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PERSPECTIVES OF RES DEVELOPMENT IN POLAND UP TO 2020

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This paper describes selected aspects of current development of renewable energy sources in Poland. Analysis and assessment of renewable energy sources in Poland is made. Perspectives of development of renewable energy sources up to 2020 in context of the implementation of the EU's "3 x 20%" climate package by Poland and national quantitative target for RES development by year 2020 are described. Conclusions contain analysis of perspectives of development of renewable energy sources in Poland in the future. References 10, tables 3, figures 1.
Key words: renewable energy sources, development

Introduction. The renewable energy sources (RES) sector records dynamic development worldwide. Over the past ten to twenty years, renewable energy and especially the wind energy has become an important electricity source in a number of countries, improving their energy independence and limiting emission of pollutions. In Poland development of RES is a chance to achieve ecological, low-emission electricity generation, higher energy security, and to meet the EU requirements with regard to energy generation from renewable sources. These requirements are connected with the implementation of the EU's "3 x 20%" climate package by Poland and national quantitative target for RES development by year 2020 [1,3].

Polish national 2020 target for renewable energy sources is 15% share of energy generated from RES in the total primary energy and CO_2 emissions reduction by 20% [4].

Current state of res installations in Poland. Up to 2005 period the RES development was characterised by stagnation, caused primarily by the instability of the support scheme and poorly tailored legal regulations, resulting in risk levels unacceptable for the investors (the RES installation owners) [10]. Development of RES brought to a halt. After the Poland's accession to the European Union in 2005 and elimination of part of legal barriers, the number of RES investments started to rise. Government put favourable legal and economic regulations for RES into practice, imposed support scheme for green energy and created good investment climate for them [7]. At the end of 2011, the total RES installed capacity in Poland amounted to 3082 MW and number of licensed RES installations was 1270 [5].

Total installed capacity of RES and total amount of produced electricity in RES in years 2005-2011 in Poland are shown in Table 1.

Table 1. Cumulative power installation and electric energy production in RES in years 2005-2011 in Poland [6]

	Source	2005	2006	2007	2008	2009	2010	2011
Nominal power [MW]	Biogas	32.00	36.80	45.70	54.61	71.62	82.88	103,49
Amount of produced electricity [MWh] in year	Biogas	104465	116692	161768	220883	295311	315543	430537
Nominal power [MW]	Biomass	189.80	238.80	255.40	232.00	252.49	356.19	409,68
Amount of produced electricity [MWh] in year	Biomass	467976	503846	545765	560967	601088	664497	1055151
Nominal power [MW]	Wind	83.30	152.00	287.90	451.00	724.68	1 180.27	1616,36
Amount of produced electricity [MWh] in year	Wind	135292	257037	472116	805939	1035019	1484929	3126432
Nominal power [MW]	Water	922.00	931.00	934.80	940.57	945.20	937.00	951.39
Amount of produced electricity [MWh] in year	Water	2175559	2029636	2252659	2152822	2375778	2633162	2316833
Nominal power [MW]	Photo-voltaic	0	0	0	0	0	0	1,12
Amount of produced electricity [MWh] in year	Photovo-voltaic	0	0	0	0	0	0	178
Nominal power [MW]	Total	1227.10	1358.60	1523.80	1678.18	1993.99	2556.38	3082,04
Amount of produced electricity [MWh] in year	Total	2883292	2907211	3432308	3740611	4307196	5098131	5443443

As regards wind power, large increase in installed capacity and in energy production has been observed in the past years. It stems from high technological maturity of wind power, increased output of individual wind turbines and wind farms and cost competitiveness compared to other renewable technologies used in Poland to produce electricity [8]. Wind energy is a leader in the production of "green" electricity in Poland and is also the fastest developing renewable energy source in Poland [8].

