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SOURCES IN 2009**

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Preface

The publication “Energy from renewable sources in 2009” is the 4th edition of 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 2009, as well as data available for 2001 – 2008.

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, Production Division.

Wanda Tkaczyk

Deputy Director of the Production Division

Warsaw, November 2010

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1. Introduction

1.1. The general objectives of the use energy from renewable sources

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.

Renewable energy is an energy derived from repeating natural processes, obtained from renewable non-fossil energy sources (energy: water, wind, solar, geothermal, waves, currents and tides, and energy produced from solid biomass, biogas and liquid biofuels.)

In Polish conditions energy from renewable sources includes energy from direct use of solar energy, 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:

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC,
- White Paper – Energy for the Future: Renewable sources of energy (1997),
- Green Paper – Towards a European strategy for the security of energy supply (2001),

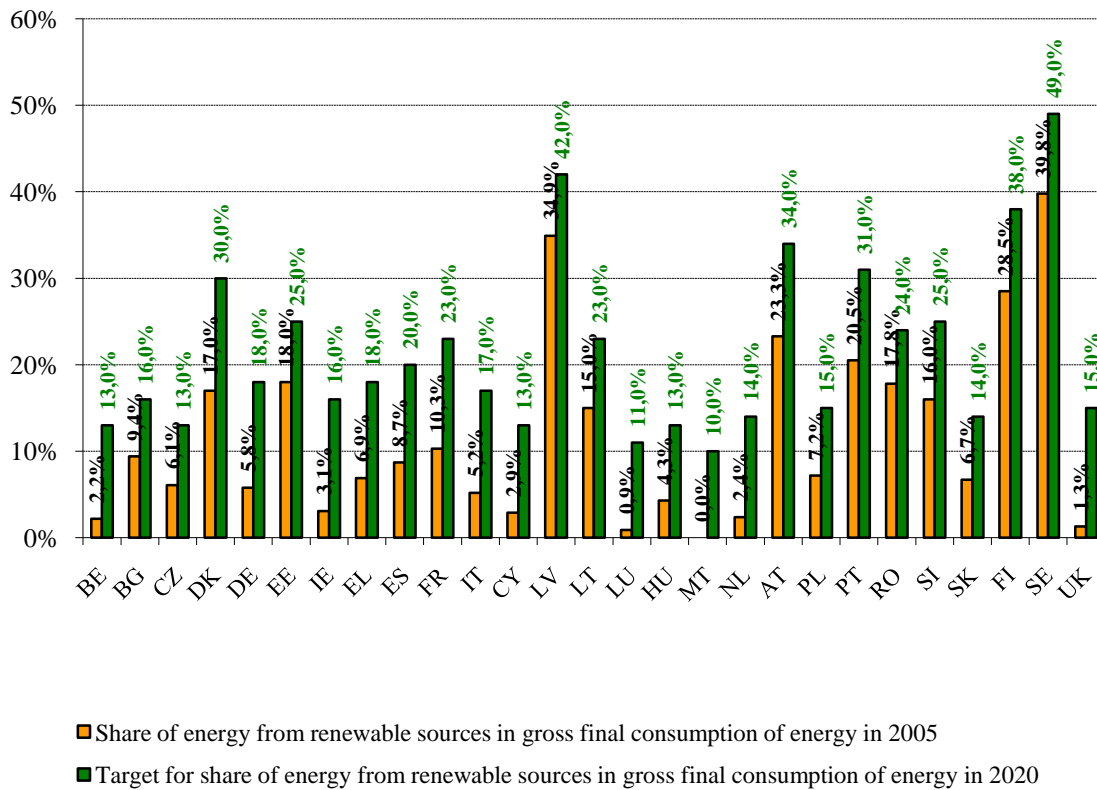
- Directive of the European Parliament and of the Council no 2001/77/EC of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market (O.J. EC L 283 of 27.10.2001),
- Directive of the European Parliament and of the Council no 2003/30/EC 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).

In adopted on 23 April 2009 by the European Parliament and Council Directive 2009/28/EC on the promotion of energy from renewable sources has identified a number of tasks for the EU Member States, in particular:

- ⇒ the common frameworks for the promotion of renewable energy;
- ⇒ mandatory national overall targets for the total share of renewables in gross final energy consumption and in relation to share of energy from renewable sources in transport;
- ⇒ rules concerning:
 - a) statistical transfers a certain amount of energy from renewable sources between Member States,
 - b) common projects between Member States and third countries,
 - c) guarantees of origin,
 - d) administrative procedures,
 - e) information and training,
 - f) access of renewable energy to the electricity grid;
- ⇒ sustainability criteria for biofuels and bioliquids.

Established in the Directive the overall targets for the share of energy from renewable sources in final energy consumption in 2020 for individual EU Member States are shown in Fig. 1.

Fig. 1. National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020.



Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 5 December 2010.

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 10 November 2009) 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 is increasing the use of renewable energy resources so that the share of this energy in gross final energy consumption achieves 15% 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: 2009 – 8,7%; 2010 to 2012 – 10,4%; up to 12,9% in 2017.

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 of 2006, No 89, item. 625 as amended),
- Regulation of the Minister of Economy of 14 August 2008 on the specific responsibilities to obtain and submit to the redemption of certificates of origin to pay the replacement fee, purchase of electricity and heat produced from renewable energy sources and the obligation to confirm the data on the amount of electricity generated in the renewable energy source (Journal of Laws of 2008, No 156, item. 969),
- Law of 25 August 2006 on biocomponents and liquid biofuels (Journal of Laws of 2006, No 169, item. 1199).

1.2. Characteristics of renewables (energy commodities)

Occurring in the publication renewable energy carriers are defined as follows:

Solid biomass

Solid biomass includes organic, non-fossil material of biological origin, which can be used as fuel to produce heat or electricity generation.

The basic solid fuel from biomass is forest biomass (firewood) 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. wastes from horticultural production, animal manure, briquettes and pellets of straw and so on).

The group of solid biomass fuels also contains charcoal, understood more broadly than solid products of biomass degassing.

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.

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.

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.

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*:
 - a) *agricultural biogas obtained from anaerobic fermentation of biomass from energy crops, residues from crop production and animal manure;*
 - b) *biogas obtained from anaerobic fermentation of biomass from wastes of slaughterhouses, breweries and from other activities in agricultural and food manufacturing.*

Biofuels (liquid biofuels for transport 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).

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).

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.

Besides the above discussed in the study renewable energy carriers (covered obligatory in statistical reporting), Directive 2009/28/EC introduced a new concepts defined as follows:

Aerothermal energy

‘Aerothermal energy’ means energy stored in the form of heat in the ambient air.

Hydrothermal energy

‘Hydrothermal energy’ means energy stored in the form of heat in surface water.

Bioliquids

‘Bioliquids’ means liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass.

Some of the Directive's definition differ from those employed in the Polish energy statistics. Thus, the term "biofuels" for transport extended to "gas fuel" produced from biomass. Occurring in the statistics the concept of "solid biomass" was replaced by a term "biomass" to include additional products in this group, "the biodegradable fraction of industrial and municipal waste". "Geothermal energy" was defined as: "the energy stored in the form of heat beneath the surface of the earth". Moreover, obtained by using heat pumps aerothermalna energy, geothermal and hydrothermal energy is considered to be from renewable sources (Annex VII).

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 2001 – 2009. 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. For obtaining fuller picture in this respect a new questionnaire (G-02o) pertaining only to renewable energy sources has been introduced to the “Statistical Survey Programme for Public Statistics” since 2008”.

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

- solid biomass,
- solar energy,
- water energy,
- wind energy,
- biogas,
- liquid biofuels for *transport*,
- geothermal energy,
- municipal waste,
- ambient heat for heat pumps.

The publication also includes the data pertaining to the amount of electricity and heat obtained from RES.

The consumption of biomass in households is not covered by regular surveys, and data presented are the result of estimates made on the basis of an inquiry form conducted in 2002

The statistical data presented in the publication are expressed in energy units (TJ – terajoules, GWh – giga-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-02o** – report of a heat from renewable sources,
- **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 according to the statements in balance sheets drawn up and released by EUROSTAT¹

Some of the data presented in this publication have been given on the basis of the preliminary data, so that they may be slight changes in the next edition.

Due to the electronic technique of data processing, in some cases, the sum of the components may vary slightly from the stated amount "of the total."

¹ <http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database>

2.2. 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 quantity of energy commodities (the only energy derivative) obtained through the energy transformation processes

Stock change (+/-) any increase in energy commodities stocks is indicated by a sign "-" and reduction by a sign "+".

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 of transformation, being subject to conversion into another energy commodities),
- **own consumption in transformation process** (use of energy by auxiliary devices operating transformation process, such as: fuel feeders, pump drives and ventilators, etc.)

Final energy consumption is the consumption of energy commodities by consumers (industry, services, households) to their technological, productive and living needs. Final consumption does not include the processing to other energy commodities.

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.

Total final consumption is divided into two parts: the consumption of energy and the non-energy consumption (raw materials).

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

Ambient heat it is the energy obtained from the environment, i.e. from the air, soil, groundwater and shallow geothermal surface (rocks, waters), using heat pumps.

Heat pump transfers heat from the environment of the lower temperature (lower source) to the environment with higher temperature (upper source), using energy from the outside (in the form of a work or heat).

Installed capacity it is the maximum constant power with which the devices can work having good technical state and in normal operating conditions

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 (Production and distribution of heat).

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.

(Definitions with regard to Main Activity Producer Plants and Autoproducer Plants are for the classification of PKD-2004. In the case of PKD-2007 the section 40 corresponds to a section 35, and the group of 40.1 corresponds to a group of 35.1, moreover the group of 40.3 corresponds to a group of 35.3).

3. Energy from renewables in the 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 2001-2008 are presented in table 1.

Table 1. Production of primary energy (including from renewable sources) for EU-25 and Poland in the years 2001 – 2008

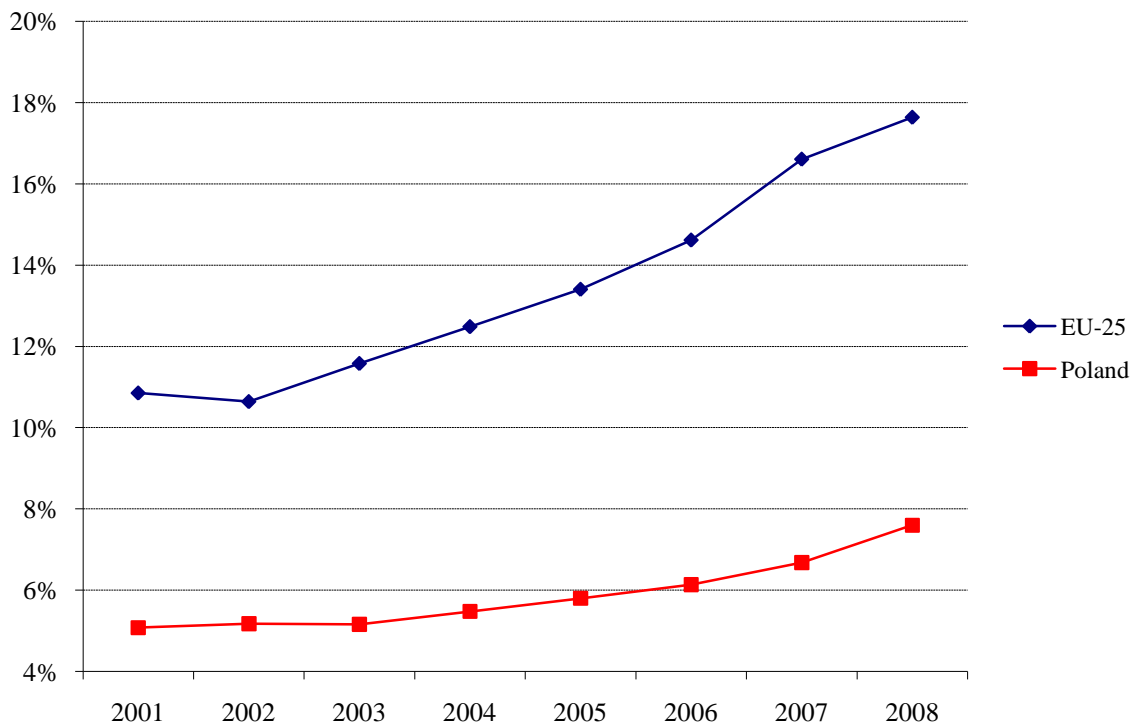
Specification	2001	2002	2003	2004	2005	2006	2007	2008
Total primary energy ^{*)} in EU [Mtoe]	893,8	892,6	886,9	882,8	850,0	831,3	811,5	803,6
in Poland [Mtoe]	80,2	80,0	79,9	78,7	78,4	77,7	72,6	71,3
<hr/>								
<i>from renewable sources</i> in EU [Mtoe]	97,0	95,0	102,7	110,2	113,9	121,5	134,7	141,7
<i>in Poland [Mtoe]</i>	4,1	4,1	4,1	4,3	4,5	4,8	4,9	5,4
Share of energy from renewable sources in the total primary energy in EU [%]	10,9	10,6	11,6	12,5	13,4	14,6	16,6	17,6
in Poland [%]	5,1	5,2	5,2	5,5	5,8	6,1	6,7	7,6

^{*)} according to the accepted rules “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 8.1% in 2003 as compared with the preceding year and by 7.3% in 2004, 3.4% in 2005, 6.6% in 2006, 10.9% in 2007 and 5.2% in 2008 respectively). However, in the case of production of total primary energy there was a decline tendency (decline by 0.6% in 2003, 0.5% in 2004, 3.7% in 2005, 2.2% in 2006, 2.4% in 2007 and 1.0% in 2008 respectively) which results in increase of share of energy from renewable sources in total primary energy.

Fig. 2 shows share of energy from renewable sources in production of primary energy for EU-25 and Poland in the years 2001 – 2008.

Fig. 2. Share of energy from renewable sources in production of primary energy for EU-25 and Poland in the years 2001 – 2008



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. 3) present how these values were developed in selected EU countries.

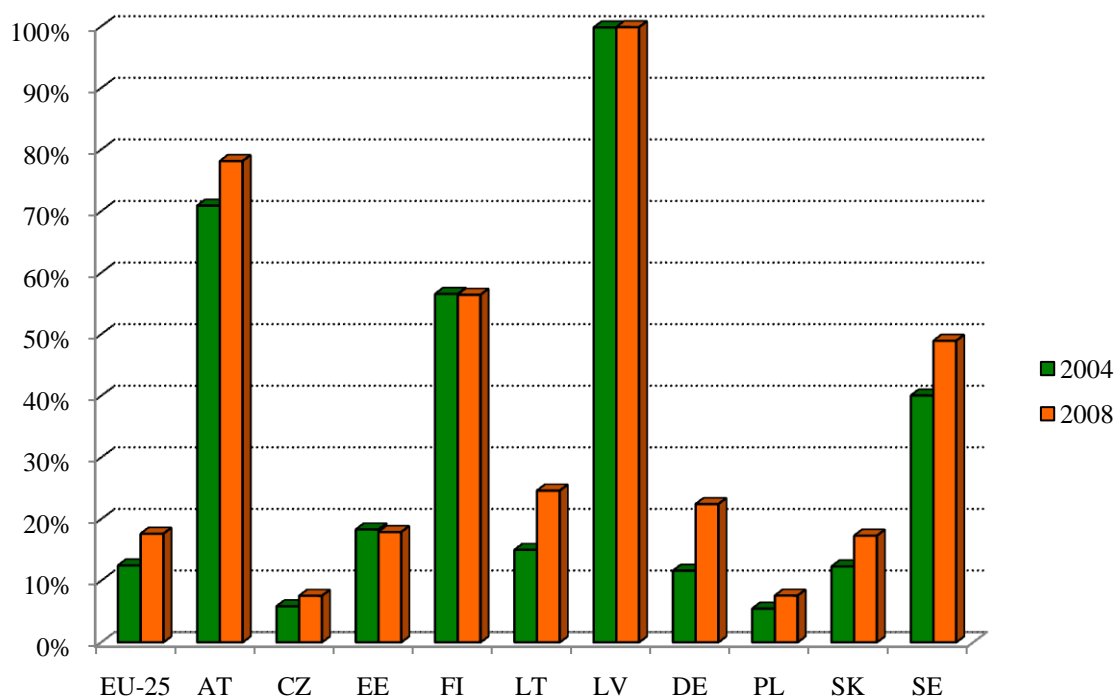
In most EU-25 countries there is an increase in the share of energy from renewable energy sources in production of total primary energy.

