MONITOR POLSKI

THE OFFICIAL JOURNAL OF THE REPUBLIC OF POLAND

Warsaw, 1 March 2012

Item 108

NOTICE

OF THE MINISTER OF ECONOMY[1]

of 16 February 2012

on the report evaluating the progress in increasing the share of high-efficiency cogeneration in the total annual production of electricity in Poland

Pursuant to Article 9n (2) of the Act of 10 April 1997 – the Energy Law (Journal of Laws of 2006 No 89, item 625, as amended[2]), we announce a report evaluating the progress towards increasing the share of high-efficiency cogeneration in the total annual production of electricity in Poland, which is attached to this notice.

Minister of Economy: *W. Pawlak*

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[1] Pursuant to Article 1 (2) of the Regulation of the Prime Minister on the detailed scope of responsibilities of the Minister of Economy (Journal of Laws No 248, item 1478), the Minister of Economy is in charge of the economic sector of governmental administration.

[2] Amendments to the consolidated text of the above-mentioned Act were published in Journal of Laws of 2006 No 104, item 708, No 158, item 1123 and No 170, item 1217, of 2007 No 21, item 124, No 52, item 343, No 115, item 790 and No 130, item 905, of 2008 No 180, item 1112 and No 227, item 1505, of 2009 No 3, item 11, No 69, item 586, No 165, item 1316 and No 215, item 1664, of 2010 No 21, item 104 and No 81, item 530 and of 2011 No 94, item 551, No 135, item 789, No 205, item 1208, No 233, item 1381 and No 234, item 1392.

Appendix to the Notice of the Minister of Economy
of 16 February 2012 (item 108)

REPORT EVALUATING THE PROGRESS TOWARDS INCREASING THE SHARE OF HIGH-EFFICIENCY COGENERATION IN THE TOTAL ANNUAL PRODUCTION OF ELECTRICITY IN POLAND

Warsaw, February 2012

Contents

Introduction

The report evaluating the progress towards increasing the share of high-efficiency cogeneration in the total annual production of electricity in Poland, hereinafter referred to as the “Report”, has been drawn up to Article 9n (2) of the Act of 10 April 1997 – the Energy Law (Journal of Laws of 2006 No 89, item 625, as amended), hereinafter referred to as the “Energy Law”, in conjunction with Article 9 of the Act of 12 January 2007 amending the Energy Act, the Environmental Protection Act and the Act on the compliance evaluation system (Journal of Laws No 21, item 124), hereinafter referred to as the “Act of 2007”.

The report has been drawn up in compliance with the guidance provided in Article 6 (3) and Article 10 (2) of Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC (OJ L 52, 21.2.2004, p. 50, as amended, OJ special edition in Polish, Chapter 12, Volume 3, p. 3), hereinafter referred to as “Directive 2004/8/EC”, and on the basis of the report template attached to the request for a report from the European Commission (ENER/PL/jma/pc/S-309427) dated 11 April 2011, made pursuant to Article 6 (3) and Article 10 (2) of Directive 2004/8/EC.

The structure of the Report is derived from the above-mentioned report template, which specifies the main sections of the report and supporting questions to be answered by the Member States in the national reports.

Due to the fact that statistics have distinguished between high-efficiency cogeneration and cogeneration since the introduction of the high-efficiency cogeneration support system in 2007, the data on high-efficiency cogeneration covers the period from 2007 to 2010.

The forecasts included in the Report are based on the MARKAL forecasting model.

The following documents were used, *inter alia*, to prepare the Report:

1) document titled: Data analysis for the purposes of the “Report evaluating the progress in increasing the share of high-efficiency cogeneration in the total annual production of electricity in Poland”, prepared for the Ministry of Economy by a Consortium led by EU-Consult sp. z o.o. (Gdańsk, September 2011);
2) statistical studies carried out by Agencja Rynku Energii SA (hereinafter referred to as “ARE”) and the Central Statistical Office (hereinafter referred to as “GUS”);
3) “Programme for the Development of Cogeneration in Poland” (“*Program rozwoju w Polsce kogeneracji*”) prepared by the University Research Centre for the Power Industry and Environmental Protection of the Warsaw University of Technology (Warsaw, November 2010);
4) Annual activity report of the President of the Energy Regulatory Office, 2010 - the Energy Regulatory Office, hereinafter referred to as “URE”;
5) national reports of the President of the Energy Regulatory Office – URE;
6) “Balance of Mineral and Groundwater Resources in Poland (as at 31 December 2010)” – Polish Geological Institute.

1. Development of high-efficiency cogeneration in Poland

Installed electricity capacity and electricity production in high-efficiency cogeneration

The total installed capacity in the national power system, hereinafter referred to as “NPS”, was 35 949 MW as at the end of 2010. The vast majority of the power (91%) is installed in the main activity producer electricity plants and main activity producer combined heat and power plants, hereinafter referred to as “CHP plants” (32 757 MW in 2010). Both the installed capacities and the shares of individual plant types have not changed significantly within the last 15 years. Since 1995, the total installed capacity has changed by 2 789 MW (i.e. just under 8%). Slight increases in installed capacities due to the start-up of new generation units have been offset by the decommissioning of obsolete units. The installed capacity in main activity producer CHP plants was 5 810 MW as at the end of 2006 and 6 163 MW as at the end of 2010.

The total annual electricity output in Poland in 2010 was 15 7658 GWh, marking a reversal in the downward trend initiated in 2008, which resulted from the global economic downturn. The shares of individual power plant types are similar to those for the installed capacity. The dominance of thermal power stations in the main activity producer electricity plant category is even more remarkable. It results from the lower utilisation time of installed capacity in other main activity producer electricity plants, mostly hydroelectric plants.

In 2005, the production of cogenerated electricity in main activity producer and autoproducer power plants and CHPs was 21 702 GWh (13.8% of the total gross electricity production). In 2010, the production increased to 26 377 GWh (16.7% of the total gross electricity production), which means a 21.5% increase when compared with 2005. On the other hand, considering the period from 2007 to 2010, it needs to be noted that the increase in the production of cogeneration electricity in the categories of thermal power stations, main activity producer CHP plants and autoproducer CHP plants was not noticeable until the year 2010.

Electricity is cogenerated in Poland with a substantial share of main activity producer combined heat and power plants (18 832 GWh in 2010, 71.4% of the total cogeneration output). In 2010, autoproducer CHP plants (with a capacity above 0.5 MW) generated 5 753 GWh of electricity in the cogeneration mode (21.8% of the total cogeneration electricity). Main activity producer electricity plants have a minor share (6.8% in 2010) in the cogeneration output.

The data on electricity production from high-efficiency cogeneration covers not only main activity producer and autoproducer generators, but also independent entities whose production is considered to be high-efficiency cogeneration. In 2010, the total output of cogeneration electricity was 26 892 GWh. It means that the annual output increased by 1 961 GWh (7.9%) when compared with 2007. At the same time, the share of electricity produced from high-efficiency cogeneration in the gross total production of electricity in Poland increased from 15.6% in 2007 to 17.1% in 2010.

Table 1. Installed capacity and electricity production in high-efficiency cogeneration units [ARE data]

Installed capacity and electricity production in high-efficiency cogeneration units	**units of measure**	**2007**	**2008**	**2009**	**2010**
Electrical generation capacity	MW	27 453.0	28 865.5	27 758.5	30 007.5
Electricity production, of which:	GWh	24 931.0	25 012.7	24 775.2	26 891.8
units below 1 MW	GWh	4.5	7.6	14.2	9.7
gas-fired units	GWh	2 513.9	2 892.2	2 875.7	2 990.8
other units	GWh	22 412.6	22 112.9	21 885.3	23 891.3
Total electricity production	GWh	159 348.0	155 494.0	151 720.0	157 658.0
Share of high-efficiency cogeneration in the total annual production of electricity in Poland	**%**	**15.6%**	**16.1%**	**16.3%**	**17.1%**

Shares of individual sources in the production of electricity from high-efficiency cogeneration are similar. In 2010, main activity producer combined heat and power plants generated 18 608 GWh, i.e. 69.2% of the total production from high-efficiency cogeneration. In 2007, the production from main activity producer CHP plants qualifying as electricity from high-efficiency cogeneration was 17 580 GWh, which means that it was 5.8% higher in 2010 than in 2007. The output levels of high-efficiency cogeneration electricity in Poland are presented in the table below. As there is no data available for high-efficiency cogeneration from 1995 to 2006, this period is not included in the analysis.

Table 2. Production of electricity from high-efficiency cogeneration in Poland From 2007 to 2010 [GWh], [ARE data]

Breakdown	**2007**	**2008**	**2009**	**2010**
total production from high-efficiency cogeneration, of which	24 931	25 013	24 775	26 892
main activity producer electricity plants and CHP plants, of which	19 753	20 327	20 123	20 862
main activity producer CHP plants	17 580	18 194	18 218	18 608
Autoproducer CHP plants over 0.5 MW	4 641	4 686	4 645	5 690

From 2008 to 2010, electricity produced from gas-fired cogeneration or with a source capacity below 1 MW had a 12% share in the total electricity generated from high-efficiency cogeneration. The remaining 88% was generated by other cogeneration units, mostly coal-fired. The share of cogeneration using methane gas from mines and biomass gas did not exceed 1% in 2010, amounting to as little as 101.1 GWh.

Heat generation capacity and heat output

In 2006, the total heat generation capacity of the heat plants of distribution and production companies, as well as main activity producer electricity plants and CHP plants was 50 712 MW, of which 25 656 MW was installed in heat plants, and 25 056 MW – in electricity plants and CHP plants. In 2009, the heat generation capacity was 43 673 MW (15 205 MW – heat plants; 28 467 MW – electricity plants and CHP plants). This structure shows that the share of heat generation capacities of electricity plants and CHP plants are strongly increasing, with relatively visible reductions in the capacities of heat plants in distribution and production companies.

