energy intensity indicator is characterized by larger changes but similarly to the previous case its value remains stable (Figure 25).

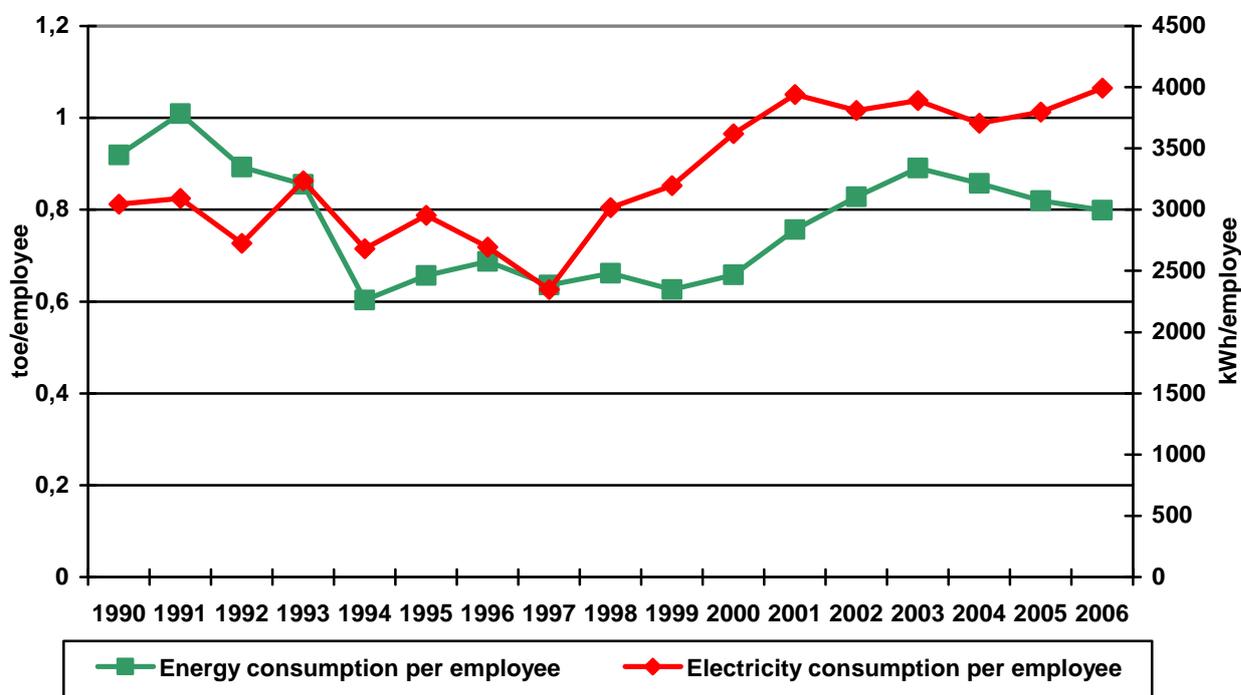
<sup>8</sup> Calculation of this indicator excludes energy consumption of transport but includes value addend of transport. The same procedure concerns electricity intensity indicator.

In case of changes of unit consumption of energy and electricity per employee irregular decrease trend which ended in the second half of the 90's can be observed (Figure 26). First to occur was the increase of unit consumption of electricity followed after 2 years by increase of total energy consumption. At the beginning of the following decade the increase trends stopped which could result from increase of energy carriers prices. Increase of significance of the electricity is related to increasing equipment of service sector enterprises in electronic devices.

**Figure 25. Changes of energy intensity and electricity intensity indicator in service sector**



**Figure 26. Changes in indicator of energy consumption and electricity consumption per employee of the service sector**

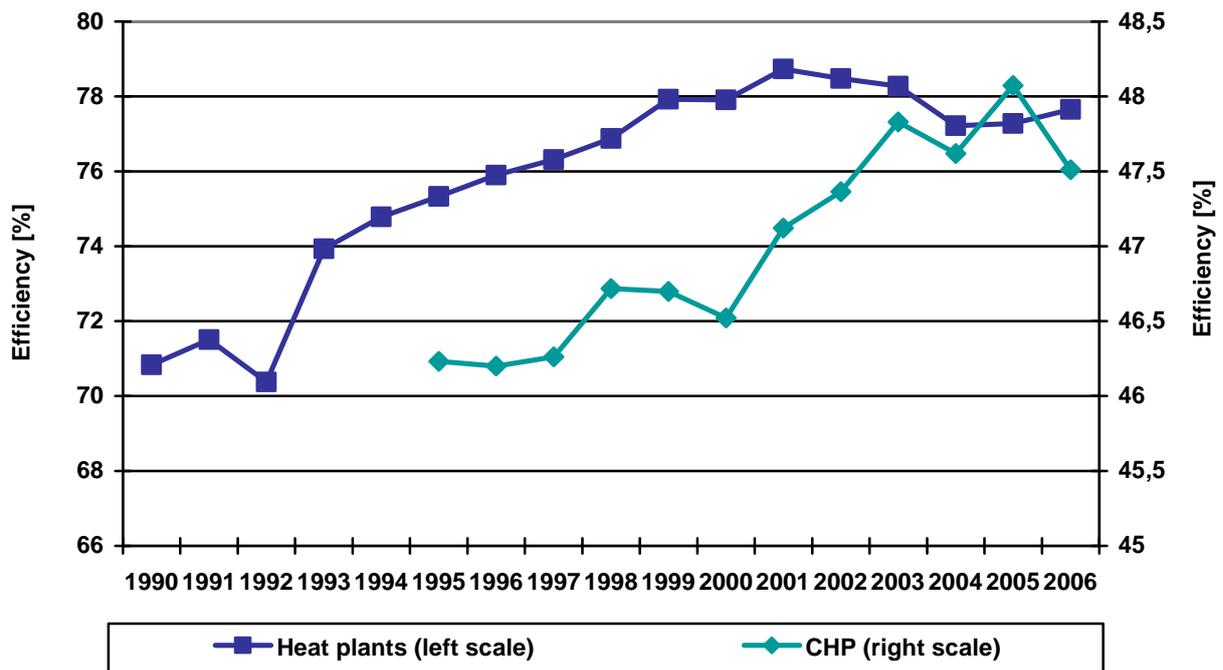


### 2.7. Heat plants and heat and power generating plants

Figure 27 present changes of efficiency of heat plants and combined heat and power plants. In 2006, in heat plants a slight growth of indicator value was observed after few years of decline. Efficiency of heat and power generating plants fell from the highest level in history.