In 2004-2008 the share of renewable energy in primary energy increased in the EU-25 from 12.5% to 17.6% and in Poland from 5.5% to 7.7%. At the same time, the production of primary energy from RES has grown in the EU-25 by 28.6% and in Poland by 25.6%.

Table 2. Production of energy from renewable sources in selected EU countries in the years 2004 – 2008

Specification		EU-25	AT	CZ	EE	FI	LT	LV	DE	PL	SK	SE
Production of total primary energy [Mtoe]	2004	882,8	9,6	32,8	3,7	15,5	5,0	1,8	135,5	78,7	6,2	33,8
	2005	850,0	9,7	30,8	3,9	16,3	3,7	1,9	133,9	78,4	6,3	34,1
	2006	831,3	9,8	33,2	3,7	17,9	3,2	1,8	134,9	77,7	6,3	32,3
	2007	811,5	10,6	33,4	4,4	15,9	3,5	1,8	136,9	72,6	5,6	33,1
	2008	803,6	10,6	32,5	4,2	16,3	3,6	1,8	132,5	71,3	6,1	32,8
Production of primary energy from renewable sources [Mtoe]	2004	110,2	6,8	1,9	0,7	8,8	0,7	1,8	15,8	4,3	0,8	13,5
	2005	113,9	7,3	2,0	0,7	8,2	0,8	1,9	17,6	4,5	0,9	15,3
	2006	121,5	7,2	2,2	0,6	8,8	0,8	1,8	20,8	4,8	0,9	14,8
	2007	134,7	8,0	2,4	0,7	8,8	0,8	1,8	29,5	4,9	1,0	15,7
	2008	141,7	8,3	2,5	0,8	9,2	0,9	1,8	29,7	5,4	1,1	16,1
Share of energy from renewable sources in the total primary energy [%]	2004	12,5	70,9	5,9	18,3	56,6	15,0	99,8	11,6	5,5	12,3	40,1
	2005	13,4	75,5	6,5	17,9	50,2	21,1	99,9	13,1	5,8	14,1	44,7
	2006	14,6	73,8	6,6	17,2	49,1	25,1	99,8	15,4	6,1	14,1	45,9
	2007	16,6	75,5	7,2	16,9	55,1	23,1	99,8	21,6	6,7	17,5	47,3
	2008	17,6	78,2	7,6	17,9	56,4	24,6	99,9	22,4	7,6	17,3	49,0

Fig. 3. Share of energy from renewable sources in total primary energy in selected EU countries in the years: 2004 and 2008



The structure of production of energy by sources in selected European Union countries in the years 2005 – 2008 is presented in table 3. Moreover, on the figures 4 and 5 it was illustrated

the share of energy from solid biomass, wind and water in the total production of energy from renewable sources in the years 2005 and 2008

Table 3. The structure of energy production from particular sources in selected EU countries in the years 2005 – 2008 [%]

Specification		EU-25	AT	CZ	EE	FI	LT	LV	DE	PL	SK	SE
Solid biomass	2005	51,6	48,4	76,4	98,6	82,9	93,0	83,8	44,5	91,6	45,2	52,0
	2006	50,4	47,1	78,0	98,1	86,7	93,4	86,2	40,7	90,8	46,2	56,1
	2007	47,0	47,4	81,0	98,1	83,5	90,0	85,4	33,2	91,1	49,2	53,9
	2008	46,0	47,8	79,8	97,9	80,8	86,6	82,4	35,0	87,7	47,5	51,7
Solar energy	2005	0,7	1,3	0,1	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
	2006	0,8	1,4	0,1	0,0	0,0	0,0	0,0	2,3	0,0	0,0	0,0
	2007	0,9	1,4	0,2	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,1
	2008	1,2	1,4	0,2	0,0	0,0	0,0	0,0	2,5	0,0	0,0	0,1
Hydro	2005	21,3	42,5	10,2	0,3	14,4	5,0	15,4	9,6	4,2	45,3	41,0
	2006	20,2	41,0	10,0	0,2	11,2	4,2	12,6	8,2	3,7	42,7	35,8
	2007	18,6	39,5	7,5	0,3	13,9	4,4	13,1	6,1	4,2	39,0	36,3
	2008	18,6	39,4	7,1	0,3	16,0	4,0	15,0	6,1	3,4	32,9	37,0
Wind	2005	5,3	1,6	0,1	0,6	0,2	0,0	0,2	13,3	0,3	0,1	0,5
	2006	5,8	2,1	0,2	1,1	0,1	0,1	0,2	12,7	0,5	0,1	0,6
	2007	6,7	2,2	0,5	1,1	0,2	1,1	0,3	11,6	0,9	0,1	0,8
	2008	7,2	2,1	0,9	1,5	0,2	1,2	0,3	11,7	1,3	0,1	1,1
Biogas	2005	4,0	2,6	2,8	0,6	0,5	0,3	0,4	7,6	1,2	0,6	0,2
	2006	4,0	2,3	2,9	0,6	0,4	0,2	0,4	8,0	1,3	0,9	0,2
	2007	5,3	2,7	3,2	0,5	0,5	0,2	0,4	12,5	1,3	0,7	0,3
	2008	5,4	3,0	3,7	0,4	0,5	0,3	0,5	12,4	1,8	0,9	0,6
Biofuels	2005	3,4	0,6	5,6	0,0	0,0	1,4	0,1	12,7	2,6	4,1	1,4
	2006	5,2	1,9	4,5	0,0	0,0	1,8	0,5	18,5	3,5	4,7	2,1
	2007	6,5	3,3	3,7	0,0	0,0	3,9	0,8	17,3	2,3	6,0	2,7
	2008	7,1	3,4	4,3	0,0	0,1	7,7	1,9	15,0	5,5	13,2	2,9
Geothermal energy	2005	4,6	0,5	0,0	0,0	0,0	0,3	0,0	0,8	0,2	0,9	0,0
	2006	4,5	0,5	0,0	0,0	0,0	0,2	0,0	0,8	0,3	0,7	0,0
	2007	4,2	0,4	0,0	0,0	0,0	0,2	0,0	0,7	0,2	1,0	0,0
	2008	4,0	0,5	0,0	0,0	0,0	0,1	0,0	0,8	0,2	1,0	0,0
Municipal waste	2005	9,1	2,6	4,9	0,0	1,9	0,0	0,0	9,5	0,0	3,9	4,8
	2006	9,0	3,7	4,4	0,0	1,5	0,0	0,0	8,8	0,0	4,7	5,2
	2007	10,7	3,1	4,0	0,0	2,0	0,0	0,0	16,7	0,0	4,0	5,9
	2008	10,5	2,5	4,1	0,0	2,3	0,0	0,0	16,5	0,0	4,4	6,6

Fig. 4. Share of energy from solid biomass, wind and hydro in total production of energy from RES in 2005 [%]

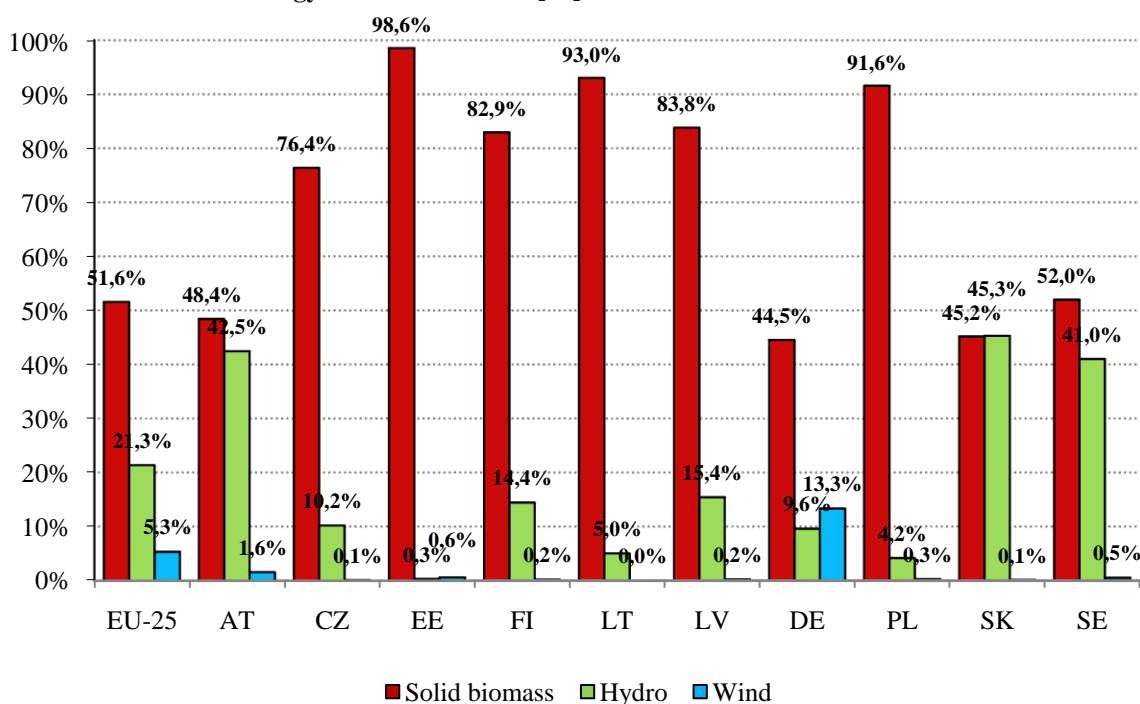
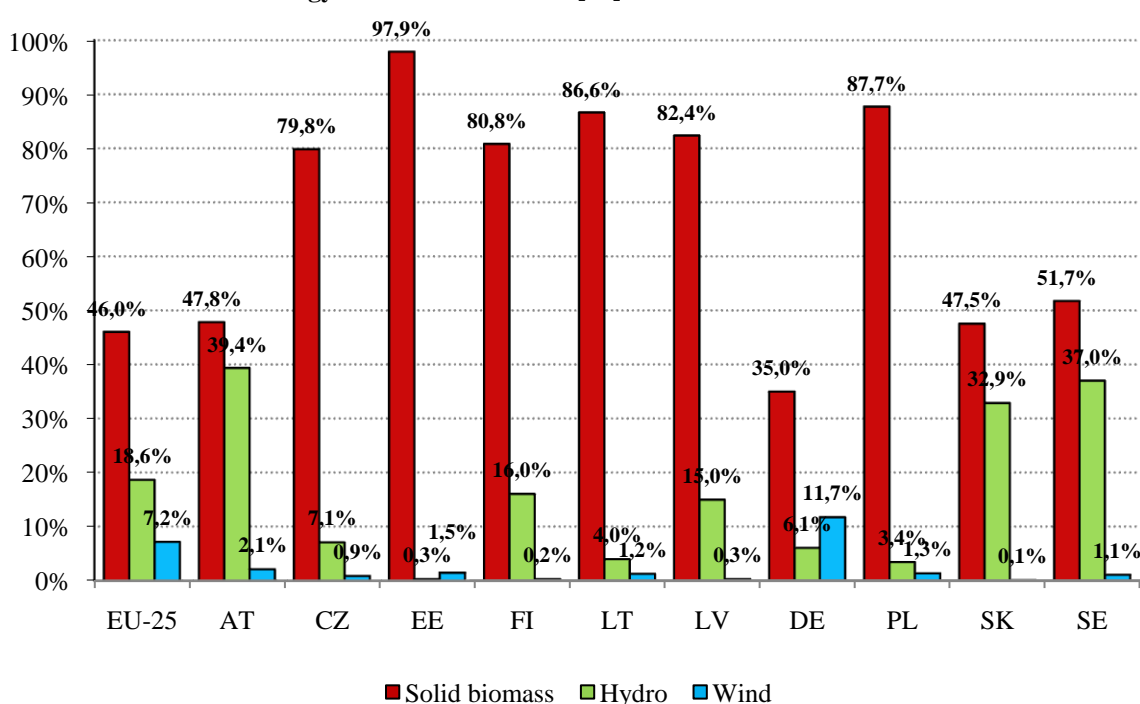


Fig. 5. Share of energy from solid biomass, wind and hydro in total production of energy from RES in 2008 r. [%]



Due to different geological and climatic conditions production of energy from renewable sources in particular countries varies – the energy from solid biomass dominates (in 2008: from 35.0% in Germany to 97.9% in Estonia). The second in respect of its consumption was hydro power (in 2008: from 0.3% in Estonia to 39.4% in Austria). The small share of solar

energy in almost all countries is significant (in 2008: varying from trace amounts in the majority of countries to 1.4% in Austria and 2.5% in Germany). In Poland in 2008 energy from renewable sources came in 87.7% from solid biomass. Other sources of renewable energy in Poland recorded in statistics were: biofuels (5.5%), hydro power (3.4%), biogas (1.8%), wind energy (1.3%) and geothermal energy (0.2%).

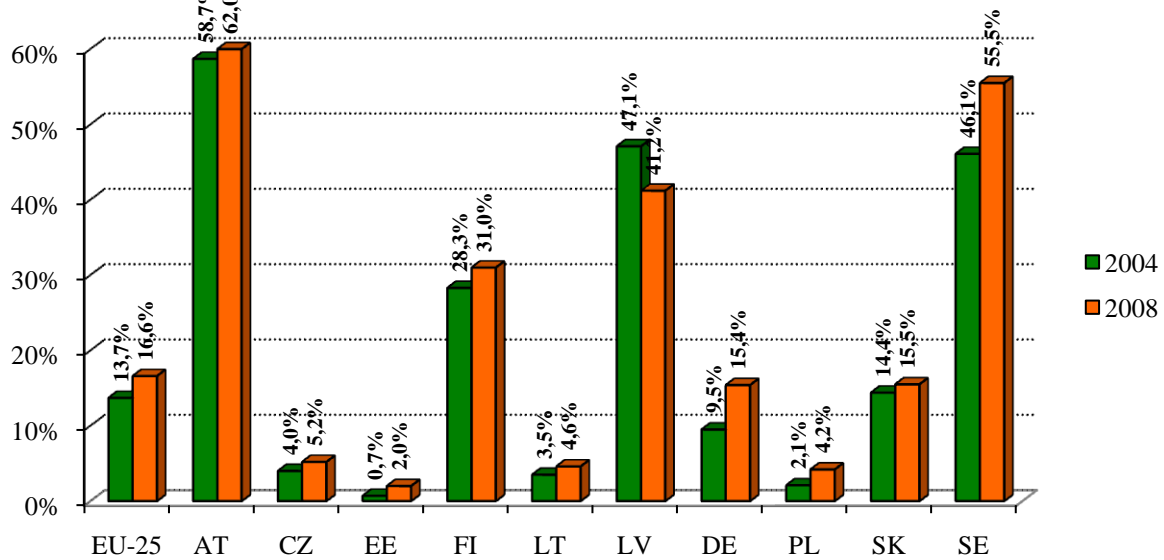
One of the aims of European Union in respect of development of renewable energy is to increase the share of electricity generated from renewable sources in the national use of this energy. The indicators for selected EU countries in 2004 – 2008 are presented in table 4 and in figure 6.

Table 4. The share of generated electricity from renewable sources in the total gross use of electricity in selected EU countries in the years 2004 – 2008 [%]

Specification	2004	2005	2006	2007	2008
EU-25	13,7	13,7	14,3	15,4	16,6
Austria	58,7	58,4	56,5	60,5	62,0
Czech Republic	4,0	4,5	4,9	4,7	5,2
Estonia	0,7	1,1	1,4	1,5	2,0
Finland	28,3	26,9	24,0	26,0	31,0
Lithuania	3,5	3,9	3,6	4,6	4,6
Latvia	47,1	48,4	37,7	36,4	41,2
Germany	9,5	10,5	12,0	14,8	15,4
Poland ^{*)}	2,1	2,6	2,8	3,5	4,2
Slovakia	14,4	16,7	16,6	16,6	15,5
Sweden	46,1	54,3	48,1	52,0	55,5

^{*)} The share of electricity generated from renewable energy in national gross electricity consumption is defined as the ratio of energy generated from renewable energy sources to gross electricity consumption (ie including losses and balance sheet differences.)

