

CENTRAL STATISTICAL OFFICE

**ENERGY FROM RENEWABLE
SOURCES IN 2006**

WARSAW 2007

STATISTICAL INFORMATION AND ELABORATIONS

Publisher: Central Statistical Office, Industry Division
Ministry of Economy, Energetics Department

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Printed: Statistical Publishing Establishment
Al. Niepodległości 208,
00-925 Warszawa

ISSN: 1898-4347

Publikacja dostępna na www.stat.gov.pl
Publication available on www.stat.gov.pl

Preface

The publication “Energy from renewable sources in 2006” is the first study prepared by the Central Statistical Office pertaining to renewable energy sources (RES) within the series “Statistical Informations and Elaborations”.

The publication aims at presenting information on production and use of energy from renewable sources in 2006, as well as data available for 2000 – 2005.

The aggregated statistical data contained in the study, presented in tables and in graphs, do not give full picture of the situation, due to limited subject and object scope of statistical survey in this area.

The publication was elaborated by Energy Market Agency staff and by the employees of Central Statistical Office, Industry Division.

Wanda Tkaczyk
Director of the Industry Division

Warsaw, October 2007

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1. Introduction

Demand for energy growing with civilization development, with simultaneous exhaustion of its traditional resources – mainly fossil fuels (coal, oil, natural gas) and an increase in natural environment pollution accompanying their use, brings increased interest in use of “renewable energy”. The following definition of this energy is commonly accepted:

“Renewable energy is an energy obtained from repeating natural processes. Available forms of renewable energy origin directly or indirectly from solar radiation or heat generated deep in the Earth.”

In Polish conditions energy from renewable sources includes energy from direct use of solar energy (transformed into heat or electricity), wind, geothermal resources (from Earth interior), water, solid biomass, biogas and liquid biofuels.

Renewable energy sources (RES) are alternative for traditional primary non-renewable energy sources (fossil fuels). Their resources replenish themselves in natural processes, which in practice allows to treat them as inexhaustible. Moreover, obtaining energy from such sources is, as compared to traditional sources (fossil), more environmentally friendly. Use of RES significantly lowers negative impact of power industry on the natural environment, mainly by limiting emission of harmful substances, especially greenhouse gases.

The scope of use of renewable energy in EU member states is governed by EU documents and regulations, establishing general and detailed aims pertaining to the obligation to obtain certain indicators of share of renewable energy in use of primary energy, as well as that of electricity produced from renewable sources in total use of this energy. The basic EU documents and legal regulations in this respect are:

- White Paper – Energy for the Future: Renewable sources of energy (1997),
- Green Paper – Towards a European strategy for the security of energy supply (2001),
- Directive of the European Parliament and of the Council no 2001/77/EC of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market (O.J. EC L 283 of 27.10.2001),

- Directive of the European Parliament and of the Council no 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (O.J. EC L 123 of 17.05.2003),

Information on intentions pertaining to increasing the share of RES in energy balances of EU countries are contained in a document of the European Commission of 10 January 2007 entitled: “Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future” (final document’s symbol: COM(2006) 848). The document assumes that the basic aims in this respect concern increasing safety of energy supplies and lowering emissions of greenhouse gases. It is proposed to gradually increase the share of energy from renewable sources in the national gross energy consumption, so that in 2020 the indicator reaches the value of at least 20%. Simultaneously it is postulated to establish at 10%, for the year 2020, a minimum share of biofuels to be obtained in the use of fuels in transport.

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) 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). The strategic aim of the state policy was increasing the use of renewable energy resources so that the share of this energy in primary energy consumption achieves 7.5% in 2010 and 14% in 2020. As far as the use of electricity is concerned, the assumed share of electricity produced from RES in national consumption amounted to 7.5% in 2010. In order to obtain this aim, a system of support for renewable energy sources was established, by introduction of appropriate amendments to the Energy Law. The energy sector enterprises selling electricity to the final users were obliged to present for remittance certificates of RES origin of electricity (so-called “green certificates”). 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:

- 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. General remarks

2.1 Subject scope of the study

This publication is a “resulting statistical information” containing statistical data on renewable energy sources (RES). This information was collected within statistical surveys on energy included in annual programmes of statistical surveys of the public statistics realized in 2000 – 2006. The scope of the presented data does not give full picture of the situation in respect of production and consumption of energy sources from RES in Poland, mostly due to significant dispersion of sources and to a large degree local character of their use.

Low production capacity of the majority of facilities producing and consuming energy from renewable sources make it difficult to include them in the statistical survey. Obtaining fuller picture in this respect will be possible thanks to introduction to the “Statistical Survey Programme for Public Statistics for 2008” a new questionnaire pertaining only to renewable energy sources (G-02o).

The publication contains collective statistical data pertaining to production and consumption of energy from renewable energy sources used in Poland, in particular:

- biomass,
- solar energy,
- water energy,
- wind energy,
- geothermal energy.

The publication also includes information on production and use of biofuels and biogas and data pertaining to the amount of electricity and heat obtained from RES as well as use of municipal waste for energy production.

The statistical data presented in the publication are expressed in energy units (TJ – terajoules, MWh – megawatt-hours, toe - tons of oil equivalent [1 toe = 41.868×10^9 J]) and for liquid biofuels additionally in natural units (t (Mg) – tons).

The study uses statistical data obtained from questionnaires with symbols:

- **G-02b** – balance report on energy commodities and heating infrastructure,

- **G-03** – report on fuels and energy consumption,
- **G-10.1(w)k** – report on basic operation of hydro-electric power station,
- **G-10.2** – report on basic operation of thermal main activity producer power station,
- **G-10.3** – report on capacity and production of heat and power of autoproducer (electricity / CHP) plants,
- **G-10.6** – report on capacity and production of hydro-electric power stations and renewable sources,
- **RAF-1** – report on squaring of transformation process in enterprises producing and processing refined petroleum products,
- **RAF-2** – report on production and turnover of petroleum products.

The study also presents data for UE-25, for selected neighbouring countries or for countries with similar climatic conditions.

2.2 Characteristics of renewable energy sources (energy carriers)

2.2.1. Solid biomass

Solid biomass consists of organic, non-fossil materials of plant origin, used as fuel for heating or electricity generation.

The basic solid fuel from biomass is firewood (forest biomass) in the form of chunks, round timber, chips, briquettes, pellets, and waste from forestry, wood and paper industry, i.e. branches, poles, thinning, shrubs, brush-wood, rootwood, bark, sawdust, black liquor. A separate group consist of agricultural biomass fuels from energy crops (fast-growing trees, dicotyledonous perennials, perennial grasses, energy cereals) and organic remnants from agriculture and horticulture (e.g. straw, animal manure, wastes from horticultural production). The group of solid biomass fuels also contains charcoal, understood more broadly than solid products of biomass degassing.

2.2.2. Solar energy

Solar energy is energy of solar radiation transformed into heat or electricity. Solar energy is used in:

- flat, vacuum-tube and other types of solar collectors (liquid or air) for heating running water, water in swimming pools, heating rooms, in drying processes, in chemical processes;
- photovoltaic cells for direct production of electricity;
- solar power stations for production of electricity.

Solar energy is used in passive heating systems (by system of direct gains through windows, by annexed greenhouses, and other), cooling and lighting of rooms is not included in the statistical reporting.

2.2.3. Hydro power

Water energy (potential and kinetic) is determined on the basis of the amount of electricity produced in hydro-electric power stations. Renewable energy includes only production of electricity in power stations with natural flow.

2.2.4. Wind energy

Wind energy is a kinetic energy of wind used for production of electricity in wind turbines. Similarly as in the case of hydro-electric power station, the potential of wind power stations is determined by their potential to generate electricity.

2.2.5. Biogas

Biogas is a gas composed mostly of methane and carbon dioxide, obtained in the process of anaerobic fermentation of biomass. In statistical reporting, due to the method of production, we distinguish:

- *landfill gas*, obtained from fermentation of wastes in landfills,
- *sludge gas*, produced in result of anaerobic fermentation of sludge
- *other biogases*, such as biogas obtained from anaerobic fermentation of animal manure, wastes from slaughterhouses, breweries and from other activities in agricultural and food manufacturing.

2.2.6. Liquid biofuels (biofuels – liquid fuels from biomass)

Biofuels are produced from organic materials (from biomass or biodegradable fractions of wastes). The statistical reporting includes the following products: bioethanol, biodiesel, biomethanol, bio-dimethyl-ether, bio-ETBE (ethyl-tertio-butyl-ether produced on the basis of

bioethanol), bio-MTBE (methyl-tertio-butyl-ether produced on the basis of biomethanol). Also natural plant oils may serve as biofuels.

The aforementioned products are used as biocomponents added to engine fuels produced from oil. The most frequently used additives are: bioethanol (engine fuels additive) and biodiesel (diesel fuels additive).

2.2.7. Geothermal energy

Geothermal energy is heat obtained from Earth interior in the form of hot water or steam. Geothermal energy is used directly as heat for municipal heating and in production processes in agriculture, as well as for production of electricity (using dry steam or brine with high enthalpy).

2.2.8. Municipal waste

The national statistical reporting on fuel and energy management includes also waste fuels coming from flammable industrial waste and municipal waste, such as: rubber, plastics, waste oils, and other similar products. They have solid or liquid form and are classified as renewable fuels or not, depending on whether they undergo biodegradation.

Renewable fuels used in the process of electricity and/or heat production include renewable solid municipal waste incinerated in appropriately adapted installations. These include wastes from households, hospitals, and services sector (waste biomass) consisting of organic fractions subject to biodegradation.

2.3 Definitions

Primary energy is energy contained in primary energy sources obtained directly from natural resources, both renewable and non-renewable.

Renewable primary energy is an energy obtained from natural, constantly repeating natural processes.

Derived energy is energy contained in secondary energy sources, i.e. sources generated in processes of energy transformations.

Indigenous production is the amount of energy obtained from natural primary energy sources.

Transformation output is the amount of energy contained in secondary energy sources obtained in processes of energy transformations.

Energy transformation is the technological process in which one form of energy (mostly primary energy sources) is transformed into other, secondary form of energy.