Earlier, in effect of modernization the growth of efficiency of heat plants (years 1992- 2001) and heat and power-generating plants (years 1995-2003 without 1999-2000) can be observed.

**Figure 27. Efficiency of heat plants and CHP**



## 2.8. ODEX indicator and energy savings

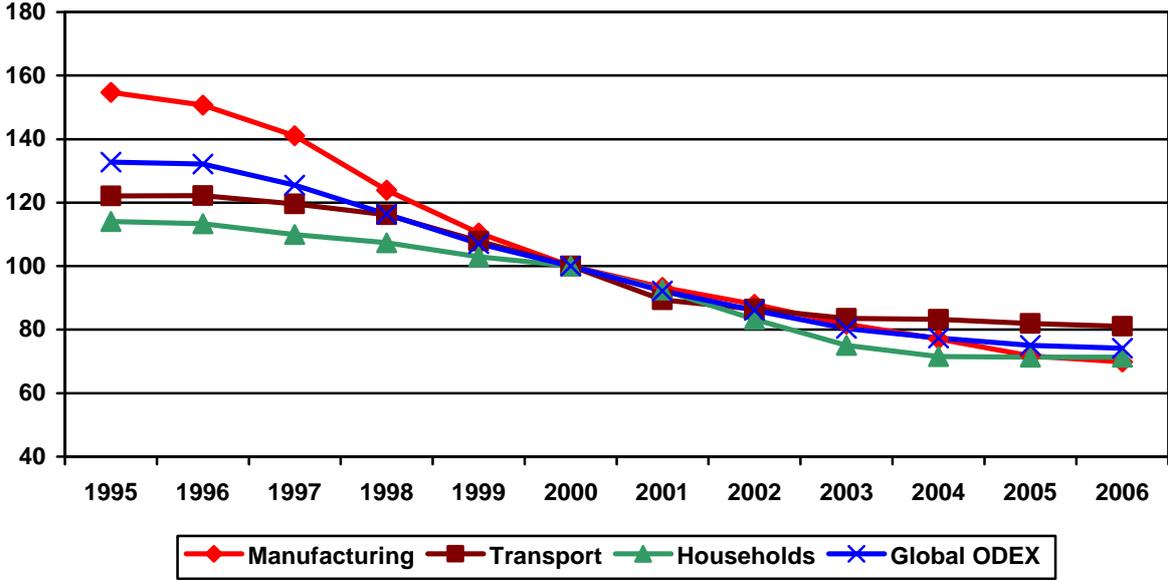
ODEX indicator is an aggregated energy efficiency indicator. It was elaborated to meet the needs related to monitoring of energy effectiveness and in order to obtain understandable, simple to elaborate and comparable indicator reflecting progress in respect of energy efficiency in the European Union Member States. The indicator is obtained through aggregation of changes in unit energy consumption observed in a given period of time at the specified levels of end-use. By application of reference physical parameters, the ODEX indicator illustrates progress in respect of energy efficiency. ODEX is an alternative for monetary indicators of energy intensity which depend on many factors related - not directly - to energy efficiency. ODEX indicator does not show current level of energy intensity but the progress in respect of the base year. The ODEX indicators are useful for monitoring of indicative target implementation in the scope of energy efficiency laid down in Directive 2006/32/EC.

The methodology of ODEX indicators calculation is currently being elaborated *inter alia* under the programmes of the European Commission named ODYSSEE which is participated by GUS and KAPE S.A. At present, two alternative methods of ODEX calculation are applied which give the same result. The first method (aggregation method based on unit consumption effect) combines the progress in energy efficiency achieved in all sub-sectors on the basis of

saved energy quantity (e.g. Mtoe): it is based on „unit consumption effect”. The second method (weighted indicator method) weighs a separate unit consumption indicator of each sub-sector on the basis of its share in energy consumption for the entire sector.