Fig. 6. Share of electricity generated from renewable sources in the total gross use of electricity in selected EU countries in the years 2004 and 2008 [%]



The share of generated electricity from renewable sources in the total gross use of electricity in selected EU countries in the years 2004 – 2008 [%] remained at the level of about 15%. For particular countries the value of this indicator is very diverse, e.g. in 2008 its value varied between 2.0% (Estonia) and 62.0% (Austria). For Poland the share of electricity produced from renewable sources in the national use of electricity in 2004 amounted to 2.1%, in 2005 – 2.6%, in 2006 – 2.8%, in 2007 – 3.5% and in 2008 – 4.2%.

The share of particular sources of renewable energy in the production of electricity from RES in selected EU countries in 2004 – 2008 is presented in table 5. Moreover, on the figures 7 and 8 there are shown shares of energy from solid biomass, hydro and wind in the production of electricity in the years 2005 to 2008

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 69.3%, in 2005 – to 64.6%, in 2006 – 62.0%, in 2007 – 58.0%, and in 2008 – 56.6%. For particular countries in 2008 the share of hydro power in the production of electricity from RES varies from 14.1% (Estonia) to 96.8% (Latvia). For Poland in 2008 the hydro power constituted 33.4% of electricity from RES (in 2004 – 67.7%, in 2005 – 57.2%, in 2006 – 47.6%, and in 2007 43.3%). 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.

Table 5. The structure of electricity production from renewable energy sources in selected EU countries in the years 2004 – 2008 [%]

Specification		EU-25	AT	CZ	EE	FI	LT	LV	DE	PL	SK	SE
Solid biomass	2004	8,6	4,3	20,5	38,3	39,6	0,9	0,2	6,7	25,0	0,1	9,6
	2005	9,5	4,8	17,8	18,9	39,2	0,7	0,2	7,3	36,4	0,1	8,4
	2006	9,9	6,0	20,7	19,5	46,8	4,4	0,3	9,0	42,7	7,6	10,5
	2007	10,0	7,1	28,3	16,1	39,5	8,3	0,2	9,3	43,5	8,9	10,9
	2008	10,2	7,3	31,3	14,1	36,0	10,0	0,2	9,7	49,7	10,4	10,9
Solar energy	2004	0,2	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
	2005	0,3	0,1	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
	2006	0,5	0,1	0,0	0,0	0,0	0,0	0,0	3,0	0,0	0,0	0,0
	2007	0,8	0,1	0,1	0,0	0,0	0,0	0,0	3,4	0,0	0,0	0,0
	2008	1,4	0,1	0,3	0,0	0,0	0,0	0,0	4,8	0,0	0,0	0,0
Hydro	2004	69,3	92,3	73,4	36,7	58,6	98,4	97,3	36,2	67,7	99,0	87,3
	2005	64,6	89,7	75,8	19,8	58,5	98,0	97,4	30,8	57,2	98,7	88,8
	2006	62,0	87,6	72,3	10,9	51,1	91,2	96,8	27,4	47,6	91,1	86,1
	2007	58,0	85,0	61,1	14,8	58,0	72,5	96,6	24,0	43,3	89,8	84,8
	2008	56,6	85,1	54,1	14,1	61,2	66,8	96,8	22,7	33,4	88,3	84,1
Wind	2004	13,5	2,3	0,4	13,3	0,5	0,2	1,5	43,3	4,6	0,1	1,2
	2005	16,1	3,3	0,7	48,6	0,7	0,4	1,4	42,9	3,5	0,1	1,1
	2006	17,6	4,1	1,4	59,4	0,7	3,2	1,7	42,2	6,0	0,1	1,4
	2007	20,7	4,7	3,7	61,1	0,8	18,3	1,8	44,0	9,6	0,2	1,8
	2008	21,8	4,5	6,6	67,2	0,9	21,8	1,8	44,0	13,0	0,2	2,4
Biogas	2004	2,7	0,1	5,1	11,7	0,1	0,5	1,0	5,6	2,7	0,0	0,1
	2005	3,2	1,4	5,1	12,6	0,1	0,9	1,1	7,4	2,9	0,1	0,1
	2006	3,4	1,1	5,0	10,2	0,1	1,2	1,3	8,5	3,7	0,2	0,1
	2007	3,8	1,9	6,3	8,1	0,1	0,9	1,3	9,3	3,6	0,2	0,1
	2008	3,7	2,2	7,1	4,5	0,3	1,5	1,2	9,0	3,9	0,3	0,0
Geothermal energy	2004	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	2005	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	2006	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	2007	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	2008	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Municipal waste	2004	4,5	0,9	0,6	0,0	1,2	0,0	0,0	7,3	0,0	0,7	1,8
	2005	5,2	0,8	0,6	0,0	1,5	0,0	0,0	9,6	0,0	1,0	1,6
	2006	5,3	1,2	0,5	0,0	1,3	0,0	0,0	10,0	0,0	1,0	2,0
	2007	5,6	1,2	0,6	0,0	1,5	0,0	0,0	10,0	0,0	0,9	2,4
	2008	5,4	0,8	0,5	0,0	1,5	0,0	0,0	9,8	0,0	0,9	2,6

The second place in respect of consumption is taken by wind energy, the share of which for EU-25 increased from 13.5% in 2004 to 21.8% in 2008. For particular countries in 2008 the share of wind energy in the production of electricity from RES varies from 0.2% (Slovakia) to 0.9% (Finland), 44.0% (Germany) and to 67.2% (Estonia). In Poland the wind energy in 2008 amounted to 13.0% of electricity from RES (in 2004 – 4.6%, and in 2005 – 3.5%, in 2006 – 6.0%, and in 2007 r. – 9.6%). For EU countries the share of electricity produced from solid biomass incineration increases (for UE-25 in 2004 – 8.6%, in 2005 – 9.5%, in 2006 – 9.9% in

2007 – 10.0% and in 2008 – 10.2%). In 2008 the share of solid biomass in the production of electricity from RES in particular countries varied from 0.2% (Latvia) to 49.7% (Poland).

Fig. 7. Share of solid biomass and hydro energy in production of electricity from RES in some EU countries in the years 2005-2008

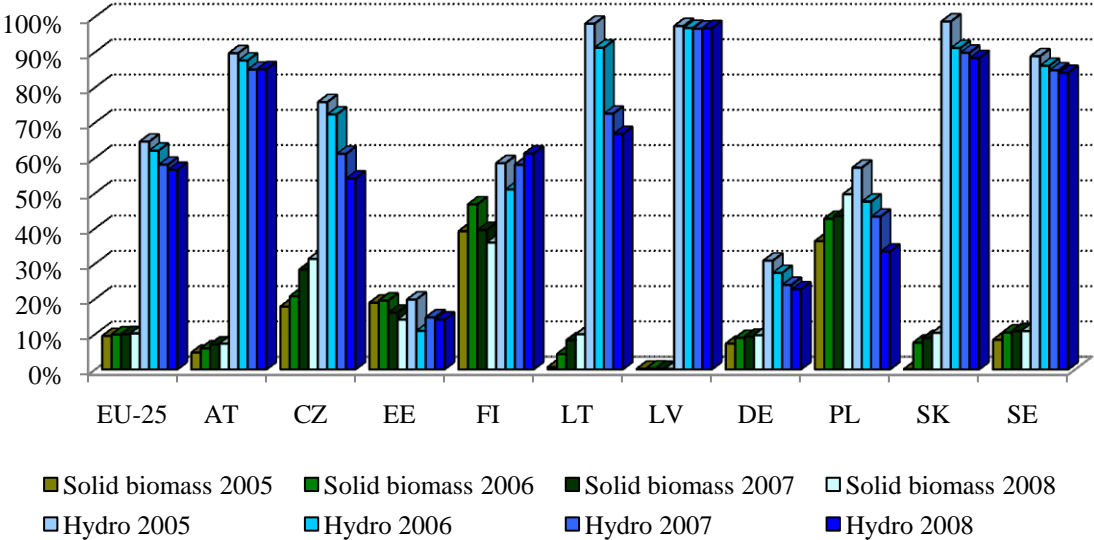
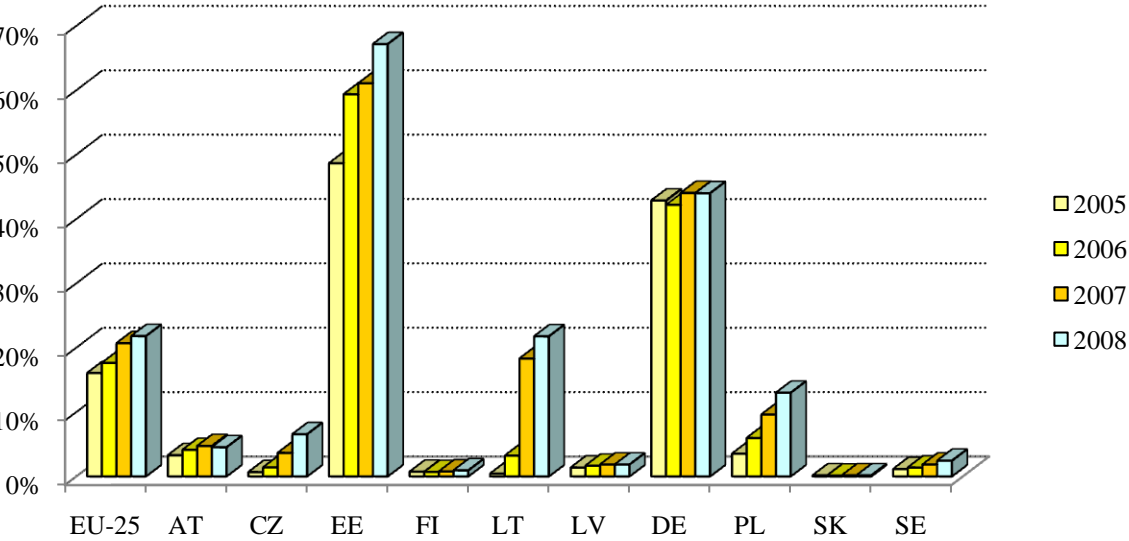


Fig. 8. Share of wind in production of electricity from RES in some EU countries in the years 2005-2008



In Poland the electricity produced from solid biomass in 2008 amounted to 49.7% of electricity from RES (in 2004 – 25.0%, in 2005 – 36.4%, in 2006 – 42.7% and in 2007 – 43.5%). The smallest share in production of electricity from RES in EU countries has solar energy (for EU-25 in 2008 – 1.4%, in 2007 – 0.8%, in 2006 – 0.5%, in 2005 – 0.3%, and in 2004 – 0.2%). Among the mentioned countries the solar energy which was used in production of electricity (photovoltaic cells) only in Germany exceeded a level of 1% in the share of RES (in 2008 – 4.8%, in 2007 – 3.4%, in 2006 – 3.0%, in 2005 – 2.0%, and in 2004 – 1.0%).

In table 6 and figure 9 there are the data on final energy consumption including renewable energy for the EU-25 and Polish in the years 2001 - 2008.

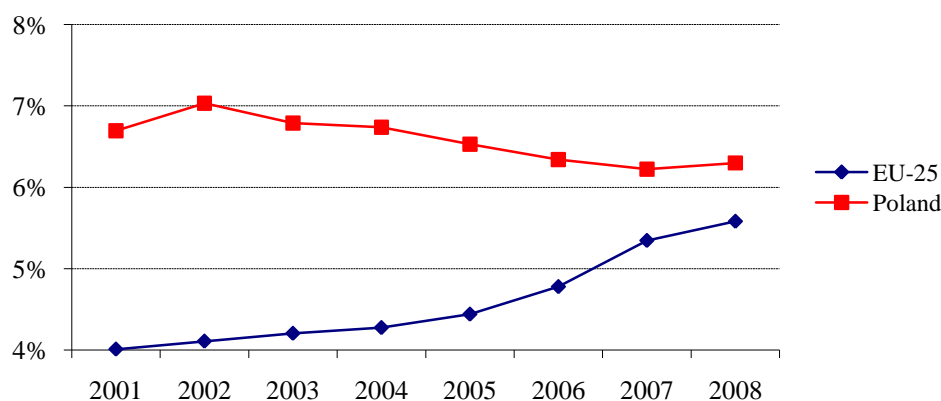
Table 6. Total final energy consumption (including from renewable sources) for EU-25 and Poland in the years 2001-2008

Specification	2001	2002	2003	2004	2005	2006	2007	2008
Total final energy consumption in EU-25 [Mtoe]	1 111,3	1 097,1	1 132,2	1 146,5	1 148,1	1 151,2	1 130,9	1 134,1
in Poland [Mtoe]	55,9	54,2	56,1	57,5	57,8	60,8	61,2	61,8
<hr/>								
<i>including from renewable sources</i> ^{*)} in EU-25 [Mtoe]	44,6	45,1	47,6	49,0	51,0	55,0	60,5	63,3
in Poland [Mtoe]	3,7	3,8	3,8	3,9	3,8	3,9	3,8	3,9
<hr/>								
Share of energy from renewable sources in the total final energy consumption in EU-25 [%]	4,0	4,1	4,2	4,3	4,4	4,8	5,3	5,6
in Poland [%]	6,7	7,0	6,8	6,7	6,5	6,3	6,2	6,3

^{*)} in energy consumption from renewable energy sources it was in total included consumption of municipal waste (biodegradable and non-biodegradable) and consumption of biofuels in transport and for blending of petroleum products.

Share of energy from renewable sources in the total final energy consumption in 2008 amounted to 5.6% in EU-25 and 6.3% in Poland (Fig. 9).

Fig. 9. Share of energy from renewable sources in the total final energy consumption in EU-25 and Poland



4. National balances of renewable energy

National balance of renewable energy sources for years 2006-2009, prepared on the basis of data collected within public statistics, is presented in table 7.

During this period there was a continuous increase in the production of energy from renewable sources with the simultaneous decrease of the total primary energy production, which resulted in systematic increase of the share of renewables in total primary energy production. And so:

- in 2006 was produced 199566 TJ from RES, which represented 6.1% of total primary energy (3253 PJ),
- in 2007 was produced 203141 TJ from RES, which represented 6.7% of total primary energy (3040 PJ),
- in 2008 was produced 226788 TJ from RES, which represented 7.6% of total primary energy (2985 PJ),
- in 2009 was produced 253153 TJ from RES, which represented 9.0% of total primary energy (2817 PJ),

In 2009 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 85.8%. The subsequent places in respect of RES share were occupied by:

- liquid biofuels – 7.1%,
- hydro – 3.4%,
- biogas – 1.6%,
- wind – 1.5%,
- heat pumps – 0.3%,
- geothermal energy – 0.2%,
- solar energy – 0.033%,
- municipal waste – 0.012%.

Table 8 presents synthetic balance for solid biomass for years 2001 – 2009. The data presented indicate a constant increase in the amount of produced and used solid biomass. As an example, the highest increase of production 9.5% and of consumption 9.3% was in 2009 as compared with the year 2008. At the same time compared to the year 2001 there was an increase production and consumption by 35.5%. In 2008 this increase amounted to 7.3% and 8.1% compared to 2007, and compared to the year 2001 - 23.7% (production) and 24.0% (consumption).

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]

Specification	Solid biomass				Solar energy			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	181 108	184 917	198 401	217 302	11	15	54	83
Imports(+)	-	-	-	-	-	-	-	-
Exports (-)	-	-	-	-	-	-	-	-
Stock Changes (+/-)	-73	-924	500	-	-	-	-	-
Inland Consumption	181 035	183 993	198 902	217 302	11	15	54	83
Transformation Sector of which:	21 180	25 434	38 251	55 082	-	-	-	-
Main Activity Producer Electricity /CHP Plants	13 430	17 471	30 428	47 232	-	-	-	-
Main Activity Producer Heat Plants	1 601	1 529	1 897	1 555	-	-	-	-
Autoproducer Electricity/CHP Plants	5 954	6 266	5 726	5 915	-	-	-	-
Autoproducer Heat Plants	195	168	200	381	-	-	-	-
For Blending to Motor Gasoline/Diesel	-	-	-	-	-	-	-	-
Energy Sector of which:	11	57	20	134	-	-	-	-
Own Use in Electricity, CHP and Heat Plants	10	56	20	47	-	-	-	-
Coal mines	-	-	-	87	-	-	-	-
Oil and Natural Gas Extraction Plants	1	1	-	-	-	-	-	-
Final Energy Consumption of which:	159 844	158 502	160 631	162 086	11	15	54	83
Industry Sector of which:	30 763	31 939	34 088	33 423	-	-	-	-
Iron and Steel	1	1	1	1	-	-	-	-
Non-Metallic Minerals	140	116	223	285	-	-	-	-
Transport Equipment	7	5	5	4	-	-	-	-
Machinery	29	25	37	45	-	-	-	-
Food, Beverages and Tobacco	239	164	366	192	-	-	-	-
Paper, Pulp and Printing	19 379	18 644	19 729	19 171	-	-	-	-
Wood and Wood Products	7 952	9 925	11 532	11 718	-	-	-	-
Non-specified (industry)	3 016	3 059	2 196	2 008	-	-	-	-
Construction	24	21	6	34	-	-	-	-
Transport Sector	-	-	-	-	-	-	-	-
Other Sectors of which:	129 057	126 542	126 537	128 629	11	15	54	83
Commerce and Public Services	4 580	5 482	5 013	19 031	11	15	54	83
Households	104 500	102 000	102 500	102 500	-	-	-	-
Agriculture / Forestry	19 977	19 060	19 024	7 098	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(cont.)