Table 3. Heat generation capacities and output in high-efficiency cogeneration units [ARE data]

Heat generation capacities and output in high-efficiency cogeneration units	**units of measure**	**2007**	**2008**	**2009**	**2010**
Heat generation capacity	MW	21 375.9	20 808.2	20 477.5	25 340.8
Heat output	TJ	224 297.7	223 960.9	224 802.5	251 960.5

In 2010, 251 960.5 TJ of heat was obtained from high-efficiency cogeneration. From 2007 to 2009, the heat output from high-efficiency cogeneration fluctuated around 224 000 TJ, which accounted for 43 to 44% of the total output, while in 2010 the share increased to 48.5%. Main activity producer combined heat and power plants have a substantial share (68.6% in 2010) in the heat production from high-efficiency cogeneration. Together with electricity plants, they cogenerated 172 857 TJ in 2010 (compared with 166 424 TJ in 2009).

In 2010, the heat output from sources other than high-efficiency cogeneration systems (from main activity producer thermal power stations, main activity producer combined heat and power plants and autoproducer combined heat and power plants) was 47 556 TJ, and by way of comparison, in 2007 the heat output from sources other than high-efficiency cogeneration was 83 093 TJ. The decreasing heat output from sources other than high-efficiency cogeneration systems is due to the upgrading of obsolete heat generation systems to high-efficiency cogeneration units or shutdowns.

The heat output forecast in the previous Report for national grid power plants, including main activity producer electricity and CHP plants projected the 2010 output to be at a level of 209 000 TJ. The output in 2010 was 232 880 TJ. The heat output forecast in the Report for autoproducer CHP plants envisaged that the output would increase from 125 000 TJ in 2005 to 147 000 TJ in 2010. In 2006, the heat output from autoproducer CHP plants was 145 867 TJ, and it substantially decreased to 126 659 TJ in 2010. It should be noted, however, that after 2008, a certain number of autoproducer CHP plants were classified as main activity producer and independent plants, adding to the output from that group. The total heat output forecast for main activity producer and autoproducer CHP plants should be considered to be close to the actual output.

Table 4. Heat production at electricity plants, combined heat and power plants and heat plants (main activity producer and other) in Poland in the period from 2006 to 2010 [TJ] [ARE data]

Breakdown	**2006**	**2007**	**2008**	**2009**	**2010**
	[TJ]				
Total heat output	528 877	513 947	526 702	513 039	519 343
Main activity producer electricity plants, CHP plants and heat plants	287 651	281 206	289 882	288 673	314 686
High-efficiency cogeneration	NDA	224 298	223 961	224 802	251 961
Main activity producer electricity plants and CHP plants	189 939	189 342	211 976	212 604	232 880
Cogeneration main activity producer electricity plants and CHP plants	171 180	171 274	159 970	166 424	172 857
Autoproducer CHP plants	145 867	136 118	118 832	115 306	126 659
Heat plants other than main activity producers	95 359	96 624	117 989	109 060	77 997
Main activity producer heat plants	97 713	91 863	77 907	76 069	81 806

Heat produced from high-efficiency cogeneration is mostly used (approx. 60%) to heat buildings and domestic hot water, hereinafter referred to as "DHW". The rest of the heat is used for industrial processes (approx. 40%). Other uses of heat from high-efficiency cogeneration can be considered to be negligible. The table below shows the utilisation of useful heat from high-efficiency cogeneration units covered by certificates of origin from cogeneration.

Table 5. Uses of heat from high-efficiency cogeneration from 2007 to 2010 [URE data]

Year of generation	Heating of buildings and domestic hot water	In industrial processes	In facilities using heat for plant and animal production	Secondary cooling	Other	Total
	[GJ]					
Second half of 2007	68 694 082.15	41 133 118.07	153 434.72	57 774.00	0.00	110 038 408.95
2008	75 688 539.52	48 268 114.98	480 377.54	NDA	0.00	124 437 032.04
2009	142 148 348.34	105 535 738.92	1 000 057.24	72 676.00	29.00	248 756 849.50
2010	145 911 101.20	94 117 893.45	723 547.29	63 567.67	NDA	240 816 109.61

2. Transposition of Directive 2004/8/EC

The current legal framework in respect of supporting and promoting cogeneration is a consequence of the implementation of Directive 2004/8/EC, which obliges Member States to bring into force the laws, regulations and administrative provisions necessary to implement the Directive not later than by 21 February 2006.

Directive 2004/8/EC was implemented by the Act of 2007, which entered into force on 24 February 2007. The provisions implementing the new mechanism for promoting energy from high-efficiency cogeneration and supporting the development of electricity production from high-efficiency cogeneration entered into force on 1 July 2007.

In accordance with the guidance provided in Directive 2004/8/EC, a certification system was put in place and sanctioned for electricity produced in a high-efficiency cogeneration process, and the certification became mandatory for entities applying for the support system. Moreover, the obligation to buy certificates or to pay a substitution fee was imposed on entities selling electricity to end customers, in proportion to the amount of energy provided by those entities.

The provisions of the Act of 2007 were set out in the Regulation of the Minister of Economy of 26 August 2007 *on the calculation of the data provided in the application for a certificate of origin from cogeneration and on the specific scope of the responsibility to obtain such certificates and to present them for cancellation, on the payment of the substitution fee and on the obligation to validate the data on the amount of electricity produced from high-efficiency cogeneration* (Journal of Laws No 185, item 1314), hereinafter referred to as the “Regulation of 2007”. Aside from implementing Directive 2004/8/EC, the provisions of the Regulation of 2007 implemented Commission Decision 2007/74/EC of 21 December 2006 establishing harmonised efficiency reference values for the separate production of electricity and heat in the application of Directive 2004/8/EC of the European Parliament and of the Council (OJ L 32, 6.2.2007, p. 183)

The Regulation of 2007 was replaced by the Regulation of the Minister of Economy of 26 July 2007 *on the calculation of the data provided in the application for a certificate of origin from cogeneration and on the specific responsibility to obtain such certificates and to present them for cancellation, on the payment of the substitution fee and on the obligation to validate the data on the amount of electricity* (Journal of Laws No 176, item 1052), hereinafter referred to as the “Regulation of 2011”, which implements Commission Decision 2008/952/EC of 19 November 2008 establishing detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC of the European Parliament and of the Council (OJ L 338, 17.12.2008, p. 55).

3. National potentials for increasing the share of high-efficiency cogeneration

Heat demand forecast

A forecast of heat demand for the residential sector is presented below. It is based on the forecast of population, useful floor space as well as the DHW heat use indicators and the heating standard indicator. It is assumed that the average number of inhabitants per dwelling will decrease from 2.87 (in 2009) to 2.54 in 2020. Moreover, it is assumed that the average useful floor space of a dwelling will increase from 70.5 m2 in 2009 to 73.2 m2 in 2020. The average residential thermal standard indicator for 2005 is 120 kWh/m2. It is assumed that this indicator will improve (decrease) by 1% YoY before 2020.

The DHW heat use indicator in 2005 is estimated at 2 090 kJ/person. This indicator will not change significantly before 2020. We may assume that the increased efficiency of DHW use can be offset by increased hot water use per capita.

Table 6. Useful heat demand forecast for the residential sector

Breakdown	**2010**	**2015***	**2020***
Dwellings [‘000]	13 412.7	14 132.4	14 893.7
Useful floor space [‘000 m2]	949 616	1 017 530	1 090 216
Population [‘000]	38 092.0	38 016.1	37 829.9
Demand for heat for DHW [PJ]	**79.2**	**78.7**	**77.9**
Demand for heat for room heating [PJ]	**389.7**	**395.6**	**400.3**
Total demand for heat from the residential sector [PJ]	**468.9**	**474.3**	**478.2**

*forecast values

The next table shows the useful heat demand forecast for industry and services. This forecast was developed on the basis of GDP changes, including the trend in the primary energy intensity of GDP.

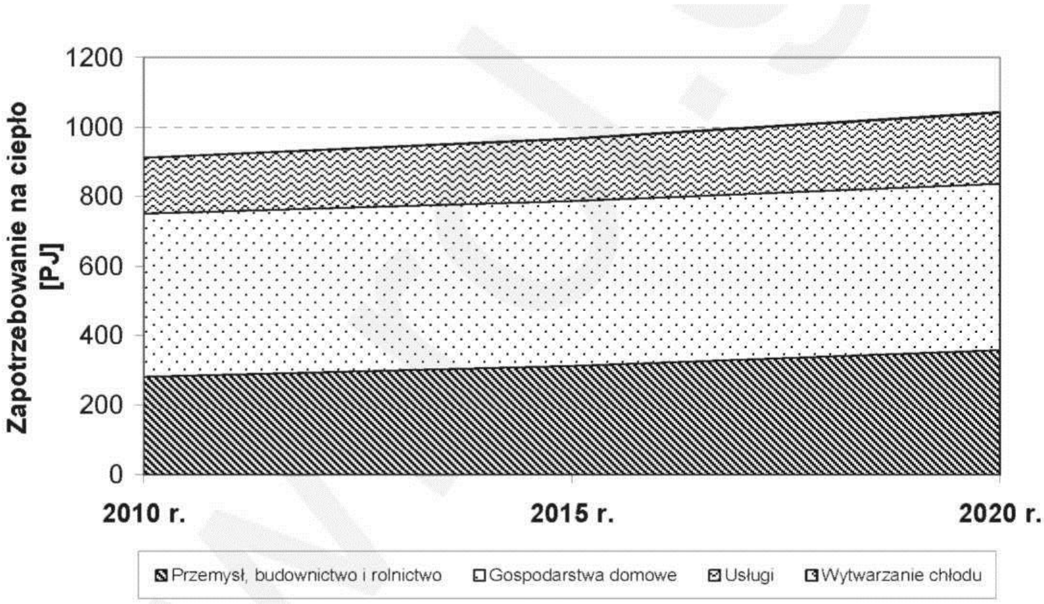
Table 7. Useful heat demand forecast for industry and services
[on the basis of ARE and GUS data]

Item	**Breakdown**	**Unit of measure**	**2010**	**2015***	**2020***
1	Useful heat demand forecast for industry	PJ	281.7	313.2	358.7
2	Useful heat demand forecast for services	PJ	160.6	178.6	204.5

*forecast values

The useful heat demand forecast is shown in the chart below. The forecast envisages an increase in the demand for useful heat to 1 043 PJ in 2020 (by 14% compared to 2010).