Energy used in the transformation is used for:

- **transformation sector** (use of energy sources constituting technological material),
- **own consumption in transformation process** (use of energy by auxiliary devices, such as: feeders, pump drives and ventilators, etc.)

Direct consumption is the amount of energy sources used in final receivers without further transformation into other energy carriers. This position also includes use of energy for energy transformations energy demand, non-energy-related use of energy sources (material for production of non-energy-related products) and natural losses and partial losses at the users.

Final energy consumption is consumption of energy carriers for technological, production and household needs excluding transformation into other energy sources. Input and needs of energy transformation and losses resulting at the producers' and distributors are not included in this position. The final consumption, on the other hand, includes consumption of fuels for production of heat used entirely by the producer.

Energy sector is use of a given energy source in energy transformations for own consumption in transformation process.

Main Activity Producer Plants includes entities for which the basic type of activity is the activity mentioned in NACE classification within group 40.1 (Production and distribution of electricity) and group 40.3 (Steam and hot water supply).

Autoproducer Plants includes entities for which the activity mentioned in section 40 of PKD constitutes an additional type of activity. Usually the energy produced in these objects is used for own needs of these entities.

The full scope of definitions and terms used in energy statistics is contained in the study entitled “Methodological rules of statistical reporting on fuels and energy and definitions of the terms used” – CSO methodological notebook, Warsaw 2006.

3. Energy from renewable sources in EU countries

The data pertaining to the amount of total primary energy (including energy from renewable sources) in 25 states of the European Union (EU-25) in 2000-2005 are presented in table 1.

Table 1. Production of primary energy (including from renewable sources) for EU-25 in 2000 – 2005 [Mtoe]

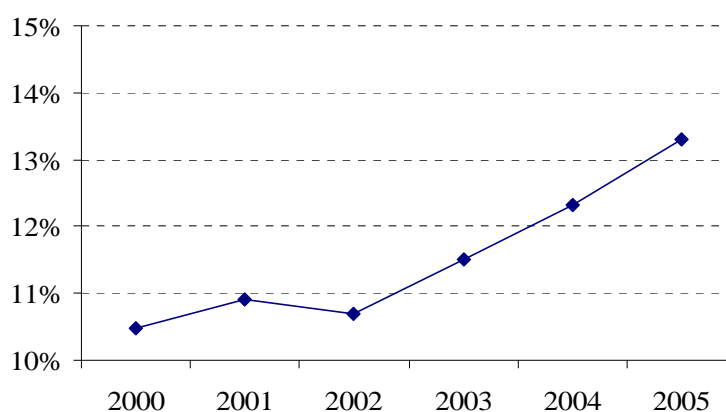
Specification	2000	2001	2002	2003	2004	2005
Total primary energy* of which:	892.7	894.4	894.3	886.3	882.4	852.0
<i>from renewable sources</i>	<i>93.4</i>	<i>97.6</i>	<i>95.7</i>	<i>102.1</i>	<i>108.7</i>	<i>113.2</i>
Share of energy from renewable sources in the total primary energy [%]	10.5	10.9	10.7	11.5	12.3	13.3

* according to the rules accepted by the International Energy Agency (IEA) the “total primary energy” position does not include energy from coal reclaimed from mine waste dumps and energy from waste fuels of non-organic origin.

Since 2003 in EU-25 countries there is a constant increase in the amount of energy from renewable sources (increase by 6.7% in 2003 as compared with the preceding year and by 6.5% in 2004 and by 4.1% in 2005, respectively). However, in the case of production of total primary energy there was a decline tendency (decline by 0.9% in 2003 and by 0.4% in 2004 and 3.5% in 2005, respectively) which results in increase of share of energy from renewable sources in total primary energy by approximately 7 – 8 % as compared to the preceding year.

Share of energy from renewable sources in the total production of primary energy is presented in the graph below (Fig. 1).

Fig. 1. Share of energy from renewable sources in production of primary energy for EU-25 in 2000 – 2005

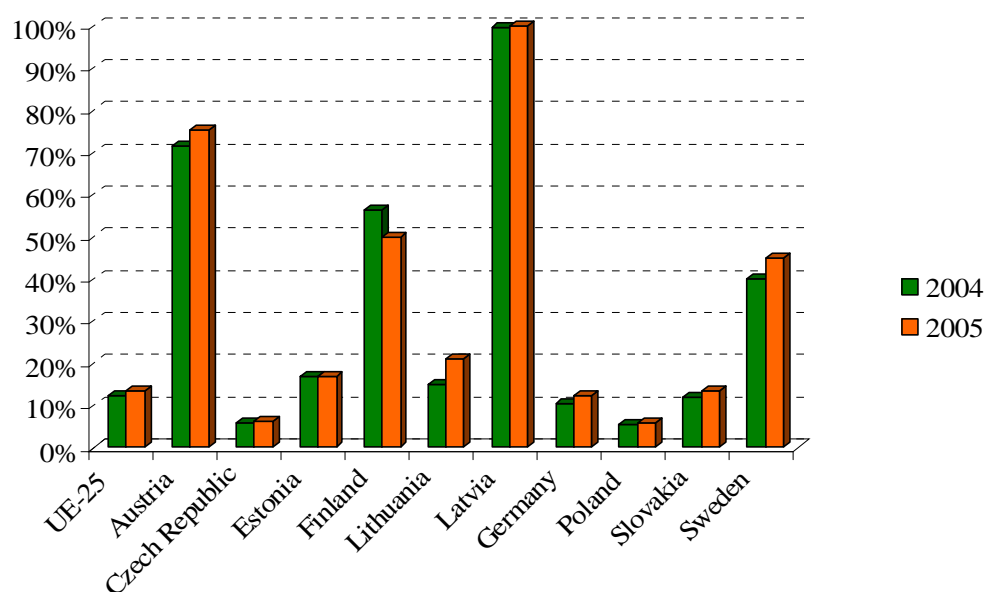


The amount of primary energy obtained from renewable sources and its share in the total energy produced in particular EU countries is very diverse. Table 2 and graph (fig. 2) present the values for 2004 – 2005 in selected countries.

Table 2. Production of energy from renewable sources in selected EU countries in 2004 – 2005

Specification		Production of primary energy		Share of energy from renewable sources in the total primary energy [%]
		total [Mtoe]	from renewable energy [Mtoe]	
EU-25	2004	882,4	108,7	12,3
	2005	852,0	113,2	13,3
Austria	2004	9,6	6,9	71,4
	2005	9,4	7,1	75,1
Czech Republic	2004	32,7	1,9	5,9
	2005	32,4	2,0	6,2
Estonia	2004	4,1	0,7	16,8
	2005	4,2	0,7	16,9
Finland	2004	15,4	8,7	56,2
	2005	16,2	8,1	49,8
Lithuania	2004	5,0	0,7	15,0
	2005	3,7	0,8	21,1
Latvia	2004	2,1	2,1	99,7
	2005	2,3	2,3	99,9
Germany	2004	135,5	14,0	10,3
	2005	134,9	16,7	12,4
Poland	2004	77,9	4,3	5,5
	2005	77,7	4,6	5,9
Slovakia	2004	6,2	0,7	12,0
	2005	6,5	0,9	13,5
Sweden	2004	33,9	13,6	40,0
	2005	34,3	15,4	44,7

Fig. 2. Share of energy from renewable sources in total primary energy in selected EU countries in 2004 – 2005



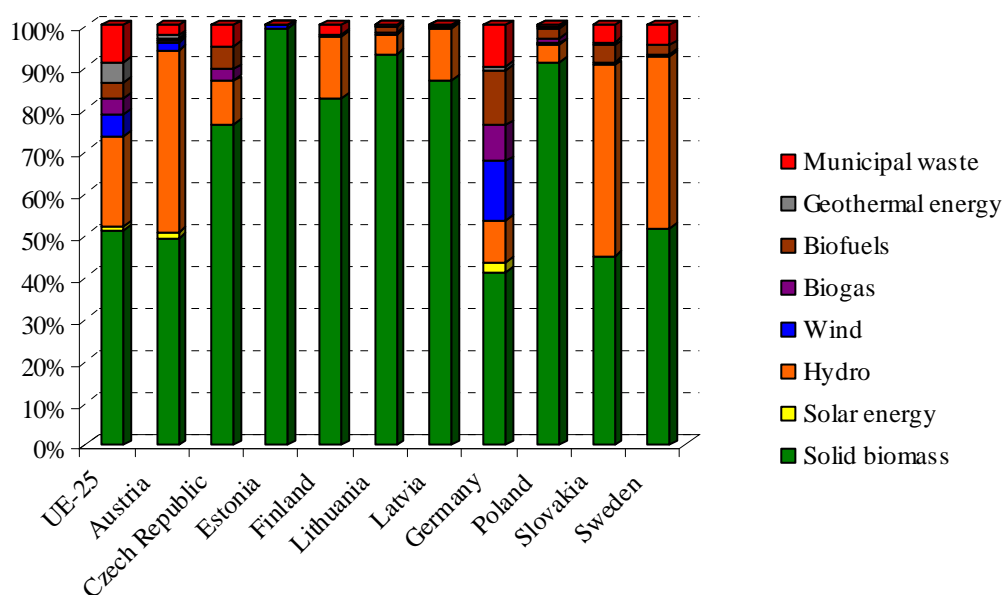
In Poland the share of energy from renewable sources in total primary energy increased from 5.5% in 2004 to 5.9% in 2005. In EU-25 the production of energy from renewable sources increased from 7.0% with simultaneous decline in production of total primary energy by 0.3%. Increase in the amount of energy produced from renewable sources in Poland in these years was (by 7.0%) higher than the value of this indicator for EU-25 countries (4.1%).

The structure of production of energy by sources in selected European Union countries in 2005 is presented in table 3 and in figure 3.