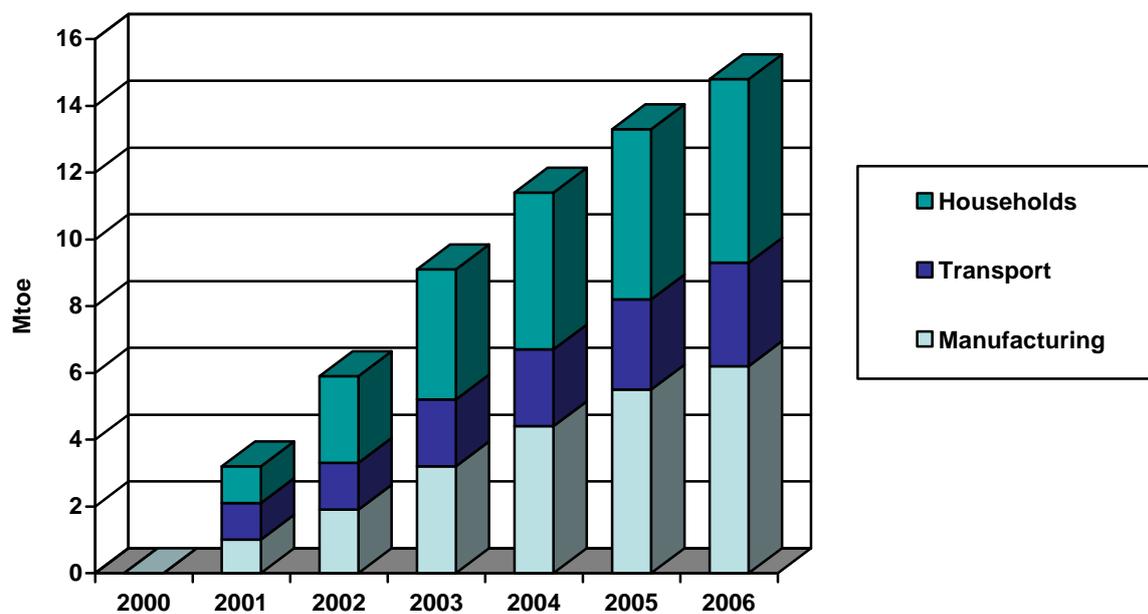
We can observe decreasing trend of ODEX indicators in years 1995-2006 what means improvement of energy efficiency. The rate of improvement amounts to 5.2% annually. The fastest rate was achieved by manufacturing, which amounted to 7.0% and was higher before 2000. Pace of improvement in transport sector was stable and amounted to 3.7% per year. In households sector ODEX indicator started to fall dynamically after 2000, average annual improvement in years 1995-2006 amounted to 4.2%. It can be observed that dynamic of improvement in different sectors began to converge after year 2000. Figure below presents values of ODEX indicator between 1995 and 2006.

**Figure 28. ODEX indicator**



ODEX indicator, apart from energy efficiency assessment can be used to calculate energy savings. Figure below presents cumulated energy savings in manufacturing, households and transport since year 2000.

**Figure 29. Cumulated energy savings**

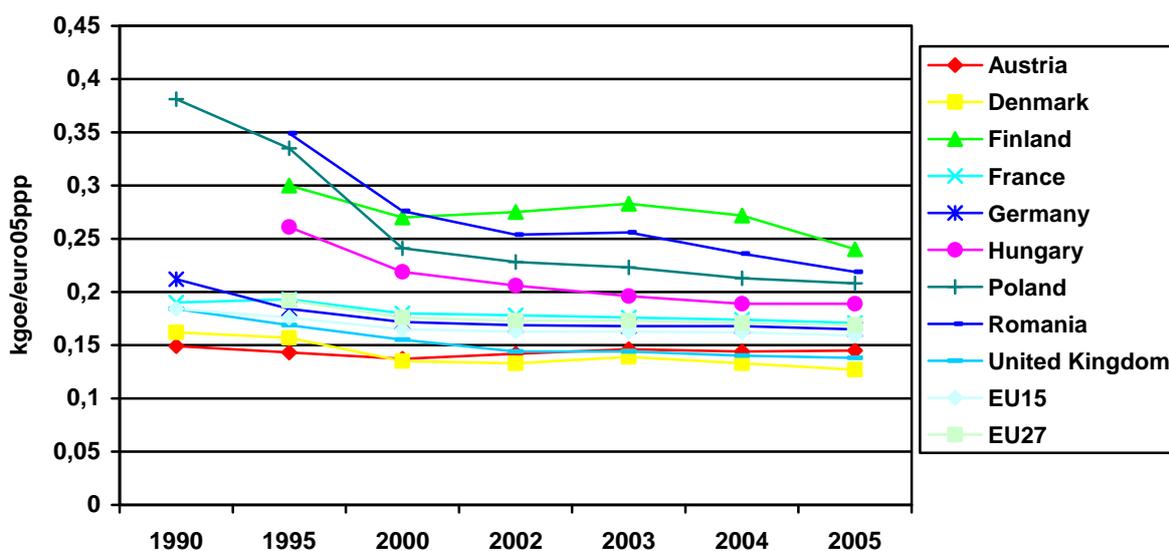


Cumulated energy savings since year 2000 amounted to 15.1 Mtoe, i.e. above 20% of annual final energy consumption in Poland.

### 3. Poland against a background of other EU countries<sup>9</sup>

Primary intensity of GDP in Poland at constant prices and purchasing power parity amounted in 2005 to 0.208 koe/euro05ppp and was 23% higher than European average. It can be observed high dynamic of energy efficiency improvement before 2005, contrasting with little and stable improvement in “old” Member States.

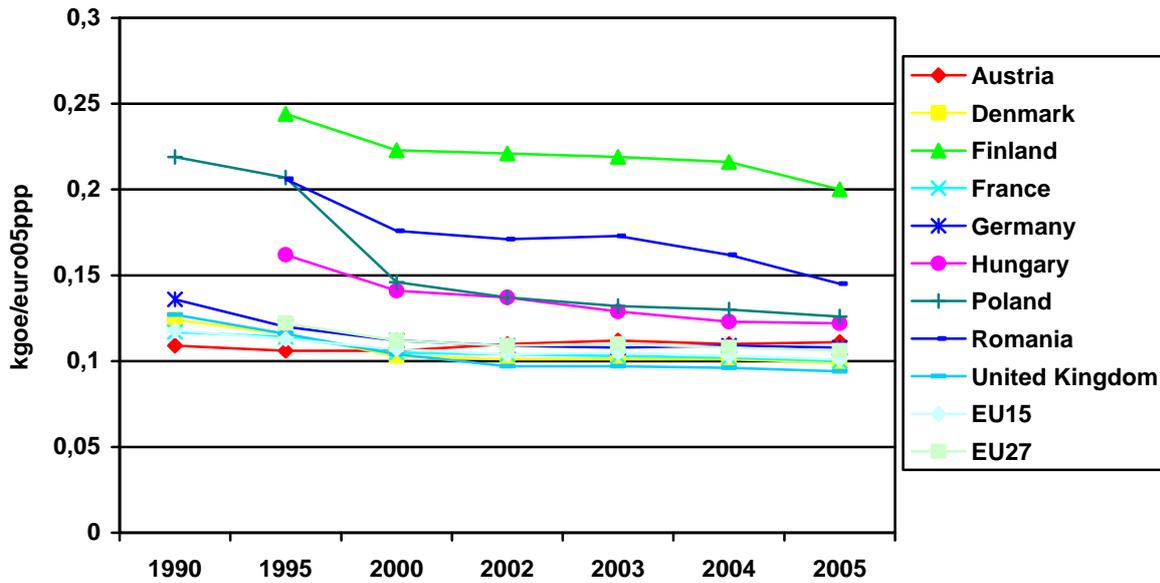
**Figure 30. Primary intensity of GDP (euro05, ppp)**