Chart 1. Useful heat demand forecast [PJ] [on the basis of ARE and GUS data]



Heat demand [PJ]

Industry, construction and agriculture	Residential sector	Services	Cooling

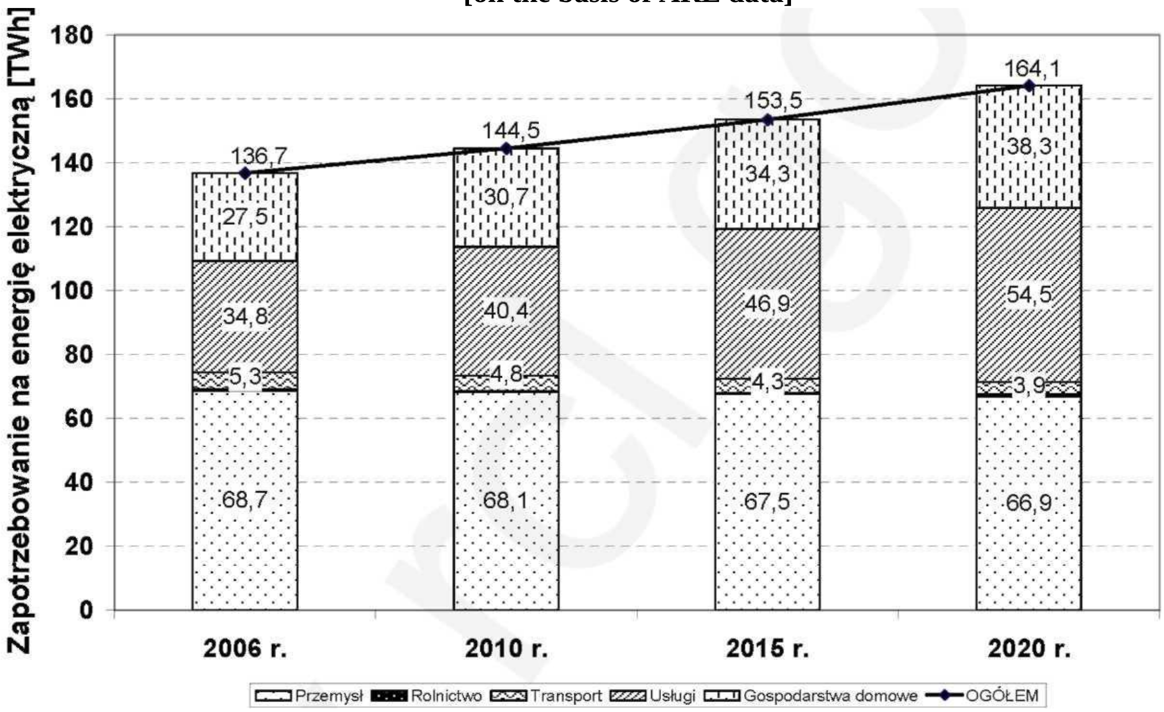
Breakdown	2010	2015*	2020*
Industry, construction and agriculture [PJ]	281.7	313.2	358.7
Residential sector [PJ]	468.9	474.3	478.2
Services (PJ)	160.6	178.6	204.5
Cooling [PJ]	0.50	1.00	2.00
Total [PJ]	911.7	967.0	1 043.4

*forecast values

Electricity demand forecast

The forecast of the national demand for electricity was developed on the basis of the data on electricity consumption in individual sectors of the national economy. Trends were determined from historical data, and formed the basis for the adjustment of the objectives of the Polish Energy Policy until 2030, which is attached to the Notice of the Minister of Economy of 21 December 2009 on the national energy policy until the year 2030 (*Monitor Polski* of 2010 No 2, item 11), hereinafter referred to as the “Polish Energy Policy until 2030”. It is envisaged that the electricity consumption will slightly decline in the industrial and transport sectors, while the demand for electricity will increase in the service and residential sectors. The forecast envisages that from 2010 to 2020, the total demand for electricity will increase by 14.5%.

Figure 2. National electricity demand forecast [TWh]
[on the basis of ARE data]



Electricity demand [TWh]

Industry	Agriculture	Transport	Services	Residential	TOTAL

Breakdown	**2006**	**2010**	**2015***	**2020***
TOTAL [TWh]	136.7	144.5	153.5	164.1
Industry [TWh]	68.7	68.1	67.5	66.9
Agriculture [TWh]	0.4	0.5	0.5	0.5
Transport [TWh]	5.3	4.8	4.3	3.9
Services [TWh]	34.8	40.4	46.9	54.5
Residential [TWh]	27.5	30.7	34.3	38.3

*forecast values

Technical potential for cogeneration

The technical potential for high-efficiency cogeneration results primarily from the production volume of useful heat. The total production of heat was calculated considering the heat demand forecast. In 2010, the heat production from high-efficiency cogeneration was 252.0 PJ. The heat production with a useful heat forecast in 2010 is 995.9 PJ. Therefore, the remaining portion of the heat output is the theoretical potential for high-efficiency cogeneration. Part of that heat is cogenerated but does not meet the criteria for primary energy savings and overall efficiency of electricity and heat production. However, it may constitute the potential for high-efficiency cogeneration. The theoretical potential for cogeneration is presented in the table below.

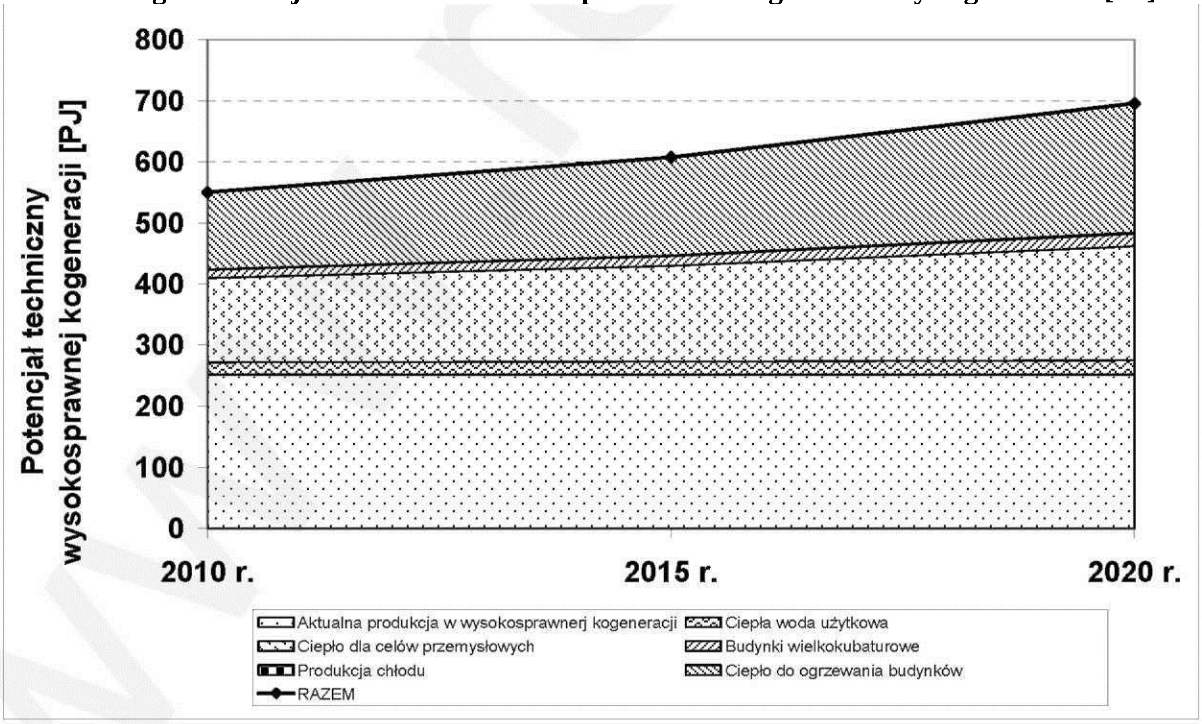
Table 8. Theoretical potential for cogeneration [PJ]

Breakdown	**2010**	**2015***	**2020***
Total heat production [PJ]	995.9	1 046.7	1 120.1
Current production from high-efficiency cogeneration [PJ]	252.0	252.0	252.0
Theoretical potential for high-efficiency cogeneration [PJ]	743.9	794.7	868.1

*forecast values

In line with the assumptions, the technical potential for high-efficiency cogeneration is the portion of the demand for useful heat that may be covered by units operating in the high-efficiency cogeneration mode, meeting the primary energy savings criteria. A projection of the technical potential for high-efficiency cogeneration is shown in the chart below.

Figure 3. Projection of the technical potential for high-efficiency cogeneration [PJ]



Technical potential for high-efficiency cogeneration [PJ]

Current production from high-efficiency cogeneration	Domestic hot water
Heat for industrial purposes	Large buildings
Cooling	Heat for heating of buildings
TOTAL	

Breakdown	**2010**	**2015***	**2020***
Current production from high-efficiency cogeneration [PJ]	252.0	252.0	252.0
Domestic hot water [PJ]	19.8	21.2	23.4
Heat for heating of buildings [PJ]	126.6	160.8	211.7

Heat for industrial purposes [PJ]	138.0	156.6	186.5
Large buildings [PJ]	13.6	16.1	20.5
Cooling [PJ]	0.5	1.0	2.0
TOTAL [PJ]	550.5	607.6	696.0

