Humanities and Social Sciences **2016**
HSS, vol. XXI, 23 (2/2016), pp. 49-62 **April - June**

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STRATEGIC DIRECTIONS OF DEVELOPMENT OF THE POLISH POWER SECTOR IN THE LIGHT OF CLIMATE AND ENERGY POLICY OF THE EUROPEAN UNION

The paper analyzes the possible directions of development of the Polish electricity sector by 2050 in terms of its adaptation to the EU requirements. The analysis was performed for different scenarios of development of CCS technology, nuclear energy development conditions and forecasted fuel prices on the domestic market, assuming the EU's targets for energy and climate policy. Strategic directions of sector development, taking into account investments in gas-fired and nuclear power plants were considered. Position of coal in the future fuel structure of Polish electricity generation and its conditions were discussed. The costs of electricity production in the analyzed scenarios are set out. The areas of government activityessential for strategic decisions determining the direction of development of the energy sector in Poland are presented.

The presented studies assumed equal preferences for all types of fuels and technologies while assuming the market prices of fuels. The Government, determining the desired directions of development of the sector, can stimulate their development by creating preferences, such as preferential tax treatment.

Essential is active participation of the Polish government in setting the specific targets valid for European countries in future. Without denying the need to reduce emissions, Poland should have an impact on the choice of quantity and quality of indicative targets, which will have to be met. A target to reduce emissions should not be accompanied by further objectives. For example, a target to increase share of renewable energy sources limits the development of energy mix.
Keywords: energy policy, energy security, electricity.

1. INTRODUCTION

The transformations that have taken place in the world over the last decades covered all aspects of life. Broadly understood changes affect the society, economy and environmental resources.

Natural resources are the wealth of every country. Currently, the importance of natural resources, especially energy sources converted into usable energy, is particularly important as

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they provide energy security in light of the growing demand for energy. The economic development and living standards of the society determine energy supply of sufficient quantity and quality. Energy supply is a decisive factor for the economic development opportunities and civilization of the world.Nowadays, it is difficult to imagine functioning without constant and secure access to electricity.Thus, the government's concern is to provide uninterrupted supply to all potential users, both individual and industrial – therefore ensuring the energy security of the country. The efficient use of energy sources is also important. This can be done by focusing on energy technologies ensuring the synergy of economy, security of supplies and the natural environment.

2. THE ENERGY POLICY OF POLAND

In Poland the basic rules concerning all aspects of energy supply management are collected in the Energy Law Act.[3]. The document takes into account the internal rules of operation and interaction between the individual sectors of energy management chain, including: generation, transmission, distribution and marketing. Multiple amendments to the act are, among other things, a result of the gradual adjustment of Polish law to the European Union energy market regulations.

The Act defines energy security as „the condition of the economy which enables full coverage of the customer's ongoing and prospective demand for fuels and energy in a technically and economically justified manner, with the observance of the environment protection requirements".

To ensure energy security, not only current supply management, but also strategic and long-term development planning are needed. Therefore, the Council of Ministers, under the provisions of the Energy Law Act, is responsible for the preparation and implementation of national energy policy, which should be subjected to successive revisions along with the changing conditions. The new document - taking into account extended time frameof activities - should be approved every four years.

The energy policy of Poland was based on the following government documents:

- The Assumptions of the Polish Energy Policy for the years 1990-2010, August 1990,
- The Assumptions for Poland's Energy Policy Until the Year 2010, adopted by the Council of Ministers on 17 October 1995
- Assumptions for Poland's Energy Policy Until the Year 2020, adopted by the Council of Ministers on 22 February 2000,
- Evaluation of Implementation and Amendments to Assumptions for Poland's Energy Policy Until the Year 2020 with Annexes, adopted by the Council of Ministers on 2 April 2002,
- The Energy Policy of Poland until 2025, adopted by the Council of Ministers on 4 January 2005.

[3]The Energy Law Act of 12 April 1997 (Bulletin of Acts and Decrees 1997.54.348), Pursuant to Art.1 Paragraph 1-2.

At present, the current document is the Polish Energy Policy until 2030, adopted by the Council of Ministers on 10 November 2009.[4].

The document was created after the adoption of the European Union climate and energy package, which specifies the objectives until 2020. [5]. The lines of action included in the Polish Energy Policy until 2030 were intended to ensure the implementation of the EU law and to meet the European Union indicative targets adopted by Poland, through[6]:

- The improvement of energy efficiency,
- The increase in the security of fuel and energy supply,
- Diversification of the electricity generation structure by introducing nuclear energy;
- The development of renewable energy sources, including biofuels,
- The development of competitive fuel and energy markets
- Reducing the power sector on the natural environment.