Specification	Hydro				Wind			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	7 352	8 468	7 748	8 550	922	1 878	3 012	3 878
Imports(+)	-	-	-	-	-	-	-	-
Exports (-)	-	-	-	-	-	-	-	-
Stock Changes (+/-)	-	-	-	-	-	-	-	-
Inland Consumption	7 352	8 468	7 748	8 550	922	1 878	3 012	3 878
Transformation Sector of which:	7 352	8 468	7 748	8 550	922	1 878	3 012	3 878
Main Activity Producer Electricity /CHP Plants	7 346	8 459	7 740	8 543	922	1 878	3 012	3 878
Main Activity Producer Heat Plants	-	-	-	-	-	-	-	-
Autoproducer Electricity/CHP Plants	6	8	8	8	-	-	-	-
Autoproducer Heat Plants	-	-	-	-	-	-	-	-
For Blending to Motor Gasoline/Diesel	-	-	-	-	-	-	-	-
Energy Sector of which:	-	-	-	-	-	-	-	-
Own Use in Electricity, CHP and Heat Plants	-	-	-	-	-	-	-	-
Coal mines	-	-	-	-	-	-	-	-
Oil and Natural Gas Extraction Plants	-	-	-	-	-	-	-	-
Final Energy Consumption of which:	-	-	-	-	-	-	-	-
Industry Sector of which:	-	-	-	-	-	-	-	-
Iron and Steel	-	-	-	-	-	-	-	-
Non-Metallic Minerals	-	-	-	-	-	-	-	-
Transport Equipment	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-
Food, Beverages and Tobacco	-	-	-	-	-	-	-	-
Paper, Pulp and Printing	-	-	-	-	-	-	-	-
Wood and Wood Products	-	-	-	-	-	-	-	-
Non-specified (industry)	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-
Transport Sector	-	-	-	-	-	-	-	-
Other Sectors of which:	-	-	-	-	-	-	-	-
Commerce and Public Services	-	-	-	-	-	-	-	-
Households	-	-	-	-	-	-	-	-
Agriculture / Forestry	-	-	-	-	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(cont.)

Specification	Biogas							
	from landfills				from sludge			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	791	879	1 432	1 487	1 803	1 802	2 486	2 429
Imports(+)	-	-	-	-	-	-	-	-
Exports (-)	-	-	-	-	-	-	-	-
Stock Changes (+/-)	-	-	-	-	-	-	-	-
Inland Consumption	791	879	1 432	1 487	1 803	1 802	2 486	2 429
Transformation Sector of which:	791	879	1 432	1 471	1 211	1 399	1 498	1 464
Main Activity Producer Electricity /CHP Plants	18	15	-	-	-	-	-	-
Main Activity Producer Heat Plants	-	-	-	-	2	4	19	16
Autoproducer Electricity/CHP Plants	773	864	1 432	1 471	1 209	1 395	1 477	1 437
Autoproducer Heat Plants	-	-	-	-	-	-	2	11
For Blending to Motor Gasoline/Diesel	-	-	-	-	-	-	-	-
Energy Sector of which:	-	-	-	1	15	28	17	2
Own Use in Electricity, CHP and Heat Plants	-	-	-	1	15	28	17	2
Coal mines	-	-	-	-	-	-	-	-
Oil and Natural Gas Extraction Plants	-	-	-	-	-	-	-	-
Final Energy Consumption of which:	-	-	-	15	577	375	971	963
Industry Sector of which:	-	-	-	-	72	84	94	127
Iron and Steel	-	-	-	-	-	-	-	-
Non-Metallic Minerals	-	-	-	-	-	-	-	-
Transport Equipment	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-
Food, Beverages and Tobacco	-	-	-	-	72	84	94	109
Paper, Pulp and Printing	-	-	-	-	-	-	-	18
Wood and Wood Products	-	-	-	-	-	-	-	-
Non-specified (industry)	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	3
Transport Sector	-	-	-	-	-	-	-	-
Other Sectors of which:	-	-	-	15	505	291	877	833
Commerce and Public Services	-	-	-	15	505	291	877	833
Households	-	-	-	-	-	-	-	-
Agriculture / Forestry	-	-	-	-	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(cont.)

Specification	Biogas							
	other biogas				Total			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	19	27	107	188	2 613	2 708	4 025	4 104
Imports(+)	-	-	-	-	-	-	-	-
Exports (-)	-	-	-	-	-	-	-	-
Stock Changes (+/-)	-	-	-	-	-	-	-	-
Inland Consumption	19	27	107	188	2 613	2 708	4 025	4 104
Transformation Sector of which:	19	27	107	188	2 021	2 305	3 037	3 123
Main Activity Producer Electricity /CHP Plants	-	-	-	-	18	15	-	-
Main Activity Producer Heat Plants	-	-	-	-	2	4	19	16
Autoproducer Electricity/CHP Plants	19	27	107	188	2 001	2 286	3 016	3 096
Autoproducer Heat Plants	-	-	-	-	-	-	2	11
For Blending to Motor Gasoline/Diesel	-	-	-	-	-	-	-	-
Energy Sector of which:	-	-	-	-	15	28	17	3
Own Use in Electricity, CHP and Heat Plants	-	-	-	-	15	28	17	3
Coal mines	-	-	-	-	-	-	-	-
Oil and Natural Gas Extraction Plants	-	-	-	-	-	-	-	-
Final Energy Consumption of which:	-	-	-	-	577	375	971	978
Industry Sector of which:	-	-	-	-	72	84	94	127
Iron and Steel	-	-	-	-	-	-	-	-
Non-Metallic Minerals	-	-	-	-	-	-	-	-
Transport Equipment	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-
Food, Beverages and Tobacco	-	-	-	-	72	84	94	109
Paper, Pulp and Printing	-	-	-	-	-	-	-	18
Wood and Wood Products	-	-	-	-	-	-	-	-
Non-specified (industry)	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	3
Transport Sector	-	-	-	-	-	-	-	-
Other Sectors of which:	-	-	-	-	505	291	877	847
Commerce and Public Services	-	-	-	-	505	291	877	847
Households	-	-	-	-	-	-	-	-
Agriculture / Forestry	-	-	-	-	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(cont.)

Specification	Biofuels (for transport)							
	bioethanol				biodiesel			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	3 542	2 792	2 459	3 838	3 423	1 822	9 943	14 010
Imports(+)	66	665	3 027	4 322	5	-	3 547	5 819
Exports (-)	989	45	11	-	1 979	746	-	320
Stock Changes (+/-)	-61	-56	-184	2	49	-4	-279	92
Inland Consumption	2 558	3 356	5 291	8 162	1 498	1 072	13 211	19 600
Transformation Sector of which:	2 558	3 356	5 291	7 249	1 249	972	12 986	16 199
Main Activity Producer Electricity /CHP Plants	-	-	-	-	-	-	-	-
Main Activity Producer Heat Plants	-	-	-	-	-	-	-	-
Autoproducer Electricity/CHP Plants	-	-	-	-	-	-	-	-
Autoproducer Heat Plants	-	-	-	-	-	-	-	-
For Blending to Motor Gasoline/Diesel	2 558	3 356	5 291	7 249	1 249	972	12 986	16 199
Energy Sector of which:	-	-	-	-	-	-	-	-
Own Use in Electricity, CHP and Heat Plants	-	-	-	-	-	-	-	-
Coal mines	-	-	-	-	-	-	-	-
Oil and Natural Gas Extraction Plants	-	-	-	-	-	-	-	-
Final Energy Consumption of which:	-	-	-	913	249	100	225	3 401
Industry Sector of which:	-	-	-	-	-	-	-	-
Iron and Steel	-	-	-	-	-	-	-	-
Non-Metallic Minerals	-	-	-	-	-	-	-	-
Transport Equipment	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-
Food, Beverages and Tobacco	-	-	-	-	-	-	-	-
Paper, Pulp and Printing	-	-	-	-	-	-	-	-
Wood and Wood Products	-	-	-	-	-	-	-	-
Non-specified (industry)	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-
Transport Sector	-	-	-	913	249	100	225	3 401
Other Sectors of which:	-	-	-	-	-	-	-	-
Commerce and Public Services	-	-	-	-	-	-	-	-
Households	-	-	-	-	-	-	-	-
Agriculture / Forestry	-	-	-	-	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(cont.)

Specification	Biofuels (for transport)				Geothermal energy				Municipal waste			
	Total				2006	2007	2008	2009	2006	2007	2008	2009
	2006	2007	2008	2009								
Indigenous Production	6 965	4 614	12 402	17 847	535	439	531	600	27	35	9	29
Imports(+)	71	665	6 574	10 141	-	-	-	-	-	-	-	-
Exports (-)	2 968	791	11	320	-	-	-	-	-	-	-	-
Stock Changes (+/-)	-12	-60	-463	94	-	-	-	-	3	-	-	-
Inland Consumption	4 056	4 428	18 502	27 762	535	439	531	600	30	35	9	29
Transformation Sector of which:	3 807	4 328	18 277	23 448	-	-	-	-	-	-	-	-
Main Activity Producer Electricity /CHP Plants	-	-	-	-	-	-	-	-	-	-	-	-
Main Activity Producer Heat Plants	-	-	-	-	-	-	-	-	-	-	-	-
Autoproducer Electricity/CHP Plants	-	-	-	-	-	-	-	-	-	-	-	-
Autoproducer Heat Plants	-	-	-	-	-	-	-	-	-	-	-	-
For Blending to Motor Gasoline/Diesel	3 807	4 328	18 277	23 448	-	-	-	-	-	-	-	-
Energy Sector of which:	-	-	-	-	-	-	-	-	-	-	-	-
Own Use in Electricity, CHP and Heat Plants	-	-	-	-	-	-	-	-	-	-	-	-
Coal mines	-	-	-	-	-	-	-	-	-	-	-	-
Oil and Natural Gas Extraction Plants	-	-	-	-	-	-	-	-	-	-	-	-
Final Energy Consumption of which:	249	100	225	4 314	535	439	531	600	30	35	9	29
Industry Sector of which:	-	-	-	-	-	-	-	-	2	6	1	29
Iron and Steel	-	-	-	-	-	-	-	-	-	-	-	-
Non-Metallic Minerals	-	-	-	-	-	-	-	-	-	1	-	29
Transport Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-	-	-	-	-
Food, Beverages and Tobacco	-	-	-	-	-	-	-	-	-	-	-	-
Paper, Pulp and Printing	-	-	-	-	-	-	-	-	-	-	-	-
Wood and Wood Products	-	-	-	-	-	-	-	-	2	5	1	-
Non-specified (industry)	-	-	-	-	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-	-	-	-	-
Transport Sector	249	100	225	4 314	-	-	-	-	-	-	-	-
Other Sectors of which:	-	-	-	-	535	439	531	600	28	29	8	-
Commerce and Public Services	-	-	-	-	100	82	129	140	28	29	8	-
Households	-	-	-	-	435	357	402	460	-	-	-	-
Agriculture / Forestry	-	-	-	-	-	-	-	-	-	-	-	-

Table 7. The balance of renewable energy commodities in the years 2006 – 2009 [TJ]
(end)

Specification	Heat pumps (ambient heat)				Total			
	2006	2007	2008	2009	2006	2007	2008	2009
Indigenous Production	33	68	605	758	199 566	203 141	226 788	253 153
Imports(+)	-	-	-	-	71	665	6 574	10 141
Exports (-)	-	-	-	-	2 968	791	11	320
Stock Changes (+/-)	-	-	-	-	-82	-984	37	94
Inland Consumption	33	68	605	758	196 587	202 031	233 389	263 067
Transformation Sector of which:	-	-	-	-	35 282	42 412	70 325	94 082
Main Activity Producer Electricity /CHP Plants	-	-	-	-	21 716	27 823	41 180	59 653
Main Activity Producer Heat Plants	-	-	-	-	1 603	1 533	1 916	1 570
Autoproducer Electricity/CHP Plants	-	-	-	-	7 961	8 560	8 750	9 019
Autoproducer Heat Plants	-	-	-	-	195	168	202	392
For Blending to Motor Gasoline/Diesel	-	-	-	-	3 807	4 328	18 277	23 448
Energy Sector of which:	-	-	-	-	26	85	37	138
Own Use in Electricity, CHP and Heat Plants	-	-	-	-	25	84	37	50
Coal mines	-	-	-	-	-	-	-	87
Oil and Natural Gas Extraction Plants	-	-	-	-	1	1	-	-
Final Energy Consumption of which:	33	68	605	758	161 278	159 534	163 027	168 848
Industry Sector of which:	-	-	-	-	30 837	32 029	34 183	33 580
Iron and Steel	-	-	-	-	1	1	1	1
Non-Metallic Minerals	-	-	-	-	140	117	223	314
Transport Equipment	-	-	-	-	7	5	5	4
Machinery	-	-	-	-	29	25	37	45
Food, Beverages and Tobacco	-	-	-	-	311	248	460	302
Paper, Pulp and Printing	-	-	-	-	19 379	18 644	19 729	19 189
Wood and Wood Products	-	-	-	-	7 954	9 930	11 533	11 718
Non-specified (industry)	-	-	-	-	3 016	3 059	2 196	2 008
Construction	-	-	-	-	24	21	6	37
Transport Sector	-	-	-	-	249	100	225	4 314
Other Sectors of which:	33	68	605	758	130 168	127 384	128 612	130 917
Commerce and Public Services	33	68	605	758	5 257	5 967	6 686	20 859
Households	-	-	-	-	104 935	102 357	102 902	102 960
Agriculture / Forestry	-	-	-	-	19 977	19 060	19 024	7 098

Table 8. Energy balance of solid biomass in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	160 406	163 308	164 163	170 056	174 431	181 108	184 917	198 401	217 302
Stock Changes (+/-)	-	66	-83	-	-	-73	-924	500	-
Inland Consumption	160 406	163 374	164 080	170 056	174 431	181 035	183 993	198 902	217 302
Transformation Sector of which:	4 886	4 809	5 799	8 905	17 500	21 180	25 434	38 251	55 082
Main Activity Producer Electricity /CHP Plants	1 181	1 126	2 001	3 837	9 641	13 430	17 471	30 428	47 232
Main Activity Producer Heat Plants	252	388	619	1 244	1 412	1 601	1 529	1 897	1 555
Autoproducer Electricity/CHP Plants	3 058	2 878	2 742	3 598	6 194	5 954	6 266	5 726	5 915
Autoproducer Heat Plants	395	417	437	226	253	195	168	200	381
Energy Sector of which:	39	29	8	4	2	11	57	20	134
Own Use in Electricity, CHP and Heat Plants	36	8	7	4	2	10	56	20	47
Coal mines	3	21	1	-	-	-	-	-	87
Oil and Natural Gas Extraction Plants	-	-	-	-	-	1	1	-	-
Final Energy Consumption of which:	155 481	158 536	158 273	161 147	156 929	159 844	158 502	160 631	162 086
Industry Sector of which:	26 185	29 258	30 394	31 864	30 990	30 763	31 939	34 088	33 423
Iron and Steel	6	3	4	4	2	1	1	1	1
Chemical (incl. Petrochemical)	-	1	153	102	165	-	121	-	58
Non-Ferrous Metals	5	1	-	-	-	-	-	-	-
Non-Metallic Minerals	275	292	102	261	110	140	116	223	285
Transport Equipment		3	3	6	1	7	5	5	4
Machinery	6	10	22	52	54	29	25	37	45
Mining and Quarrying	2	-	6	10	1	-	-	0	-
Food, Beverages and Tobacco	62	60	323	373	214	239	164	366	192
Paper, Pulp and Printing	15 138	16 622	17 950	18 957	18 611	19 379	18 644	19 729	19 171
Wood and Wood Products	8 032	9 871	9 297	9 327	9 641	7 952	9 925	11 532	11 718
Textile and Leather	-	-	2	4	1	-	1	1	-
Non-specified (industry)	2 659	2 395	2 532	2 768	2 190	3 016	2 937	2 195	1 949
Construction	17	21	35	17	30	24	21	6	34
Other Sectors of which:	129 279	129 257	127 844	129 266	125 909	129 057	126 542	126 537	128 629
Commerce and Public Services	5 736	5 747	5 752	6 028	6 171	4 580	5 482	5 013	19 031
Households	104 500	104 500	103 075	103 360	100 700	104 500	102 000	102 500	102 500
Agriculture / Forestry	19 043	19 010	19 017	19 878	19 038	19 977	19 060	19 024	7 098

Since the year 2003, the presented data in transformation sector (input) have shown a clear trend towards increased of consumption solid biomass (compared to the previous year: in 2003 – 20.6%, in 2004 – 53.6%, in 2005 – 96.5%, in 2006 – 21.0%, in 2007 – 20.1%, in 2008 – 50.4% and in 2009 – 44.0%), particularly in main activity producer electricity and CHP plants (in 2003 – 77.7%, in 2004 – 91.8%, in 2005 – 151.3%, in 2006 – 39.3%, in 2007 – 30.1%, in 2008 – 74.2% and in 2009 – 55.2%).