*forecast values

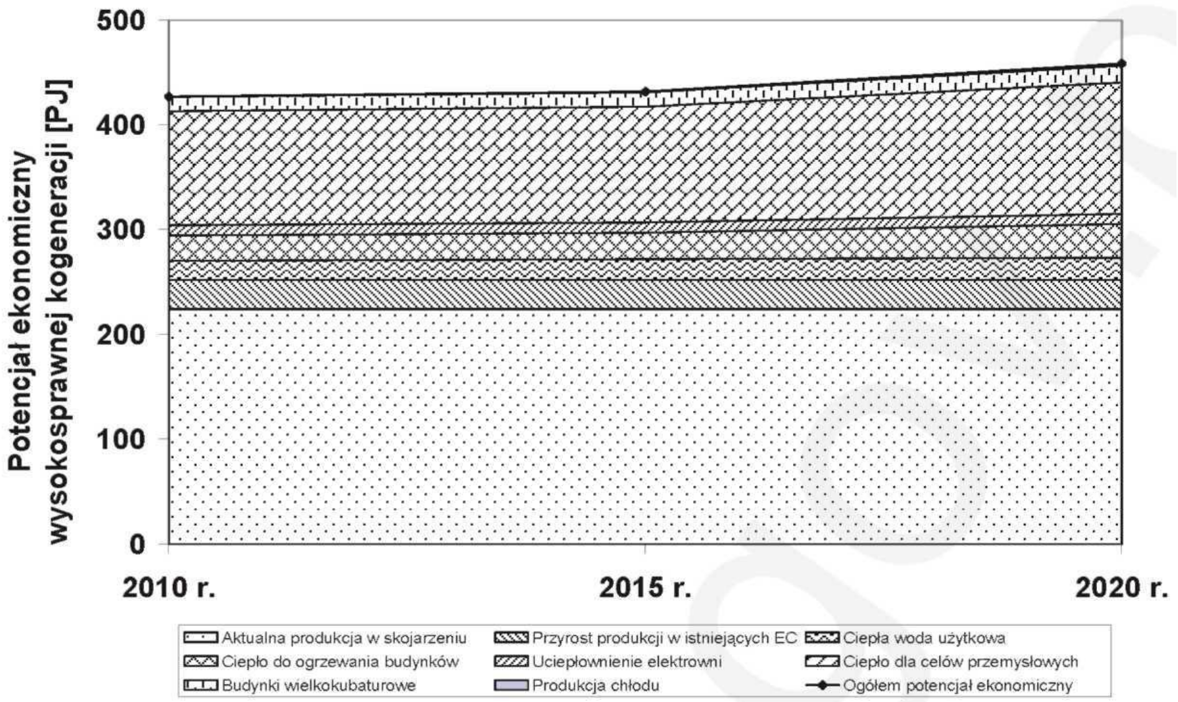
Economic potential for high-efficiency cogeneration

Various technologies of electricity and heat generation from high-efficiency cogeneration were considered in order to determine the economic potential. The marginal costs of electricity and heat are the primary economic criteria. The analysis includes revenues from the sale of property rights to certificates of origin from cogeneration and renewable energy sources.

The economic potential for high-efficiency cogeneration (see the chart below) covers the current heat production from high-efficiency cogeneration (in 2010) and increments of heat production from high-efficiency cogeneration in the existing CHP plants. In addition, the following may be considered to constitute the economic potential for cogeneration:

1) heat produced for DHW purposes;
2) 20% of the heat used for room heating in heating systems using heating plants;
3) heat produced for the purposes of large buildings;
4) 80% of the heat produced for industrial purposes;
5) heat generated to provide cooling in the summer season.

Figure 4. Economic potential for high-efficiency cogeneration [PJ]



Economic potential for high-efficiency cogeneration [PJ]

Current production from cogeneration	Production increment in existing CHP plants	Domestic hot water
Heat for heating of buildings	Introduction of cogeneration in electricity plants	Heat for industrial purposes
Large buildings	Cooling	Total economic potential

Breakdown	2010	2015*	2020*
Current production from cogeneration [PJ]	224.3	224.3	224.3
Production increment in existing CHP plants [PJ]	27.7	27.7	27.7
Domestic hot water [PJ]	18.3	19.8	21.2
Heat for heating of buildings [PJ]	24.2	25.3	32.2
Introduction of cogeneration in electricity plants [PJ]	9.7	9.7	9.7
Heat for industrial purposes [PJ]	108.8	110.4	125.3
Large buildings [PJ]	13.6	13.6	16.1
Cooling [PJ]	0.5	1.0	2.0
Total economic potential [PJ]	427.1	431.9	458.4

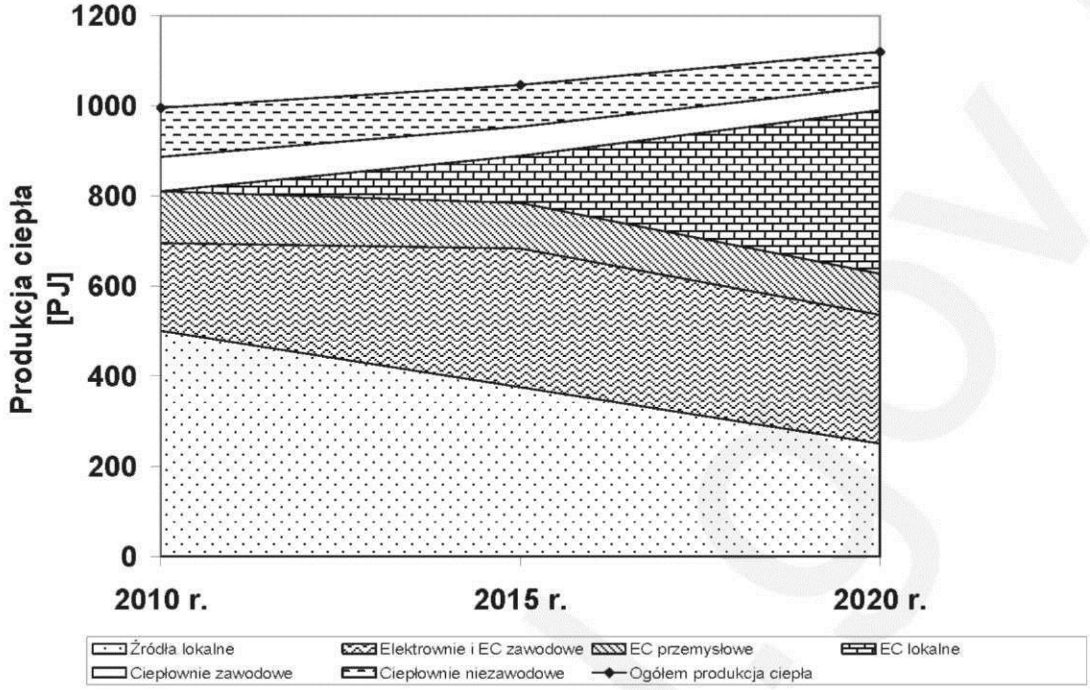
*forecast values

The presented forecasts take into account the support mechanisms for cogeneration and renewable sources. Additionally, it was assumed that from 2015 onwards it would be necessary to incur costs relating to the issuing of CO2 emission allowances. This system covers plants burning fuels with a heat output from fuel of more than 20 MJ/s.

The mechanism supporting high-efficiency cogeneration was modelled on the basis of the electricity demand and the mandatory share of electricity from high-efficiency cogeneration, as set out in the Regulation of 2007.

The forecast assumed a gradual increase of the unit value of the substitution fee until 2020.

Figure 5. Heat production forecast using the technical potential for high-efficiency cogeneration [PJ]



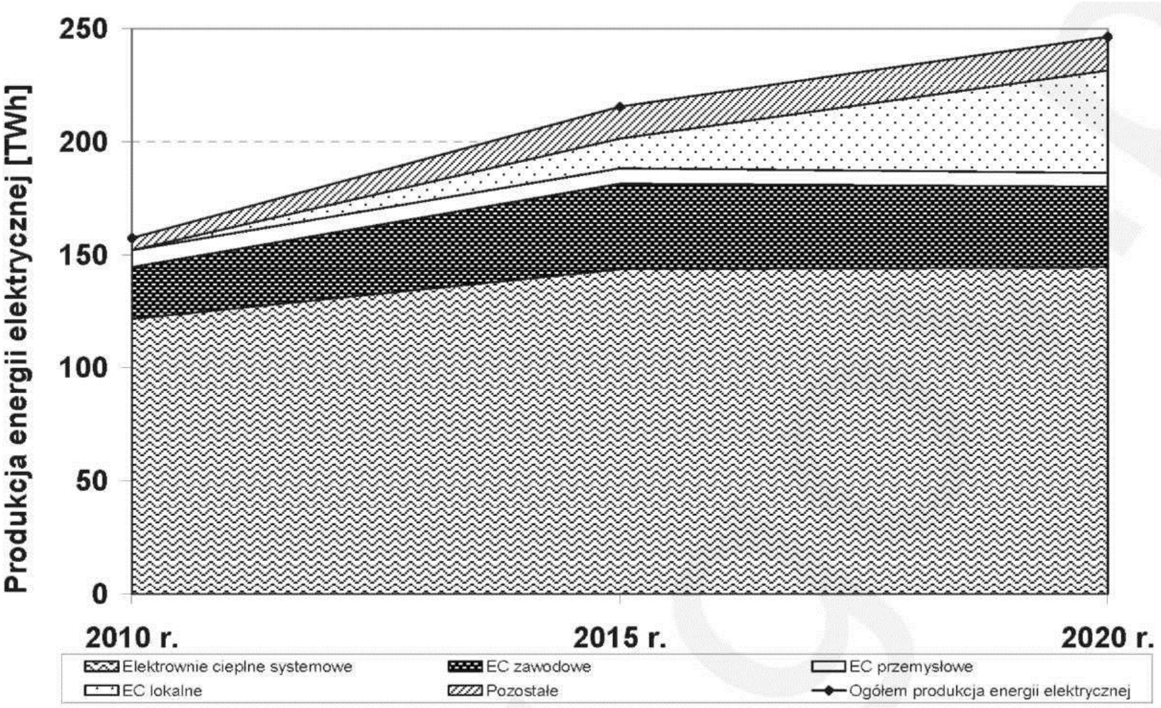
Heat production

Local sources	Main activity producer electricity plants and CHP plants	Autoproducer CHP plants	Local CHP plants
Main activity producer heat plants	Heat plants other than main activity producers	Total heat output	

Breakdown	**2010**	**2015***	**2020***
Local sources [PJ]	501.0	375.8	250.5
Main activity producer electricity plants and CHP plants [PJ]	194.4	307.8	285.6
Autoproducer CHP plants [PJ]	115.3	100.9	91.6
Local CHP plants [PJ]	0.0	104.9	362.8
Main activity producer heat plants [PJ]	76.1	64.7	53.3
Heat plants other than main activity producers [PJ]	109.1	92.7	76.3
Total heat output [PJ]	995.9	1 046.7	1 120.1

*forecast values

Figure 6. Electricity production forecast using the technical potential for high-efficiency cogeneration [TWh]



Electricity production [TWh]

National grid thermal power stations	Main activity producer CHP plants	Autoproducer CHP plants
Local CHP plants	Other	Total electricity production