After five years, the Polish Energy Policy requires adjustments and there is an urgent need for the government's adoption of the new document, which should take into account, among others:

- Changes in the global fuel and energy markets[7,8],
- The current situation in the energy sector,[9,10]
- The economic difficulties of coal mining,[11,12,13]
- Delays in the implementation of nuclear power in Poland,[14]
- The EU's strategy for building a low-carbon Europe.[15,16]

[4]Energy Policy of Poland until 2030.Ministry of Economy. Warsaw 2009.

[5]Decision No 406/2009/EC of the European Parliament and the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. OJ L 140, 5.6.2009, 136–148.

[6]Energy Policy of Poland until 2030.op. cit.

[7]M. Kaliski, A.P. Sikora, A. Szurlej, Hard coal in Poland's energy policy. Polityka Energetyczna – Energy Policy Journal 2014, 17(3): 7–18 – in Polish with English abstract.

[8]Duda et al., 2014 – Duda, M., Gabrys, H.L., Kaliski, M., Malko, J., Kamrat, W. 2014. Experiences and challenges of the energy market. Rynek Energii, thematic issue no.1, 5–42 – in Polish with English abstract.

[9] ERO 2014. National Report of the President of the Energy Regulatory Office of Poland. www.ure.gov.pl [17.03.2015]

[10]J. Kamiński, *Primary energy consumption in the power generation sector and various market structures: a modelling approach.*„Mineral Resources Management"2014, Volume 30, Issue 4, Pages 37–50.

[11]L. Gawlik, U. Lorenz, *How much coal for the power sector?* „Polityka Energetyczna – Energy Policy Journal" 2014, 17(3): 19-32 – in Polish with English abstract.

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[13]T. Olkuski, *Hard coal import dependence of Poland*. "Gospodarka Surowcami Mineralnymi – Mineral Resources Management 2013, 29(3): 115-130 – in Polish with English abstract.

[14]*Polish Nuclear Power Programme*. Ministry of Economy, Warsaw, January 2014.

The „Energy Security and the Environment – 2020 perspective" adopted by the Council of Ministers in 2014[17] confirms the objectives set out in the Polish Energy Policy until 2030, but this is a short-term strategy while the energy policy requires a much longer perspective, given the long-term targets (until 2050)in the European Union energy and climate policy.

The new policy until 2050 is being prepared for a long time, but determining the direction of diversification of Polish energy mix is a very complicated task and such decisions have not yet been taken.

3. THE STRUCTURE OF ELECTRICITY PRODUCTION IN POLAND

In 2013, thedomestic gross electricity consumption amounted to 157 980 GWh and was higher by 0.6% than in 2012. The level of national electricity consumption is associated with a constant low growth rate of GDP in 2013, which, according to Central Statistical Office preliminary estimates for 2013, amounted to 1.6%.

Table 1. The structure of electricity generation in 2011-2013 [GWh][18]

	2011	2012	2013
Total electricity generation	163 153	159 853	162 501
Hard coal-fired power plants	90 813	84 493	84 566
Lignite-fired power plants	53 623	55 593	56 959
Gas-fired power plants	4 355	4 485	3 149
Industrial power plants	9 000	8 991	9 171
Water-based utility power plants	2 529	2 265	2 762
Wind and other renewable sources	2 833	4 026	5 895
Balance of cross-border trade	-5 243	-2 840	-4 521
Domestic electricity consumption	157 910	157 013	157 980

As a result, the volume of domestic gross electricity production in 2013 amounted to 162 501 GWh and was higher than the volume for the previous year by about 1.7%.Detailed data on the structure of electricity production in Poland is shown in Table 1. The surplus electricity production over domestic consumption is a result of prosperity in foreign electricity trade,

[15]Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions.EnergyRoadmap 2050, COM(2011) 885/2 final. EuropeanCommission (EC), 2011

[16]A 2030 framework for climate and energy policies. Green paper. COM(2013) 169 final. European Commission (EC), 2013.

[17]Energy Security and the Environment – 2020 perspective. Ministry of Economy (Ministerstwo Gospodarki) and Ministry of Environment (Ministerstwo Środowiska), Warsaw, April – in Polish.