Table 3. The structure of energy production from particular sources in selected EU countries in 2005 [%]

Specification	Solid biomass	Solar energy	Hydro	Wind	Biogas	Biofuels	Geothermal energy	Municipal waste
UE-25	51,3	0,7	21,4	5,4	3,8	4,0	4,7	8,7
Austria	49,5	1,3	43,5	1,6	0,4	0,8	0,5	2,4
Czech Republic	76,4	0,1	10,2	0,1	2,8	5,6	0,0	4,8
Estonia	99,0	0,0	0,3	0,7	0,0	0,0	0,0	0,0
Finland	82,7	0,0	14,7	0,2	0,5	0,0	0,0	1,9
Lithuania	92,9	0,0	5,0	0,0	0,3	1,4	0,4	0,0
Latvia	86,9	0,0	12,5	0,2	0,3	0,1	0,0	0,0
Germany	41,3	2,2	10,1	14,0	8,6	13,1	0,8	9,9
Poland	91,2	0,0	4,1	0,3	1,2	2,6	0,2	0,4
Slovakia	45,1	0,0	45,2	0,1	0,6	4,1	0,9	4,0
Sweden	51,7	0,0	40,7	0,5	0,2	2,1	0,0	4,8

Fig. 3. Structure of production of primary renewable energy sources in selected EU countries in 2005



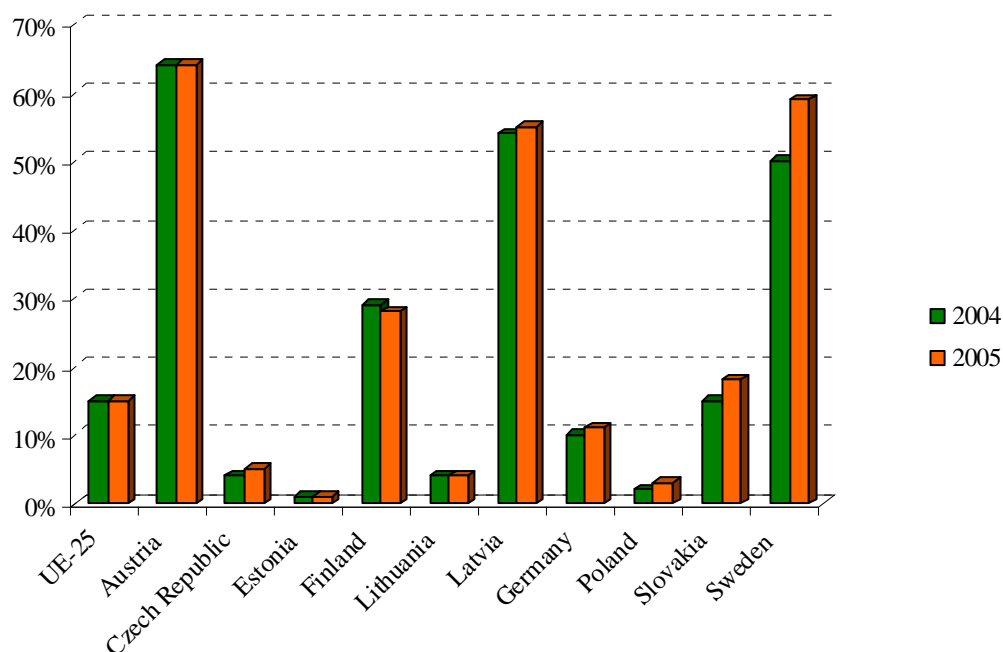
Due to different geological and climatic conditions production of energy from renewable sources in particular countries varies – the energy from solid biomass dominates (from 41.3% in Germany to 99.0% in Estonia). The second in respect of its consumption was hydro power (from 0.3% in Estonia to 45.2% in Slovakia). The small share of solar energy in almost all countries is significant (varying from trace amounts in the majority of countries to 1.3% in Austria and 2.2% in Germany). In Poland in 2005 energy from renewable sources came in 91.2% from solid biomass. Other sources of energy in Poland recorded in statistics were: hydro power (4.1%), biofuels (2.6%), biogas (1.2%), biodegradable municipal waste (0.4%), wind energy (0.3%) and geothermal energy (0.2%).

One of the aims of European Union in respect of development of renewable energy is to increase the share of electricity produced from renewable sources of energy in the national use of this energy. The indicators for selected EU countries in 2004 – 2005 are presented in table 4 and in figure 4.

Table 4. The share of electricity produced from renewable energy sources in the total use of electricity in selected EU countries in 2004 – 2005 [%]

Specification	2004	2005
UE-25	15	15
Austria	64	64
Czech Republic	4	5
Estonia	1	1
Finland	29	28
Lithuania	4	4
Latvia	54	55
Germany	10	11
Poland	2	3
Slovakia	15	18
Sweden	50	59

Fig. 4. Share of electricity from renewable sources in total consumption of electricity in selected EU countries in 2004 – 2005



The share of electricity produced from renewable energy sources in total electricity consumption in EU-25 in 2004 – 2005 remained at the level of 15%. For particular countries

the value of this indicator is very diverse, e.g. in 2005 its value varied between 1% (Estonia) and 64% (Austria). For Poland the share of electricity produced from renewable sources in the national use of electricity in 2004 amounted to 2% and in 2005 – to 3%.

The share of particular sources of renewable energy in the production of electricity from RES in selected EU countries in 2004 – 2005 is presented in table 5 and figures 5 and 6.

Table 5. The structure of electricity production from renewable energy sources in selected EU countries in 2004 – 2005 [%]

Specification		Solid biomass	Solar energy	Hydro	Wind	Biogas	Geothermal energy	Municipal waste
EU-25	2004	8,5	0,2	69,5	13,4	2,6	1,3	4,5
	2005	9,5	0,3	64,6	16,1	3,1	1,2	5,2
Austria	2004	4,3	0,0	92,4	2,3	0,1	0,0	0,9
	2005	4,9	0,0	90,7	3,4	0,2	0,0	0,8
Czech Republic	2004	20,5	0,0	73,4	0,4	5,1	0,0	0,6
	2005	17,8	0,0	75,8	0,7	5,1	0,0	0,6
Estonia	2004	43,4	0,0	41,5	15,1	0,0	0,0	0,0
	2005	21,6	0,0	22,7	55,7	0,0	0,0	0,0
Finland	2004	39,6	0,0	58,6	0,5	0,1	0,0	1,2
	2005	39,2	0,0	58,5	0,7	0,1	0,0	1,5
Lithuania	2004	0,9	0,0	98,6	0,0	0,5	0,0	0,0
	2005	0,7	0,0	98,4	0,0	0,9	0,0	0,0
Latvia	2004	0,2	0,0	97,3	1,5	1,0	0,0	0,0
	2005	0,2	0,0	97,3	1,4	1,1	0,0	0,0
Germany	2004	6,7	1,0	36,0	43,5	5,6	0,0	7,2
	2005	7,3	2,0	30,8	42,9	7,4	0,0	9,6
Poland	2004	25,0	0,0	67,7	4,6	2,7	0,0	0,0
	2005	36,4	0,0	57,2	3,5	2,9	0,0	0,0
Slovakia	2004	0,1	0,0	99,1	0,1	0,0	0,0	0,7
	2005	0,1	0,0	98,7	0,1	0,1	0,0	1,0
Sweden	2004	9,6	0,0	87,3	1,2	0,1	0,0	1,8
	2005	8,4	0,0	88,8	1,1	0,1	0,0	1,6

Fig. 5. The structure of electricity production from renewable energy sources in selected EU countries in 2004

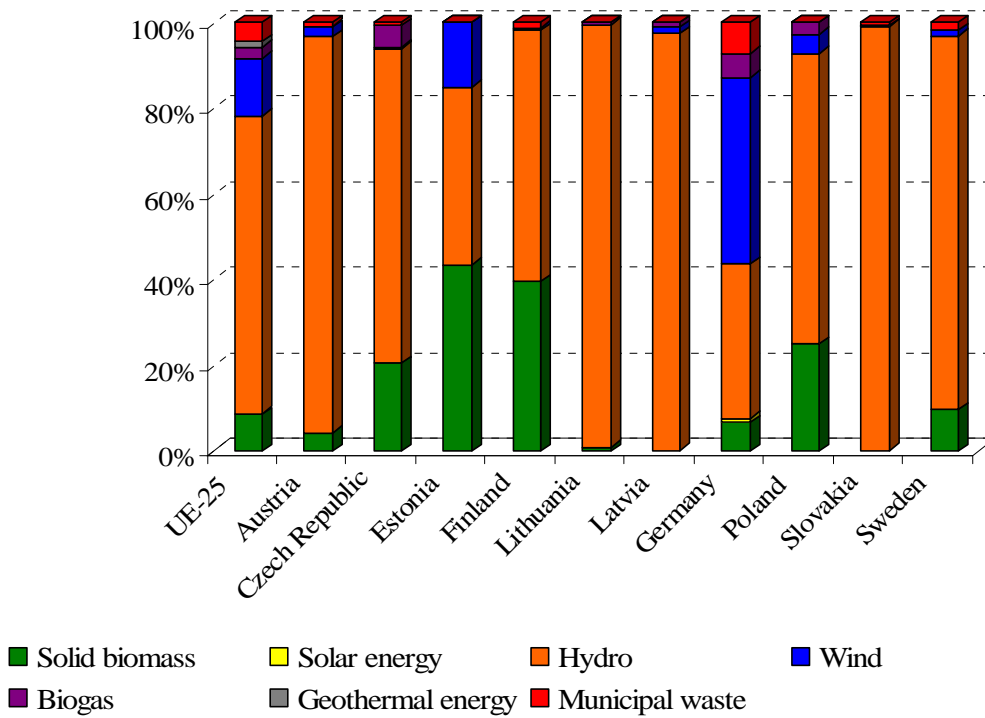
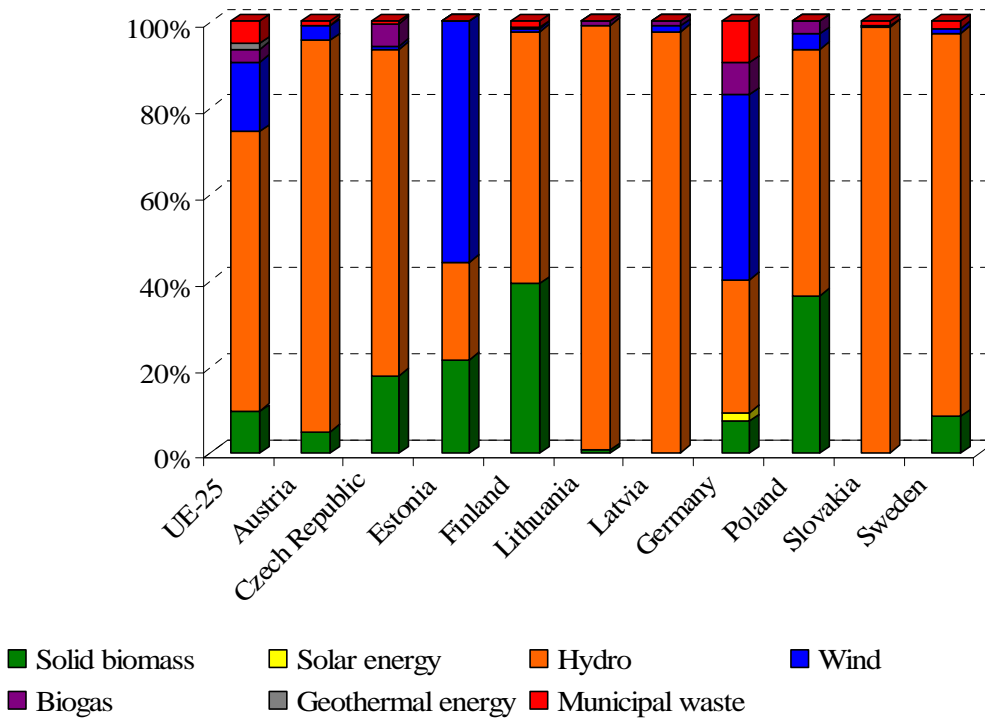