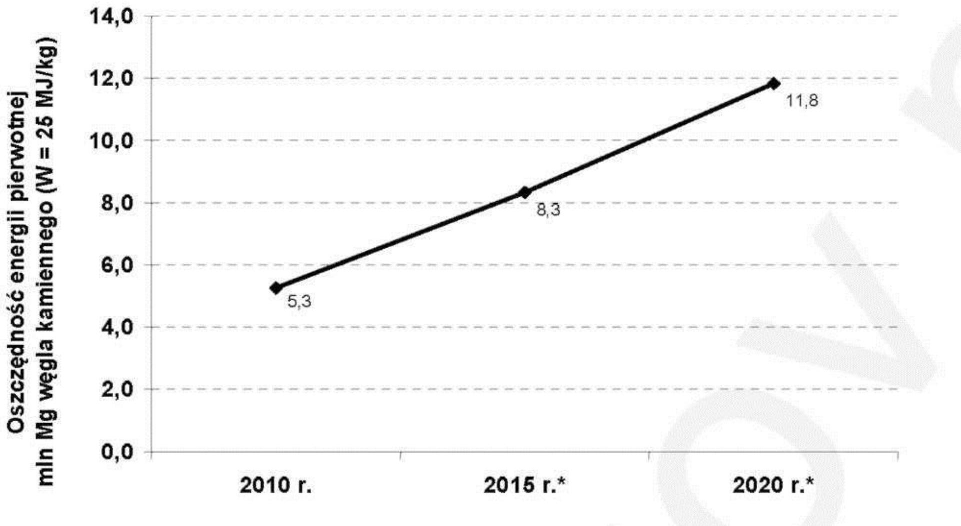
Breakdown	2010	2015*	2020*
National grid thermal power stations [PJ]	121.6	143.6	144.5
Main activity producer CHP plants [PJ]	22.9	37.9	35.6
Autoproducer CHP plants [PJ]	7.5	6.7	6.0
Local CHP plants [PJ]	0.0	13.1	45.4
Other [PJ]	5.4	14.2	14.9
Total electricity production [PJ]	157.4	215.5	246.4
Total production from high-efficiency cogeneration [PJ]	16.8	22.3	25.4

*forecast values

Primary energy savings

Savings of primary energy (coal) resulting from cogeneration are shown in the chart below. The efficiency reference values for the separate production of electricity and heat, as well as the efficiencies of the cogeneration technologies under consideration were used to calculate the savings. The calculated primary energy savings provided by high-efficiency cogeneration are at a level of 19-20%. It was assumed that the development of high-efficiency cogeneration would provide 20% savings in primary energy.

Figure 7. Primary energy savings provided by high-efficiency cogeneration



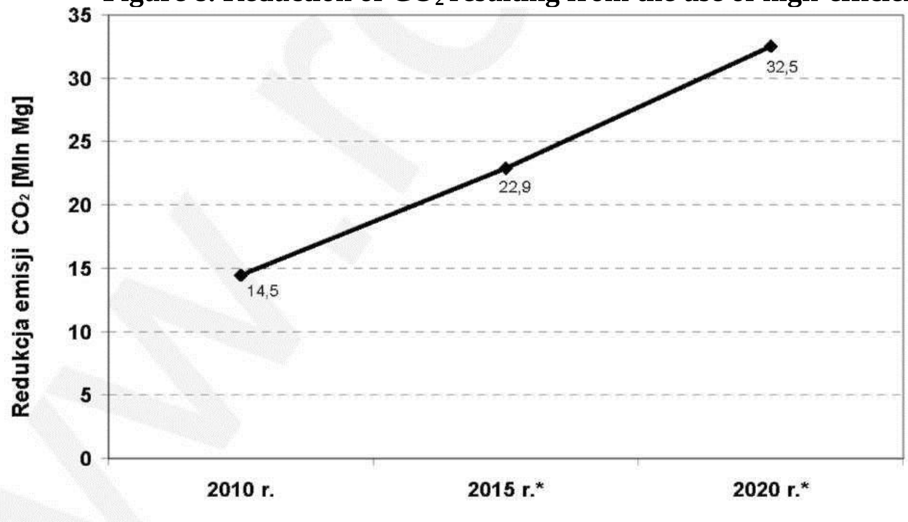
Primary energy savings
Million Mg of coal (W=25 MJ/kg)

*forecast values

Reduction of CO_2 emissions

The possible reduction of CO_2 emissions resulting from the use of high-efficiency cogeneration plants is shown in the chart below. The CO_2 emissions shown in the chart are the emissions that can be avoided if coal-based high-efficiency cogeneration units are used, when compared with separate production in coal-fired electricity plants and heat plants.

Figure 8. Reduction of CO_2 resulting from the use of high-efficiency cogeneration



Reduction of CO_2 [Million Mg]

*forecast values

Fuels for high-efficiency cogeneration

The available high-efficiency cogeneration technologies for the production of electricity and heat may use coal, natural gas, municipal waste and certain combustible industrial waste and biofuels as fuel. In theory, it is also possible to use nuclear fuel, geothermal heat or solar energy as a source for cogeneration. However, with the present state of development in energy technology and with the conditions existing in Poland, it is practically impossible to use them.

In Poland, coal and natural gas provide the primary fuel potential for high-efficiency cogeneration. Currently, the production level of electricity from high-efficiency cogeneration using coal is ten times higher than when using natural gas. However, the introduction of a system of paid emission allowances, and more stringent environmental requirements, will lead to the relative increase of the cost-effectiveness of gas-fired plants. The use of fuels in high-efficiency cogeneration is presented below.

Table 9. Fuel consumption in high-efficiency cogeneration in the period from 2007 to 2010 [URE data]

Fuel type	**Unit**	**Group**	**2nd half of 2007**	**2008**	**2009**	**2010**
Coal	Mg	**Solid**	13 874 761.55	18 065 100.06	33 797 353.52	40 168 474.66
Lignite	Mg		39 871 594.00	30 912 336.50	46 684 578.70	47 678 667.50
Firewood and wood waste	Mg		1 127 535.34	1 853 242.62	3 839 055.42	3 050 444.48
Biomass originating from agriculture	Mg		44 060.25	130 107.65	1 174 560.65	1 756 810.14
Biodegradable municipal waste	Mg		32 542.47	36 397.14	137 859.46	77 410.38
Non-renewable municipal and industrial waste	Mg		24.76	NDA	572.08	262.48

Diesel	Mg	**Liquid**	221.00	197.10	4 827.19	2 912.49
Fuel oil	Mg		506 041.87	754 050.88	1 118 053.38	1 198 501.01
Biofuels	Mg					832.12
Biodegradable waste	Mg		297 828.00	309 880.00	1 944 431.44	1 000 094.83
Non-renewable waste	Mg					4 270.29
Natural gas	‘000 m^3	**Gaseous**	556 845.61	848 563.32	1 050 486.92	1 279 744.02
Refinery gas	‘000 m^3		105 962.34	95 483.45	160 304.13	185 631.28
Biogas	‘000 m^3				1 881.46	6 467.08
Coke oven gas	‘000 m^3		186 688.82	201 661.90	469 794.13	411 540.52
Blast furnace gas	‘000 m^3				1 728 503.73	2 450 224.00
Other flue gas	‘000 m^3				7 336.47	10 081.32
Other	‘000 m^3		1 443 254.32	62 889.69	2 324 127.72	2 244 989.33
Methane	‘000 m^3					32 025.71

The prospects for the use of both fuels are determined, *inter alia*, by their prices and availability. Within the next few decades, the availability of coal will not be limited. Some limitations may occur, however, in the availability of natural gas. While the investments that are under way and the existing contracts will cover the increased consumption in terms of quantity, in many cases the possibility of using gas for cogeneration will still be restricted by the poorly developed gas network. This is primarily the case for the north east of Poland, the middle part of the Polish coast and partly for the Świętokrzyskie and Łódzkie provinces.

Coal and lignite

The domestic coal resources are approx. 40 billion tons, while the annual domestic production is approx. 75 million tons and main activity producer power plants use approx. 40 million tons. Given the deposits identified so far, we may consider the coal resources to be sufficient until 2050.

The national lignite resources are approx. 20 billion tons, of which 1.3 billion tons are exploited resources, which – with the domestic production at approx. 56 million tons annually – ensures a 20-year supply of coal for the power industry if the consumption level stays close to the current level. Attention should be drawn, however, to the intensification of brown coal production and use, e.g. in the new 833 MW unit of the Bełchatów II power station.

Natural gas

In 2010, the exploitable resources of natural gas were approx. 147 billion m^3 (of which approx. 65 billion m^3 in industrial resources). The annual production of natural gas is approx. 4.2 billion m^3 (in methane-rich natural gas equivalents), and covers approx. 30% of domestic demand. Domestic production may substantially increase provided that gas extraction from non-conventional deposits is initiated (mostly shale gas). In the future, shale gas may play a significant role in meeting the demand, as long as the costs of extraction are competitive in comparison with the costs of imports.

At present, however, we need to assume that the primary source for satisfying the demand for gas is gas imports through transmission pipelines, in particular the Yamal-Europe pipeline running across Belarus and the transmission pipelines crossing the Ukrainian territory. The new Nord Stream pipeline may also play a role in ensuring security of gas supply to Poland by way of gas reimports from Germany, if economic and political disputes arise between Russia and Ukraine or Belarus.

The LNG gas terminal (Gazoport LNG) – the key project for the diversification of gas supplies to Poland – is now under construction. Completion is scheduled for mid-2014. The LNG terminal will receive up to 5 billion m^3 of natural gas annually, and can be extended to 7.5 billion m^3. Thus it will be a strategic source of gas supply for the power industry and other sectors of the economy.

Biogas and biofuels

The most important types of gaseous fuels (biogas) are:

1) products of methane fermentation: of manure, slurry and plant waste;

2) methane from landfills;

3) biomass (wood) gasification.

The potential of the first two sources is estimated at several dozen PJ annually.

In the Polish climate, the best effects are currently yielded by the gasification of non-cellulosic waste. For example, medium-sized biogas plants operating in Poland are equipped with generators and produce both electricity and heat for their own purposes and for local communities.