[18]ERO 2014, *op. cit*.

favoring Polish entities entities generating electricity. In the 2013, the surplus of exports over imports of energy amounted to 4 521 GWh[19].

4. SCENARIO STUDY ON THE DEVELOPMENT OF POLISH ENERGY SECTOR

The objective of reducing EU emissions of greenhouse gases by 80-95% below 1990 levels[20]is reflected in the currently discussed indicative targets. The EU will reduce CO2 emissions by 40% and the share of renewable energy in final consumption will increase to 27% by 2030, which was agreed in October 2014 in Brussels.

These activities pose a serious threat to the Polish energy sector, as determining the direction of development is of crucial importance.

The problem is illustrated by the research results presented below.

Five from more than a dozen of scenarios, developed in order to determine the future demand for coal, were selected for further analysis.[21]

Specialized mathematical model designed for analysis of fuel and energy systems, optimized, under the given limitations, the sector of electricity generation by 2050, so that the system costs of building new generation capacities and exploitation were the lowest. Calculations were performed using the PL-Grid computing infrastructure for the power industry field[22].

A certain level of demand for electricity - rising to the level of 204 TWh in 2050 - was assumed on the basis of projections. The forecast prices for different fuels for energy supply, based on price forecasts of energy resources and taking into account the specifics of the Polish market, were determined. The levels of capital expenditures on the construction of various types of power generating units, their operating costs and their efficiency and emissivity were also defined.

The Reference Scenario is The COAL scenario, assuming that:

- it is possible to build three nuclear units 1.5 GW each in the years 2025, 2030 and 2035 provided that such solution will be optimal from the point of view of the system,
- The CCS technology will reach commercial maturity and will be able to use on an industrial scale starting from 2030,

[19] ERO 2014. National Report of the President of the Energy Regulatory Office of Poland. www.ure.gov.pl [17.03.2015]

[20]A 2030 framework for climate and energy policies. Green paper. COM(2013) 169 final. European Commission (EC), 2013.

[21]L. Gawlik (ed), 2013. Coal for Polish energy sector in 2050 perspective – scenario analysis. Mining Chamber of Industry and Commerce, Katowice, 300 p. – in Polish. http://www.giph.com.pl/giph/attachments/article/278/Wegiel_dla_polskiej_energetyki_2050_GIPH_MINPAN.pdf [3.05.2015].

[22]T. Mirowski, J. Kamiński, A. Wyrwa, Implementation of Energy Modeling Systems in the PLGridPlus Infrastructure. Polityka Energetyczna – Energy Policy Journal 2014, 17(4): 217–224 – in Polish with English abstract.

- The current situation regarding the availability and the price of gas will not be subjected to dramatic changes over the analysis period, while gas prices in Poland will follow the global trends in this area.

The alternative scenarios changed one of abovementioned assumptions to examine its impact on the obtained results.

- The GASscenario assumes that gas prices will be reduced as a result ofthe development of domestic production of natural gas, including gas from shale formations, and other measures aimed at diversifying gas supplies.
- The NUCLEAR scenario assumes the commissioning of a 1.5 GW nuclear power plant every 5 years in the period 2025-2050, if such a solution will be optimal from the point of view of the system.
- The CCS scenario assumesthe rapid development of the carbon capture and storage technology, which will be available by 2025.
- TheNO-CCS scenario assumes that CCS technology will not develop and reach commercial maturity over the analysis period and therefore will not be available by 2050.

The abovementioned five scenarios reduce the wide margin of uncertainty regarding the future operating conditions of the energy sector.

The scenarios selected for analysis assumed that the efforts to implement the energy and climate policy using the EU emissions trading system will lead to a systematic and significant increase in the price CO2 emissions allowances, as assumed in the Road Map 2050[23], to a level of 210 PLN (constant prices for 2011).

It was also assumed that an obligation to systematically increase the share of renewable energy sources will be imposed on Member States. The continued increase in the share of electricity production from renewable energy sources should amount to 23% in 2020, 27% - in 2030 and 35% by 2050.

The model works in such a way that energy demand is primarily covered by the existing generation units of the power sector. In order to replace old units and to cover the growing demand for energy, the model completes the manufacturing base through the selection of units constituting the most cost-effective solutions among the available energy technologies using available fuels and renewable sources. At the same time, the aforementioned units meet the EU's obligations, among others regarding the share of renewable energy sources in electricity production. To meet this condition, 36.3 GW of generating capacity - based on renewable energy sources - should be installed by 2050.The suitability of a given renewable energy source depends on the potential of Polish power sector, the investment and operating costs of these technologies and on the expected pace of their development.