The structure of solid biomass use in 2009 is presented in figures 10. Figure 11 presents the amount of biomass use by final recipients in 2001 – 2009. The structure of solid biomass use as input for energy transformations is presented in fig. 12.

Fig. 10. The structure of solid biomass consumption in 2009

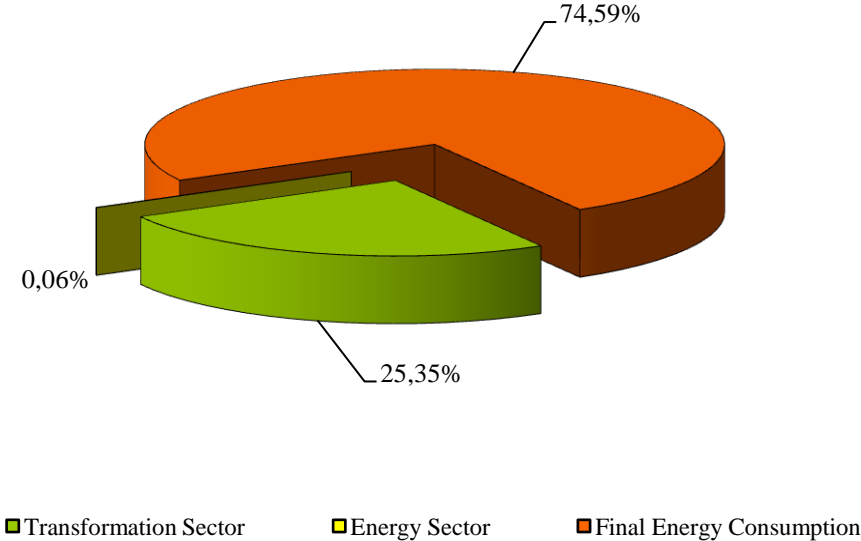


Fig. 11. Consumption of solid biomass by final users in 2001 - 2009 [TJ]

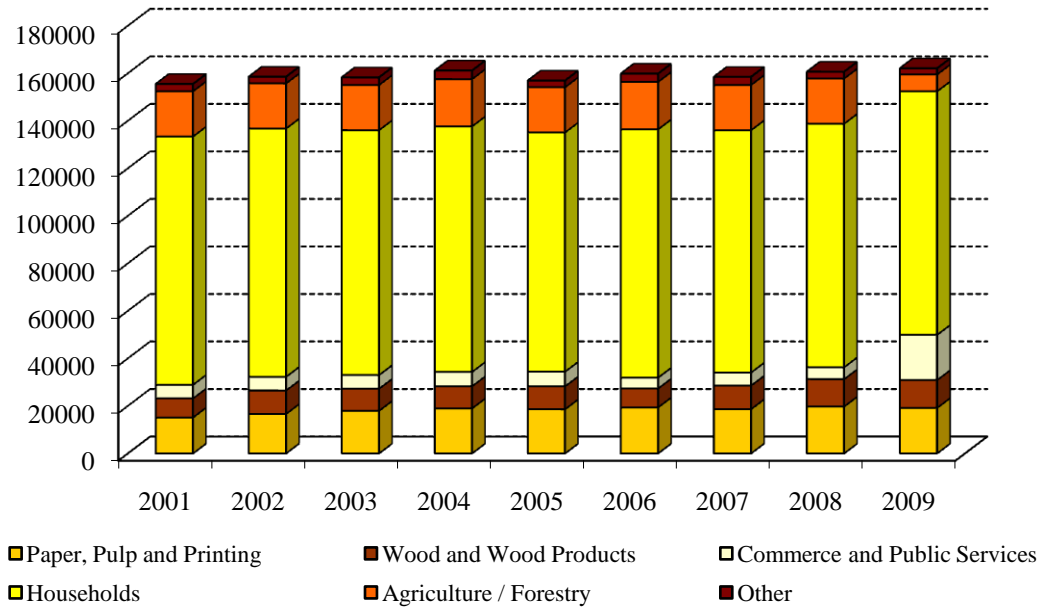
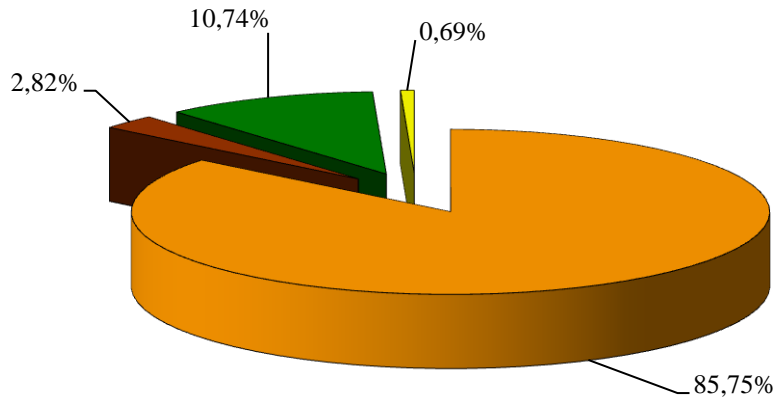


Fig. 12. The structure of solid biomass consumption for transformation sector in 2009



- Main Activity Producer electricity/CHP Plants
- Main Activity Producer Heat Plants
- Autoproducer electricity/CHP Plants
- Autoproducer Heat Plants

Table 9. Production of heat in solar collectors in the years 2002-2009 [TJ]

Specification	2002	2003	2004	2005	2006	2007	2008	2009
Solar energy	0,6	0,9	3,6	6,3	10,6	15,0	54,0	83,4
Final Energy Consumption of which:	-	-	-	-	10,6	15,0	54,0	83,4
Commerce and Public Services:	-	-	-	-	10,6	15,0	54,0	83,4

The data on heat obtained from solar collectors, presented in Table 9, show steady growth in this area, and so in 2005 compared to last year achieved 76% growth, in 2006 - 68%, in 2007 - 41%, in 2008 - 260% and in 2009 - 55%. However, figures given in the table do not give a full picture of the use of solar panels. This follows from the fact that statistical survey are led mainly by the way of selection of special-purpose entities which are included in the group of users: commerce and public services.

The reports for 2009 showed that the total installed collector area is 74 thousand. m², while the analysis of the Institute for Renewable Energy EC BREC, in terms of sales of solar collectors, showed that the total area of solar collectors installed in Poland in 2009 probably reached the size of 510 thousand. m².

Summary data for water and wind which were used for electricity generation in the years 2001 - 2009 are shown in Table 10

Table 10. Generation of electricity from hydro and wind in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hydro	8 370	8 204	6 016	7 494	7 924	7 352	8 468	7 748	8 550
Wind	50	220	446	512	488	922	1 878	3 012	3 878

The data presented above demonstrate that in situation of being maintained on similar level of water energy use (on average 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 50 TJ in 2001 to 3878 TJ in 2007. 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-sheet data for biogases for years 2001 – 2009 are presented in table 11 and in tables 12 – 14 presented detailed data on particular types of biogases (landfill, from sludge and others).

Table 11. Balance of biogas in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	1 477	1 353	1 624	1 941	2 243	2 613	2 708	4 025	4 104
Transformation Sector of which:	563	615	861	1 293	1 820	2 021	2 305	3 037	3 123
Main Activity Producer CHP Plants	-	-	127	57	21	18	15	-	-
Main Activity Producer Heat Plants	29	5	19	-	-	2	4	19	16
Autoproducer CHP Plants	532	609	714	1 236	1 798	2 001	2 286	3 016	3 096
Autoproducer Heat Plants	2	1	1	-	1	-	-	2	11
Energy Sector	12	18	-	16	12	15	28	17	3
Final Energy Consumption of which:	902	720	763	632	411	577	375	971	978
Food, Beverages and Tobacco	42	37	63	74	68	72	84	94	109
Paper, Pulp and Printing	-	-	-	-	-	-	-	-	18
Construction	-	-	-	-	-	-	-	-	3
Commerce and Public Services	860	683	700	558	343	505	291	877	847

In the discussed period (except for 2002) there was a significant increase in the amount of produced biogas. The fuel was mostly used as input of energy transformations in heat and power stations and thermal power stations. The production of biogas in 2009 was higher by 2.0% than the production in 2008. As input of energy transformations was used 76.1% of produced biogas, and 23.8% was constituted by final consumption, of which majority in units

belonging to commerce and public services (86.7%). The structure of biogases use in 2009 is presented in figure 13.

Fig. 13. The structure of biogas consumption in 2009

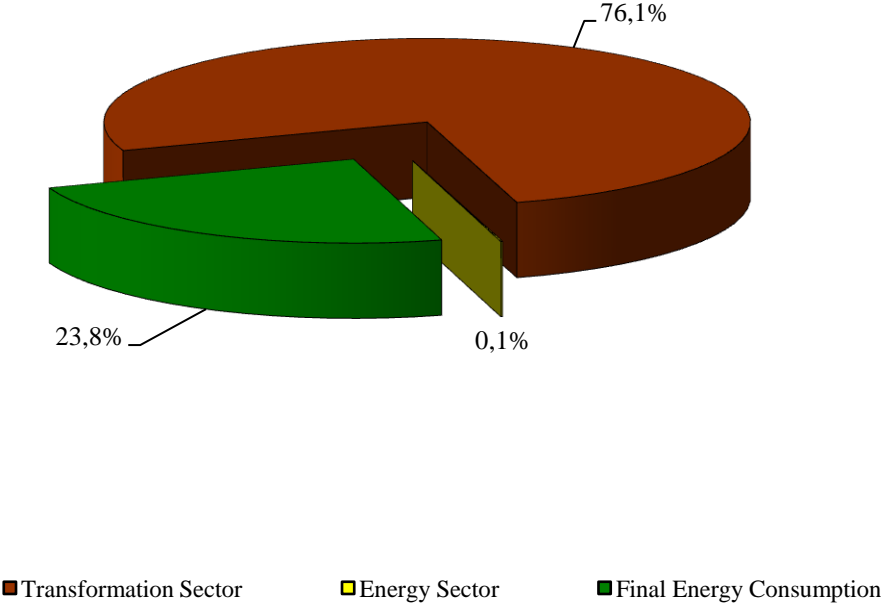


Table 12 presents detailed data for 2001 – 2009 pertaining to gas obtained from landfills.

In 2001 – 2009 production of landfill biogas remained at a level, between 544 and 1487 [TJ]. In 2006 there was an increase in production of biogas, as compared with 2005, by 21.9%. In 2007 the increase amounted to 11.1%, in 2008 – 62.9% and in 2009 – 3.8%.

Landfill gas was entirely used in energy transformations for generation of electricity and heat.

Table 12. Balance of biogas from landfills in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	544	628	704	636	649	791	879	1 432	1 487
Transformation Sector of which:	532	610	704	636	649	791	879	1 432	1 471
Main Activity Producer CHP Plants	-	-	127	57	21	18	15	-	-
Autoproducer CHP Plants	532	609	576	579	628	773	864	1 432	1 471
Autoproducer Heat Plants	-	1	1	-	-	-	-	-	-
Energy Sector	12	18	-	-	-	-	-	-	1
Final Energy Consumption	-	-	-	-	-	-	-	-	15

Table 13 presents balance-sheet data for years 2001 – 2009 pertaining to biogas obtained from sludge.

During this period it was reported generally increases the quantities of biogas extracted from sewage treatment plants, and so in 2003 compared with the previous year there was a 23.6% increase, and in subsequent years: in 2004 by 44.8%, in 2005 by 22.3% in 2006 by 13.7% and in 2008 by 38.0%. In respect of this gas there was a relatively large share of direct final use recorded in the total consumption (85.2% in 2003, 48.7% in 2004, 25.9% in 2005, 32.0% in 2006, 20.8% in 2007, 39.1 in 2008 and 39.6% in 2009).

Table 13. Balance of biogas from sludge in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	933	725	896	1 297	1 586	1 803	1 802	2 486	2 429
Transformation Sector of which:	31	5	133	649	1 163	1 211	1 399	1 498	1 464
Main Activity Producer CHP Plants	29	5	19	-	-	2	4	19	16
Autoproducer CHP Plants	-	-	114	649	1 162	1 209	1 395	1 477	1 437
Autoproducer Heat Plants	2	-	-	-	1	-	-	2	11
Energy Sector	-	-	-	16	12	15	28	17	2
Final Energy Consumption of which:	902	720	763	632	411	577	375	971	963
Food, Beverages and Tobacco	42	37	63	74	68	72	84	94	109
Paper, Pulp and Printing	-	-	-	-	-	-	-	-	18
Construction	-	-	-	-	-	-	-	-	3
Commerce and Public Services	860	683	700	558	343	505	291	877	833

Table 14 presents detailed data on production and consumption of other biogases for years 2003 – 2009.

Table 14. Balance-sheet of other biogas in the years 2003 – 2009 [TJ]

Specification	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	24	8	8	19	27	107	188
Transformation Sector (Autoproducer CHP Plants)	24	8	8	19	27	107	188

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%, for 2007 – 1.0%, 2008 – 2.7% and for 2009 – 4.6% of the total amount of obtained biogases.

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 15 (bioethanol) and in table 16 (biodiesel). Table 15 presents data available for years 2005 – 2009 for bioethanol and table 16 for biodiesel.

Table 15. Balance of bioethanol in the years 2005 – 2009

Specification	2005		2006		2007		2008		2009	
	tony	TJ	tony	TJ	tony	TJ	tony	TJ	tony	TJ
Indigenous Production	80 940	2 404	119 261	3 542	92 679	2 792	92 088	2 459	127 344	3 838
Imports(+)	-	-	2 232	66	22 392	665	113 376	3 027	136 873	4 322
Exports (-)	28 902	858	33 302	989	1 509	45	400	11	-	-
Stock Changes (+/-)	1 440	43	-2 056	-61	-1 875	-56	-6 906	-184	80	2
Inland Consumption of which:	53 478	1 589	86 135	2 558	111 687	3 356	198 158	5 291	264 297	8 162
For Blending to Motor Gasoline/Diesel	53 478	1 589	86 135	2 558	111 687	3 356	198 158	5 291	233 563	7 249
Final in Transport	-	-	-	-	-	-	-	-	30 734	913

Table 16. Balance of biodiesel in the years 2005 – 2009

Specification	2005		2006		2007		2008		2009	
	tony	TJ	tony	TJ	tony	TJ	tony	TJ	tony	TJ
Indigenous Production	64 336	2 471	89 126	3 423	47 447	1 822	263 729	9 943	364 832	14 010
Imports(+)	-	-	142	5	-	-	94 094	3 547	151 535	5 819
Exports (-)	48 599	1 866	51 528	1 979	19 440	746	-	-	8 343	320
Stock Changes (+/-)	1 344	52	1 282	49	-107	-4	-7 408	-279	2 392	92
Inland Consumption of which:	17 081	657	39 022	1 498	27 900	1 072	350 415	13 211	510 416	19 600
For Blending to Motor /Diesel	14 652	563	32 516	1 249	25 307	972	344 451	12 986	421 837	16 199
Final in Transport	2 429	94	6 506	249	2 593	100	5 964	225	88 579	3 401

The balance of bioethanol shows that in subsequent years inland consumption of fuel increased compared to previous year (in 2006 by 61%, 2007 by 31.2%, 2008 by 57.7% and in 2009 by 54.3%). By 2008, inland consumption of bioethanol was entirely used to blending with gasoline (for engine). In 2009 reported its direct consumption in transport in the amount of 913 TJ, that is about 11% of total consumption.