Effective gasification of cellulosic waste could take place in a network of main activity producer biogas plants equipped with biogas enrichment and purification plants and feeding to natural gas networks.

The energy uses of non-cellulosic biomass resources achieved a market profitability level not just owing to support mechanisms, but also because they address the issues of storage and disposal of that waste.

The potential of the biofuels available in Poland was determined in the course of the development of the Polish Energy Policy until 2030. Excluding the biofuels intended for internal combustion engines (bioethanol, biodiesel), the economic and market potentials are shown in the table below. In addition, the assessment took into account the demand for renewable energy, with the assumption that Poland will meet its 2020 obligations; i.e. that a 15% share of the total energy consumption will come from renewable sources.

A comparison of the demand and the existing potential make it obvious that in light of the aforementioned obligations up to 2020, the biomass market potential can be considered sufficient.

Table 10. The economic potential and the prospects for its use — the market potential for biofuels

<table>
<tr><th>Biofuel</th><th>Economic potential</th><th colspan="2">Market potential until 2030</th></tr>
<tr><td>- firewood</td><td>24 452 TJ</td><td>24 452 TJ</td><td>1 540 MW_t</td></tr>
<tr><td>- dry solid waste</td><td>165 931 TJ</td><td>150 000 TJ</td><td>16 000 MW_t</td></tr>
<tr><td rowspan="3">- wet waste – biogas*) (cogeneration)</td><td rowspan="3">123 066 TJ</td><td colspan="2">80 000 TJ</td></tr>
<tr><td>9 TWh_e</td><td>1 640 MW_e</td></tr>
<tr><td>47 060 TJ</td><td>2 340 MW_t</td></tr>
<tr><td>- energy crops</td><td>286 719 TJ</td><td colspan="2">286 719 TJ</td></tr>
<tr><td>- cellulose – cogeneration*)</td><td>145 600 TJ</td><td colspan="2">120 600 TJ</td></tr>
</table>

		7.7 TWh,	1 180 MW_e
		92 768 TJ	3 940 MW_t
- corn silage – biogas (cogeneration)*)	81 638 TJ	81 638 TJ	
		9.3 TWh_e	1 690 MW_e
		48 022 TJ	2 410 MW_t
Total	827 406 TJ	743 409 TJ	

* Assumed cogeneration ratios (electricity output to heat output): for solid fuel-fired cogeneration systems: 0.3; for biogas-fired cogeneration systems: 0.7.

Municipal waste

Approximately 10 million tons of municipal waste is generated annually in Poland. The area from which municipal waste originated (urban or rural) has a substantial impact on the possibility of using that waste to generate energy. From the perspective of using the waste as cogeneration fuel, waste from large urban agglomerations of over 100 000 inhabitants is particularly important. There are 39 such agglomerations in Poland, inhabited by a total of 11 million people and generating 3.3 million tons of waste annually.

The moisture content and the lower heating value of waste determine whether the waste can be used as fuel. At present, the moisture content in municipal waste ranges between 40 and 50%, and the lower heating value depends on the fractional composition (average lower heating value being 8.11 MJ/kg).

The energy balance of waste at the national level and for large agglomerations is shown in the table below. Additionally, the table shows the electricity and heat output obtainable from that waste with the use of high-efficiency cogeneration.

Table 11. Energy potential of waste

	Energy potential [TJ/year]	Potential heat production from cogeneration [TJ/year]	Potential electricity production from cogeneration (GWh/year)
National waste	59 300	4 118	1 716
Waste from cities	31 637	2 197	915

It should be noted that waste from big cities, accounting for 33% of national waste, carries more than half of the energy potential of all waste. Due to the relatively high lower heating value, waste from big cities can be incinerated in power plants on its own. On the other hand, the low heating value of waste from outside big cities may make combustion difficult without the use of supporting fuels.

Within the next few years, we should expect both the volume of waste and the lower heating value of waste to increase.

4. Identification of barriers to the development of high-efficiency cogeneration

Among the reasons for the underdevelopment of cogeneration there are economic (financial), environmental, infrastructural, legal, administrative and social barriers. With the actual state of development in energy technology there are no technical barriers. A substantial number of these barriers have been identified, and the Polish Energy Policy until 2030 promises that improvements and measures will be taken in order to eliminate the majority of the identified issues.

Substantial changes, which eliminated two significant barriers, were introduced with the most recent revision of the Energy Law. They abolish the obligation to have heating tariffs approved, and provide for the possibility of combining property laws relating to high-efficiency cogeneration using renewable energy sources.

In the Act of 15 April 2011 on energy efficiency (Journal of Laws No 94, item 551), provisions were introduced to promote electricity and heat production from high-efficiency cogeneration, aiming at the obligatory connection of new buildings to district heating networks.

Economic barriers

Economic barriers mainly consist of factors affecting the condition of the entire national economy, in particular the high cost of investment loans, price fluctuations on the fuel market, unstable foreign exchange rates and high environmental costs.

According to the applicable regulations, the support system based on certificates of origin, often used by investors to balance their costs, will be in use until 31 March 2013. The absence of regulations governing the future functioning of the support system for high-efficiency cogeneration may provide an additional barrier for the decision-making process for new investments or upgrades of existing generation units.

Another significant economic barrier is the high cost of construction of district heating networks, making it difficult to extend the coverage of the district heating system, and thus to develop the heating market by connecting new users.

The development of cogeneration is further hindered by problems relating to the connection of cogeneration plants to the power grid. In many instances, the cost of connections, which must be borne by the investor, makes up a substantial part of the entire investment cost.

Barriers relating to emissions

Emission-related barriers to the development of cogeneration are mostly connected with the requirements of two Directives:

1) Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275, 25.10.2003, p. 32, as amended; OJ Polish Special Edition, Chapter 15, Volume 7, p. 631, as amended), hereinafter referred to as the “ETS Directive”;

2) Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L 334, 17.12.2010, p. 17), hereinafter referred to as the “IED Directive”.

The main emission-related barrier is the carbon dioxide emission limit. According to the data held by the National Centre for Emission Balancing and Management (KOBiZE), in 2010, main activity producer combined heat and power plants exceeded the limit of emission allowances by approx. 0.3 million tons of CO2 (i.e. 0.1% of all Polish emissions). It is noteworthy that no allowances for additional installations are envisaged in the 2008-2012 trading period. If we are to assume that the development of cogeneration will result, to a large extent, from the development of district heating systems fed from large main activity producer combined heat and power plants, we should envisage increased CO2 emission limits for each year of the next trading period. It would mean lower emission limits for other sectors, including power grid electricity plants.

The ETS Directive introduces the ultimate obligation to buy allowances in open EU emission auctions. The introduction of the fully paid allowance scheme favours CHP plants over heat plants and electricity plants, as the fuel savings effect is augmented by the corresponding reduction in the demand for allowances. Unfortunately, the obligation to buy allowances will not apply to small sources, and thus the production of heat from cogeneration systems will become uncompetitive in relation to local heat production, which may lead to a substantial shrinkage of the district heating market.

Barriers to the development of district heating systems

Over the next few years, the rationalisation of heat use and the improvement of energy efficient building processes will significantly reduce the demand for heat. This phenomenon is favourable in all possible respects. However, it reduces the potential for energy production from high-efficiency cogeneration.

A substantial increase in heat prices, which is due to the necessity of upgrading flue gas treatment systems in order to meet increasing environmental requirements, and to the producers of district heating having to buy CO2 emission allowances for sources with an installed capacity exceeding 20 MW, could form another barrier for the development of district heating systems. The increased heat prices might encourage users to disconnect from district heating systems, which will contribute to the decrease in the demand for district heat (produced from high-efficiency cogeneration).

Another barrier, that has already been mentioned, is the high cost of construction of district heating networks, and high unit costs of low-capacity plants.

Social barriers

Social barriers can be divided into two categories. The first one is due to the fact that building owners are reluctant to connect to the district heating network because of the procedures and costs involved in the connection of the building to the central district heating system.

Another social barrier is the low number of new investments relating to the development of micro-cogeneration. This situation is mostly due to high costs, as well as to the absence of information on the methods of operation and efficiency (energy and economic efficiency) of micro-cogeneration that would promote its use. Sample implementations of those solutions and dissemination of operating results, as well as preferential terms for investment loans, could improve the situation, but would not eliminate the problem.

Limited fuel resources

The competition is strong on the biomass market (produced for energy purposes), due to the requirement to ensure a certain percentage of renewable energy in the production of electricity. Main activity producer electricity plants and large main activity producer combined heat and power plants compete against smaller users of energy-producing biomass. They use biomass primarily in co-combustion with coal. It is true that in this way they create the Polish biomass market, but on the other hand, they hamper the development of small-scale renewable energy sources.

Competition is also noticeable in the use of cultivated land, between cellulosic biomass plantations and plantations for the purposes of liquid fuel production. Here, in turn, the liquid fuel sector seems to prevail. The area covered by cellulosic energy crops is much lower than, for example, the area of oilseed rape crops.

For coal and gas fuels, there are no barriers other than the limitations relating to air pollution emissions and the increasing prices of those fuels.

Administrative procedures

Amendments to the Energy Law have abolished the licensing requirement for energy cogeneration from low- and medium capacity sources, with the exception of biogas sources. In this way, one of the administrative barriers has been eliminated. The decision seems to be right given the situation in which owners of buildings with a heat demand of 50 kW or more will be obliged to use their own cogeneration sources.

The current legal framework shifts the responsibility for energy security in respect of heat supply from central administration to communes. The activities of the commune in this respect are based on the so-called “Objectives for the heat, electrical energy and gaseous fuel supply plan”. Communes have a legal obligation to develop the “Objectives...”, but no legal sanctions are envisaged if they do not comply. As a result, most of the Polish communes have not developed the “Objectives...”. Moreover, in the communes where the “Objectives...” have been developed, no one actually checks whether the measures envisaged by the objectives are being implemented. This is a consequence of not only the aforementioned absence of formal discipline, but also of the incompetence of the communes in the field of energy. Commune offices lack staff specialising in energy. The Polish Energy Policy until 2030 promises that this situation will change.

Measures aimed at eliminating the barriers

In order to increase the volume of sales, heat producers and distributors carry out intense marketing efforts, in particular among potential new customers.