[23]Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050, COM(2011) 885/2 final. European Commission (EC), 2011.

Fig. 1 compares the results of optimizing the construction of new production capacities in the power system obtained under the conditions described in each scenario.

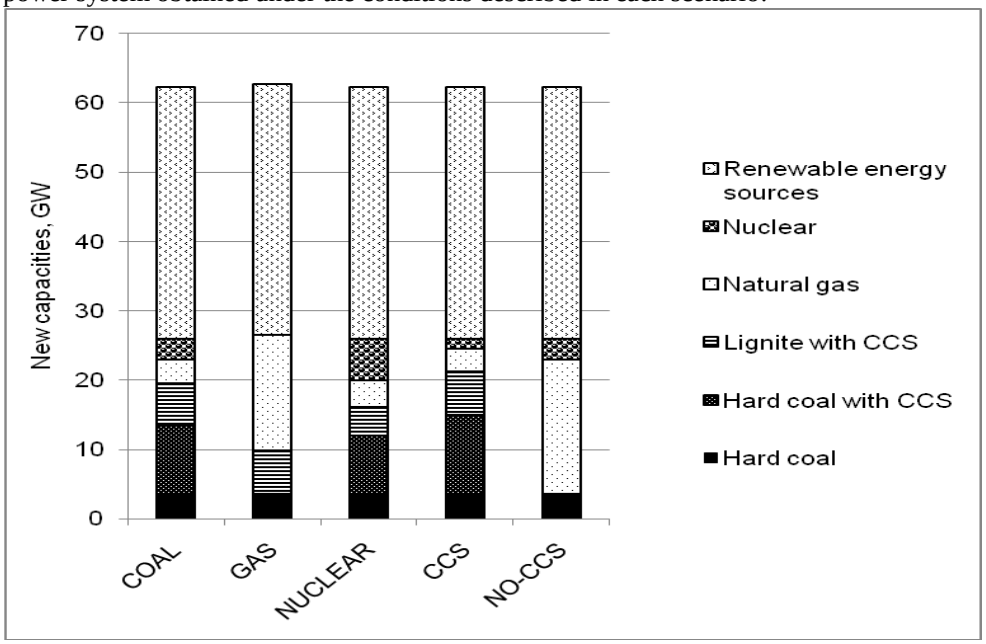
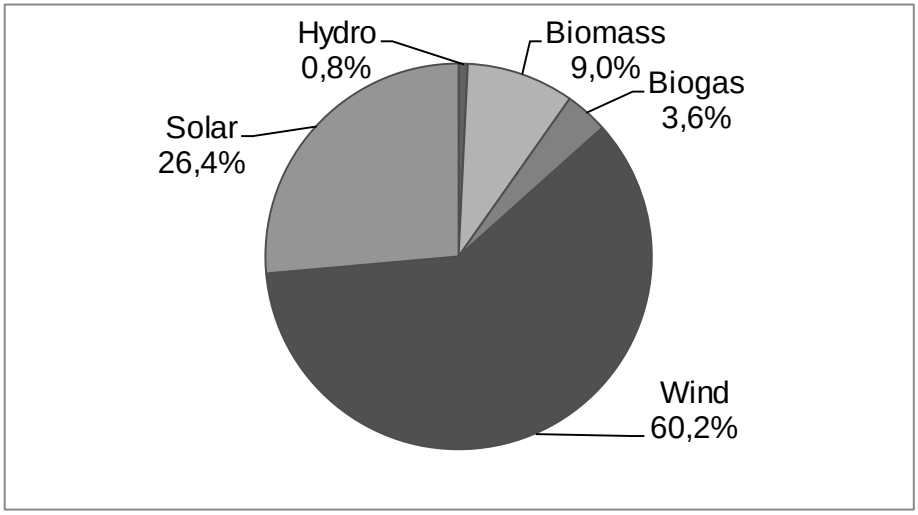


Fig. 1. New capacities built in energy sector in 2015−2050 in conditions of analyzed scenarios, [GW]
Source: Own elaboration

In all the analyzed scenarios, out of 36.3 GW of newly installed capacityin power plants , combinedheating and power plants and heating plants based on renewable energy sources, up to 21.8 GW (60.2%) are wind power plants, while 9.6 GW account for solar technologies (26.4%).