In case of final energy intensity difference is smaller and amounts to 19% between Poland (0.126) and EU-27 average (0.106). It is the result of the fact, that ratio of final to primary energy consumption is lower in Poland than in Europe. This ratio is shaped mainly by efficiency of energy transformation and rate of electricity consumption growth.

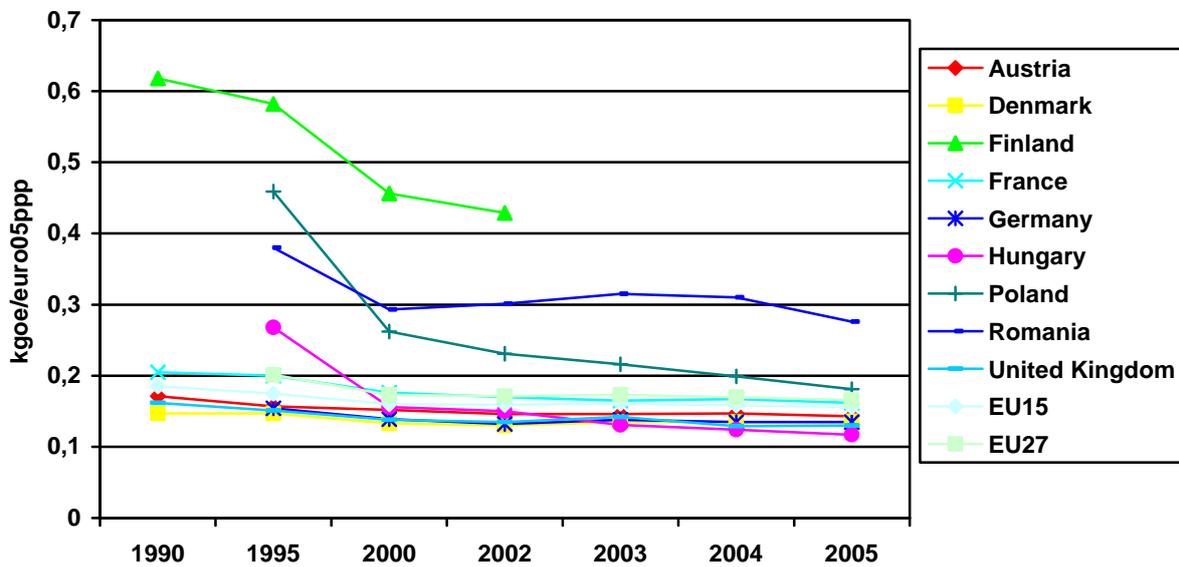
<sup>9</sup> Data comes from Odyssee database

Figure 31. Final intensity of GDP (euro05, ppp)



Final energy intensity of manufacturing in Poland was higher by 9% in comparison with European average.

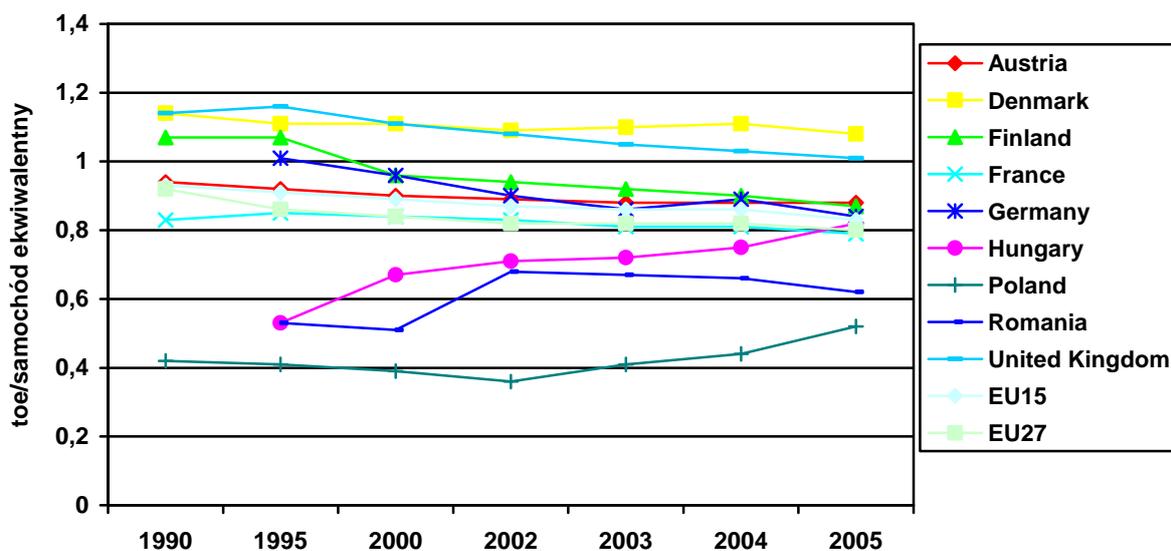
Figure 32. Final intensity of manufacturing (euro05, ppp)



Energy consumption per equivalent car<sup>10</sup> reaches almost the lowest level in Europe and amounts to 0.52 toe per vehicle. It results from big number of registered but very rare used cars.