In the years 2005 - 2009 biodiesel production and consumption showed upward trends in the comparison to previous years except 2007, in which there was a decline in production and consumption. In subsequent years there was a significant increase in of the size and so: in 2008 by 446% (production) and 1132% (inland consumption) compared to the year 2007, in 2009 about 41% (production) and 48% (inland consumption) compared to the year 2008. The structure of this fuel consumption in the years 2005 - 2009 is shown in figure 14th.

Fig. 14. Consumption of biodiesel in the years 2005 - 2009 [TJ]

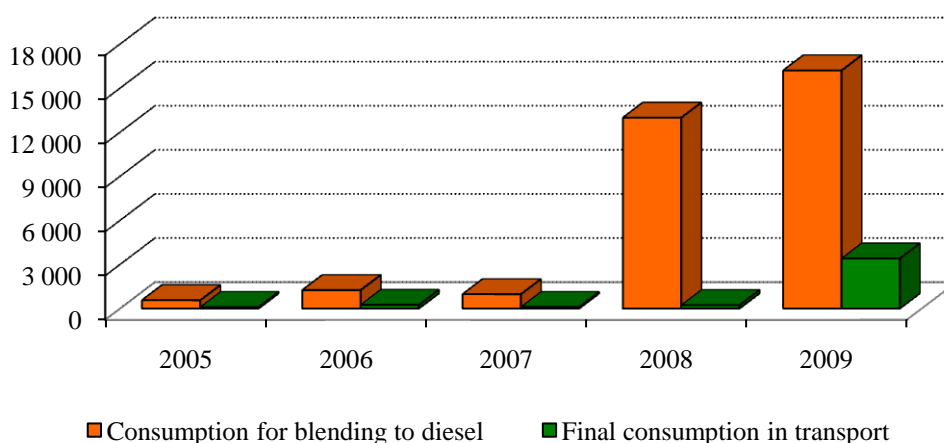


Table 17 presents the available data (based on reports: G -02b – Balance report on energy commodities and heating infrastructure, and G -02o – Report of a heat from renewable sources) of the quantity of geothermal heat which was obtained in the years 2001 - 2009.

Table 17. The balance of geothermal energy in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Geothermal energy	120,0	263,0	311,0	318,0	476,1	534,7	439,0	531,0	599,5
Final Energy Consumption of which:	120,0	263,0	311,0	318,0	476,1	534,7	439,0	531,0	599,5
Commerce and Public Services	20,0	51,0	70,0	70,0	90,0	100,0	82,0	129,0	139,5
Households	100,0	212,0	241,0	248,0	386,1	434,7	357,0	402,0	460,0

The aforementioned data indicate constant increase in consumption of geothermal energy with the exception of 2007, in which was observed a decrease by 17.9%. 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 – 12.3% in 2008 – 21.0% and in 2009 – 12.9%.

Majority of geothermal energy is used for satisfying demand for heat of households (about 79%). Consumption of geothermal energy by households, commerce and public services entities in the years 2001 – 2009 is presented in figure 15 and 16.

Fig. 15. Consumption of geothermal energy in the years 2001 – 2009

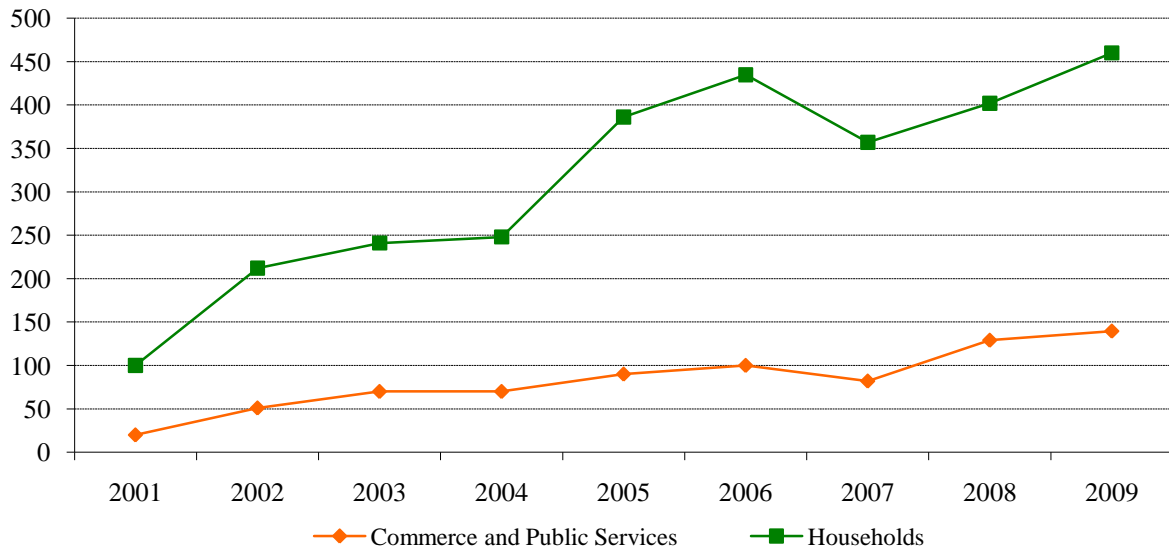
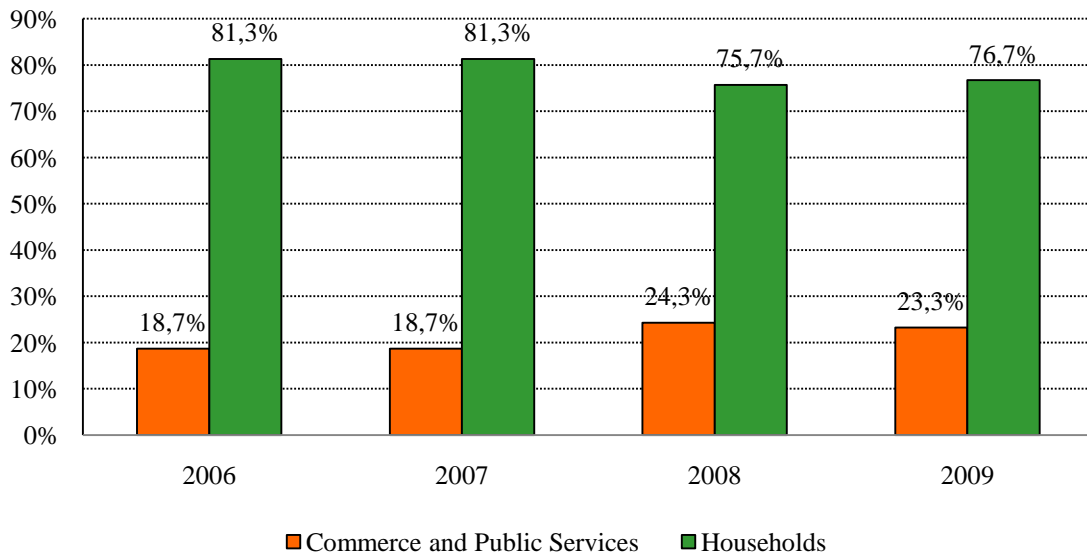


Fig. 16. Structure of the consumption of geothermal energy in the years 2001 – 2009



Balance-sheets of biodegradable municipal waste for years 2001 – 2009 are presented in table 18.

Table 18. The balance of renewable municipal waste in the years 2001 – 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indigenous Production	11	10	14	13	30	27	35	9	29
Stock Changes (+/-)	-	-	-	-	-	3	-	-	-
Inland Consumption	11	10	14	13	30	30	35	9	29
Energy Sector (Own Use in Electricity, CHP and Heat Plants)	1	-	-	-	-	-	-	-	-
Final Energy Consumption:	10	10	14	13	30	30	35	9	29
Industry Sector of which:	-	-	-	-	-	2	6	1	29
Non-Metallic Minerals	-	-	-	-	-	-	1	-	29
Wood and Wood Products	-	-	-	-	-	2	5	1	-
Other Sectors of which:	-	-	-	-	-	28	29	8	-
Commerce and Public Services	-	-	-	-	-	28	29	8	-

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

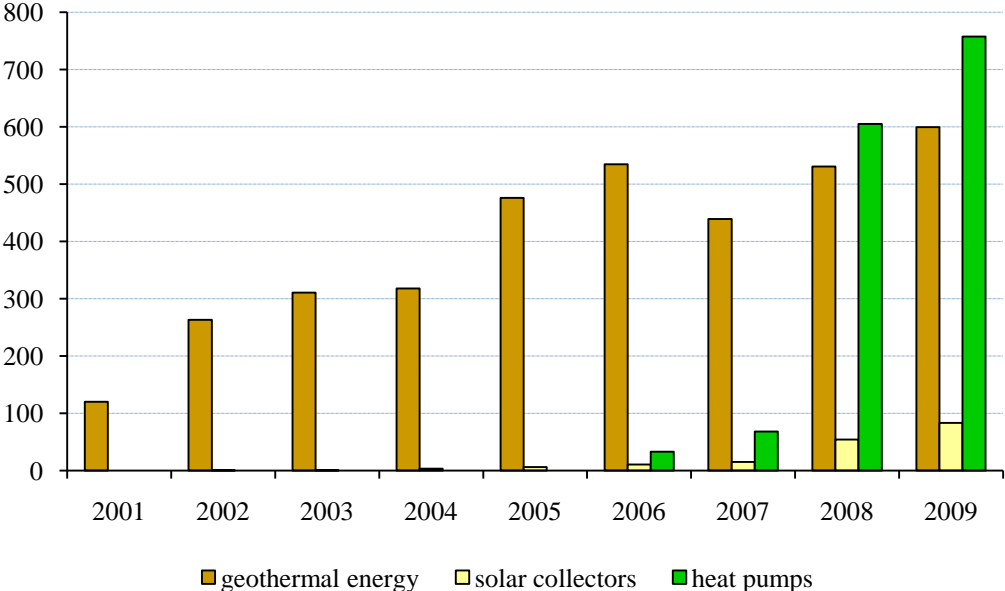
Data on the amount of renewable energy produced by the heat pumps in the years 2006 - 2009 are presented in Table 19. In all subsequent years, compared with the year before, was an increase in the amount of produced energy, and so: in 2007 by 106.1%, in 2008 by 789.7% and in 2009 by 25.2%.

Table 19. Energy production from heat pumps in the years 2006 - 2009 [TJ]

Specification	2006	2007	2008	2009
Heat pumps	33,0	68,0	605,0	757,6
Final Energy Consumption of which:	33,0	68,0	605,0	757,6
Commerce and Public Services	33,0	68,0	605,0	757,6

Data concerning heat produced by solar collectors, geothermal and heat pumps, which are given in Tables 9, 17 and 19, are presented by graphs shown in Figure 17.

Fig. 17. Heat production from geothermal, solar collectors and heat pumps in the years 2001-2009 [TJ]



5. Production of electricity and heat from renewables

The amount of electricity generated from renewables in the years 2001 – 2009 was given in table 20 and figure 18. Figure 19 shows the amount of electricity produced by hydroelectric power stations in the three intervals of capacity (< 1MW; 1 – 10 MW, > 10 MW).

Table 20. Generation of electricity from renewables in the years 2001 – 2009 [GWh]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	2 783,0	2 767,0	2 250,0	3 074,4	3 847,3	4 291,2	5 429,3	6 440,4	8 679,0
Hydro of which:	2 325,0	2 279,0	1 671,0	2 081,7	2 201,1	2 042,3	2 352,1	2 152,2	2 375,1
Hydro-1 MW	239,0	262,0	242,0	273,5	358,2	247,9	306,3	290,2	292,2
Hydro 1-10 MW	532,0	585,0	431,0	616,9	504,2	566,6	658,1	605,4	627,9
Hydro 10+ MW	1 554,0	1 432,0	998,0	1 191,4	1 338,7	1 227,8	1 387,7	1 256,6	1 455,0
Wind	14,0	61,0	124,0	142,3	135,5	256,1	521,6	836,8	1 077,3
Solid biomass	402,0	379,0	399,0	768,2	1 399,5	1 832,7	2 360,4	3 199,8	4 907,3
<i>in which co-combustion</i>	-	-	-	620,5	1 236,3	1 644,6	2 126,2	2 963,3	4 663,8
Biogas of which:	42,0	48,0	56,0	82,2	111,3	160,1	195,2	251,6	319,2
Landfill gas	42,0	48,0	53,0	63,3	75,3	92,0	113,6	148,4	174,8
Sludge gas	-	-	2,0	18,1	35,4	66,7	79,5	94,9	122,7
Other biogas	-	-	1,0	0,8	0,6	1,5	2,1	8,3	21,7

Fig. 18. Generation of electricity from renewables in the years 2001 – 2009 [GWh]

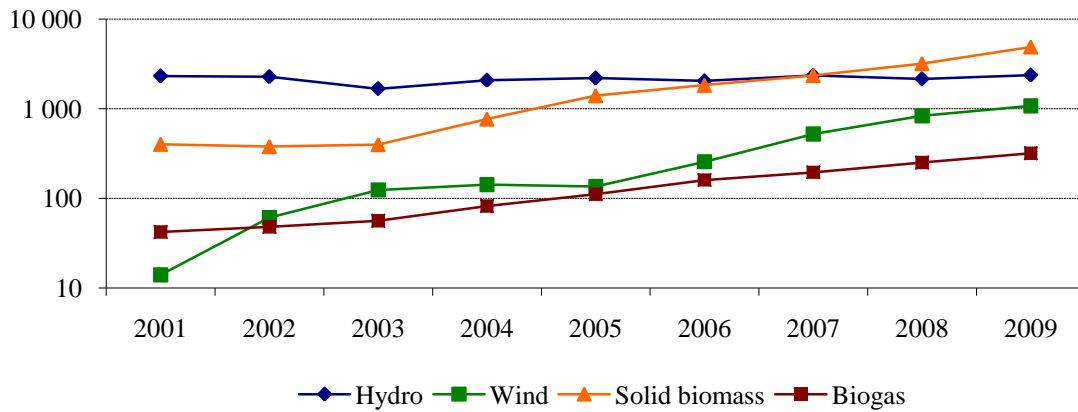
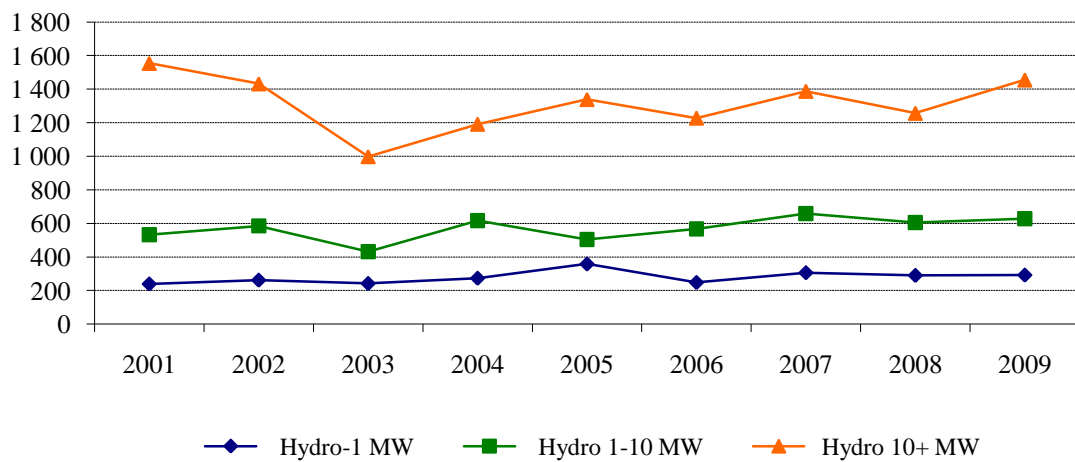


Fig. 19. Generation of electricity in hydro power stations in the years 2001 – 2009 [GWh]



Since 2004, electricity production from renewable sources has increased in comparison with the previous year (in 2004 – 36.6%, in 2005 – 25.1%, in 2006 – 11.5%, in 2007 – 26.5%, in 2008 – 18.6%, in 2009 – 34.8%). The largest increase was recorded in relation to wind power (in 2002 - 335.7%, in 2003 - 103.3%, in 2004 - 14.8%, in 2006 - 89.0%, in 2007 - the 103.7%, in 2008 - 60.4%, in 2009 - 28.7%). High increase (since 2004) occurred also in relation to electricity generated from solid biomass (in 2004 by 92.5%, in 2005 - 82.2%, in 2006 - 31.0%, in 2007 - 28.8%, in 2008 - 35.6% in 2009 - 53.4%). Also in the case of electricity generated on the basis of biogas in these years shows an upward trend (in 2002 - 14.3%, in 2003 - 16.7%, in 2004 - 46.7%, in 2005 - 35.4%, in 2006 - 43.9%, in 2007 - 21.9%, in 2008 - 28.9%, in 2009 - 26.9%).