The structure of new capacities based on renewable energy sources is shown in Fig. 2.

Fig. 2. The structure of installed capacity in units based on renewable energy sources in new investments scheduled for the period 2015 - 2050.



Source: Own elaboration

Construction of new power units using non-renewable energy sources depends on the assumptions in each scenario.However, 3.6 GW of newly installed capacity based on hard coal is a priority. Technologies based on hard coal using CCS technology will be implemented in the following scenarios: CCS - 11.4 GW, COAL - 9.5 GW and NUCLEAR scenario - 8.5 GW. The construction of new lignite-based power plants depends on use of CCS technologies in the following scenarios: COAL – 6.2 GW, GAS – 6.4 GW, CCS – 6.3 GW and – to a smaller extent - in the NUCLEAR scenario – 4.0 GW.Nuclear energy is the optimal solution, except for the conditions specified in the GAS scenario. The new nuclear units should become operational around 2030.The installed capacities of nuclear power plants for the individual scenarios are shown in Table 2.

Table 2. The installed capacities of nuclear power plants in the years 2015- 2050 [GW]

Scenario	Year							
	2015	2020	2025	2030	2035	2040	2045	2050
COAL				1,5	1,5			
GAS								
NUCLEAR				1,5	1,5	1,5	1,5	
CCS					1,5			
NO-CCS				1,5	1,5			

Source: Own elaboration

The development of gas-based energy sector is limited in the case of COAL (3.4 GW), NUCLEAR (3.9 GW) and CCS scenarios (3.2 GW), while in the case of GAS scenario - characterized by lower gas prices - this development is significant (16.6 GW). If the CCS technology will not be available (NO-CCS scenario), thegas-based energy sector will develop rapidly (19.4 GW).

The fuel structure of the energy sector in 2050 broken down into individual scenarios is shown in Table 3.

Table 3. The fuel structure of the energy sector in 2050 [%]

Fuel/ energysource	Scenario				
	COAL	GAS	NUCLEAR	CCS	NO-CCS
Hard coal	45,8	15,9	41,6	50,8	26,6
Lignite	18,3	22,2	12,2	18,5	1,9
Natural gas	1,5	33,5	1,6	1,5	31,1
Nuclear	10,7	0,0	21,2	5,4	12,5
Fueloils	2,5	3,0	2,4	2,5	2,9
Hydro	0,6	0,7	0,6	0,6	0,7
Biomass	9,1	10,9	9,0	9,2	10,7
Biogas	2,5	3,0	2,5	2,5	2,9
Wind	7,4	9,0	7,3	7,5	8,7
Solar	1,6	1,9	1,6	1,6	2,0

Source: Own elaboration

Table 1 shows the diversity in the share of individual non-renewable fuels - depending on the assumptions used. Meanwhile, the shares of renewable energy sources are comparable, which is the result of the imposed obligatory share of electricity production from these sources.

The share of hard coal can be over 50% in the case of rapid deployment of CCS technologies or only about 16% in the case of development of gas-based power sector, given the lower gas prices. If the CCS technology will not be developed, the share of coal will decrease (26.6%).

The use of lignite depends on the CCS technology. Otherwise, the use of lignite will be marginalized. The development of nuclear energy (as in the NUCLEAR scenario) reduces the share of lignite in the energy sector by 12.2% that is 6.1% less than in the case of COAL scenario.

The development of energy based on natural gas will be possible if the price of this raw material will be lower. In that case, this solution is cheaper than nuclear power development.

No CCS technology (NO-CCS scenario) limits the use of solid fossil fuels. Therefore, power industry will be based on gas fuel (even without lowering its prices) and nuclear energy.

Each of the scenarios is associated with an increase in the cost of electricity production (Fig. 3), which is mainly due to the high costs associated with reduction of CO_2 emissions,

increasing prices of CO_2 allowances andobligation to use more expensive - due to technological immaturity - renewable energy sources, When compared to current prices, the increases in manufacturing costs are close to 40% (calculated in constant prices).