Analysis of res development in Poland. The national RES sector has a very significant development potential. An important issue demonstrating the market potential of the RES sector in Poland is the presence of leading European and world's energy groups and producers of devices and equipment for RES. Significant interest from foreign companies and their activity make the Polish RES sector dynamic. The conditions and development perspectives of the RES sector in Poland are very good especially in area of wind power. From point of view of renewable energy country attractiveness indices, Poland was classified on the fourteenth position. Among the EU-27 Poland was ranked the ninth, whereas among new EU Member States and countries in Central and Eastern Europe it was first [5].

Government established a political quantitative target for RES by year 2020 - the share of RES in gross final energy consumption on level of 15% [3]. Rapid high development of RES will play key role in achieving this target. Table 2 presents forecast of cumulative power installation and electricity production in RES in 2013-2020. Table 3 presents forecast of results of RES development in 2013-2020 in area of greenhouse gas emission abatement.

Table 2. Forecast of power installation and electric energy production in RES in years 2013-2020 in Poland [4]

	Source	2013	2015	2016	2017	2018	2019	2020
Nominal power [MW]	Biogas	140	230	280	380	480	730	980
Amount of produced electricity [GWh] in year	Biogas	574	943	1148	1558	1968	2993	4018
Nominal power [MW]	Biomass	590	795	805	790	775	685	595
Amount of produced electricity [GWh] in year	Biomass	5453	5793	5866	5836	5806	5468	5131
Nominal power [MW]	Wind	2520	3540	4060	4580	5100	5620	6650
Amount of produced electricity [GWh] in year	Wind	5327	7541	8784	9860	11210	12315	15210
Nominal power [MW]	Water	982	1002	1012	1022	1032	1042	1152
Amount of produced electricity [GWh] in year	Water	2375	2439	2471	2503	2535	2567	2969
Nominal power [MW]	Photo-voltaic	2	2	2	3	3	3	3
Amount of produced electricity [GWh] in year	Photovo-voltaic	2	2	2	3	3	3	3
Nominal power [MW]	Total	4234	5569	6159	6775	7390	8080	9380
Amount of produced electricity [GWh] in year	Total	13731	16718	18269	19760	21522	23346	27331

Costs in the renewable sector are strongly correlated with local conditions, usually falling in quite a wide range, in particular when new technologies enter the market using various support schemes in different countries [7]. Official data and data averaged for larger groups of the EU countries where support schemes and energy markets do not differ significantly let describe in document *"An EU Energy Security Action Plan"* costs and economic efficiency of different energy production technologies, including renewable energy sources, in terms of economy and greenhouse gas emissions for conditions averaged for the entire EU [2]. For comparative purposes all costs have been translated into 2005 € on the basis of the average inflation rate for the "Euro zone" as quoted by Eurostat. The primary indices used to compare economic feasibility of particular technologies were: investment expenditures, operation costs and total energy production costs [2].

Table 3. Forecast of results of RES development in Poland, in years 2013-2020 [4]

	2013	2015	2016	2017	2018	2019	2020
Reduction of CO_2 emissions [k Mg/year]	11534.6	13912.5	15123.5	16361.5	17791.2	19479.6	22680.0
Reduction of SO_2 emissions [t/year]	7.1	8.5	9.3	10.1	10.9	12.0	13.9
Reduction of NO_X emissions [t/year]	7.1	8.5	9.3	10.1	10.9	12.0	13.9

