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WP-3 Technology data

Country Report for Poland

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Abstract

The current country report comprises of 3 distinct parts: an introduction, technology data on energy efficiency and technology data on renewable energy sources. Moreover, in the introduction an attempt has been made to present the most important energy policy measures. In this framework, a synopsis of the current status and evolvments compared to the past years on the above mentioned sectors takes place. The technology data referred to energy efficiency are presented categorized by sector, while the data related to RES are presented depending on the renewable energy source.

1 Introduction

1.1 Current Energy Status

The energy sector in Poland is still dominated by the hard coal and lignite industries which provide most of the country's energy needs. Poland is relatively self-sufficient with indigenous energy sources (mainly coal) to cover its demand for heat and power [1]. However, much of older energy infrastructure is often less efficient than in the EU. Many power plants and other elements of the grid systems already need refurbishment and upgrading.

Final energy consumption in Poland in 2005 was at almost the same level as in 1990 – 56,6 Mtoe [2]. Simultaneous growth of Gross Domestic Product (GDP) caused decreasing of final intensity of economy by 3,40% per year. The biggest structural change of energy consumption consists in decline of industry share and increase of transport share. The impact of structural changes in manufacturing became important after 2000. Overall this effect is responsible for less than one third of total improvement. Transport sector experienced radical change in modal structure: freight traffic in trains decreased by 40%, while freight traffic on roads almost tripled. Energy efficiency indicator - Odex has improved by 33% since 1995 [2]. The highest improvement was achieved by industry and the lowest by households.

In Figure 1 the total energy consumption in Poland for 2002 - 2005 is illustrated. Final energy consumption tended to decrease in the period 1996-2002 and slowly rose in subsequent years [2]. The share of coal has fallen from 26,6% in 1990 to 19,2% in 2005 after reaching top of 39,1% in 1996. Oil became the most important energy carrier with 31,8% share of final consumption. Share of heat consumption also fell from 27,6% to 12,5% (Figure 2).

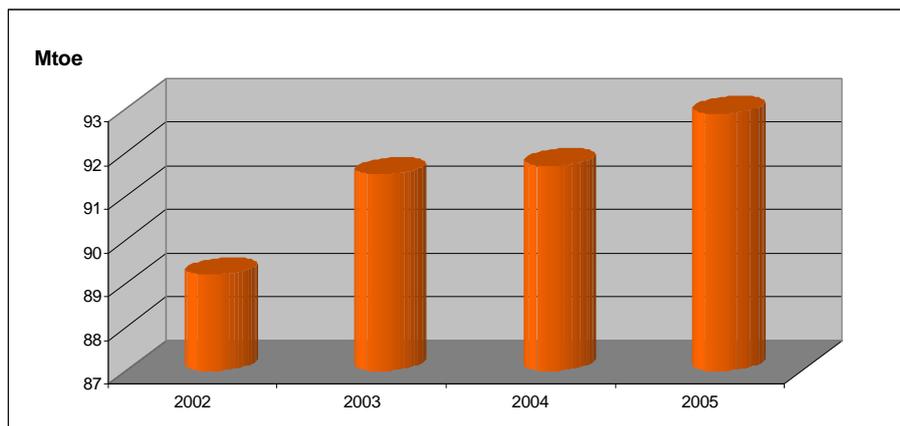


Figure 1: Total Energy Consumption

Source: Central Statistical Office, *Statistical Information and Elaborations*, 2007.

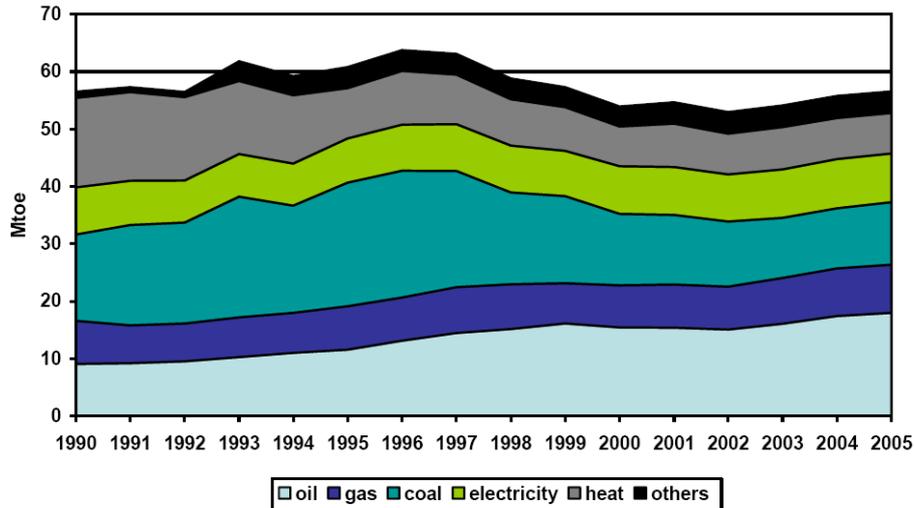


Figure 2: Final Energy Consumption by Fuels

Source: MURE – ODYSSEE, 2007

Changes of final consumption structure in main sectors of economy (Figure 3) reflect the directions of economy development [2]:

- **Industry:** Restructuring of industry caused energy consumption reduction, which was also accompanied by energy saving measures in companies.
- **Households:** The households share in final consumption remained relatively steady over the years (about 32%), but this sector experienced the activities as thermo-modernization, improving efficiencies of heating systems and totally obtained almost 20% reduction of its energy consumption since 1995
- **Services:** The share of service sector has been increasing.
- **Transport:** The development of road transport caused increase energy consumption in this sector.

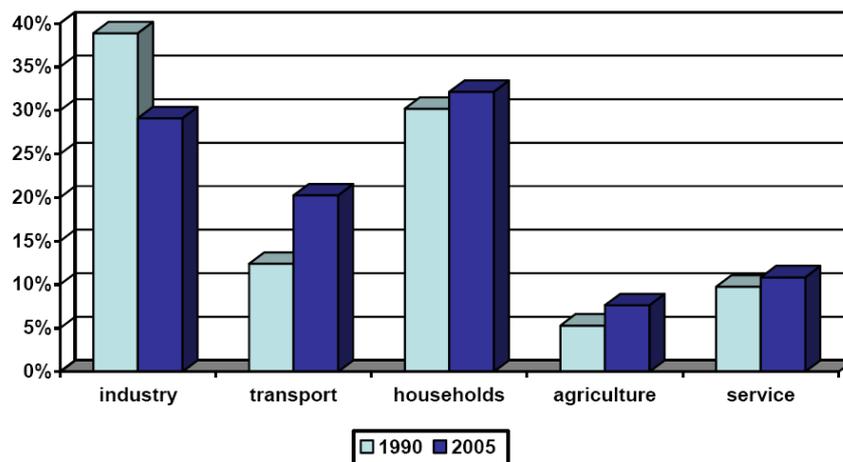


Figure 3: Final Energy Consumption by Sector

Source: MURE – ODYSSEE, 2007

Figure 4 presents the total primary energy production in Poland for 2004 - 2006. In 2006 in Poland renewable energy sources produced 210513 TJ of energy, which amounts to 6,5% of the total amount of primary energy (3252 PJ). This indicator would be higher than in 2005 (5,9%) by 10,2%. The amount of renewable energy produced in 2006 was higher than produced in 2005 by 8,7% [3].