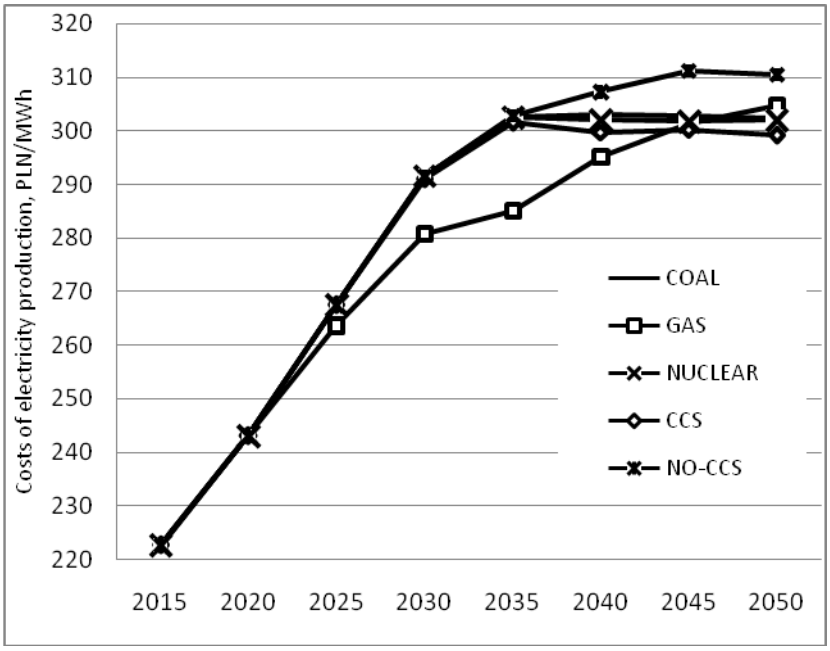


Fig. 3. The costs of electricity generation in the analyzed scenarios [PLN'2011/ MWh]
Source: Own elaboration

In the years 2025 - 2040, the lowest increases in the cost of electricity production apply to the GAS scenario. However, initially rapidly increasing costs forCOAL, NUCLEAR and CCS scenarios will stabilize and eventually be lower than in the case of the GAS scenario. In the case of development of the NO-CCS scenario will result in the highest costs of electricity production compared to other scenarios in 2050. They will be 3.8% higher than in the case of CCS scenario with the lowest constant prices of 2011 (299.1 PLN / MWh).

Capital expenditures necessary to build new power plants ensuring the assumed level of electricity supply throughout the period of the analysis are the lowest in the case of the NO-CCS scenario and amount to PLN 338.2 billion PLN. In the case of CCS scenario, necessary capital expenditures amount to PLN 442.2 billion PLN. Comparable expenditures are needed for the implementation of GAS scenario (PLN 347.1 billion PLN).The COAL scenario requires over 115 billion PLN more than GAS scenario. The NUCLEAR scenario requires the highest capital expenditures – 488.4 billion PLN,that isover 44% than needed to implement the cheapest scenario.

Fig.4 presentsthe capital expenditures on the development of analyzed scenarios and their time frame (five-year periods). Up to 2025, capital expenditures in all scenarios are almost identical. The differences in expenditures only become visible in later years.