Fig. 6. The structure of electricity production from renewable energy sources in selected EU countries in 2005



In the majority of these countries the dominant share in production of electricity is that of water. For EU-25 the share of this source in 2004 amounted to 69.5% and in 2005 – to 64.6%. For particular countries in 2005 the share of hydro power in the production of electricity from RES varies from 22.7% (Estonia) to 98.4% (Lithuania) and 98.7% (Slovakia). For Poland in 2005 the hydro power constituted 57.2% of electricity from RES (in 2004 – 67.7%). Differentiation in the level of use of this energy, as well as other RES in particular EU countries results mostly from local geographic condition and RES resources available for use. The second place in respect of consumption is taken by wind energy, the share of which for EU-25 increased from 13.4% in 2004 to 16.1% in 2005. For particular countries in 2005 the share of wind energy in the production of electricity from RES in 2005 varies from 0% (Lithuania) and 0.1% (Slovakia) to 42.9% (Germany) and 55.7% (Estonia). In Poland the wind energy in 2005 amounted to 3.5% of electricity from RES (in 2004 – 4.6%). For EU countries the share of electricity produced from solid biomass incineration increases (for UE-25 in 2004 – 8.5% and in 2005 – 9.5%). in 2005 the share of solid biomass in the production of electricity from RES in particular countries varied from 0.1% (Slovakia) to 39.2% (Finland). In Poland the electricity produced from biomass in 2005 amounted to 36,4% of electricity from RES (in 2004 – 25%). In 2005 the smallest share in production of electricity from RES in EU countries has solar energy (for EU-25 in 2005 – 0.3% and in 2004 – 0.2%). Among the mentioned countries the solar energy is used in production of electricity (photovoltaic cells) only in Germany (in 2005 – 2.0% and in 2004 – 1.0%).

4. National balances of renewable energy (year 2006 and 2000 – 2006)

National balance of renewable energy sources for 2006, prepared on the basis of data collected within public statistics, is presented in table 6.

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%.

The highest position in the renewable energy balance had solid biomass energy, the share of which in production of all renewable energy sources amounted to 91.3%. The subsequent places in respect of RES share were occupied by: hydro (3.5% share in production of energy from RES), liquid biofuels (3.3%), biogases (1.2%), wind (0.4%) and geothermal energy (0.3%). There were also small amount of energy from biodegradable municipal waste recorded (0.008%) and solar energy produced from solar collectors (0.005).

Table 7 presents balances for solid biomass for years 2000 – 2006. The data presented indicate a constant increase in the amount of produced and used solid biomass. 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%).

The structure of solid biomass use in 2006 is presented in figures 7. Figure 8 presents the amount of biomass use by final recipients in 2000 – 2006. The structure of solid biomass use as input for energy transformations is presented in fig. 9.

Table 6. The balance of renewable energy carriers in 2006 [TJ]

Specification	Solid biomass	Solar energy	Hydro	Wind	Liquid biofuels	
					bioethanol	biodiesel
Indigenous Production	192097	11	7352	922	3542	3423
Imports(+)					66	5
Exports (-)					989	1979
Stock Changes (+/-)	-73				-61	49
Inland Consumption	192024	11	7352	922	2558	1498
Transformation Sector of which:	21180		7352	922	2558	1249
Main Activity Producer Electricity /CHP/ Plants	13430		7352	922		
Main Activity Producer Heat Plants	1601					
Autoproducer CHP Plants	5954					
Autoproducer Heat Plants	195					
For Blending to Motor Gasoline/Diesel					2558	1249
Energy Sector of which:	11					
Own Use in Electricity, CHP and Heat Plants	10					
Oil and Natural Gas Extraction Plants	1					
Final Energy Consumption of which:	170833	11				249
Industry Sector of which:	41752					
Iron and Steel	1					
Non-Metallic Minerals	140					
Transport Equipment	7					
Machinery	29					
Food, Beverages and Tobacco	239					
Paper, Pulp and Printing	30368					
Wood and Wood Products	7952					
Non-specified (industry)	3016					
Construction	24					
Transport Sector						249
Other Sectors of which:	129057	11				
Commerce and Public Services	4580	11				
Households	104500					
Agriculture / Forestry	19977					

Table 6. The balance of renewable energy carriers in 2006 [TJ] cont.

Specification	Biogas				Geothermal energy	Municipal waste	Total
	Landfill Gas	Sludge Gas	Other Biogas	Total			
Indigenous Production	791	1804	18	2613	535	18	210513
Imports(+)							71
Exports (-)							2968
Stock Changes (+/-)						3	-82
Inland Consumption	791	1804	18	2613	535	21	207534
Transformation Sector of which:	791	1211	18	2020			35281
Main Activity Producer Electricity /CHP/ Plants	18			18			21722
Main Activity Producer Heat Plants		2		2			1603
Autoproducer CHP Plants	773	1209	18	2000			7954
Autoproducer Heat Plants							195
For Blending to Motor Gasoline/Diesel							3807
Energy Sector of which:		15		15			26
Own Use in Electricity, CHP and Heat Plants		15		15			25
Oil and Natural Gas Extraction Plants							1
Final Energy Consumption of which:		578		578	535	21	172227
Industry Sector of which:		72		72		21	41845
Iron and Steel							1
Non-Metallic Minerals						1	141
Transport Equipment							7
Machinery							29
Food, Beverages and Tobacco		72		72			311
Paper, Pulp and Printing							30368
Wood and Wood Products							7952
Non-specified (industry)						20	3036
Construction							24
Transport Sector							249
Other Sectors of which:		506		506	535		130109
Commerce and Public Services		506		506	100		5197
Households					435		104935
Agriculture / Forestry							19977

Table 7. Energy balance of solid biomass in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	150485	160406	163308	164163	170056	174431	192097
Stock Changes (+/-)	-292		66	-83			-73
Inland Consumption	150193	160406	163374	164080	170056	174431	192024
Transformation Sector of which:	3461	4886	4809	5799	8905	17500	21180
Main Activity Producer CHP Plants	1298	1181	1126	2001	3837	9641	13430
Main Activity Producer Heat Plants	177	252	388	619	1244	1412	1601
Autoproducer CHP Plants	1628	3058	2878	2742	3598	6194	5954
Autoproducer Heat Plants	358	395	417	437	226	253	195
Energy Sector of which:	6	39	29	8	4	2	11
Own Use in Electricity, CHP and Heat Plants	3	36	8	7	4	2	10
Coal Mines	3	3	21	1			
Oil and Natural Gas Extraction Plants							1
Final Energy Consumption of which:	146726	155481	158536	158273	161147	156929	170833
Industry Sector of which:	26089	26185	29258	30394	31864	30990	41752
Iron and Steel	3	6	3	4	4	2	1
Chemical (including Petrochemical)			1	153	102	165	
Non-Ferrous Metals	11	5	1				
Non-Metallic Minerals	6	275	292	102	261	110	140
Transport Equipment			3	3	6	1	7
Machinery	3	6	10	22	52	54	29
Mining and Quarrying		2		6	10	1	
Food, Beverages and Tobacco	49	62	60	323	373	214	239
Paper, Pulp and Printing	15938	15138	16622	17950	18957	18611	30368
Wood and Wood Products	7572	8032	9871	9297	9327	9641	7952
Textile and Leather				2	4	1	
Non-specified (industry)	2507	2659	2395	2532	2768	2190	3016
Construction	23	17	21	35	17	30	24
Other Sectors of which:	120614	129279	129257	127844	129266	125909	129057
Commerce and Public Services	8514	5736	5747	5752	6028	6171	4580
Households	95000	104500	104500	103075	103360	100700	104500
Agriculture / Forestry	17100	19043	19010	19017	19878	19038	19977

Fig. 7. The structure of solid biomass consumption in 2006

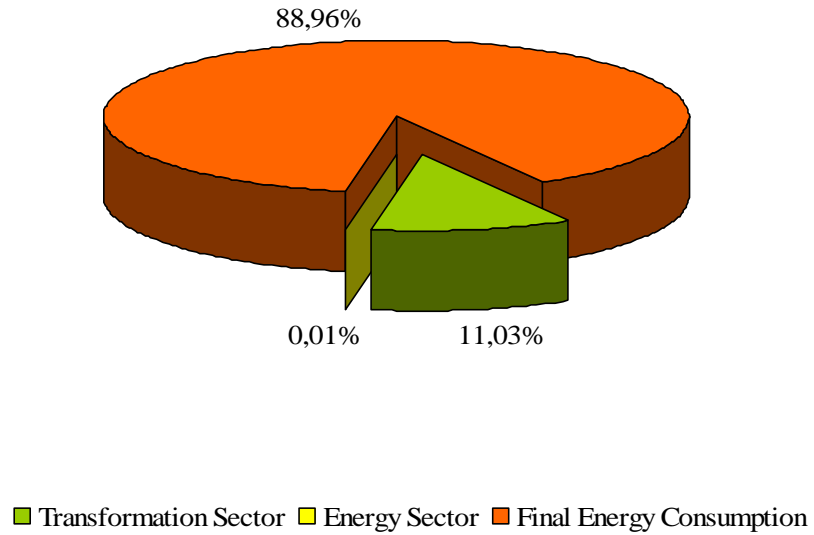


Fig. 8. Consumption of solid biomass by final users in 2000 - 2006 [TJ]