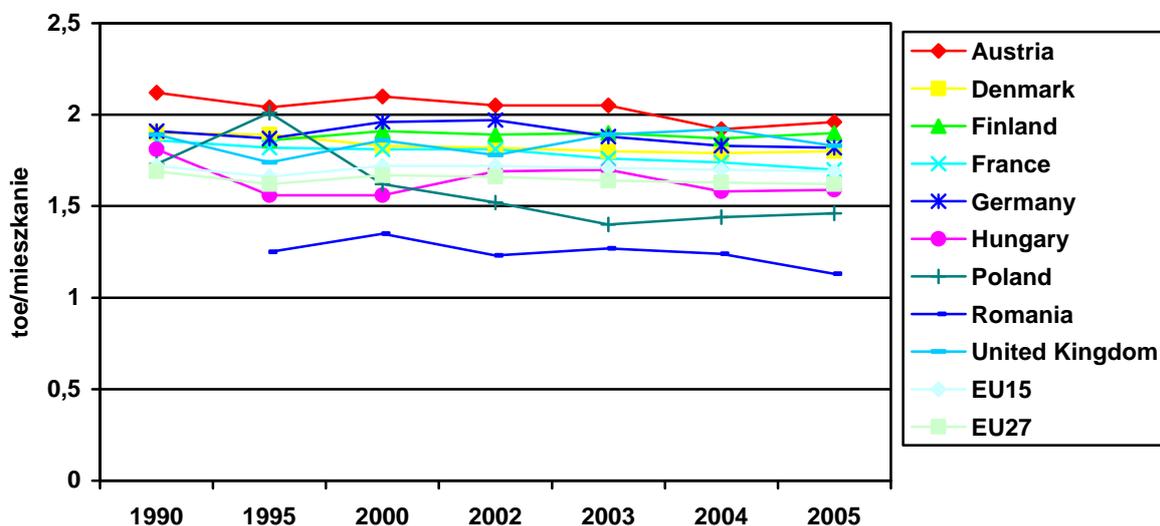
<sup>10</sup> equivalent car is a conventional measure calculated as sum of shares of specific types of vehicles multiplied by their use (estimated) of fuels in relation to average car

**Figure 33. Energy consumption per equivalent car**



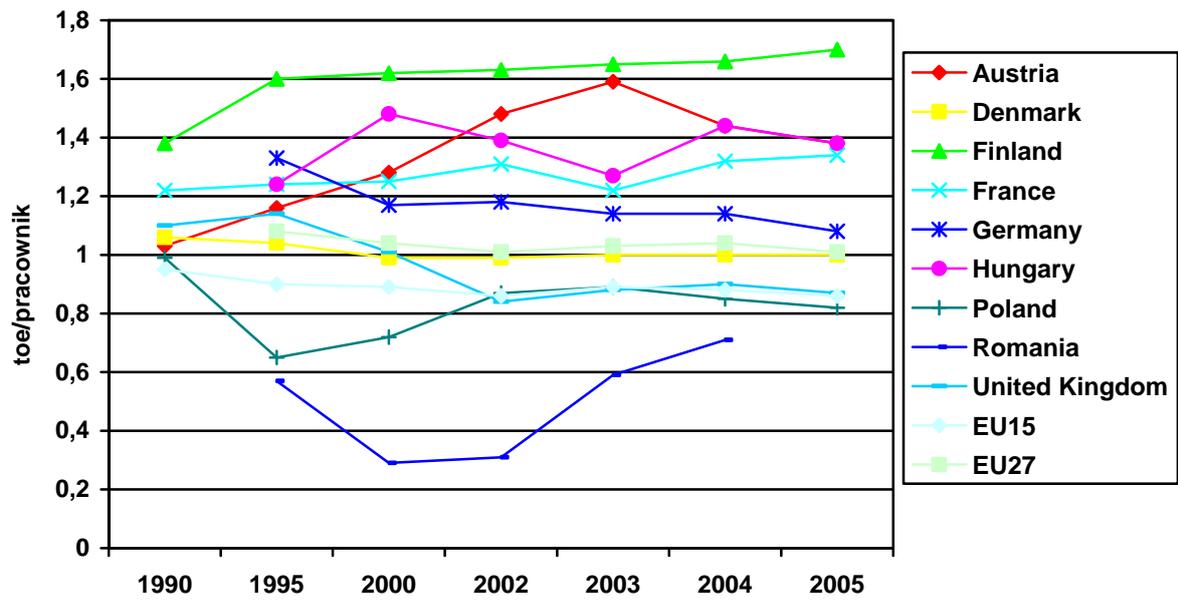
Average consumption per dwelling is lower in Poland than in the European Union. It results from the fact that floor space per person is twice lower. On the other hand cooler climate causes higher consumption for heating. After considering climate factor energy consumption per dwelling is lower in Poland by 25% (for lower floor space).

**Figure 34. Energy consumption per dwelling**



Energy consumption per employee in service sector in Poland was lower by 19% in 2005 in comparison with EU average. In that case the difference decreased significantly, as it amounted to 40% ten years earlier.

Figure 35. Energy consumption per employee in service sector



## **4. Conclusions**

New policy of the EU, expressed through new directives, especially directive on energy end-use efficiency and energy services, obliges to monitor energy efficiency. According to the articles energy savings should be counted as decrease of energy consumption as a result of organization activities and achieved as a result of realization of investments or modernizations.

At the present, statistical data obtained in frames of public statistics statistical surveys, do not allow to calculate all proposed in the directive indicators.

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).

Works carried in the European Union and Poland on further harmonization in scope of energy efficiency indicators, prepare necessary tool to asses realization of sustainable development policy and sustainable energy policy with energy and environment protection taken into account.