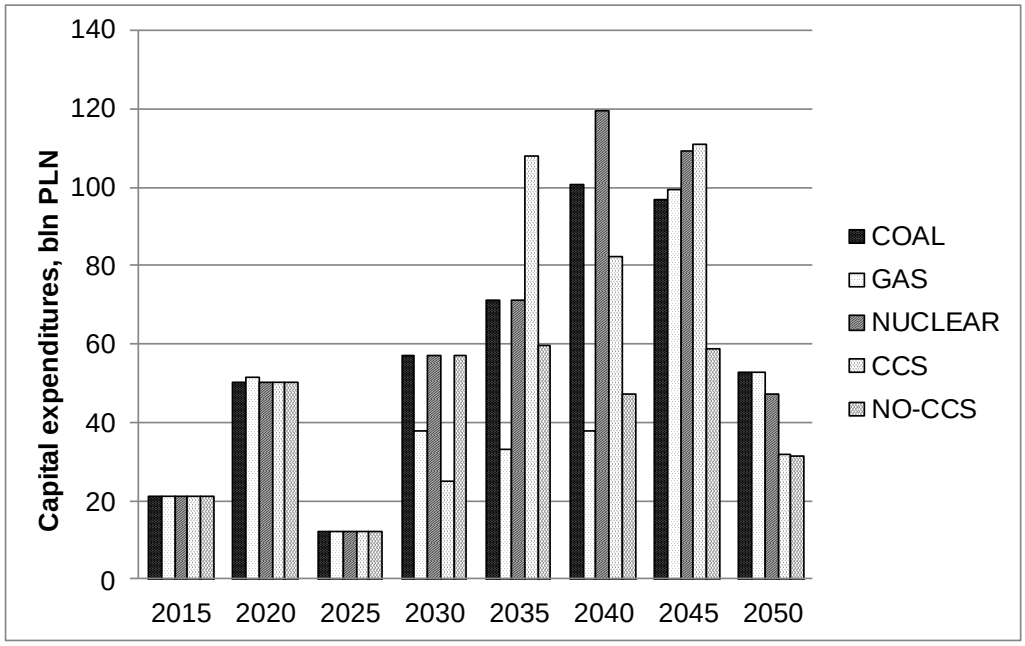


Fig. 4. Capital expenditures for the development of production capacity in the energy sector broken down into individual scenarios [billion PLN'2011 (10^9 PLN)]
Source: Ownelaboration

The results of the presented analysis show the scale of the difficulties faced by the Government, whose aim is to decide on the direction of development of the Polish energy sector.

5. SUMMARY

To ensure the long term energy security, it is necessary to invest in the energy sector.This is due to delays in the construction of new production capacities in the energy sector and obsolete production base. Despite the growing energy efficiency of the economy, an increased demand for electricity in the coming decades is expected. Coal-based power production, resulting from historical conditions of Poland and available resources of solid fuels, should be diversified. The driving force behind these changes is the EU energy and climate policy. While the conditions for implementing the energy and climate package until 2020 are not a threat and Poland is able to meet the EU targets for subsequent years, they are a serious challenge.Regardless the selected direction of development of the Polish energy sector, the

need for significant capital expenditures on the construction of generating units should be expected. What is more, the EU's decarbonisation objective will result in the inevitable large increase in the cost of electricity generation due to, among other things, required high share of renewable energy sources in the power generation sector, which, although developing rapidly, it has not yet fully reached commercial maturity required.

Potentially unknown conditions on fuel markets also make it difficult to make rational decisions. The pace and direction of technological development is also very important. The development of CCS technology, which, although a few years ago seemed to be very promising, is not growing fast enough to predict the date of its commercial maturity, is crucial for both Poland and for maintaining market share for crisis-stricken hard coal mining.

Suggestions on future development options resulting from the analysis are presented below.

1. The government's decision to develop nuclear power should stop the development of gas-based energy sector, which would be the best solution for the entire sector due to optimization of costs, provided that gas prices in the long run will fall and would be lower than today.
2. Maintaining a high share of solid fuels in power generation is possible. However, in order to meet the decarbonisation targets, CCS technology must be available.
3. If CCS technology will not develop, the share of hard coal and lignite should be limited and the development of gas and nuclear energy will be necessary.
4. Active participation of the Polish government in setting the specific reduction targets is essential. Without denying the need to reduce emissions, Poland should have an impact on the choice of quantity and quality of indicative targets, which will have to be met. A target to reduce emissions should not be accompanied by further objectives. For example,a target to increase share of renewable energy sources limits the development of energy mix.

The presented studies assumed equal preferences for all types of fuels and technologieswhile assuming the market prices of fuels. The Government, determining the desired directions of development of the sector, can stimulate their development by creating preferences, such as preferential tax treatment.

This work was done within the framework of statutory research of the Mineral and Energy Economy Research Institute, Polish Academy of Sciences.

BIBLIOGRAPHY

[1] A 2030 framework for climate and energy policies. Green paper. COM(2013) 169 final. European Commission (EC), 2013.
[2] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions. EnergyRoadmap 2050, COM(2011) 885/2 final. EuropeanCommission (EC), 2011