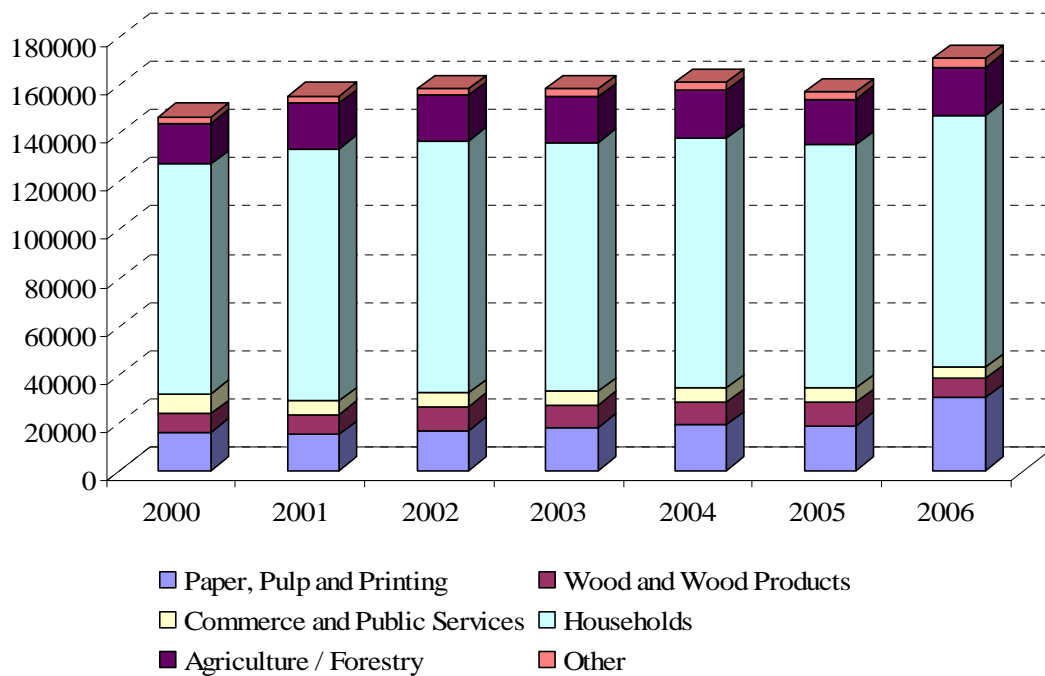


Fig. 9. The structure of solid biomass consumption for transformation sector in 2006

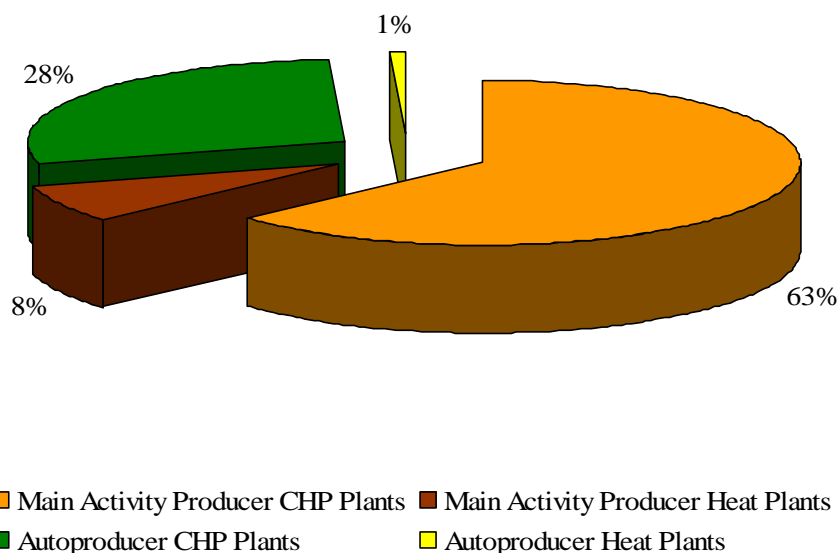


Table 8 presents the amounts of heat produced in solar collectors recorded in reports G-02b (Balance report on energy commodities and heating infrastructure) for years 2002 – 2006

Table 8. Production of heat in solar collectors in 2002-2006 [TJ]

Specification	2002	2003	2004	2005	2006
Indigenous Production	1	1	4	6	11

The collective data presented in the table above do not give a full picture in this respect due to very low capacities and local character of used solar collectors. Among about 15 thousand entities obliged to present G-02b reports, the data for 2001 were submitted by 1 entity, in 2002 – 3, in 2003 – 7, in 2004 – 16, in 2005 – 17, and in 2006 – 36. These were entities classified into the following group of users: commerce and public services. Simultaneously, 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%.

Collective data pertaining to hydro and wind power used for production of electricity in 2000 – 2006 are presented in table 9.

Table 9. Production of hydro and wind power in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Hydro	7580	8369	8204	6017	7494	7924	7352
Wind	20	49	219	448	512	488	922

The data presented above demonstrate that in situation of maintained similar level of water energy use (7 – 8 PJ), the discussed period saw a constant increase in the use of wind energy. Production of electricity in wind power stations increased from 20 TJ in 2000 to 922 TJ in 2006. Detailed data pertaining to use of electricity in hydro and wind power stations are presented in points 5 and 6 of this study.

The balance of basic biofuels in trade of liquid fuels, prepared on the basis of reports included in the public statistics survey programmes for a particular years, are presented in table 10 (bioethanol) and in table 11 (biodiesel). Table 10 presents data available for years 2005 – 2006 for bioethanol and table 11 for years 2005 – 2006 for biodiesel.

Table 10. Balance of bioethanol in 2005 – 2006

Specification	2005		2006	
	tons	TJ	tons	TJ
Indigenous Production	80940	2404	119261	3542
Imports(+)			2232	66
Exports (-)	28902	858	33302	989
Stock Changes (+/-)	1440	43	-2056	-61
Inland Consumption for mixing with motor gasoline	53478	1589	86125	2558

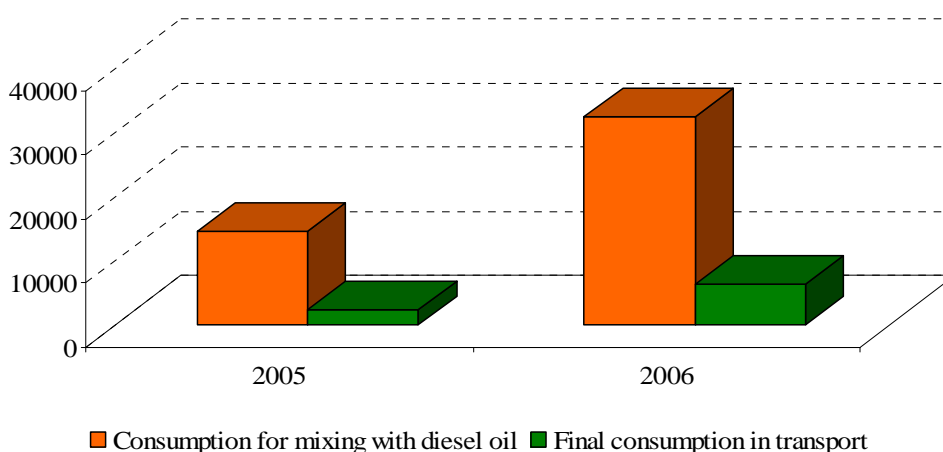
Table 11. Balance for biodiesel in 2005 – 2006

Specification	2005		2006	
	tons	TJ	tons	TJ
Indigenous Production	64336	2471	89126	3423
Imports(+)			142	5
Exports (-)	48599	1866	51528	1979
Stock Changes (+/-)	1344	52	1282	49
Inland Consumption of which:	17081	657	39022	1498
for mixing with diesel oil	14652	563	32516	1249
final consumption in transport	2429	94	6506	249

In 2006 there was a significant increase in national production and use of bioethanol, production of this product was higher by 47.3% as compared to 2005, and its use in this period increased by 61%. The whole bioethanol used in the country was added to engine fuels.

In 2006 the production of biodiesel was by 38.5% higher as compared with the production in 2005, and its use by 128.4% higher. The biodiesel used in the country was in 80% added to diesel. The structure of used fuel in 2005 – 2006 is presented in figure 10.

Fig. 10. Consumption of biodiesel in 2005 – 2006 [tons]



The balance-sheet data for biogases for years 2000 – 2006 are presented in table 12 and tables 13 – 15 present detailed data on particular types of biogases (landfill, from sludge and others).

Table 12. Balance of biogas in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	1 211	1 477	1 353	1 624	1 941	2 243	2 613
Transformation Sector of which:	443	563	615	861	1 293	1 820	2 020
Main Activity Producer CHP Plants				127	57	21	18
Main Activity Producer Heat Plants	46	29	5	19			2
Autoproducer Electricity Plants	396	532					
Autoproducer CHP Plants			609	714	1 236	1 798	2 000
Autoproducer Heat Plants	1	2	1	1		1	
Energy Sector	27	12	18		16	12	15
Final Energy Consumption of which:	741	902	720	763	632	411	578
Food, Beverages and Tobacco	63	42	37	63	74	68	72
Commerce and Public Services	678	860	683	700	558	343	506

In the discussed period (except for 2002) there was a significant increase in the amount of produced biogas, by approx. 15 – 20% per year. The fuel was mostly used as input of energy transformations in heat and power stations and thermal power stations (40 – 80% of the total consumption). The production of biogas in 2006 was higher by 16.5% than the production in 2005. As input of energy transformations was used 77.3% of produced gas, and 22.1% was constituted by final consumption, of which majority in units belonging to commerce and public services (87.5%). The structure of biogases use in 2006 is presented in figure 11.