Data on the generation of electricity from renewables by main activity producers and autoproducers in the years 2006 – 2009 are shown in Tables 21 – 23.

Electricity generated from renewables accounted for 2.8% in 2006, 3.5% in 2007, 4.2% in 2008, 5.8% in 2009 of the national gross electricity consumption (the share of electricity generated from renewable energy in national gross electricity consumption is defined as the ratio of energy generated from renewable energy sources to gross electricity consumption including losses and balance sheet differences).

In the years 2006 - 2009 the share of electricity generated from hydropower in total electricity production from renewables gradually diminishes and it amounted to: in 2006 - 47.6%, in 2007 – 43.3%, in 2008 – 33.4%, in 2009 – 27.4%. At that same time the share of electricity produced from solid biomass has increased in the total production of electricity from RES (in 2006 by 42.7%, in 2007 by 43.5%, in 2008 by 49.7%, in 2009 by 56.5 %)

Wind (in 2006 - 6.0%, in 2007 - 9.6%, in 2008 to 13.0%, in 2009, 12.4%) and biogas (in 2006 - 3.7%, in 2007 - 3.6%, in 2008 - 3.9%, in 2009 - 3.7%) are further energy carriers used for electricity production. Electricity generated from biogas derived mainly from landfill biogas (in 2006 - 57.5%, in 2007 - 58.2%, in 2008 - 59.0%, in 2009 - 54.8%) and biogas from sewage treatment plants (in 2006 - 41.6%, in 2007 - 40.7%, in 2008, 37.7%, in 2009 - 38.4%)

In figures 20 and 21 are shown the value of electricity production in the years 2006 to 2009 according to the energy commodities, separately for the main activity producers and autoproducers. By contrast, figure 22 illustrates generation of electricity from renewables by main activity producers and autoproducers, in the same period of time, by electricity power stations and CHP stations.

Table 21. Generation of electricity from renewables by main activity producers and autoproducers in the years 2006 – 2009 [GWh]

Specification	Main Activity Producer Plants				Autoproducer Plants			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	3 451,6	4 507,1	5 676,9	7 604,1	839,6	922,2	763,5	1 074,9
Hydro	2 040,6	2 349,8	2 149,9	2 372,9	1,7	2,3	2,3	2,2
of which:								
Hydro-1 MW	246,2	303,9	287,9	290,0	1,7	2,3	2,3	2,2
Hydro 1-10 MW	566,6	658,1	605,4	627,9	-	-	-	-
Hydro 10+ MW	1 227,8	1 387,7	1 256,6	1 455,0	-	-	-	-
Wind	256,1	521,6	836,8	1 077,3	-	-	-	-
Solid biomass	1 154,2	1 635,2	2 690,2	4 153,9	678,5	725,1	509,6	753,5
<i>in which co-combustion</i>	1 154,2	1 635,2	2 685,2	4 144,7	490,4	491,0	278,1	519,1
Biogas	0,7	0,5	-	-	159,4	194,7	251,6	319,2
of which:								
Landfill gas	0,7	0,5	-	-	91,3	113,1	148,4	174,8
Sludge gas	-	-	-	-	66,7	79,5	94,9	122,7
Other biogas	-	-	-	-	1,5	2,1	8,3	21,7

Table 22. Generation of electricity from renewables by main activity producer plants in the years 2006 – 2009 [GWh]

Specification	Main Activity Producer Plants							
	Electricity (only)				CHP			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	2 296,7	2 871,4	2 986,7	3 450,2	1 154,9	1 635,8	2 690,2	4 153,9
Hydro	2 040,6	2 349,8	2 149,9	2 372,9	-	-	-	-
of which:								
Hydro-1 MW	246,2	303,9	287,9	290,0	-	-	-	-
Hydro 1-10 MW	566,6	658,1	605,4	627,9	-	-	-	-
Hydro 10+ MW	1 227,8	1 387,7	1 256,6	1 455,0	-	-	-	-
Wind	256,1	521,6	836,8	1 077,3	-	-	-	-
Solid biomass	-	-	-	-	1 154,2	1 635,2	2 690,2	4 153,9
<i>in which co-combustion</i>	-	-	-	-	1 154,2	1 635,2	2 685,2	4 144,7
Biogas	-	-	-	-	0,7	0,5	-	-
of which:								
Landfill gas	-	-	-	-	0,7	0,5	-	-
Sludge gas	-	-	-	-	-	-	-	-
Other biogas	-	-	-	-	-	-	-	-

Table 23. Generation of electricity from renewables by autoproducer plants in the years 2006 – 2009 [GWh]

Specification	Autoproducer Plants							
	Electricity (only)				CHP			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	1,7	2,3	2,3	2,2	837,9	919,8	761,2	1 072,7
Hydro of which:	1,7	2,3	2,3	2,2	-	-	-	-
Hydro-1 MW	1,7	2,3	2,3	2,2	-	-	-	-
Hydro 1-10 MW	-	-	-	-	-	-	-	-
Hydro 10+ MW	-	-	-	-	-	-	-	-
Wind	-	-	-	-	-	-	-	-
Solid biomass	-	-	-	-	678,5	725,1	509,6	753,5
<i>in which co-combustion</i>	-	-	-	-	490,4	491,0	278,1	519,1
Biogas of which:	-	-	-	-	159,4	194,7	251,6	319,2
Landfill gas	-	-	-	-	91,3	113,1	148,4	174,8
Sludge gas	-	-	-	-	66,7	79,5	94,9	122,7
Other biogas	-	-	-	-	1,5	2,1	8,3	21,7

Fig. 20. Generation of electricity from renewables by main activity producer plants in the years 2006 – 2009 [GWh]

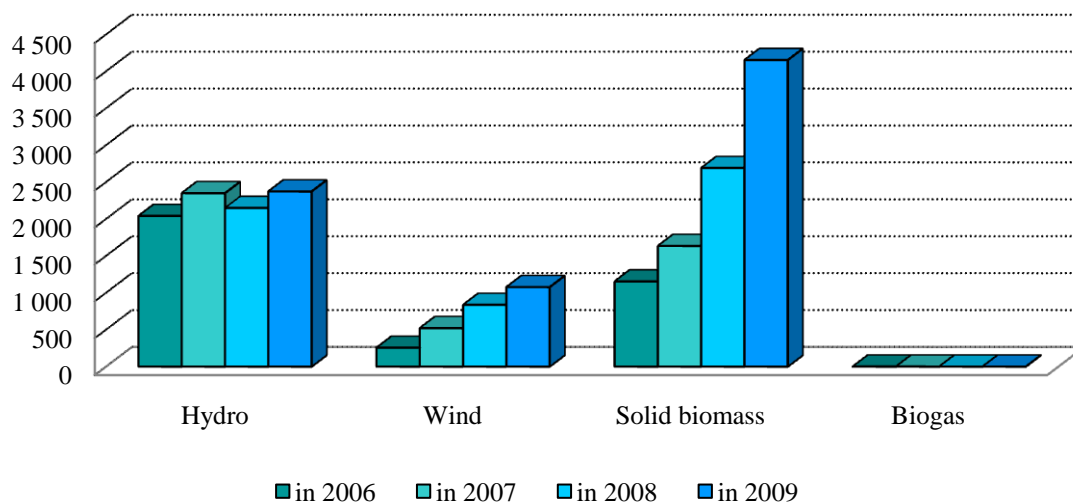


Fig. 21. Generation of electricity from renewables by autoproducer plants in the years 2006 – 2009 [GWh]

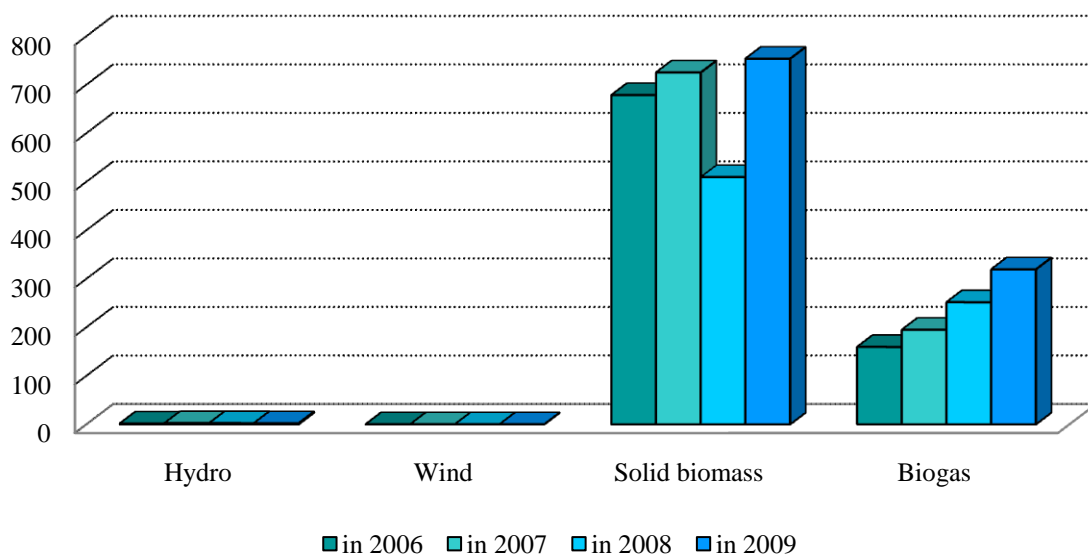


Fig. 22. Generation of electricity from renewables by main activity producers and autoproducers in the years 2006 – 2009 [GWh]

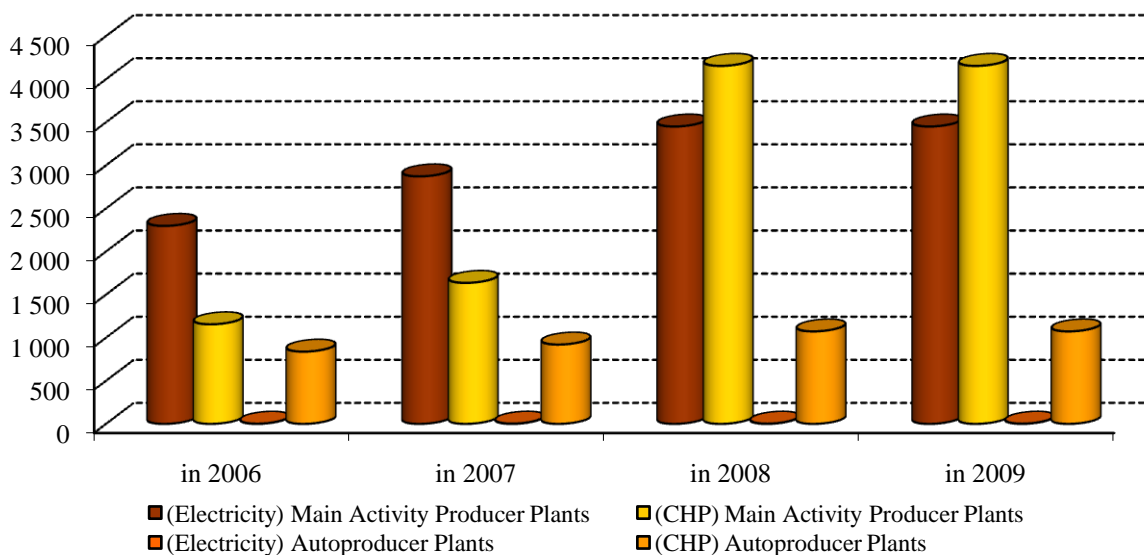


Table 24 contains data on domestic production of heat by combustion of renewable energy carriers in the years 2001 - 2009.

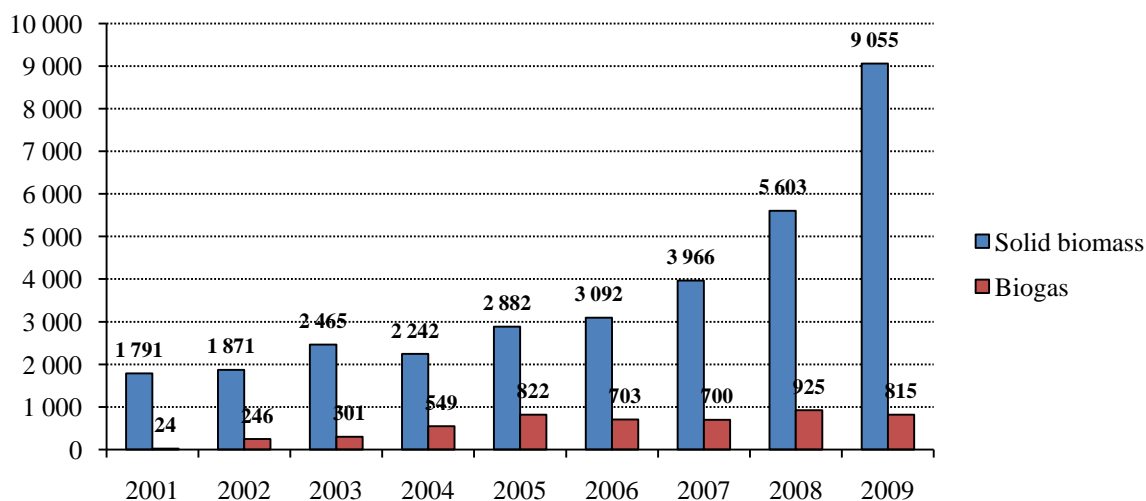
Table 24. Production of heat from renewables in the years 2001 - 2009 [TJ]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	1 815	2 117	2 766	2 791	3 704	3 795	4 666	6 528	9 870
Solid biomass	1 791	1 871	2 465	2 242	2 882	3 092	3 966	5 603	9 055
Biogas of which:	24	246	301	549	822	703	700	925	815
Landfill gas		242	230	136	92	112	32	148	112
Sludge gas	24	4	61	411	727	584	658	733	623
Other biogas			10	2	3	7	10	44	80

Data presented above show a steady increase in total heat production from RES (in 2002 by 16.6%, in 2003 by 30.7%, in 2004 by 0.9%, in 2005 by 32.7%, in 2006 by 2.5%, in 2007 by 23.0%, in 2008 by 39.9%, in 2009 by 51.2%).