Aiming to facilitate the start-up of economic activity in the aforementioned field, information has been published on the URE website concerning the procedure of applying for electricity cogeneration licences, which can be found in so-called "Information Packages".

Moreover, a number of opinions and notices are published on the URE website in order to remind power companies of their obligations and to clarify any doubts as to how to meet those obligations. Additionally, model applications for certificates of origin from cogeneration are available, including information on the appendices that need to accompany the application in order to obtain a certificate of origin from cogeneration.

With a full understanding of the situation of the entities planning investments in high-efficiency cogeneration plants, the Ministry of Economy initiated cooperation with the Polish Association of Main Activity Producer Combined Heat and Power Plants and with the Polish District Heating Chamber of Commerce in order to develop the objectives for the Polish programme for cogeneration development until 2030. This programme envisages, *inter alia*, the establishment of a further support mechanism for high-efficiency cogeneration. The final version of the programme will be subject to public and interministerial consultations.

The obligatory connection of new buildings erected within the geographical range of district heating systems, introduced into the Act of 7 July 1994 – Construction Law (Journal of Laws 2010 No 243, item 1623, as amended) by the Act of 15 April 2011 on energy efficiency, creates additional opportunities to acquire new customers. This obligation does not apply where the heating transmission or distribution company refused to issue the conditions for connection to the system, or where the supply of heat from the district heating system provides a lower energy efficiency than from a different individual heating source which may be used to supply heat to that facility.

In order to guarantee the proper implementation of the provisions of the aforementioned Act, the regulations that will further specify the provisions of the Act, to be adopted in 2012, will probably be necessary.

5. Guarantees of origin and support systems

Support for new investments

Currently there are no formal support mechanisms in Poland for the construction of new generation capacities that would encourage new investments. The preferential terms for the connection of renewable energy sources with an installed electricity capacity below 5 MW and cogeneration units with an installed electricity capacity below 1 MW are an exception – half of the connection fee calculated in the basis of the actual expenditure is charged – where the distribution or transmission system operator covers 50% of the connection expenditure. Other producers make a payment calculated on the basis of 100% of the investment expenditure incurred to ensure the connections.

Investors may apply for financial assistance to the National Fund for Environmental Protection and Water Management, hereinafter referred to as "NFOŚiGW", under the programme for renewable energy sources and high-efficiency cogeneration facility initiatives, which is aimed at increasing the production of energy from renewable energy sources and high-efficiency cogeneration facilities. The total budget of the programme is PLN 1 400 million. The programme implementation period is from 2009 to 2015. Financial assistance to initiatives is provided in the form of loans, from PLN 4 million to PLN 50 million. Beneficiaries are selected in a competitive procedure, and are obliged to prove, *inter alia*, that the minimum total cost of the project is PLN 10 million.

Investments in the conversion and construction of electricity and heat cogeneration units meeting the requirements for high-efficiency cogeneration are supported under the Operational Programme Infrastructure and Environment, measure 9.2 High-efficiency generation. Under this measure, projects are selected in a competitive procedure. The first competition was announced on 27 February 2009, and the second competition – on 25 August 2010.

Support mechanism for undertakings producing electricity from high-efficiency cogeneration

The support mechanism for undertakings producing electricity from high-efficiency cogeneration consists in the obligatory reception, transmission or distribution of the generated energy by the distribution system operator, ensuring reliability and security of the national grid, and in the issuing of certificates of origin from cogeneration by the President of URE, which are tradable on the Polish Power Exchange (Towarowa Giełda Energii S.A.).

The above-mentioned support mechanism has been complemented by the preferential terms for the connection of cogeneration sources, which, as mentioned above, enjoy a reduced connection fee. In accordance with Article 7 (8) of the Energy Law, half of the fee calculated on the basis of actual expenditure is charged for the connection to the power grid of cogeneration units with an installed capacity of under 1 MW. Moreover, in accordance with Article 5 of the Act of 2007, the fee charged for the connection of cogeneration units with an installed capacity not exceeding 5 MW shall be half of the calculated fee until 31 December 2011.

Certificates of origin system

The fact that electricity has been produced from cogeneration is confirmed by the President of URE, who issues a certificate of origin from cogeneration. The certificates of origin from cogeneration are issued on the basis of an application submitted by the producer (licence holder), validated by the power system operator with respect to the production volume in the period concerned.

There are three types of certificates of origin within the Polish system that confirm that electricity has been cogenerated:

1) certificates of origin from gas-fired units or units of installed capacity below 1 MW;
2) certificates of origin from other cogeneration sources;
3) certificates of origin from cogeneration units burning methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), or gas obtained by processing biomass.

Producers who have obtained certificates of origin from cogeneration may resell the certificates through the Polish Energy Exchange to entities obliged to buy such certificates, thus earning an additional income from energy generation activities. The cogeneration support system is complemented by the provisions of the Energy Law which make it possible to impose a fine on those undertakings that fail to comply with the obligation to cancel a sufficient number of certificates of origin from cogeneration or to pay the substitution fee.

The obligation to obtain certificates of origin from cogeneration and to present them for cancellation, or to pay the substitution fee, is imposed on undertakings generating or trading in electricity, and selling electricity to end customers.

In order to meet the aforementioned obligation, the undertakings may:

1) cancel appropriate certificates of origin;
2) pay the substitution fee to the bank account of NFOŚiGW. The fee should be used to support renewable energy sources and cogeneration sources in Poland.

In accordance with the Energy Law, the responsibilities of the President of URE include an inspection of compliance with the aforementioned obligations by the energy sector companies. The inspection is carried out after the end of every calendar year (after 31 March).

In accordance with the provisions of the applicable laws and regulations, the above described support system will be in force until 31 March 2012.

In 2010, the aforementioned Act of 2007 introduced substantial changes with respect to the support system for energy from renewable sources and high-efficiency cogeneration. In accordance with the new Article 9e (1a) of the Energy Law, from 11 March 2010, producers of electricity and heat from renewable energy sources which at the same time meet the requirements for high-efficiency cogeneration may apply for certificates of origin from renewable energy sources and also for certificates of origin from cogeneration for the same amount of generated electricity. This clarified the earlier concerns with interpretation regarding the possibility of obtaining two types of certificates of origin for the same amount of energy generated from a renewable source which meets the requirements for high-efficiency cogeneration.

From 11 March 2010, the Act of 2007 extended the support system for energy produced from high-efficiency cogeneration by introducing a support mechanism in the form of certificates of origin for sources fired by methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), or gas obtained by processing biomass, within the meaning of Article 2 (1) point 2 of the Act of 25 August 2006 on biocomponents and liquid biofuels (Journal of Laws No 169, item 1199, as amended). Additionally, the Act makes it possible to issue various types of certificates of origin for a single generation unit fired by various fuels (so-called “co-combustion in cogeneration” – Article 9l (1a) and (1b) of the Energy Law).

The table below shows the production of electricity from high-efficiency cogeneration confirmed by issued certificates of origin from cogeneration from 2007 to 2010.

Table 12. Electricity production from cogeneration from 2007 to 2010 as at 6 May 2011 [URE data]

Type of cogeneration unit	Second half of 2007	2008	2009	2010
	Energy [MWh]	Energy [MWh]	Energy [MWh]	Energy [MWh]*
gas-fired or with an installed capacity below 1 MW,	1 122 692.206	2 977 398.975	3 067 284.567	3 027 677.956
with a total installed electricity capacity over 1 MW, not fired by gas fuels (including biomass gas and methane from mines)	9 404 012.861	21 215 354.097	21 829 489.134	22 929 512.881
fired by methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), or gas obtained by processing biomass,	-	-	-	101 083.135
Total	10 526 705.07	24 192 753.07	24 896 773.70	26 058 273.97

* Data for the generation period started on 11 March 2010

Amount of electricity including adjustment cancellations;

In 2010, the President of URE issued the first four certificates of origin for cogeneration units fired by methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), covering a total of 33 334.76 MWh.

Number of cancelled certificates

In accordance with the Energy Law, power sector companies carrying out activities involving the production of or trading in electricity and selling electricity to end customers, in order to meet their statutory obligation, shall submit applications to the President of URE to cancel their certificates of origin from cogeneration.

The table below shows the energy volume reported in cancelled certificates of origin from cogeneration from 2008 to 2010 (certificates from the current year and previous years can be cancelled in a given year).

Table 13. Energy volume reported in cancelled certificates of origin from cogeneration [MWh], [URE data]

Cancellation year (includes cancelled certificates issued in the same year and in the preceding year)	**2008**	**2009**	**2010**
Energy volume reported in the cancelled certificates of origin from cogeneration [MWh]	16 147 735.05	21 471 058.95	14 761 411.37

Level of substitution fees

The President of URE calculates and publishes substitution fee rates on the basis of the average selling price of electricity on a competitive market. When determining the level of substitution fees, the President of URE takes into account:

1) the amount of electricity from high-efficiency cogeneration;
2) the difference between the cost of production of electricity from high-efficiency cogeneration and the selling price of electricity on a competitive market;
3) the level of electricity prices for end customers;
4) the utilisation level of available methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), and of gas obtained by processing biomass.

Table 14. Level of substitution fees from 2007 to 2011 [URE data]

	Year	2007	2008	2009	2010	2011
Ozg	Substitution fee [PLN/MWh]	117.00	117.00	128.80	128.80	127.15
	percentage of the average selling price of electricity on a competitive market;	97.7%	97.7%	100%	82.9%	64.5%
Ozk	Substitution fee [PLN/MWh]	17.96	17.96	19.32	23.32	29.58
	Percentage of the average selling price of electricity on a competitive market;	15%	15%	15%	15%	15%
Ozm	Substitution fee [PLN/MWh]	-	-	-	59.16	59.16
	Percentage of the average selling price of electricity on a competitive market;	-	-	-	30%	30%

Ozg – a substitution fee rate, not less than 15% and not more than 110% of the average selling price on a competitive market for the electricity generated by gas-fired units or units with a total installed electricity capacity below 1 MW,

Ozk – a substitution fee rate, not less than 15% and not more than 40% of the average selling price on a competitive market for the electricity generated by units with a total installed electricity capacity of over 1 MW and not fired by gas fuels (including biomass gas and methane from mines)

Ozm – a substitution fee rate, not less than 30% and not more than 120% of the average selling price on a competitive market for the electricity generated by units fired by methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), or gas obtained by processing biomass.