Fig. 11. The structure of biogas consumption in 2006

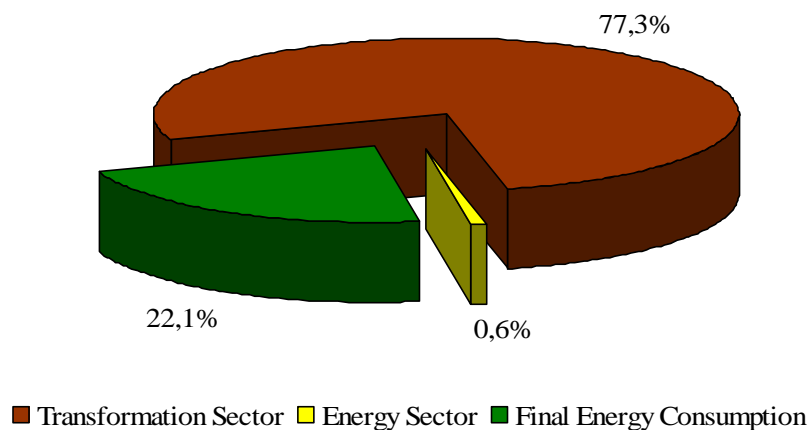


Table 13 presents detailed data for 2000 – 2006 pertaining to gas obtained from landfills.

Table 13. Balance of biogas from landfills in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	423	544	628	704	636	649	791
Transformation Sector of which:	396	532	610	704	636	649	791
Main Activity Producer CHP Plants				127	57	21	18
Autoproducer Electricity Plants	396	532					
Autoproducer CHP Plants			609	576	579	628	773
Autoproducer Heat Plants			1	1			
Energy Sector	27	12	18				

In 2002 – 2005 (except for 2003) production of landfill biogas remained at a similar level, between 628 and 649 [TJ]. In 2006 there was an increase in production of biogas, as

compared with 2005, by 21.9%. Landfill gas was entirely used in energy transformations for generation of electricity and heat.

Table 14 presents balance-sheet data for years 2000 – 2006 pertaining to biogas obtained from sludge.

Table 14. Balance of biogas from sludge in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	788	933	725	896	1 297	1 586	1 804
Transformation Sector of which:	47	31	5	133	649	1 163	1 211
Main Activity Producer Heat Plants	46	29	5	19			2
Autoproducer CHP Plants				114	649	1 162	1 209
Autoproducer Heat Plants	1	2				1	
Energy Sector					16	12	15
Final Energy Consumption of which:	741	902	720	763	632	411	578
Food, Beverages and Tobacco	63	42	37	63	74	68	72
Commerce and Public Services	678	860	683	700	558	343	506

The data presented above indicate that since the beginning of 2003 there was a constant growth in the amount of biogas obtained from sewage treatment plants, and consequently in 2003 as compared with the preceding year there was an increase by 23.6% and in subsequent years: in 2004 by 44.8%, in 2005 by 22.3% and in 2006 by 13.7%. In respect of this gas there was a relatively large share of direct final use recorded in the total consumption (85.1% in 2003, 48.7% in 2004, 25.9% in 2005, and 32.0% in 2006).

Table 15 presents detailed data on production and consumption of other biogases for years 2003 – 2006.

Table 15. Balance-sheet of other biogas in years 2003 – 2006 [TJ]

Specification	2003	2004	2005	2006
Indigenous Production	24	8	8	18
Transformation Sector (Autoproducer CHP Plant)	24	8	8	18

The presented data suggest that this group of biogases constitutes a small part of all biogases, and that for 2006 the gases constituted 0.7% of the total amount of obtained biogases.

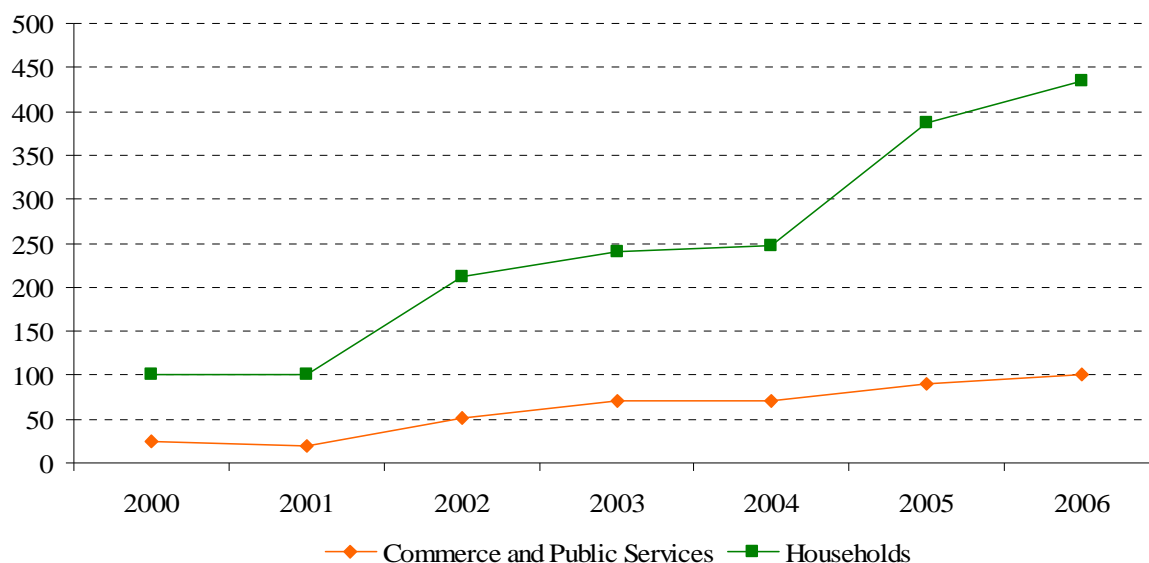
Table 16 presents data pertaining to production and consumption of geothermal energy in years 2000 - 2006.

Table 16. The balance of geothermal energy in years 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

The aforementioned data 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%. Majority of geothermal energy is used for satisfying demand for heat of 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 12.

Fig. 12. Consumption of geothermal energy in years 2000 – 2006



Balance-sheets of biodegradable municipal waste for years 2000 – 2006 are presented in table 17.

Table 17. The balance of renewable municipal waste in years 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Indigenous Production	32	11	10	14	13	30	18
Stock Changes (+/-)	4						3
Inland Consumption	36	11	10	14	13	30	21
Energy Sector (Electricity, CHP and Heat Plants)	4	1					
Final Energy Consumption of which:	32	10	10	14	13	30	21
Non-Metallic Minerals				3	13	30	1
Non-specified (industry)							20
Commerce and Public Services	19		10	11			
Agriculture / Forestry	13	10					

The data presented above indicate small share of municipal waste in national balances of renewable energy.

5. Production of electricity and heat from renewable sources (year 2006 and 2000 – 2006)

The data pertaining to the amount of production of electricity from renewable energy sources in 2006 are presented in table 18.

Table 18. Production of electricity from renewable energy sources in 2006 [MWh]

Specification	Main Activity Producer Plants		Autoproducer Plants		Total
	Electricity (only)	CHP	Electricity (only)	CHP	
Total	2 296 695	1 154 893	1 706	856 634	4 309 928
Hydro of which:	2 040 618		1 706		2 042 324
Hydro-1 MW	246 241		1 706		247 947
Hydro 1-10 MW	566 558				566 558
Hydro 10+ MW	1 227 819				1 227 819
Wind	256 077				256 077
Solid biomass		1 154 187		697 220	1 851 407
<i>in which co-combustion</i>		<i>1 154 187</i>		<i>516 830</i>	<i>1 671 017</i>
Biogas of which:		706		159 414	160 120
Landfill gas		706		91 296	92 002
Sludge gas				66 654	66 654
Other biogas				1 464	1 464

Electricity produced in 2006 from renewable energy sources constituted 3.2% of the national consumption of electricity.

In 2006 the electricity produced in hydro-power stations amounted to 47.4% of the total production of electricity from RES. The second place in respect of share of production of energy from RES has the energy produced on the basis of solid biomass (43%). 90.3% of energy produced from solid biomass came from co-incineration with other fuels. Other sources of energy used for production of electricity 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%). Figure 13 presents the amount of electricity production in 2006 by sources. Figure 14 presents the production of this energy in professional and industrial power engineering.

Fig. 13. Production of electricity from renewable energy sources in 2006 [MWh]

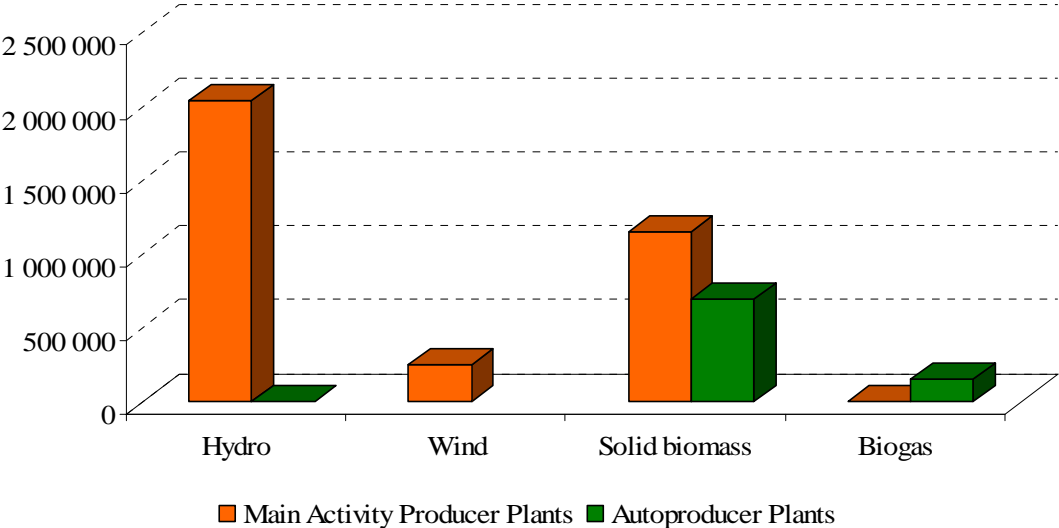
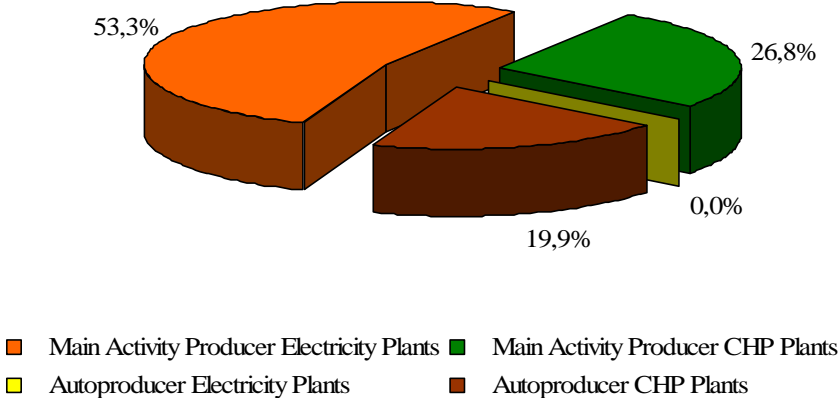