[3] Duda et al., 2014 – Duda, M., Gabrys, H.L., Kaliski, M., Malko, J., Kamrat, W. 2014. Experiences and challenges of the energy market. Rynek Energii, thematic issue no.1, 5–42 – in Polish with English abstract.
[4] Energy Law. Act of 12 April 1997 (Bulletin of Acts and Decrees 1997.54.348), Pursuant to Art.1 Paragraph 1-2.
[5] Energy Policy of Poland until 2030. Ministry of Economy. Warsaw 2009.
[6] Energy Security and the Environment – 2020 perspective. Ministry of Economy and Ministry of Environment, Warsaw, April – in Polish.
[7] ERO 2014. National Report of the President of the Energy Regulatory Office of Poland. www.ure.gov.pl [17.03.2015]
[8] Gawlik L. (ed), 2013. Coal for Polish energy sector in 2050 perspective – scenario analysis. Mining Chamber of Industry and Commerce, Katowice, 300 p. – in Polish. http://www.giph.com.pl/giph/attachments/article/278/Wegiel_dla_polskiej_energetyki_2050_GIPH_MINPAN.pdf [3.05.2015].
[9] Gawlik L., Lorenz U., 2014. How much coal for the power sector? Polityka Energetyczna – Energy Policy Journal 17(3), 19–32 – in Polish with English abstract.
[10] Gawlik L., Mokrzycki E., 2014. Scenarios of coal utilization in power engineering in Poland in the light of EU climate policy. Przegląd Górniczy 5, 1–8 – in Polish with English abstract.
[11] Kaliski M., Sikora A.P., Szurlej A., 2014. Hard coal in Poland's energy policy. Polityka Energetyczna – Energy Policy Journal 17(3), 7–18 – in Polish with English abstract.
[12] Kamiński J., 2014. Primary energy consumption in the power generation sector and various market structures: a modelling approach. Gospodarka Surowcami Mineralnymi - Mineral Resources Management30, 4, 37–50.
[13] Mirowski T., Kamiński J., Wyrwa A., 2014.Implementation of Energy Modeling Systems in the PLGridPlus Infrastructure. Polityka Energetyczna – Energy Policy Journal 17, 4, 217–224 – in Polish with English abstract.
[14] Olkuski T. 2013. Hard coal import dependence of Poland. Gospodarka Surowcami Mineralnymi – Mineral Resources Management 29, 3, 115–130 – in Polish with English abstract.
[15] Polish Nuclear Power Programme. Ministry of Economy, Warsaw, January 2014.
[16] Project of the Energy Policy of Poland by 2050. Ministry of Economy, Warsaw, August 2014 – in Polish.
[17] Decision No 406/2009/EC of the European Parliament and the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. OJ L 140, 5.6.2009, 136–148.

STRATEGICZNE KIERUNKI ROZWOJU POLSKIEGO SEKTORA ELEKTROENERGETYCZNEGO W ŚWIETLE POLITYKI ENERGETYCZNO-KLIMATYCZNEJ UNII EUROPEJSKIEJ

W artykule dokonano analizy możliwych kierunków rozwoju sektora elektroenergetycznego Polski do 2050 roku w aspekcie jego dostosowania do wymogów unijnych. Analizę przeprowadzono w warunkach różnych scenariuszy rozwoju technologii CCS, uwarunkowań rozwoju energetyki jądrowej oraz prognozowanych cen paliw na rynku krajowym, przy założeniu realizacji unijnych celów w zakresie polityki energetyczno-klimatycznej. Rozważono strategiczne kierunki rozwoju sektora z uwzględnieniem inwestycji w elektrownie gazowe i jądrowe. Określono pozycję węgla kamiennego w przyszłej strukturze paliwowej produkcji energii elektrycznej Polski i jej uwarunkowania. Określono koszty produkcji energii elektrycznej w analizowanych scenariuszach. Wskazano obszary, w jakich powinien poruszać się Rząd podejmując strategiczne decyzje określające kierunek rozwoju sektora energetycznego w Polsce.

Przedstawione badania wykonane były w warunkach równych preferencji dla wszystkich rodzajów paliw i technologii, przy przyjętych na warunkach rynkowych cenach paliw. Rząd, wprowadzając pożądane dla niego kierunki rozwoju sektora może stymulować ich rozwój poprzez stworzenie preferencji, na przykład podatkowych.

Aktywne uczestnictwo polskiego rządu w wypracowywaniu szczegółowych celów redukcyjnych obowiązujących w przyszłości kraje unijne jest niezbędne. Nawet nie negując potrzeby ograniczenia emisji, Polska powinna mieć wpływ na wybór ilości i jakości celów wskaźnikowych, z których będzie musiała się rozliczyć. Ustaleniu celu w postaci wielkości redukcji emisji nie powinny towarzyszyć dodatkowe cele. Na przykład obligatoryjny cel w postaci udziału odnawialnych źródeł energii ogranicza wybór własnej ścieżki kształtowania miksu energetycznego.

Słowa kluczowe: polityka energetyczna, bezpieczeństwo energetyczne, energia elektryczna.

DOI:10.7862/rz.2016.hss.18

Przesłano do redakcji: sierpień 2015
Przyjęto do druku: czerwiec 2016