Table 15. Average selling prices of electricity produced from high-efficiency cogeneration from 2007 to 2010 [URE data]

average selling price of electricity produced from high-efficiency cogeneration in cogeneration units:	Year	2007	2008	2009	2010
gas-fired units or units of installed electricity capacity below 1 MW;	[PLN/MWh]	133.79	150.51	191.03	187.74
with a total installed electricity capacity of over 1 MW, not fired by gas fuels (including biomass gas and methane from mines)		126.79	152.11	199.89	190.47
fired by methane released and captured during deep mining operations in coal mines (open, under liquidation or closed), or gas obtained by processing biomass		-	-	249.65	243.59
Average selling price of electricity on a competitive market	[PLN/MWh]	128.80	155.44	197.21	195.32

Information on the substitution fee rates and average selling prices of electricity produced from high-efficiency cogeneration is published on the URE website.

6. Summary and conclusions

After analysing the data and figures relating to the development of cogeneration presented in this Report, it was concluded that within the period under consideration Poland made progress in increasing the production of electricity from high-efficiency cogeneration, going from a level of ca. 15.6% in 2007 to ca. 17% in 2010.

The increased production of electricity from high-efficiency cogeneration is also corroborated by the fact that since 2007 the number of certificates of origin from cogeneration issued by the President of URE has been consistently increasing.

However, in order to maintain and improve the upward trend in the share of high-efficiency cogeneration, the option of introducing an additional financial support mechanism should be considered. This would provide an incentive to upgrade the existing units to support high-efficiency cogeneration, and for investors using funds for new investment projects.

The legal systems introduced in Poland in support of cogeneration assume that this aspect of the power industry will be subordinated to certain administrative mechanisms. The strength of this process lies in the fact that the majority of cogeneration aspects are regulated. However, the legal standardisation of the promotion of cogeneration will only be in force until the end of 2012. It is reasonable to establish legislative regulation mechanisms for the long term in order to ensure a stable administrative and legal framework for investors.

Summarising the situation on the market of fuel suppliers, the conclusion is that within the next ten years, the structure of gas supply may significantly change (the prospects for using shale gas), and the changes will have a positive impact on the security of gas supply and gas prices. Moreover, the availability of coal fuel will not be a barrier for the development of cogeneration.

7. Data sheets

Table 16. General data on electricity and heat generation from high-efficiency cogeneration [ARE data]

				concerns electricity				concerns heat			
General data				**Generation of electricity in cogeneration[1], capacity, fuel input**	**Power generation by main activity producers, capacity, fuel input**	**Power generation by autoproducers, capacity, fuel input**	**Share of CHP plants in the total output of electricity**	**Heat production from cogeneration**	**Main activity producers**	**Autoproducers**	**Share of CHP plants in the total output of heat**
2002	electricity	capacity	[GW]	6.3	4.1	2.1					
		output electric power	[TWh]	23.0	15.4	7.6	85.0				
	heat	capacity	[GW]					24.8	11.2	13.6	
		output electric power	[TWh]					85.4	38.3	47.2	51.3
	fuel	total	[PJ]	111.4	57.7	53.7		413.7	214.3	199.4	
2004	electricity	capacity	[GW]	8.2	6.3	1.9					
		output electric power	[TWh]	26.2	20.1	6.1	21.2				
	heat	capacity	[GW]					27.2	15.4	11.8	
		output electric power	[TWh]					77.9	48.1	29.9	49.0
	fuel	total	[PJ]	354.6	308.6	46.0		1 055.1	918.3	136.8	
2005	electricity	capacity	[GW]	8.3	6.4	1.9					
		output electric power	[TWh]	26.3	20.4	5.9	19.7				
	heat	capacity	[GW]					26.8	15.3	11.5	

		output electric power	[TWh]					76.5	47.2	29.4	51.3
	fuel	total	[PJ]	381.1	332.4	48.7		1 108.7	966.9	141.8	

2006	electricity	capacity	[GW]	8.5	6.8	1.7	18.9				
		output electric power	[TWh]	26.0	20.1	5.9					
	heat	capacity	[GW]					26.5	15.7	10.8	50.0
		output electric power	[TWh]					73.5	44.5	29.0	
	fuel	total	[PJ]	397.9	348.4	49.6		1 126.7	986.4	140.3	
2007	electricity	capacity	[GW]	9.0	7.2	1.8	20.3				
		output electric power	[TWh]	27.6	21.7	5.9					
	heat	capacity	[GW]					26.3	16.2	10.1	50.8
		output electric power	[TWh]					72.5	44.6	27.9	
	fuel	total	[PJ]	415.5	367.3	48.2		1 092.9	966.0	126.8	
2008	electricity	capacity	[GW]	8.8	7.1	1.7	18.8				
		output electric power	[TWh]	26.4	20.2	6.2					
	heat	capacity	[GW]					25.3	15.4	10.0	49.3
		output electric power	[TWh]					72.1	42.1	30.0	
	fuel	total	[PJ]	413.9	364.8	49.1		1 130.7	996.6	134.1	
2009	electricity	capacity	[GW]	8.6	7.2	1.4	19.4				
		output electric power	[TWh]	26.1	20.5	5.5					
	heat	capacity	[GW]					24.8	16.7	8.1	50.4
		output electric power	[TWh]					71.8	45.6	26.2	

	fuel	total	[PJ]	398.3	357.5	40.7		1 096.1	983.9	112.1	
2010	electricity	capacity	[GW]	8.7	7.2	1.5	19.8				
		output electric power	[TWh]	27.7	21.4	6.4					
	heat	capacity	[GW]					24.8	16.2	8.7	49.5
		output electric power	[TWh]					77.0	47.8	29.2	
	fuel	total	[PJ]	121.6	80.7	40.9		337.8	224.3	113.5	

Table 17. Technologies for electricity and heat generation from high-efficiency cogeneration [ARE data]

Technologies				TOTAL	CCGT turbine with heat recovery	Steam backpressure turbine	Steam condensing extraction turbine	Gas turbine with heat recovery	Internal combustion engine	Other
2002	electricity	capacity	[GW]	6.3	0.3	1.9	4.0	0.1	0.0	0.0
		output electric power	[TWh]	23.0	0.7	7.8	14.2	0.3	0.0	0.0
	heat	capacity	[GW]	24.8	0.7	8.3	15.7	0.2	0.0	0.0
		output electric power	[TWh]	85.4	0.7	30.4	53.6	0.8	0.0	0.0
	fuel	input	[PJ]	525.1	14.2	166.2	338.4	6.3	0.0	0.0
2004	electricity	capacity	[GW]	8.2	0.6	2.9	4.7	0.0	0.0	0.0
		output electric power	[TWh]	26.2	2.2	10.5	13.2	0.2	0.1	0.0
	heat	capacity	[GW]	27.2	0.5	12.1	14.5	0.1	0.0	0.0
		output electric power	[TWh]	77.9	1.7	38.2	37.6	0.3	0.1	0.0
	fuel	input	[PJ]	1 409.7	28.6	225.5	1 151.8	2.5	1.3	0.0
2005	electricity	capacity	[GW]	8.3	0.6	2.7	4.9	0.1	0.0	0.0
		output electric power	[TWh]	26.3	2.3	9.7	13.9	0.3	0.1	0.0
	heat	capacity	[GW]	26.8	0.5	11.5	14.6	0.1	0.0	0.0
		output electric	[TWh]							

		power		76.5	1.8	34.7	39.4	0.5	0.1	0.0
	fuel	input	[PJ]	1 489.8	35.6	207.5	1 241.6	3.5	1.6	0.0
2006	electricity	capacity	[GW]	8.5	0.6	2.2	5.6	0.1	0.0	0.0
		output electric power	[TWh]	26.0	2.1	7.9	15.6	0.2	0.1	0.0
	heat	capacity	[GW]	26.5	0.5	9.5	16.3	0.1	0.0	0.0
		output electric power	[TWh]	73.5	1.6	27.5	43.9	0.3	0.1	0.0
	fuel	input	[PJ]	1 524.7	31.9	162.1	1 326.2	2.8	1.6	0.0
2007	electricity	capacity	[GW]	9.0	0.6	2.7	5.7	0.0	0.0	0.0
		output electric power	[TWh]	40.4	2.5	6.3	31.4	0.1	0.1	0.0
	heat	capacity	[GW]	24.9	0.6	8.5	15.6	0.1	0.1	0.0
		output electric power	[TWh]	161.8	2.4	20.5	138.5	0.2	0.2	0.0
	fuel	input	[PJ]	1 472.3	33.9	106.9	1 327.7	1.7	2.0	0.0
2008	electricity	capacity	[GW]	8.8	0.6	1.9	6.2	0.0	0.0	0.0
		output electric power	[TWh]	42.9	2.7	6.4	33.5	0.2	0.1	0.0
	heat	capacity	[GW]	22.3	0.6	7.4	14.1	0.1	0.1	0.0
		output electric	[TWh]							

		power		166.8	2.5	21.6	142.1	0.4	0.2	0.0
	fuel	input	[PJ]	1 527.6	34.0	118.7	1 370.3	2.6	2.0	0.2
2009	electricity	capacity	[GW]	8.6	0.6	2.0	5.9	0.0	0.0	0.0
		output electric power	[TWh]	26.1	2.7	6.7	16.3	0.2	0.1	0.0
	heat	capacity	[GW]	24.8	0.7	8.2	15.8	0.1	0.0	0.0
		output electric power	[TWh]	71.8	2.6	24.4	44.3	0.3	0.2	0.1
	fuel	input	[PJ]	1 494.3	35.1	136.4	1 317.9	2.4	2.2	0.3
2010	electricity	capacity	[GW]	8.7	0.6	2.1	5.9	0.0	0.0	0.0
		output electric power	[TWh]	27.7	2.6	7.3	17.4	0.2	0.2	0.0
	heat	capacity	[GW]	24.8	0.7	8.4	15.6	0.1	0.0	0.0
		output electric power	[TWh]	77.0	2.5	26.3	47.5	0.4	0.2	0.1
	fuel	input	[PJ]	459.4	22.7	146.5	285.0	2.8	1.8	0.6