Fig. 14. The structure of electricity production from renewable energy sources in 2006



The amount of electricity production from renewable sources of energy in 2000 – 2006 is presented in table 19 and figure 15. Figure 16 presents the amount of energy in hydro-electric power stations.

**Table 19. Production of electricity from renewable energy sources
in 2000 – 2006 [MWh]**

Specification	2000	2001	2002	2003	2004	2005	2006
Total	2 332 000	2 783 000	2 767 000	2 250 000	3 074 401	3 847 332	4 309 928
Hydro of which:	2 106 000	2 325 000	2 279 000	1 671 000	2 081 739	2 201 115	2 042 324
Hydro-1 MW	298 000	239 000	262 000	242 000	273 457	358 195	247 947
Hydro 1-10 MW	422 000	532 000	585 000	431 000	616 931	504 188	566 558
Hydro 10+ MW	1 386 000	1 554 000	1 432 000	998 000	1 191 351	1 338 732	1 227 819
Wind	5 000	14 000	61 000	124 000	142 319	135 470	256 077
Solid biomass	190 000	402 000	379 000	399 000	768 180	1 399 470	1 851 407
<i>in which co-combustion</i>					620 486	1 236 338	1 671 017
Biogas of which:	31 000	42 000	48 000	56 000	82 163	111 277	160 120
Landfill gas	31 000	42 000	48 000	53 000	63 292	75 272	92 002
Sludge gas	0	0	0	2 000	18 097	35 388	66 654
Other biogas	0	0	0	1 000	774	617	1 464

**Fig. 15. Production of electricity from renewable energy sources in 2000 – 2006
[MWh]**

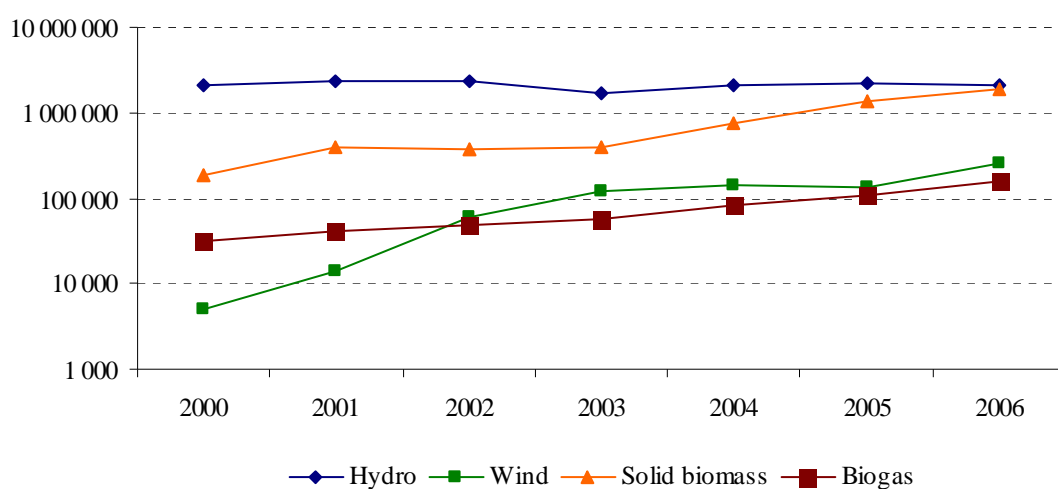
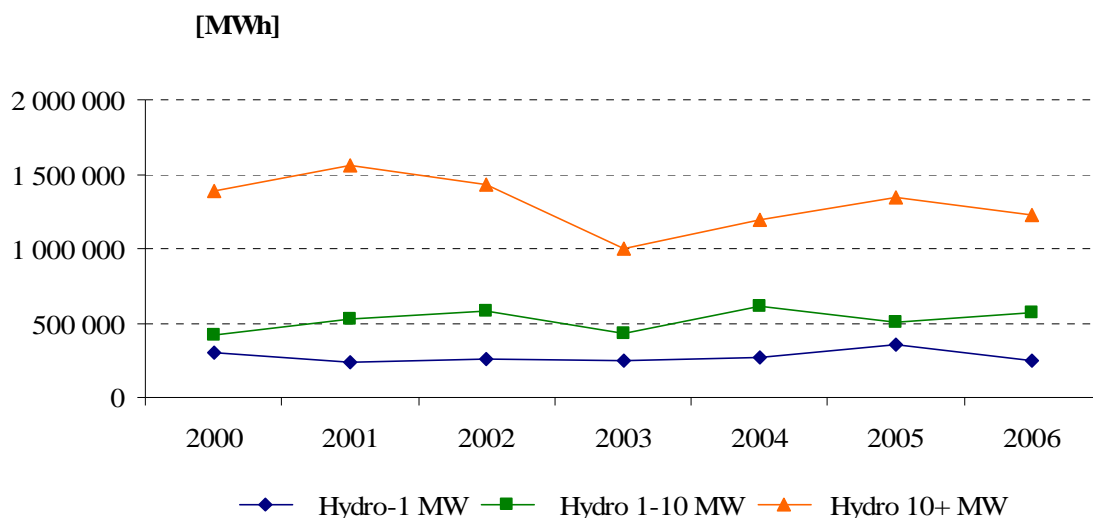


Fig.16. Production of electricity in hydro-electric power stations in 2000 - 2006



Since 2004 the production of electricity from RES increases as compared to the preceding year (in 2004 by 36.6%, in 2005 – 25.1% and in 2006 – 12.0%). The largest increase (except for 2005) was recorded for wind energy (in 2001 by 180%, in 2002 – 335.8%, in 2003 – 103.3%, in 2004 – 14.8%, in 2005 decline by 4.8% and in 2006 increase by 89.0%). High increase (since 2004) also took place for electricity produced from solid biomass (in 2004 by 92.5%, in 2005 – 82.2%, and in 2006 – 32.3%). Also in the case of electricity produced from biogas in the discussed years there was an increase tendency (in 2001 – 35.5%, in 2002 – 14.3%, in 2003 – 16.7%, 2004 – 46.7%, 2005 – 35.4% and 2006 r. – 43.9%).

Table 20 and figure 17 present the amounts of heat production in 2006 in in heat and power stations and thermal power stations, the basis of which is incineration process. Figure 18 illustrates the structure of heat production from these sources.

Table 20. Production of heat from renewable energy sources in conventional power engineering in 2006 [TJ]

Specification	Main Activity Producer Plants		Autoproducer Plants		Total
	CHP	Heat (only)	CHP	Heat (only)	
Total	860	1 255	1 547	133	3 795
Solid biomass	849	1 253	857	133	3 092
Biogas of which:	11	2	690		703
Landfill gas	11		101		112
Sludge gas		2	582		584
Other biogas			7		7

Fig. 17. Production of heat from renewable energy sources in conventional power engineering in 2006 [TJ]

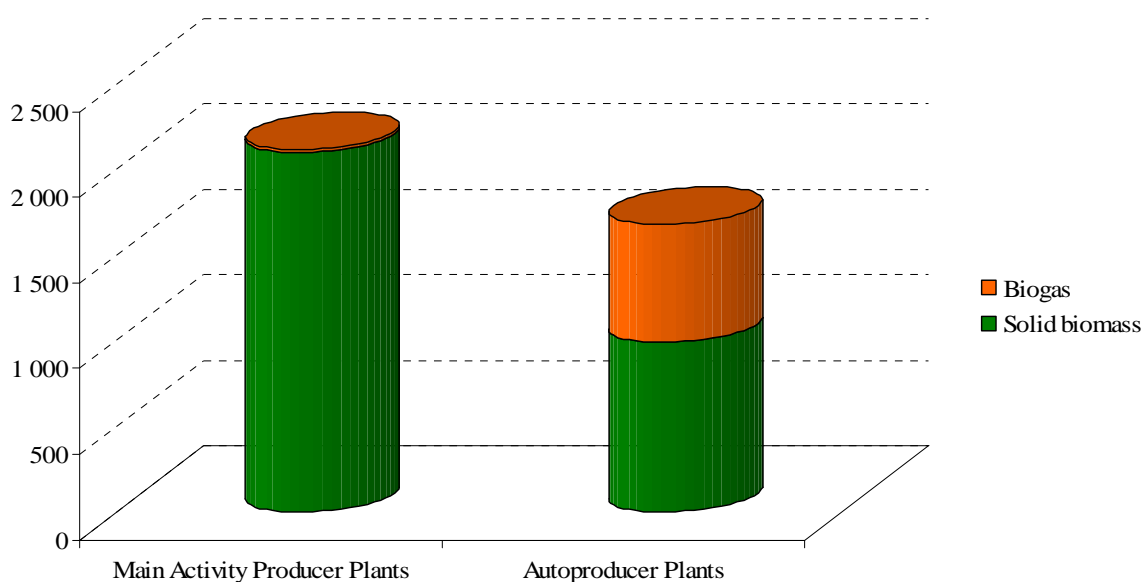
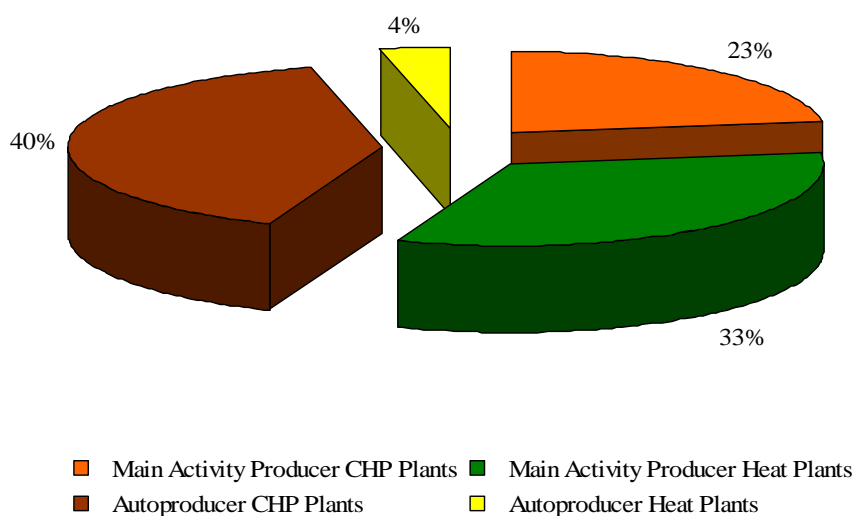