These data are illustrated in figure 23

Fig. 23. Production of heat from renewables in the years 2001 - 2009 [TJ]



In tables of 25 – 27 and figure 24 are presented the amount of heat production by main activity producers and autoproducers in the years 2006 - 2009 ie by CHP and heat plants where basic is combustion process. Moreover, figure 25 illustrates the structure of heat production from these sources in 2009

Table 25. Production of heat from renewables by main activity producers and autoproducers in the years 2006 – 2009 [TJ]

Specification	Main Activity Producer Plants				Autoproducer Plants			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	2 115	3 366	4 867	8 034	1 680	1 300	1 661	1 836
Solid biomass	2 102	3 354	4 852	8 022	990	612	751	1 033
Biogas of which:	13	12	15	13	690	688	910	803
Landfill gas	11	9	-	-	101	23	148	112
Sludge gas	2	3	15	13	582	655	718	610
Other biogas	-	-	-	-	7	10	44	80

Table 26. Production of heat from renewables by main activity producers in the years 2006 – 2009 [TJ]

Specification	Main Activity Producer Plants							
	CHP				Heat (only)			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	860	2 162	3 318	6 768	1 255	1 204	1 549	1 266
Solid biomass	849	2 153	3 318	6 768	1 253	1 201	1 534	1 254
Biogas of which:	11	9	-	-	2	3	15	13
Landfill gas	11	9	-	-	-	-	-	-
Sludge gas	-	-	-	-	2	3	15	13
Other biogas	-	-	-	-	-	-	-	-

Table 27. Production of heat from renewables by autoproducers in the years 2006 – 2009 [TJ]

Specification	Autoproducer Plants							
	CHP				Heat (only)			
	2006	2007	2008	2009	2006	2007	2008	2009
Total	1 547	1 191	1 542	1 544	133	109	119	292
Solid biomass	857	503	633	749	133	109	118	284
Biogas of which:	690	688	909	794	-	-	1	8
Landfill gas	101	23	148	112	-	-	-	-
Sludge gas	582	655	717	602	-	-	1	8
Other biogas	7	10	44	80	-	-	-	-

Fig. 24. Production of heat from renewable energy sources in conventional power engineering in the years 2006-2009 [TJ]

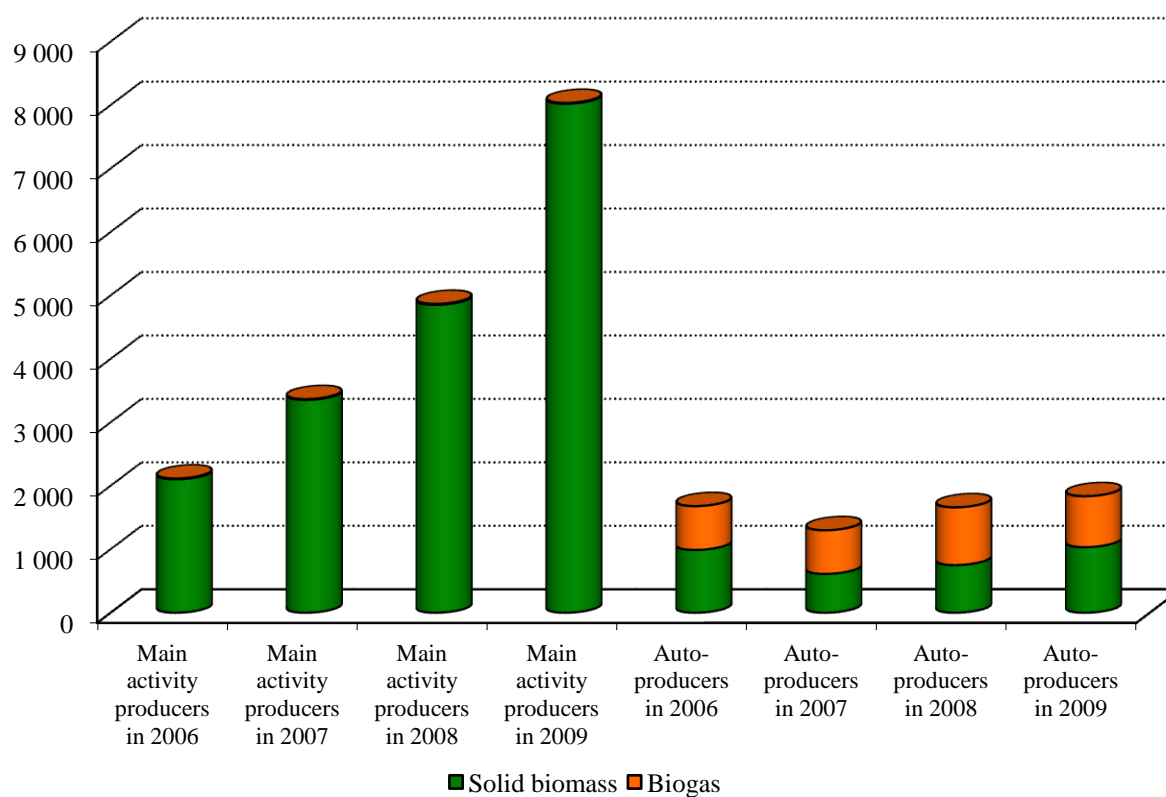
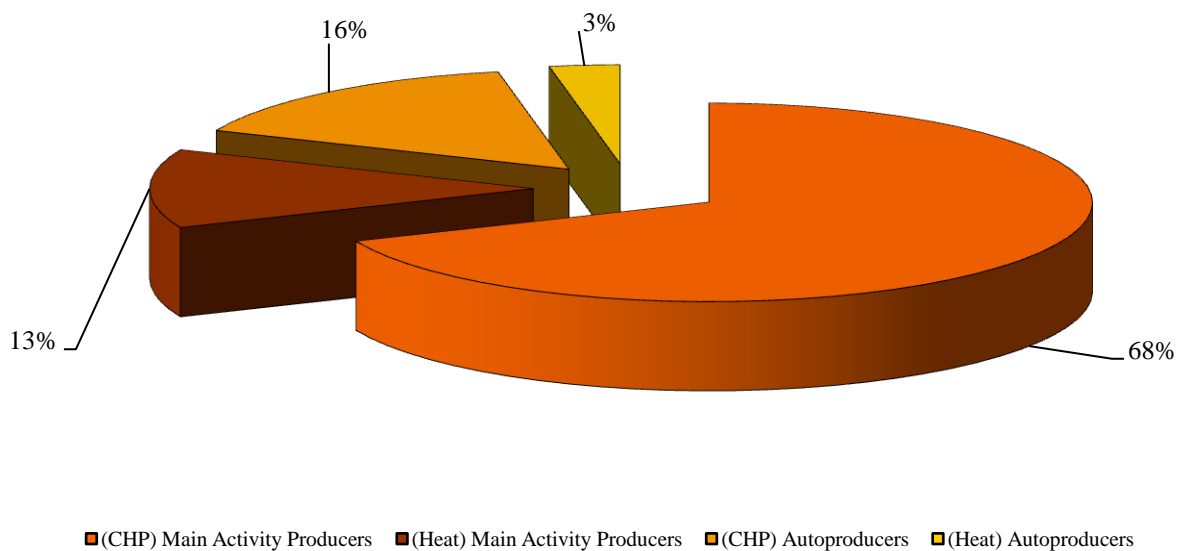


Fig. 25. Structure of production of heat from renewable energy sources in conventional power engineering in 2009



The data presented above demonstrate that from solid biomass were produced in 2006 - 81.5%, in 2007 - 85.0%, in 2008 - 85.8% and in 2009 - 91.7% of heat (and the remaining heat 18.5%, 15.0%, 14.2%, 8.3% were produced from biogas).

6. Capacities of devices using renewables for generation of electricity (in the years 2001 – 2009)

Generating capacities of power stations using renewable energy sources in 2001 – 2009 are presented in table 28 and figure 26.

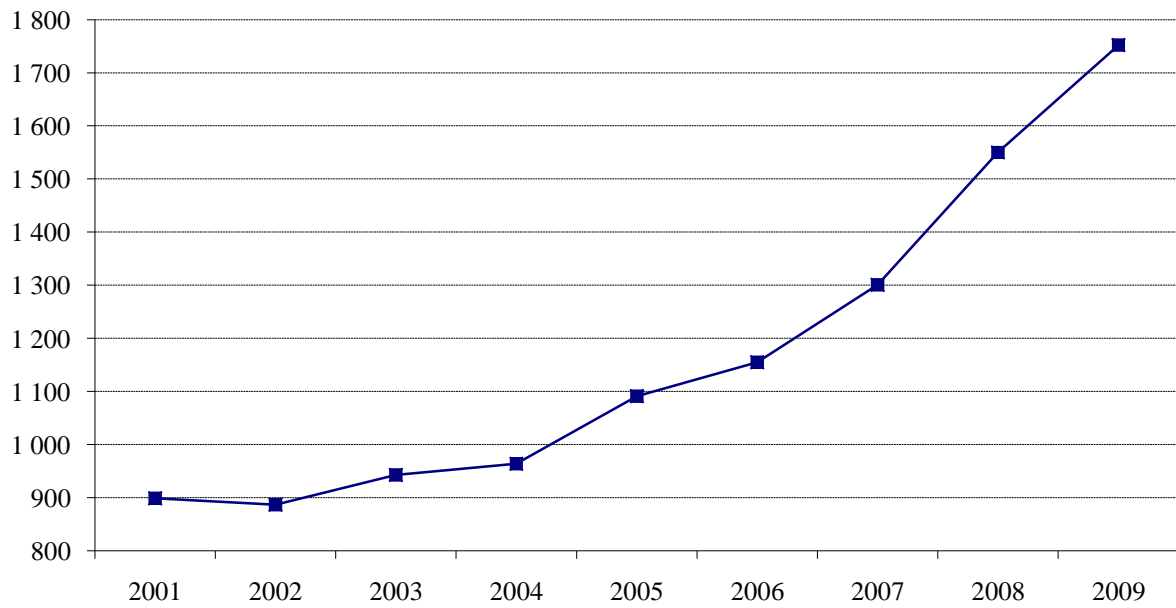
Table 28. Capacities of power stations using renewable energy sources in the years 2001 – 2009 [MW]

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	899	887	943	964	1 091	1 155	1 301	1 550	1 752
Hydro of which:	868	841	867	876	915	925	922	929	932
Hydro-1 MW	76	60	63	77	72	72	72	74	77
Hydro 1-10 MW	106	150	164	184	174	181	178	183	184
Hydro 10+ MW	686	631	640	615	669	672	672	672	672
Wind	19	32	35	40	121	172	306	526	709
Solid biomass	-	-	24	24	25	25	33	42	43
Biogas of which:	12	14	17	24	30	33	40	53	68
Landfill gas	12	14	15	18	23	25	29	31	38
Sludge gas	-	-	2	6	7	7	10	20	24
Other biogas	-	-	-	-	-	1	1	2	5

In the analyzed period there was a constant increase recorded in the total power of electricity-generating devices using RES. In 2009, the available capacity increased by 13.0% compared the year 2008. The highest annual increases of generating capacity were 13.2% in 2005 and 19.1% in 2008. 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%).

High increase in power took place for wind energy (202.5% in 2005, 77.9% in 2007, 71.9% in 2008, 34.8% in 2009) and biogas (41.2% in 2004, 25.0% in 2005, 32.5% in 2008 and 28.3% in 2009).

Fig. 26. Capacities of power stations using renewable energy sources in the years 2001 – 2009 [MW]



Units of measure to be applied in energy statistics

Units commonly used to express the amount of fuel and energy are the units that define: volume, mass and energy of carrier.

Units which are accepted in the international turnovers, cover the measurement of the quantities of fuel and energy, and are named as follow: the cubic meter (m^3), ton (metric ton, 1 ton = 10^3 kg), joule (1 J = 1 N · m, 1 N (Newton) = 1 kg · m · s⁻², s - seconds). These units are included in the International System of Units, designated by the abbreviation "SI" (Système International d'Unités). Apart from the applicable SI units there are also used other units, depending on the country and local traditions reflecting the historical conditions of each country.

1. Prefixes of decimal system and the major abbreviations

Below there are the prefixes and symbols, and more important abbreviations to express decimal multiples and sub-units of measurement commonly used in fuel economy and energy:

Prefixes of decimal system		Major abbreviations			
decy (d)	= 10^{-1}	dag	dekagram	GW	gigawatt
deka (da)	=10	kg	kilogram	kWh	kilowatt-hour
hekto (h)	= 10^2	t	ton (10^3 kg)	MWh	megawatthour
kilo (k)	= 10^3	tys. t	thousand tons	GWh	gigawatt-hour
mega (M)	= 10^6	km	kilometer (thousand meters)	TWh	terawatt hour
giga (G)	= 10^9	tys. km	one thousand km	kJ	10^3 Joule
tera (T)	= 10^{12}	m³	cubic meter	MJ	10^6 Joule
peta (P)	= 10^{15}	dam³	thousand cubic meters	GJ	10^9 Joule
		%	percent	TJ	10^{12} Joule
		l	liter (10^{-3} m ³)	PJ	10^{15} Joule
		kW	kilowatt	toe	tonne of oil equivalent
		MW	megawatt	Mtoe	million tonnes of oil equivalent

2. Selected units of mass

No.	Name	symbol	conversion factor
1.	kilogram	kg	-
2.	tona (megagram)	t (Mg)	10^3 kg
3.	long ton (tona ang.)	lt	1016 kg
4.	short ton (tona USA)	st	907,2 kg

3. Selected units of pressure

No.	Name	symbol	conversion factor
1.	paskal	Pa	$1 \text{ Pa} = 1 \text{ N} \cdot \text{m}^{-2}$
2.	atmosfera fizyczna	atm	101325 Pa
3.	tor (1 mm Hg)	Tr	133,3 Pa
4.	bar	bar	10^5 Pa

4. Selected units of energy

No.	Name	symbol	conversion factor
1.	dżul	J	$1 \text{ J} = 1 \text{ N} \cdot \text{m}$
2.	kaloria	cal	4,1868 J
3.	tona paliwa umownego	tpu	$29,3076 \cdot 10^9 \text{ J}$
4.	tona oleju ekwiwalentnego	toe	$41,868 \cdot 10^9 \text{ J}$
5.	kilowatogodzina	kWh	$3,6 \cdot 10^6 \text{ J}$
6.	brytyjska jednostka ciepła	Btu	1055 J

Ton of equivalent fuel (tpu) is the equivalent of one ton of coal with a calorific value equivalent to seven thousand kilocalories per kilogram (7000 kcal / kg).

Tonne of oil equivalent (toe) is equivalent to one metric ton of crude oil with a calorific value equivalent to ten thousand kilocalories per kilogram (10000 kcal / kg).

British thermal unit (Brytyjska jednostka ciepła) is the energy needed to heat one pound of water by 10 degrees Fahrenheit.

5. Selected units of power

No.	Name	symbol	conversion factor
1.	wat	W	$1 \text{ W} = 1 \text{ J} \cdot \text{s}^{-1}$
2.	megawat	MW	10^6 W

Degrees of Kelvin (K) and also degrees Celsius ($^{\circ}\text{C}$) are used for measuring of differences of the temperature, wherein the unit of temperature rise is the same on the both of scales:

$$1^{\circ}\text{C} = 1 \text{ K}$$

and for the determination of temperature:

$$T = t_c + 273,15$$

where: T - thermodynamic temperature in K,
 t_c - temperature in degrees of Celsius.

**Names of types of activity groupings
(classification of PKD* and NACE Rev.2**)**

Lp.		NACE Rev 2	PKD-2007	PKD-2004
1.	Industry Sector of which:	total from: 2 - 12	total from: 2 - 12	total from: 2 - 12
2.	Iron and steel	24.1, 24.2, 24.3,24.51, 24.52	24.1, 24.2, 24.3,24.51, 24.52	27.1,27.2,27.3,27.51,27.52
3.	Chemical (including Petrochemical)	20	20	24
4.	Non-Metallic Minerals	23	23	26
5.	Transport Equipment	29,30	29,30	34,35
6.	Machinery	25,28,26,27	25,28,26,27	28-32
7.	Mining and Quarrying	07,08	07,08	13,14
8.	Food, Beverages and Tobacco	10,11,12	10,11,12	15,16
9.	Paper Pulp and Printing	17,18	17,18	21,22
10.	Wood and Wood Products	16	16	20
11.	Textile and Leather	13,14,15	13,14,15	17 - 19
12.	Non-specified (industry)	22,32,31,38	22,32,31,38	25,33,36,37
13.	Construction	41,42,43	41,42,43	45(sekcja F)
14.	Transport Sector	49-51	49-51	60-62
15.	Other Sectors of which:			
16.	Commerce and Public Services	36, 45, 46, 47, 55, 56, 52, 53, 61 ,64, 65, 66, 68, 77, 62, 63, 72, 58, 69, 70, 71, 73, 74, 78, 79, 80, 81, 82, 33, 95, 84, 85, 75, 86, 87, 88, 37, 38, 39, 94, 59, 60, 90, 91, 92, 93, 96, 97, 98, 99	36, 45, 46, 47, 55, 56, 52, 53, 61 ,64, 65, 66, 68, 77, 62, 63, 72, 58, 69, 70, 71, 73, 74, 78, 79, 80, 81, 82, 33, 95, 84, 85, 75, 86, 87, 88, 37, 38, 39, 94, 59, 60, 90, 91, 92, 93, 96, 97, 98, 99	41.0,50 - 52,55,63 - 67, 70 - 75,80,85,90 -93,95,99
17.	Agriculture / Forestry	01,02,03	01,02,03	01,02,05

* Polish Classification of Activities (PKD-2007 in force since 1 January 2008)

** Statistical Classification of Economic Activities in the European Union, NACE Revision 2 (Rev. 2), in force since 1 January 2008