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## 7. Abbreviations

koe - kilogram of oil equivalent

toe - ton of oil equivalent

euro2000 - market value of euro in 2000

kWh - kilowatt hour

Names of branches used in publication are colloquial and mean:

Lp.		PKD
1.	Food	15-16
2.	Textile	17-19
3.	Wood	20
4.	Paper	21-22
5.	Chemical	24
6.	Mineral	26
7.	Primary metals	27
8.	Machinery	28-32
9.	Transport equipment	34-35
10.	Other	25, 33, 36-37

## Attachment No. 1: Data presented in brochure

Specification	Unit	1996	1997	1998
Primary energy consumption	Mtoe	103.2	102.0	95.7
Final energy consumption	Mtoe	64.1	63.2	59.0
Final energy consumption with climatic correction	Mtoe	61.6	62.9	59.2
Primary energy intensity	kgoe/euro00	0.680	0.628	0.561
Final energy intensity	kgoe/euro00	0.422	0.389	0.346
Final energy intensity with climatic correction	kgoe/euro00	0.406	0.387	0.347
<b>Final intensity in industry:</b>				
Food	kgoe/euro00	0.829	0.705	0.531
Textile	kgoe/euro00	0.402	0.308	0.240
Wood	kgoe/euro00	0.648	0.639	0.590
Paper	kgoe/euro00	0.790	0.676	0.535
Chemical	kgoe/euro00	2.058	1.745	1.811
Mineral	kgoe/euro00	2.833	2.270	1.887
Primary metals	kgoe/euro00	4.051	3.552	3.600
Machinery	kgoe/euro00	0.346	0.281	0.224
Transport equipment	kgoe/euro00	0.635	0.530	0.453
Other	kgoe/euro00	0.354	0.312	0.243
<b>Energy intensity of production:</b>				
Steel	toe/t	0.394	0.379	0.370
Cement	toe/t	0.132	0.130	0.124
Paper	toe/t	0.941	0.915	0.797

<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
93.3	90.3	90.3	88.9	91.2	91.5	92.7	97.7
57.4	53.9	54.7	53.0	54.1	55.7	56.3	58.5
58.7	56.1	54.8	54.2	54.2	56.1	56.6	59.3
0.523	0.486	0.481	0.466	0.461	0.439	0.429	0.425
0.322	0.290	0.291	0.278	0.273	0.267	0.261	0.255
0.329	0.302	0.292	0.284	0.274	0.269	0.262	0.258
0.363	0.370	0.378	0.344	0.320	0.304	0.210	0.186
0.207	0.176	0.175	0.186	0.171	0.143	0.139	0.108
0.473	0.384	0.412	0.469	0.436	0.425	0.465	0.370
0.432	0.404	0.407	0.425	0.496	0.435	0.439	0.397
1.716	1.708	1.605	1.517	1.453	1.405	1.206	1.091
1.448	1.154	1.223	1.099	0.992	0.903	0.861	0.688
3.321	3.524	6.888	4.767	5.929	6.803	5.004	3.614
0.172	0.139	0.127	0.121	0.103	0.084	0.074	0.056
0.313	0.220	0.212	0.183	0.153	0.115	0.139	0.106
0.181	0.165	0.130	0.133	0.127	0.115	0.102	0.099
0.356	0.329	0.328	0.300	0.290	0.281	0.273	0.250
0.111	0.105	0.098	0.090	0.087	0.102	0.098	0.098
0.710	0.647	0.628	0.598	0.603	0.510	0.572	0.552

Specification	Unit	1996	1997	1998
<b>Households:</b>				
Energy consumption per dwelling	toe/dwel.	1.982	1.901	1.693
Energy consumption per dwelling with climatic correction	toe/dwel.	1.806	1.877	1.710
Energy consumption per m <sup>2</sup>	kgoe/m <sup>2</sup>	29.8	30.8	28.0
Energy consumption for heating per m <sup>2</sup>	kgoe/m <sup>2</sup>	21.6	22.6	20.2
Electricity consumption per dwelling	kWh/dwel.	1664.6	1702.2	1737.7
<b>Services:</b>				
Energy intensity	kgoe/euro00	0.052	0.048	0.048
Electricity intensity	kWh/euro00	204.5	177.2	220.9
Energy consumption per employee	toe/emp.	0.687	0.636	0.662
Electricity consumption per employee	kWh/emp.	2693.7	2346.5	3016.7
<b>Transport:</b>				
Fuels consumption per vehicle	toe/vehicle	0.786	0.799	0.762
<b>Energy sector:</b>				
Heat plants efficiency	%	75.90	76.32	76.87
CHP efficiency	%	46.20	46.26	46.72
<b>ODEX indicator:</b>				
Manufacturing		150.7	141.1	123.9
Transport		122.2	119.6	116.2
Households		113.4	110.0	107.3
Global ODEX		132.1	125.5	116.4

1999	2000	2001	2002	2003	2004	2005	2006
1.686	1.478	1.608	1.455	1.402	1.414	1.447	1.508
1.773	1.626	1.618	1.529	1.408	1.440	1.465	1.551
28.9	26.4	26.2	22.4	20.5	20.9	21.1	22.3
21.2	19.3	18.6	16.1	14.1	14.0	14.6	15.8
1767.9	1775.5	1789.1	1741.0	1750.2	2008.3	1961.5	2020.5
0.044	0.045	0.049	0.053	0.055	0.051	0.049	0.046
223.3	250.0	256.5	243.2	239.2	221.7	225.1	231.8
0.626	0.658	0.757	0.828	0.891	0.857	0.820	0.799
3195.2	3620.9	3939.6	3810.0	3891.1	3706.4	3797.0	3992.9
0.820	0.648	0.619	0.567	0.643	0.686	0.732	0.751
77.92	77.90	78.73	78.48	78.27	77.22	77.27	77.65
46.70	46.52	47.12	47.36	47.83	47.62	48.07	47.51
110.5	100.0	93.3	88.0	81.7	77.0	71.7	69.8
107.8	100.0	89.4	86.5	83.6	83.3	82.0	81.0
102.9	100.0	92.5	83.3	75.0	71.5	71.3	71.3
107.0	100.0	92.2	86.1	80.3	77.3	75.0	74.1

## **Attachment No. 2. Measures towards energy efficiency improvements**

The Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC entered into force on the 17th May 2006. The purpose of the Directive is to enhance the cost-effective improvement of energy end-use efficiency in the Member States by providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks to remove existing market barriers and imperfections that impede the efficient end use of energy and by creating the conditions for the development and promotion of a market for energy services and for the delivery of other energy efficiency improvement measures to final consumers.