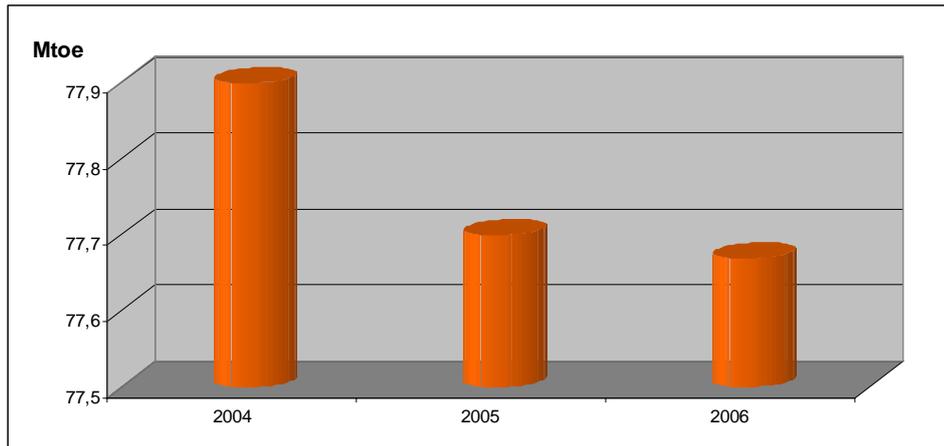


Figure 4: Total Primary Energy Production

Source: Central Statistical Office, 2007

Generating capacities of power stations using RES in 2000-2006 are presented in Figure 5. Annual increase of generating capacity varied between 2,2% (2004) and 13,2% (2005). The highest increase in power took place for wind energy (from 9,4% in 2003 to 246,9% in 2005) and biogas (between 10% in 2006 and 41,2% in 2004).

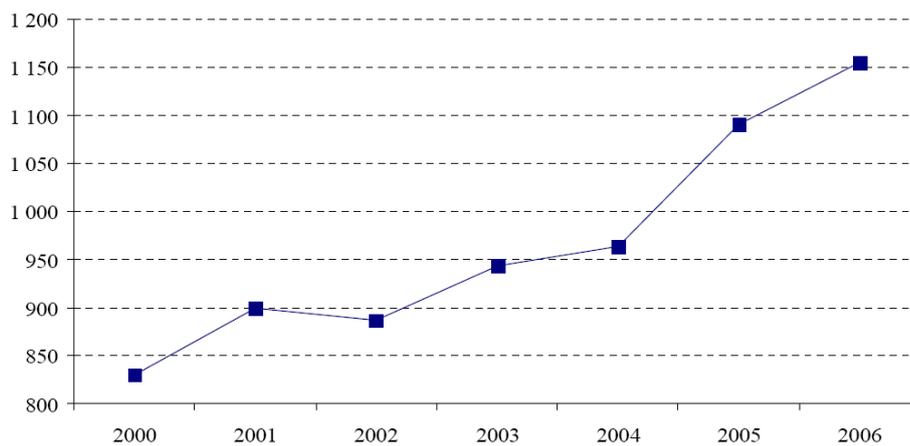


Figure 5: Capacities of Power Stations using RES (2000-2006, MW)

Source: Central Statistical Office, 2007

Figure 6 presents the total CO₂ emissions from the consumption of fossil fuels (petroleum, natural gas, and coal and the flaring of natural gas) for the period 1980-2005.

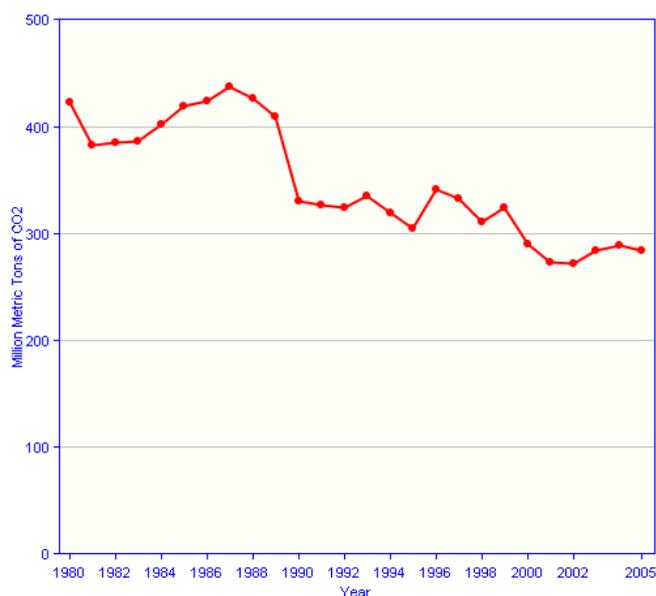


Figure 6: Carbon Dioxide Emissions

Source: Energy Information Administration (EIA), *International Energy Annual*, 2007

1.2 Main supporting policies

The Polish National Energy Conservation Agency (KAPE S.A.) was created after the resolution passed by the Polish Parliament, a decision of the Government of the Republic of Poland, together with agreement between shareholders in 1994 [4]. KAPE S.A. carries out activities aimed at rationalization of energy management with respect to the environmental protection and through pro-ecological measures related to energy generation, transmission and utilization. The mission of KAPE is to develop and implement the principles for the attainment of sustainable energy policies in Poland. There are several regional energy conservation agencies dealing in the field.

Poland continuously supports CHP development. The legal obligation for energy suppliers to purchase electricity produced in cogeneration is expressed in the Decree of the Minister of Economy on the Specific Scope of the Obligation to Purchase Electricity Produced in Cogeneration with Heat. This obligation referred to in article 9a of the Energy Law shall be considered fulfilled if the share of electricity purchased from cogeneration sources connected to the common grid is not lower than: 13,7 % in 2005 to 16 % in 2010 [2]. Energy efficiency as well RES related investments and promotional activities are strongly being supported by the environmental protection funds.

In 1998 the Act on Support for Thermo-Modernisation Investment in Buildings came into power, assisted by Thermomodernisation Fund [2]. The Act covers the rules of providing financial support to the investors (building owners or administrators) in the form of the premium which can cover up to 25% of credit loan taken out for realisation of the thermal modernisation investments.