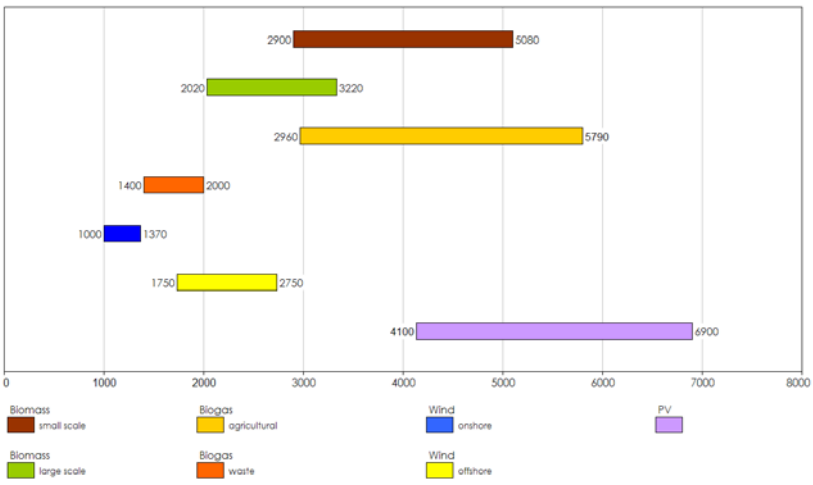
Unit investment costs for different elec
installed capacity are presented on Figur
installations using particular technologies
inexpensiveest "green" electricity productio
same situation is in terms of operational cost

The European Commission foresees a si
renewable technologies. In the 2020 perspe
power [2].

Expected average electricity production c
for onshore wind, 90 €2005/MWh for offsh
and 365 €2005/MWh for photovoltaics [2,10

Average construction time of RES install
biomass systems, four times as fast as hydro

The wind power will have extraordinary
other RES technologies [2]. It is a very cos



power will be the main RES technology in Poland. In 2020, total wind installed capacity should amount to 6650 MW and the total wind electricity production will amount to 15210 GWh [4].

Intensive RES development in Poland requires solutions of many technical, economic and legal problems which put a number of hindrances and formal, legal and technical development barriers [9]. Many of them are connected with fast changing the legal environment. The most significant are legal procedures related to spatial planning and environmental impact assessments and problems with grid connection.

Conclusions. RES development in Poland is a chance to achieve ecological, low-emission electricity generation, higher energy security, and to meet the EU requirements with regard to energy generation from renewable sources.

RES development in Poland requires solutions of many technical, economic and legal problems which put a number of hindrances and formal, legal and technical development barriers.

Implementation of the EU's „3 x 20%" climate package is a challenge and an opportunity for Poland to intensive RES development and the long-term modernisation of the national power sector in a way allowing the sector not to lose its competitiveness with implementation of more strict requirements for greenhouse gas emission abatement, increase in CO_2 emission allowance prices and gradual exhaustion of the most easily accessible and inexpensive fossil fuel resources.

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ПЕРСПЕКТИВИ РОЗВИТКУ ВІДНОВЛЮВАНИХ ДЖЕРЕЛ ЕНЕРГІЇ У ПОЛЬЩІ ДО 2020

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У роботі описуються окремі аспекти сучасного розвитку відновлюваних джерел енергії у Польщі, проведено аналіз та здійснена оцінка відновлюваних джерел енергії. Описані перспективи розвитку відновлюваних джерел енергії до 2020 року у контексті реалізації кліматичного пакету "3 х 20%" ЄС Польщею та національних кількісних цільових показників. Проаналізовано перспективи розвитку відновлюваних джерел енергії у Польщі в майбутньому. Бібл. 10, табл. 3, рис. 1.

***Ключові слова*:** відновлювані джерела енергії, розвиток, перспективи.

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ПЕРСПЕКТИВЫ РАЗВИТИЯ ВОЗОБНОВЛЯЕМЫХ ИСТОЧНИКОВ ЭНЕРГИИ В ПОЛЬШЕ ДО 2020 ГОДА

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В работе описываются отдельные аспекты современного развития возобновляемых источников энергии в Польше, проведен анализ и дана их оценка. Описаны перспективы развития возобновляемых источников энергии до 2020 года в контексте реализации климатического пакета "3 х 20%" ЕС Польшей и национальных качественных целевых показателей. Проанализированы перспективы развития в будущем. Библ. 10, табл. 3, рис. 2.

***Ключевые слова*:** возобновляемые источники энергии, развитие, перспективы.

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