The Directive shall apply to:

- providers of energy efficiency improvement measures, energy distributors, distribution system operators and retail energy sales companies. However, Member States may exclude small distributors, small distribution system operators and small retail energy sales companies;
- final customers. However, the Directive shall not apply to those undertakings involved in categories of activities listed in Annex I to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community;
- the armed forces, only to the extent that its application does not cause any conflict with the nature and primary aim of the activities of the armed forces and with the exception of material used exclusively for military purposes.

Member States shall adopt and aim to achieve an overall national indicative energy savings target of 9 % for the ninth year of application of the Directive, to be reached by way of energy services and other energy efficiency improvement measures. Member States shall take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target.

Member States shall use the annual final inland energy consumption of all energy users within the scope of the Directive for the most recent five-year period previous to the implementation of this Directive for which official data are available, to calculate an annual average amount of consumption. This final energy consumption shall be the amount of energy distributed or sold to final customers during the five-year period, not adjusted for degree days, structural

changes or production changes. On the basis of this annual average amount of consumption, the national indicative energy savings target shall be calculated once and the resulting absolute amount of energy to be saved applied for the total duration of the Directive. The national energy savings in relation to the national indicative energy savings target shall be measured as from 1 January 2008.

The Polish National Energy Efficiency Action Plan (NEEAP) fulfils the provisions of Art. 14(2) of Directive 2006/32/EC of the European Parliament. This document describes the indicative energy savings target adopted for 2016 in absolute units. This is to be achieved over nine years starting from 2008 in accordance with Art. 4 of the Directive mentioned above. A national intermediate energy savings target has also been adopted for 2010, which is indicative in nature and constitutes a path for the attainment of the target adopted for 2016 and which will help in assessing progress towards it. In addition, the document provides a description of the funds and the national measures that are to be implemented or planned on the basis of these funds aimed at achieving the national indicative targets within the projected timescale.

The funds and measures proposed under the National Energy Efficiency Action Plan (NEEAP) are aimed at:

- Achieving the indicative target for energy savings as required by Directive 2006/32/EC, i.e. 9% in 2016,
- Achieving an intermediate target of 2% in 2010.

The following assumptions were used in preparing the National Energy Efficiency Action Plan (NEEAP):

- The measures proposed comply with the measures proposed by the European Commission in its document ‘Action Plan for Energy Efficiency: Realising the Potential’, COM(2006) 545.
- The proposed measures will depend to the maximum degree on market mechanisms and to a minimum level on financing from the budget,
- The realisation of the targets will be achieved according to the principle of least cost (i.e. *inter alia*, using existing organisational infrastructure and mechanisms where possible),
- It has been assumed that all entities will participate in order to use the whole country’s energy efficiency potential.

## National energy savings target

Calculation of the national energy savings target – methodology in [GWh].

	2001	2002	2003	2004	2005	Average for 2001-2005
Total final energy consumption	649070	628172	642418	656583	703011	655851
Residential buildings	223436	210410	205421	202525	216004	
Services	61592	68105	72594	70001	69536	
Industry	197466	188383	194907	201083	217830	
Transport	106542	104461	118045	131407	147434	
Agriculture	60034	56813	51451	51567	52207	
Final energy consumption in the installations listed in Annex I to Directive 2003/87/EC (Emissions Trading Directive)						61943
Final energy consumption excluding the installations listed in Annex I to Directive 2003/87/EC						593908
Target of Directive 2006/32/EC for 2016 (9% in year 9)						53452
An intermediate target for 2010 (2 %)						11878

**Description of energy efficiency improvement programmes, energy services and other measures to improve energy efficiency by final end-user sector.**

**Energy efficiency improvement measures in the residential sector.**

No.	Planned energy efficiency improvement measure	End-use energy efficiency improvement action targeted	Duration
1	Introduction of energy evaluation system for buildings <b>Category:</b> Compulsory regulations – technical standards	Certification of new and existing residential buildings carried out as a result of the implementation of Directive 2002/91/EC	2009 to 2016 – ongoing process
2	Thermo modernisation Fund <b>Category:</b> Financial instruments	Running energy efficiency modernisation projects for the residential sector	1998 to 2016 – ongoing process
3	Promotion of rational energy consumption in residential dwellings <b>Category:</b> Information and advice – energy efficiency labels, targeted information campaigns	National information campaign on the desirability and financial savings from the use of the most energy-efficient products	2008 to 2016 – ongoing process

## Energy efficiency improvement measures in the services sector

No.	Planned energy efficiency improvement measures	End-use energy efficiency improvement action targeted	Duration
1	Increase proportion of energy saving products available <b>Category:</b> Compulsory regulations – technical standards, targeted information campaign	Set minimum energy efficiency requirements for new products sold that consume energy (implementing Directive 2005/32/EC)	2008 to 2016 – ongoing process
2	Programme of economic energy consumption in the public sector <b>Category:</b> Exemplary role of public sector	State administration to undertake energy saving measures in order to provide an example	2008 to 2016 – ongoing process
3	Promotion of energy services carried out by ESCO <b>Category:</b> Energy services	Stimulating the market for energy services companies (ESCO)	2009 to 2016
4.	2007 –2013 Infrastructure and Environment Operations Programme and Regional Operations Programmes <b>Category:</b> Financial support from public funds.	Financial support for measures reducing energy consumption in the public sector	2008 to 2013
5.	Grant from the Global Environment Facility (GEF) – Energy Efficiency Project <b>Category:</b> Financial instruments – grants	Financial support for enterprises in the area of energy efficiency modernization of buildings, district heating systems and heating networks	2005 to 2011