Political support for renewable energy development in Poland and law regulation for this area was initiated in 1999. "Resolution on Increase of Renewable Energy Sources Utilisation" from 8 July 1999 was approved by the Parliament and can be considered as a milestone. The Minister of Environment prepared the "Development Strategy of RES" [5]. The Strategy was approved on the 5 September 2000 by the Council of Ministers and endorsed by the Polish Parliament (Sejm) on the 23 August 2001. Setting out of the indicative targets has been of historic importance not only for the RES industry itself, but also for the whole energy industry in Poland. The "Strategy" has set the targets of 7,5% RES energy share in the total primary energy balance by 2010 and 14% by 2020 [1]. Such an increase in RES utilisation would require the annual energy production amounting to 340 PJ of green energy in 2010, i.e., the growth by 235 PJ in comparison with the 1999 level, assuming that in 2010 the overall demand for primary energy in Poland would be to reach 4570 PJ.

The Polish Ministry of Environment with the Inter-ministerial Group on Renewable Energy has been in the process of preparation the RES Act since July 2003. Basic issues that should be regulated through the RES Act include [1]:

- Polish law transposition according to the Directive 2001/77/EC: RES definition, creation of the RES support
- mechanisms
- Statistics on renewable energy resources on the local and regional level,
- Introduction and harmonisation of the principles of the data collection on the existing RES installations,
- Better focusing of the financing system of RES development through the creation of an earmarked fund.

Recent Governmental initiatives for the creation of a favourable legal environment for the development of the renewable energy sector in Poland [1]:

2004 – Amendment of the Energy Law.

2004 – Regulation of the Council of Ministers on bio-components on liquid biofuels in 2004.

2003 – The Parliament of the Republic of Poland (Sejm) passed an Act on the Organisation of the Market for Liquid Biofuels.

2003 – The Ministry of Environment initiated works on a high-level Act on Renewable Energy.

2003 – The Minister of Environment officially recognised renewable energy as one of the 10 key priorities of this Ministry.

2003 – The Ministry of Economy, Labour and Social Policy amended regulation on the obligation for power purchase from renewable sources of energy and initiated works on the introduction of certification of green electricity.

2002 – The Government of Poland in the negotiations on the Accession Treaty as regards the EU Directive 2001/77/EC acknowledged indicative targets for Poland in RES-e by 2010 (7,5%).

2002 – The Minister of Environment established and Inter-ministerial Group for the Implementation of the Polish national RES Strategy [6].

In Poland the assumptions for development of renewable power industry were established in a government document entitled: “Strategy for renewable power industry development” (accepted by the Sejm on 23 August 2001) [6] and in documents: “Energy politics of Poland until 2025” (accepted by the Council of Ministers on 4 January 2005) and in the “Programme for electrical power engineering” (accepted by the Council of Ministers on 28 March 2006) [3].

According to imposed obligations the share of electricity produced from RES in the amount of sold energy should in subsequent years amount to: 2006 - 3,6%; 2007 - 4,8%; 2008 - 6,0%; 2009 - 7,5%; and 2010 - 2014 - 9,0%. The basic legal regulations pertaining to the obligation in respect of RES consumption in Poland are [3]:

- Law of 10 April 1997 – Energy Law (Journal of Laws 2006, No 89, item 625 as amended),
- The Regulation of the Minister of Economy of 19 December 2005 on the detailed scope of obligations in connection with obtaining and presenting for remittance the certificates of origin, paying substitute fee and purchase of electricity and heat produced from renewable energy sources (Journal of Law No 261, item 2187),
- Law of 25 August 2006 on biocomponents and liquid biofuels (Journal of Laws No 169, item 1199).

2 Energy Efficiency Technology Data

In the period 1995-2004 the energy efficiency index for the whole economy (ODEX) decreased by 41%, against 8% for the EU25 (Figure 7). This is due to remarkable improvements in industry

sector while efficiency in transport and households sector progressed below the average of the economy [2].

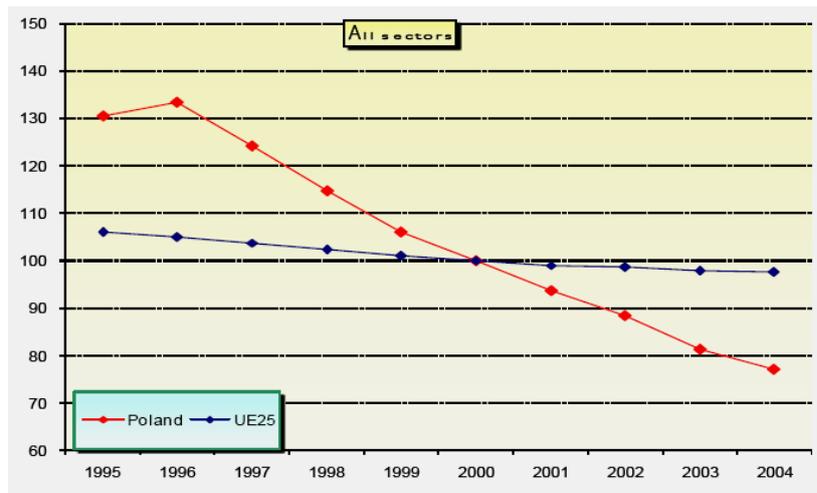


Figure 7: Energy Efficiency Index in Poland

Source: ODYSSEE data base, 2007

2.1 Households

The structure of household consumption by end use is presented in Figure 8. Decreasing share of energy consumption for heating and cooking results from replacing low efficient coal with gas and electric ovens. Growth of consumption by electrical appliances and lighting is connected with richer equipment of households in electrical appliances and behaviour changes [2].

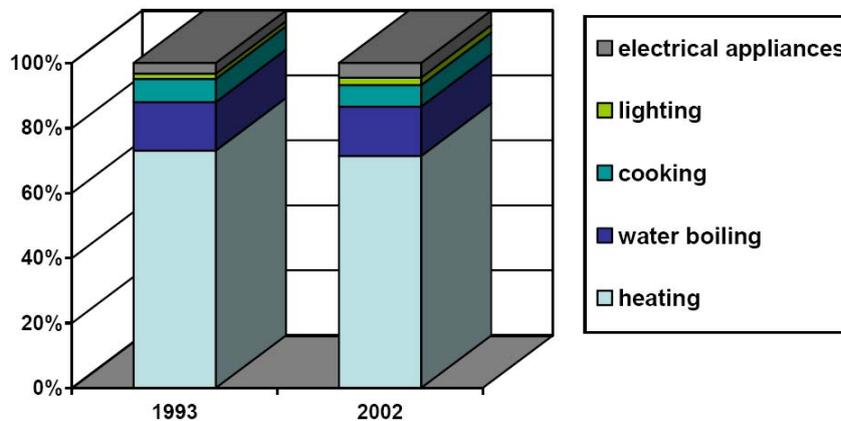


Figure 8: Structure of Energy Consumption in Household Sector

Source: MURE – ODYSSEE, 2007

Between 1990 and 2004 the energy efficiency index in the household sector decreased by 24% which means a remarkable improvement in the energy efficiency (Figure 9). This can be attributed to improvements in the efficiency of the building stock (this is made up of the large number of new houses which adhere to more stringent building regulations as well as retrofitting of existing stock) and fuel switching to oil and gas from solid fuels as well as using more energy efficient electrical appliances [2]. The improvement in the energy efficiency of households has been especially noticeable since 2000.

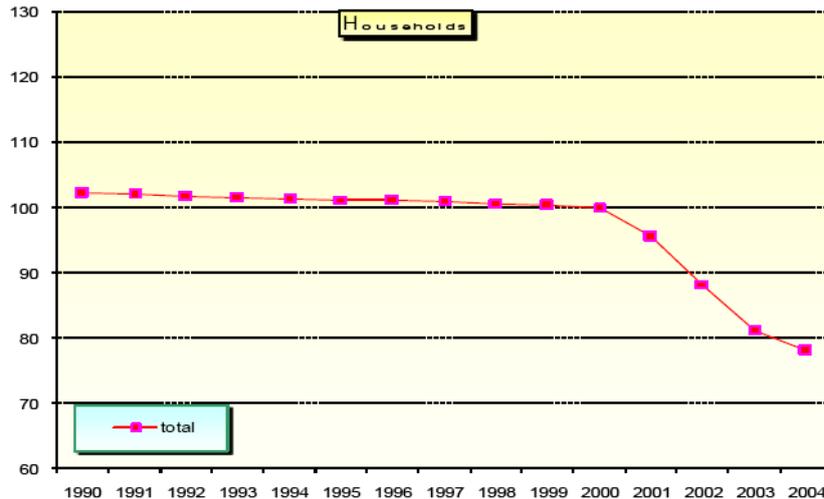


Figure 9: Energy Efficiency Index in Household Sector

Source: ODYSSEE data base, 2007

2.2 Industry

Final consumption in industry has varied since 1990 (Figure 10). The highest consumption was in 1990 at the level of 22,8 Mtoe. Before reaching local maximum of 22,2 Mtoe in 1996, consumption declined to 18,6 Mtoe in 1992. Since 1996 final consumption was generally decreasing and reached bottom of 15,2 Mtoe in 2002 [2]. The structure of consumption has changed during that period. Consumption of heat declined sharply from 8,6 Mtoe to 1,8 Mtoe, consumption of coal fell from 5,1 Mtoe to 4,0 Mtoe. At the same time consumption of oil increased from 0,9 Mtoe to 1,8 Mtoe and consumption of other energy carriers (mostly biomass) grew from 0,2 Mtoe to 0,8 Mtoe.

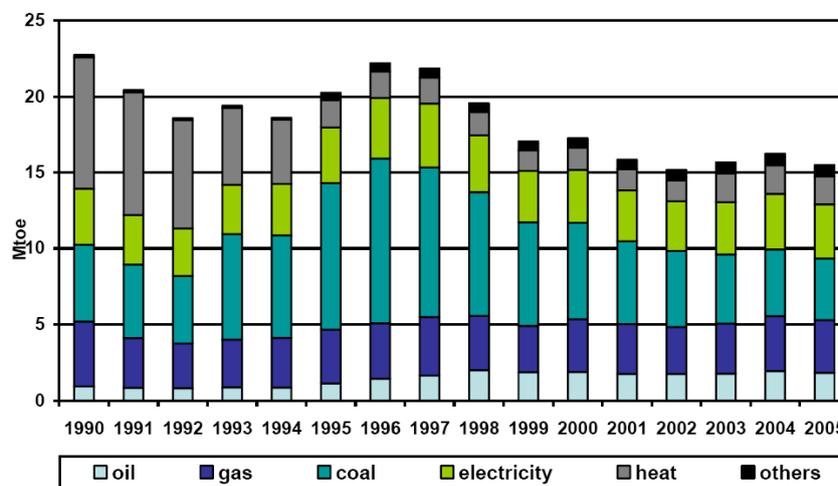


Figure 10: Final Energy Consumption in Industry Sector

Source: MURE – ODYSSEE, 2007

The energy efficiency of industry totally was systematically improving reaching 54% over the period 1995-2004 (Figure 11). The most dynamics improvement was observed between 1996 and 2000. The improvement in paper industry went almost in line with industrial average. The progress in chemical and steel industry was lower, especially before 2000. In chemicals the improvement accounted for 15%, while in steel industry for 7% until 2000. Since then the improvement was similar in all mentioned sectors as well as in total industry. Generally the improvement of the index for Poland is better than for EU due to intensive applying of more energy-saving technologies.

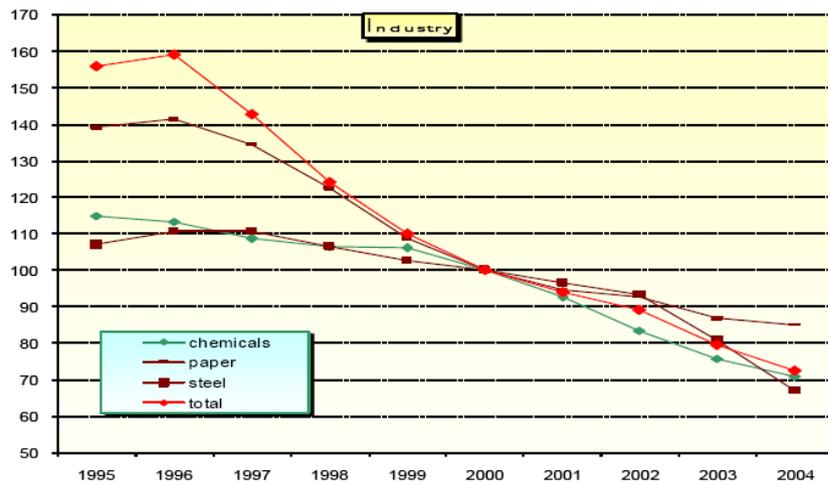


Figure 11: Energy Efficiency Index in Industry Sector

Source: ODYSSEE data base, 2007

2.3 Transport

In Poland about 89% of energy consumed in transport is from road transport and around 5,6% rail transport. Another 5% is consumed by airplanes and the rest is consumed by inland and inshore water transport. In years 1990-2005 steady growth of fuel consumption in road transport (2,5% annually) is observed, accompanied by significant drop of energy consumption by rail transport [2]. Figure 12 presents unit consumption of fuels by vehicle. The indicator is influenced mainly by country economical situation and increasing efficiency of new cars.

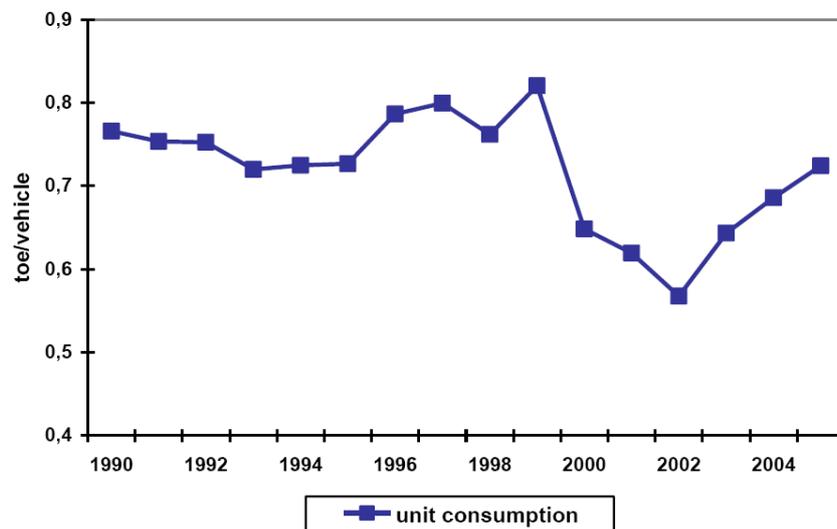


Figure 12: Unit Consumption of Vehicles

Source: MURE – ODYSSEE, 2007

Between 1990 and 2004 transport sector experienced an improvement in energy efficiency of 40%, against 12% for the EU25 (Figure 13). This steadily and rapid growth was mainly due to the penetration of new, more efficient cars and also dominating role of cars within the transport sector. In the same period the unit consumption for light and duty vehicles strongly fluctuated, compared to cars.

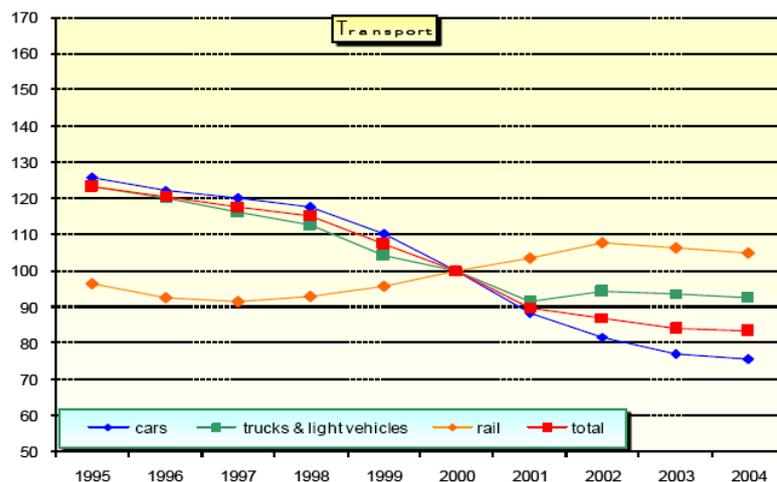


Figure 13: Energy Efficiency Index in Transport Sector

Source: ODYSSEE data base, 2007

3 Renewable Energy Technology Data

At the moment, the basic sources of renewable energy in Poland are biomass and hydro. Geothermal energy, wind power and solar energy are of lower significance. In the 1990s Poland experienced a gradual increase of the share of RES. Among the contributing factors were [5]:

- a significant increase in the utilisation of wood and waste wood mainly by rural population, the commissioning of local straw- and waste wood-fired district heating plants and the utilisation of waste wood from wood processing,
- the commissioning of two geothermal heating plants,
- the commissioning of a couple of wind power plants and of numerous small hydro power plants,
- the commissioning of heating and power plants utilising biogas from municipal landfills and waste water treatment plants.

The highest position in the renewable energy balance of 2006 had solid biomass energy, the share of which in the total indigenous production from RES amounted to 91,3% [3]. Figure 14 presents the allocation of different RES in the total energy production from RES. There were also small amount of energy from biodegradable municipal waste recorded (0,008%) and solar energy produced from solar collectors (0,005).

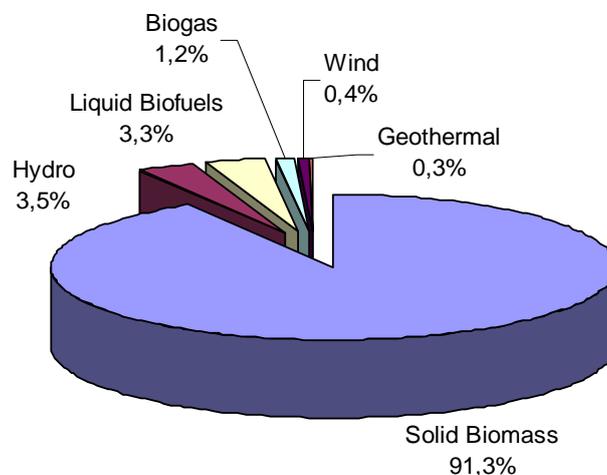


Figure 14: Total Energy Production from RES (2006)

Source: Central Statistical Office, 2007

The amount of electricity generation from RES for the period 2000-2006 is presented in Figure 15.

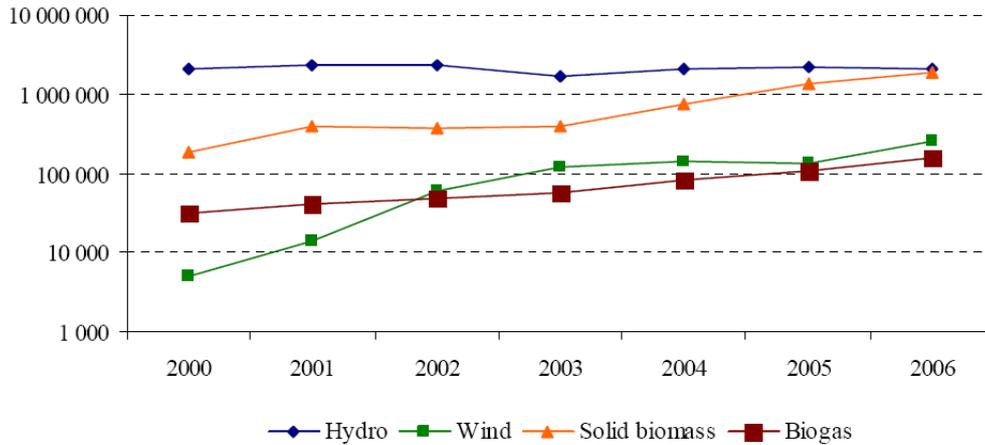


Figure 15: Electricity Generation from RES (2000-2006, MWh)

Source: Central Statistical Office, 2007

In 2006 electricity generated from RES constituted 3,2% of the national electricity consumption. In 2006 the electricity produced in hydro-power stations amounted to 47,4% of the total electricity generation from RES. The second place in respect of share energy generation from RES has the energy produced on the basis of solid biomass (43%). Energy generated from solid biomass came mainly from co-incineration with other fuels (90,3%). Other sources of electricity generation were: wind energy (5,9%) and biogas (3,7%). Electricity generated from biogas came entirely from landfill biogas (57,5%) and biogas from sludge (41,6%) [3]. Figure 16 presents the amount of electricity generation in 2006 by sources.

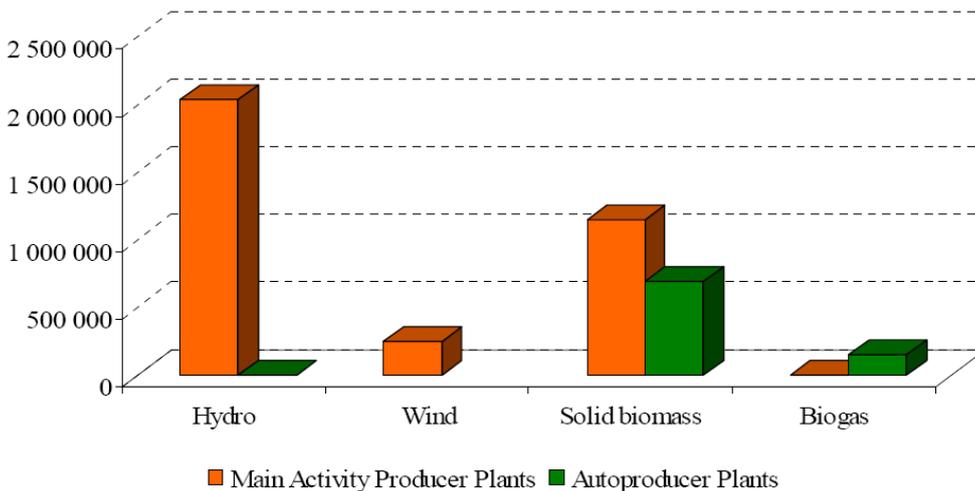


Figure 16: Electricity Generation from RES in 2006 (MW)

Source: Central Statistical Office, 2007

3.1 Hydro Energy

Among the various methods of electricity generation, hydro power has the longest tradition in Poland. The Polish hydro power resource is small due to the limited and unfavourably distributed rainfall, high soil permeability and relative flatness of the country. In Poland small hydro includes facilities with an installed capacity below 5000 kW. The total installed capacity of large hydro-

electric power stations (without pumped-storage plants) in 2002 was around 339,2 MW, and of the small ones (< 5MW) - 185 MW [1]. Total technical potential of hydro energy amount to 49 PJ/year from that 6 PJ/year is a technical potential of small hydro. As for the small hydro plants (< 5MW) about 1000 plants could be build with total capacity 200 MW and estimated electricity generation 1000 GWH/year [7].

Collective data pertaining to hydro energy used for electricity generation in 2000-2006 are presented in Figure 17.

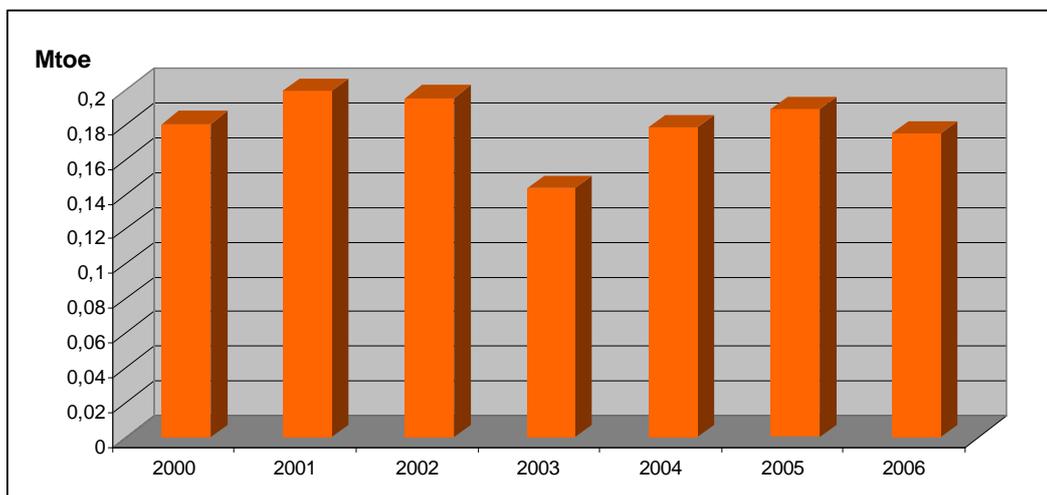


Figure 17: Electricity Generation from Hydro Energy (2000-2006, Mtoe)

Source: Central Statistical Office, 2007

Figure 18 presents the amount of energy in hydro-electric power stations in Poland.

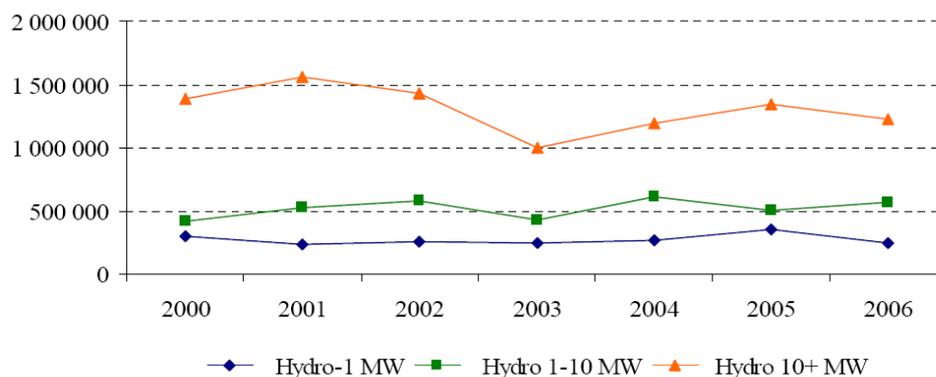


Figure 18: Electricity Generation in Hydro-electric Power Stations (2000-2006, MWh)

Source: Central Statistical Office, 2007

3.2 Wind Energy

It was only the beginning of the 1990's, when wind power began to be exploiting in Poland, mainly on the Baltic seaside. The most privileged areas in terms of wind energy potential are the Baltic coast, Suwalki area and Mazovian lowland plain. Till 2002, 42 wind turbines with a total power over 28,5 MW had been connected to the grid and placed in service [1]. There are also a number of small scale wind installations. Investors take keen interest in wind power installations, especially in north-western Poland. In 2003 Zagorze a wind farm with capacity 30 MW was put into operation.

There was an increase in the use of wind energy during the period 2000-2006 (Figure 19). Electricity generation in wind power stations increased from 20 TJ (0,0005 Mtoe) in 2000 to 922 TJ (0,022 Mtoe) in 2006.

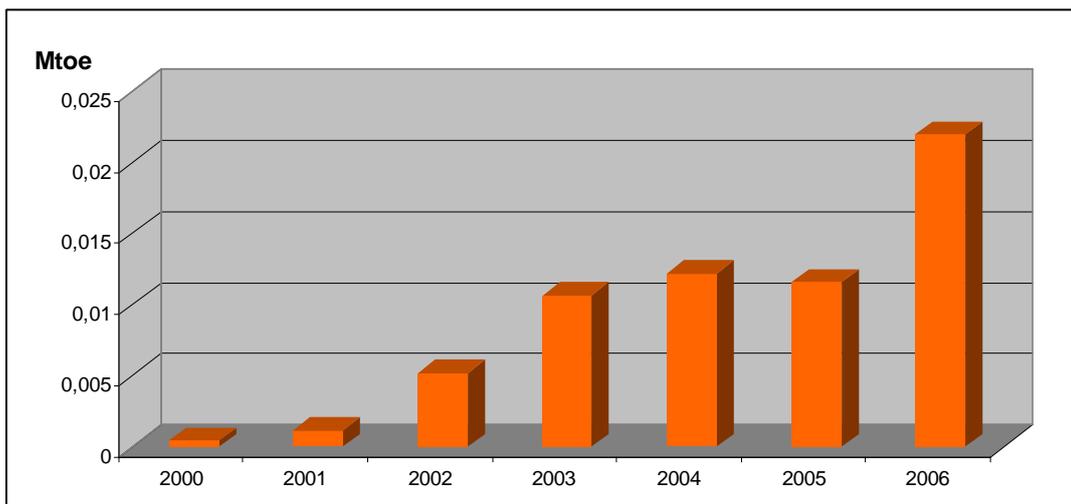


Figure 19: Electricity Generation from Wind Energy (2000-2006, Mtoe)

Source: Central Statistical Office, 2007

3.3 Solar Power

Poland has a very uneven distribution of solar radiation throughout the year, with around 80% of the total annual insolation falling within six months in spring and summer. The distribution of density of a solar radiation flux and its structure show that opportunities of its utilisation are somewhat limited, especially in winter. Air collectors are most frequently used at farms for crop drying. The total number of air collectors is estimated at 50-60 units (up to 2002) and their surface area at 6.000 m² [1]. They are operated for 300-600 hours per year on average. Liquid solar collectors are mainly used for heating water in homes, camping and summer cottages, sports and recreation facilities, livestock buildings and fodder stores. Also, liquid solar collectors heat up water in tanks and swimming pools as well as process water in small industrial plants. Until 2002, around 4.000 solar installations for the heating of usable water have been installed in Poland [1]. Efforts have been made to introduce solar thermal applications for space heating in Poland.

PV technology it is relatively new and not wide spread in Poland. Until 2002 about 240 PV applications was installed in Poland with total installed capacity about 77 kW [1]. Most of the applications can be defined as off grid non-domestic (applications for traffic light, maritime navigation signs, yachts). There are also several demonstration projects with PV applications installed on the roofs or walls of buildings.

Figure 20 presents the amounts of heat generated from solar collectors recorded for years 2002-2006. With increase in the number of units using solar collectors since 2004, there was an increase in the amount of produced heat, and so in 2005 as compared to the preceding year the increase amounted to 50%, and in 2006 – 67%.

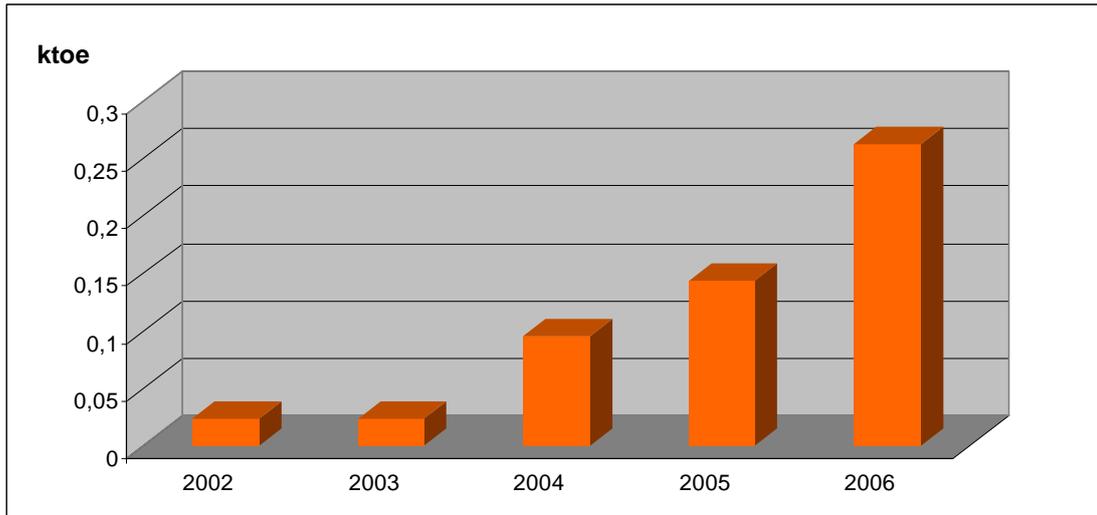


Figure 20: Heat Generation from Solar Collectors (2002-2006, ktoe)

Source: Central Statistical Office, 2007

3.4 Biomass

Biomass is the most promising renewable source of energy in Poland. The greater opportunities for biomass technology implementation have been recognised in forestry, wood processing and agriculture sectors. In short term perspective it can be forecasted the great development of fuel wood (logs) and straw utilisation in individual dwellings especially because of it's profitability in comparison with fossil fuels [1].

The energy balances for solid biomass (period 2000-2006) indicate a constant increase in the amount of produced and used solid biomass [3]. Accordingly, in 2006 10,1% of biomass more were produced and used than in 2005. Simultaneously as compared to 2000 there was an increase in production recorded by 27,7%, and that of total national use by 27,8%. The largest increase, especially in the last three years, took place in respect of use as input for energy transformations (in comparison with the preceding year: in 2004 by 53,6%, in 2005 by 96,5% and in 2006 by 21%), especially in professional heat and power stations (in 2004 by 91,7%, in 2005 by 151,3% and in 2006 by 39,3%) [3].

The structure of solid biomass use in 2006 is presented in Figures 21. Figure 22 presents the amount of biomass use by final recipients in 2000-2006.

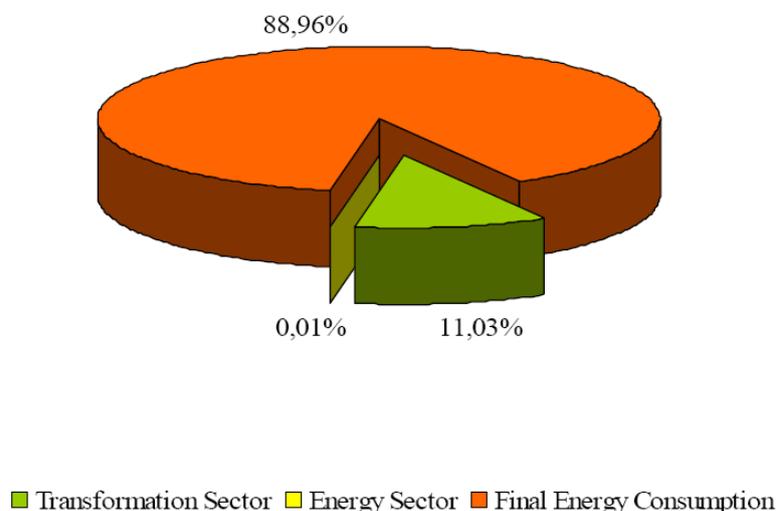


Figure 21: The Structure of Solid Biomass Consumption in 2006

Source: Central Statistical Office, 2007

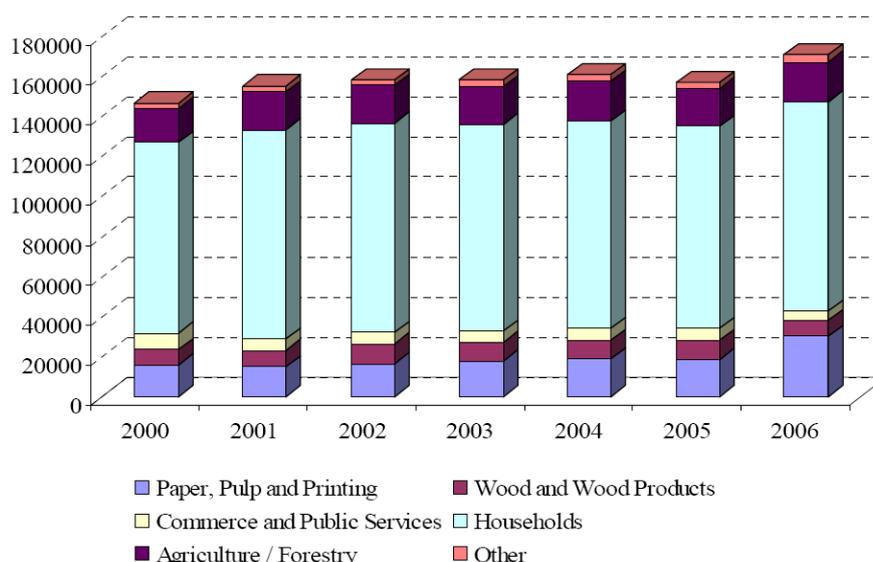


Figure 22: Solid Biomass Consumption by Final Users (2000 – 2006, TJ)

Source: Central Statistical Office, 2007

3.5 Geothermal

Geothermal waters have been used in Poland for a long time for therapeutic purposes. Concerning energy, space heating is the main area of geothermal energy use. Until 2002, 4 geothermal installations were operating in Poland with total installed capacity of 55,7 MW_{th}. They are located in Banska at the Tatra Foothills, and in Pырzyce near Szczecin, in Mszczonów (the Polish Lowland) and in Uniejów (the Polish Lowland). Another installation in Słomniki (Fore-Carpathians province) is in a starting phase (7,3 MW_{th}) [1]. There are about 700-1000 medium and small scale heat pumps based on ground or ground water heat installed by individual consumers or in office buildings. At present, use of geothermal energy for electricity generation in Poland remains at a research stage.

Table 1: Geothermal Energy Balance (2000-2006, TJ)

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	124	120	263	311	318	476	535
Final Energy Consumption of which:	124	120	263	311	318	476	535
Commerce and Public Services	24	20	51	70	70	90	100
Households	100	100	212	241	248	386	435

Source: Central Statistical Office, 2007

The data in Table 1 indicate constant increase in consumption of geothermal energy continuing since 2002. In subsequent years, as compared to the preceding year, the increase amounted to: in 2002 - 119,2%, in 2003 - 18,3%, in 2004 - 2,3%, in 2005 - 49,7%, in 2006 - 12,4% [3]. Majority of geothermal energy is used for satisfying the heat demand in households (in 2006 - 81,3%). The use of geothermal energy by households and commerce and public services entities in 2000-2006 is presented in Figure 23.

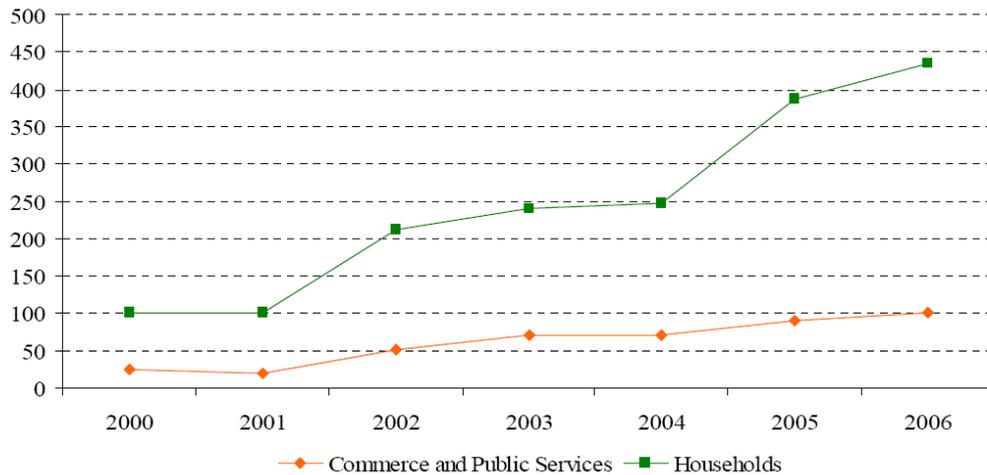


Figure 23: Solid Biomass Consumption by Final Users (2000 – 2006, TJ)

Source: Central Statistical Office, 2007

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