Fig. 18. Structure of production of heat from renewable energy sources in conventional power engineering in 2006



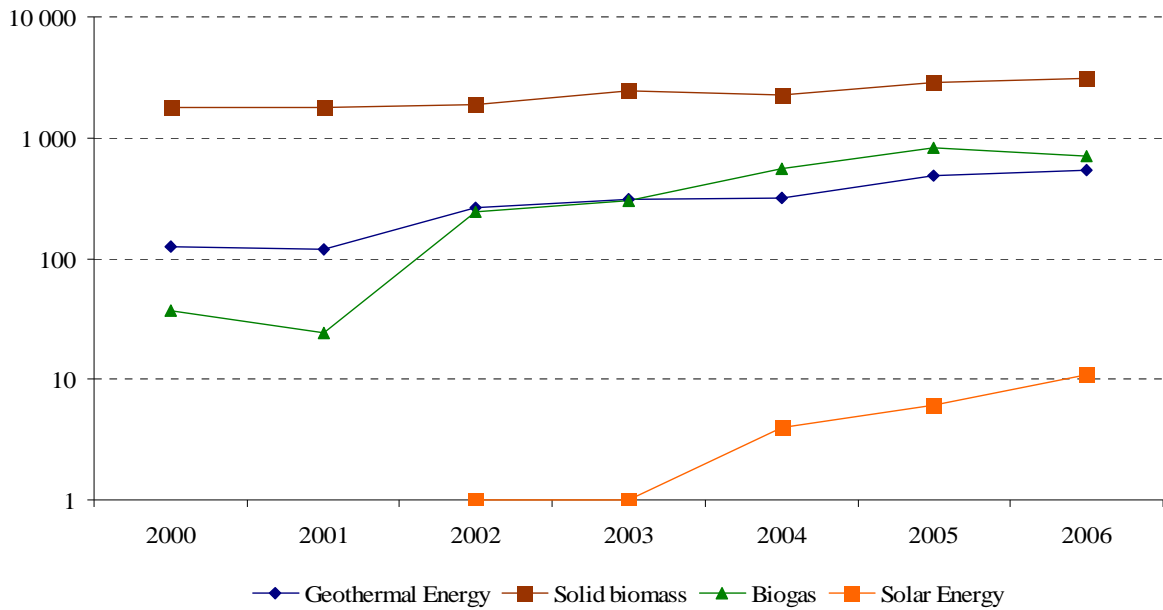
The data presented above demonstrate that 81.5% of heat was produced from biomass and the remaining 18.5% from biogas.

Table 21 and figure 19 present data on production of heat from all sources of energy available in the country in 2000 - 2006.

Table 21. Production of heat from renewable energy sources in 2000 – 2006 [TJ]

Specification	2000	2001	2002	2003	2004	2005	2006
Total	1 963	1 935	2 381	3 078	3 113	4 197	4 341
Solid biomass	1 802	1 791	1 871	2 465	2 242	2 882	3 092
Solar Energy			1	1	4	6	11
Biogas of which:	37	24	246	301	549	822	703
Landfill gas			242	230	136	92	112
Sludge gas	37	24	4	61	411	727	584
Other biogas				10	2	3	7
Geothermal Energy	124	120	263	311	318	487	535

Fig. 19. Heat generation from renewable energy sources in 2000 – 2006 [TJ]



The data presented above indicate a constant increase in total production of heat from RES since 2002 (in 2002 by 23.0%, in 2003 – 29.3%, in 2004 – 1.1%, in 2005 – 34.8% and in 2006 - 3.4%) and in respect of heat produced from biogas in 2002 – 2005 (in 2002 by 925%, in 2003 – 22.4%, in 2004 – 82.4% and in 2005 – 49.7%). The production of biogas in 2006 was by 14.5% lower than in 2005.

6. Capacities of devices using renewable sources for production of electricity (years 2000 – 2006)

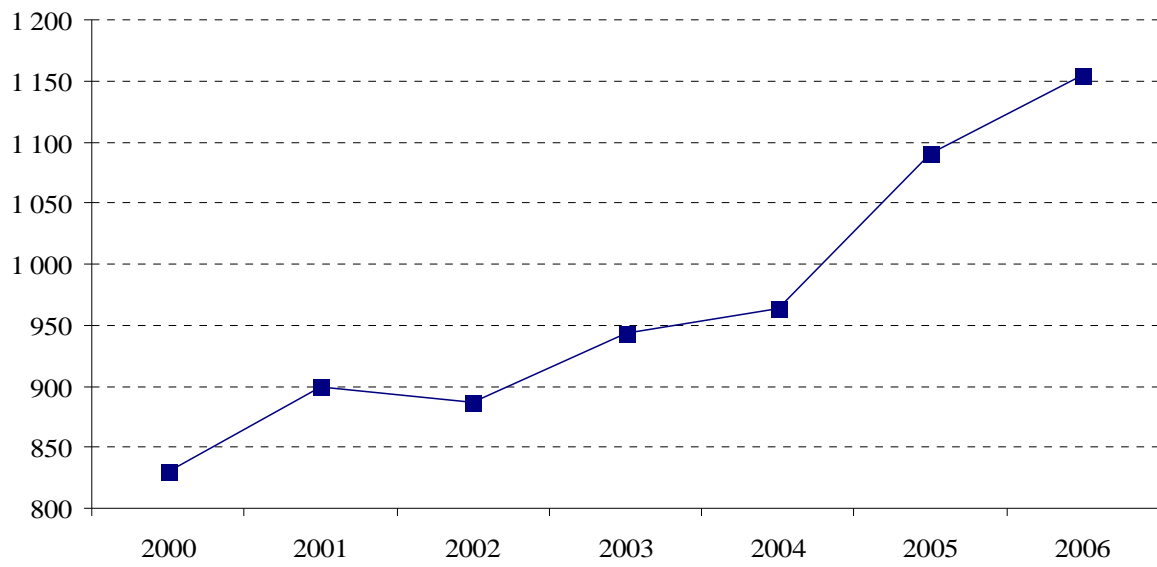
Generating capacities of power stations using renewable energy sources in 2000 – 2006 are presented in table 22 and figure 20.

Table 22. Capacities of power stations using renewable energy sources in 2000 – 2006 [MW]

Specification	2000	2001	2002	2003	2004	2005	2006
Total	830	899	887	943	964	1 091	1 155
Hydro of which:	817	868	841	867	876	915	925
Hydro-1 MW	57	76	60	63	77	72	72
Hydro 1-10 MW	98	106	150	164	184	174	181
Hydro 10+ MW	662	686	631	640	615	669	672
Wind	4	19	32	35	40	121	172
Solid biomass				24	24	25	25
Biogas of which:	9	12	14	17	24	30	33
Landfill gas	9	12	14	15	18	23	25
Sludge gas				2	6	7	7
Other biogas							1

In the analyzed period there was a constant moderate increase recorded in the total power of electricity-generating devices using RES. Annual increase of generating capacity varied between 2.2% (2004) and 13.2% (2005). Only in 2002 there was a slight decline in capacity (by 1.3%) resulting from decline in the total power of water-power stations (by 3.1%). The highest increase in power took place for wind energy (from 9.4% in 2003 to 246.9% in 2005) and biogas (between 10% (2006) and 41.2% (2004)).

**Fig. 20. Capacities of power stations using renewable energy sources
in 2000 – 2006 [MW]**



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Annex 1. Statistical classification of economic activities (according to NACE and ISIC (OECD))

No		NACE	ISIC (OECD)
1.	Industry Sector of which:	section D	total from: 2 - 12
2.	Iron and steel	27.1,27.2,27.3,27.51,27.52	27.1, 27.31
3.	Chemical (including Petrochemical)	24	24
4.	Non-Metallic Minerals	26	26
5.	Transport Equipment	34,35	34,35
6.	Machinery	28 - 32	28 - 32
7.	Mining and Quarrying	13,14	13,14
8.	Food, Beverages and Tobacco	15,16	15,16
9.	Paper Pulp and Printing	21,22	21,22
10.	Wood and Wood Products	20	20
11.	Textile and Leather	17 - 19	17 - 19
12.	Non-specified (industry)	25,33,36,37	25,33,36,37
13.	Construction	45(section F)	45(section F)
14.	Transport Sector	60-62	60-62*
15.	Other Sectors of which:		
16.	Commerce and Public Services	41.0,50 - 52,55,63 - 67,70 - 75,80,85,90 -93,95,99	41.0,50 - 52,55,63 - 67,70 - 75,80,85,90 - 93,95,99
17.	Agriculture / Forestry	01,02,05	01,02,05

* including international air transport, excluding sea transport