**Energy efficiency improvement measures in the industry sector (excluding installations covered by the EU emissions trading scheme).**

No.	<b>Planned energy efficiency improvement measures</b>	<b>End-use energy efficiency improvement action Targeted</b>	<b>Duration</b>
1	Promotion of high efficiency cogeneration (CHP) <b>Category:</b> Support mechanism – obligation imposed on electricity providers	Support for the growth of high efficiency cogeneration through obligation imposed on electricity providers as well as support mechanisms	2007 to 2016 – ongoing process
2	System of voluntary undertakings in industry <b>Category:</b> Voluntary undertaking	Undertaking by decision makers in industry to implement measures resulting in increased energy efficiency in their companies	2009 to 2016 – ongoing process
3	Development of energy management system and an energy audit system for industry <b>Category:</b> Information measures – energy audit, training and education	Raising the qualifications and skills of employees involved in the management of energy, equipment and staff in industrial facilities and carrying out energy audits in industry	2008 to 2016 – ongoing process
4	2007 – 2013 Infrastructure and Environment Operations Programme and Regional Operations Programme <b>Category:</b> Financial support from public funds	Financial support for actions relating to high efficiency electricity generation and the reduction of losses in electricity distribution	2008 to 2013
5	2007 – 2013 Infrastructure and Environment Operations Programme and Operations Programme <b>Category:</b> Financial support from public funds	Support for enterprises for the introduction of best available technologies (BAT)	2008 to 2013

**Energy efficiency improvement measures in the transport sector (excluding air and sea transport)**

No.	Planned energy efficiency improvement measures	End-use energy efficiency improvement action targeted	Duration
1	Introduction of management systems for traffic and transport infrastructure <b>Category:</b> Information measure – information centre, targeted information campaigns, training and education.	Measure aimed at improving energy efficiency in transport through planning and coordinating traffic management and transport infrastructure	2008 to 2016 – ongoing process
2	Promotion of sustainable transport systems and efficient use of fuel in the transport sector. <b>Category:</b> Information measure – targeted information campaigns, training and education; Compulsory regulations - standards and norms	Measures to promote the introduction of energy saving means of transport and ecological transport methods	2008 to 2016 – ongoing process

**Horizontal issues**

No.	Planned energy efficiency improvement measures	End-use energy efficiency improvement action targeted	Duration
1	System of white certificates <b>Category:</b> Support mechanism – system of so-called white certificates involving an obligation placed on suppliers of electricity, heat or gas fuels to end-users.	Introduction of a support mechanism in the form of so-called white certificates to stimulate energy saving actions together with an obligation placed on suppliers of electricity, heat or gas fuels to end users	2009 to 2016 – ongoing process
2	Information campaigns, training and education in the area of energy efficiency improvements <b>Category:</b> Information measures –	Organising and running information campaigns and educational projects on energy efficiency and financial support for actions relating to the	2008 to 2016 – ongoing process

	targeted information campaign, energy efficiency labelling, training and education. Financial support from public funds.	promotion of energy efficiency	
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### **Others Energy efficiency improvement measures**

The other already implemented in Poland measures towards energy efficiency improvements are presented in the database MURE II ([www.mure2.com](http://www.mure2.com)), which database is being developed in framework of EEE-NMC and ODYSSEE-MURE projects.

## **Attachment No. 3. 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 (PEEEREA). (1994)
- 3) White Paper Energy for the Future: RES. (1997)
- 4) Council Resolution on energy efficiency in the European Community (1998).
- 5) Action Plan to Improve Energy Efficiency in the European Community. (2000)
- 6) European Climate Change Programme (ECCP). (2000)
- 7) A sustainable Europe for a better world – A European Union strategy for sustainable development. *Gothenburg European Council (2001)*
- 8) Green Paper - Towards a European Strategy for Energy Supply Security. (2001)
- 9) White Paper. European Transport Policy for 2010: Time to Decide.(2001)
- 10) 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.

### **Directives concerning energy efficiency of appliances:**

1. Council Directive 78/170/EEC of 13 February 1978 on the performance of heat generators for space heating and the production of hot water in new or existing non-industrial buildings and on the insulation of heat and domestic hot-water distribution in new non-industrial.
2. Council Directive 79/531/EEC of 14 May 1979 applying to electric ovens Directive 79/530/EEC on the indication by labelling of the energy consumption of household appliances.
3. Council Directive 92/42/EEC of 21 May 1992 on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels.
4. Council Directive 92/75/EEC on the indication by labelling and standard product information of the consumption of the energy and other resources by household appliances.

5. Commission Directive 94/2/EC of 21 January 1994 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations.
6. Commission Directive 95/12/EC of 23 May 1995 r. implementing Council Directive 92/75/EEC with regard to energy labelling of household washing.
7. Commission Directive 95/13/EC of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric tumble driers.
8. Directive 96/57/EC of the European parliament and of the council of 3 September 1996 on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof.
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. Commission Directive 96/89/EC of 17 December 1996 r. amending Directive 95/12/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines.
11. Commission Directive 97/17/EC of 16 April 1997 implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers.
12. Council Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.
13. Directive 2000/55/EC of the European Parliament and of the Council of 18 September 2000 on energy efficiency requirement for ballasts for fluorescent lighting.
14. Commission Directive 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioners.
15. Commission Directive 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioners.
16. Commission Directive 2003/66/EC of 3 July 2003 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations.