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Introduction of Regional Energy Concepts

„HOW TO DO IT WELL”

4.6.1

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1. INTRODUCTION, OBJECTIVES AND ENERGY COMMITMENTS, INTEGRATED ENERGY MANAGEMENT SYSTEMS

1.1. Renewable Energy Sources (RES)

Due to thePolishmembershipin the EU,Polishdevelopment objectives, including objectives related tothe use of renewableenergy sources,are consistentwith priorities ofEuropeanlong-termdevelopment strategy–*Europe2020 Strategy -A strategy for smart, sustainable and inclusive growth* and arethe implementation of guidelineNo5.*More efficientuse of resourcesand reducinggreenhouse gas emissions* andflagship initiatives: *Resource efficient Europe, Innovation Union* and*An Industrial Policy for the Globalisation Era*. In linewith this strategy,the EUis expectedtoincrease upto 20% of share ofrenewable energy in gross finalenergy consumption.Guidelines forachievementsof the abovetargets were determinedforeach member stateindividually and consequently were 15.48% forPoland.

The development of renewableenergy sources in Polandissupportedby a numberof normative actsincluding:Act on *Energy Law*andimplementing regulations, *Environment Protection Law*and its implementing legislation,*The Energy Policy of Poland until 2030*and *Environmental Policy*. The law of renewable energy sources is in the stage of consultations held by the Ministry of Economy (draft, October 2012).

Oneof the goals of*The Energy Policy of Poland until 2030*is to achieveby2020at least 15% share of energyfrom renewablesources ingross final energy consumption(in 2010 the share was9.5%).Thisgoalfollows directlyfrom the implementationof Directive2009/28/EC on the promotionanduse of energy fromrenewable sources in Poland.

Challengesrelated to the developmentof renewable energyhave been included in national strategicdocuments: *The National Development Strategy2020 -Medium-termNational Development Strategy(SSRK),* report *Poland2030.Development Challenges*-long-termNational Development Strategy, *The Strategy ofEnergy SecurityandEnvironment*. The above challenges are alsolistedamong the nationalsmartspecialization(*Sustainable energy-High-performancelow-emission integratedsystems of energy generation, storage, transmission and distribution, environmentally friendlytransport solutions, intelligent andenergy-efficientbuilding*) representing R&D&I priority, development of whichwill be supportedin a particular way.It is expected that the above priority will ensurethe increase ofgross added value and the economycompetitiveness on foreign markets.

Initiatives aiming at RES level increase in gross final energy consumption are described in the National Renewable Energy Action Plan (NREAP). One of the assumption of NREAP is the possibility of selective development of RES branch, but the biggest dynamics is expected in energy production from wind and biomass.

Poland does not consider renewable energy to meet its own energy needs. The development of renewable energy is supportedonly due the requirements of EU obligations. According to them, in 2020 Poland has to achieve a 15% share of RES in gross final energy consumption. The lack of further commitment implies limited reduction of promotion and development of renewable energy sources - in accordance with assumed policies share of RES in gross final energy in 2030 is expected to be 16%, which means that the increase in the use of RES in between 2020 and 2030 is expected to be only 1%.

It should also be noted that the mechanisms for the promotion and implementation of renewable energy used in Poland are not effective. According to the report of the Supreme Audit Office (NIK) achieving the presumed for 2020 level of RES share in gross final energy production is threatened[13].

Tab. 1. Planned resultsof the transition to low-carbon economy

Indicator	Measure unit	Base value	Base year	Data source	Measurement frequency	Mid-term value (2020)	Target value (2023)
Primary energy consumption	Mtoe	93,3	2012	GUS/ Eurostat	Annually	96	96,0
The share of RES in gross final energy consumption	%	11,0	2012	GUS	Annually	15,5	16,0
Greenhouse gases emissions	(1990=100)	86,1	2012	KOBiZE	Annually	80,7	79,68

Mazovia region

Mazoviais the secondenergy consumptionregion in Poland. Currently,energy needs of Mazoviaaremetmainly byfossil fuels.The potential ofrenewable energy sourcesis almostuntapped.

Tab. 2. Renewable energy resources in Mazovia and their use

RES type		Energy potential	RES potential already used	Remaining RES potential	
				Units	% of potential
Solid biomass	TJ	7 780	2 500	5 280	68
Solar energy	TJ	10 900	2	10 898	100
Wind energy	TJ	835	1	834	100
Hydro energy	TJ	563	346	217	40
Geothermal energy	TJ	8 700	10	8 690	99

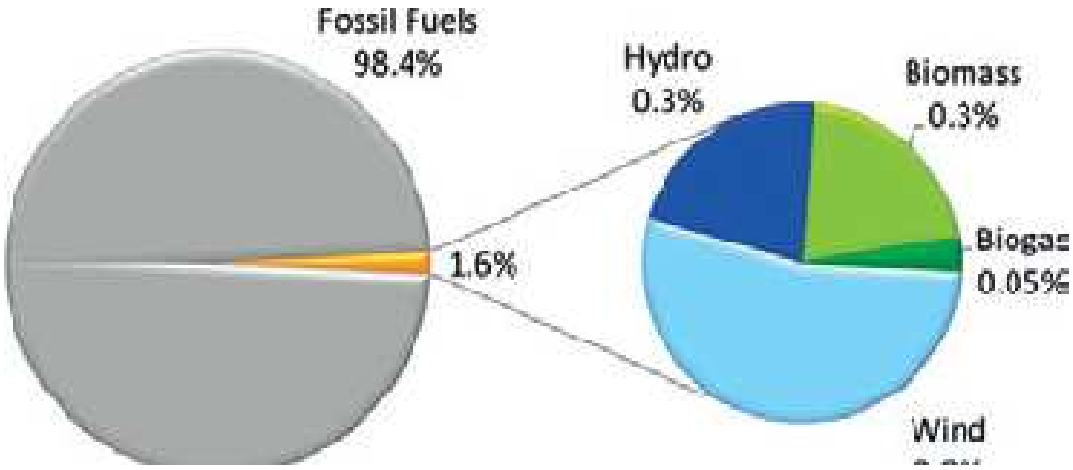

Fig. 1. The Mazovia's energy potential and use of RES in Mazovia, MAE, 2011

Share of energy from renewable sources in in the final gross energy in the Mazowsze region is very low (about 1.56%, 2011). The main RES used are wind and water as well as biomass, which can be used either for direct combustion and production of biofuels and bio-gas[12].

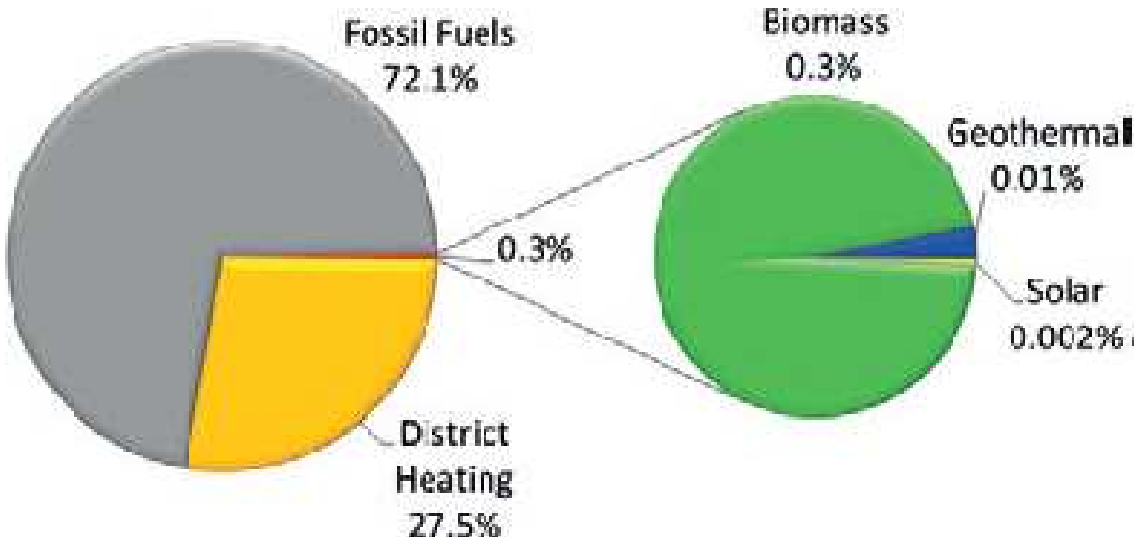

Fig. 2. Heat production by renewable energies in Mazovia, MAE, 2011

At the end of 2011, total installed capacity of renewable energy sources in Mazovia region was 150 MW. It gives Mazovia the sixth position in the ranking of Polish regions and points out the existing potential for further development [3,4].

Lower use of RES in the MazowieckieVoivodship compared to other regions is the result of previous actions in Mazovia, which were mainly focused on energy efficiency improvement. In the field of RES actions focused mainly on wind farms development and the use of biomass for heat production and cogeneration.

Projects aim at increase the use of RES in the Mazowsze region have been mainly financed by the Regional Operational Programme of the MazowieckieVoivodship. Until 2014 28 RES

projects have been supported with the co-finance of nearly 129 million PLN. Due to the implementation of these projects more than 38 MW RES energy should be installed andmore than 62 tons / year reduction in emissions of major air pollutants: SO2, NOx, particulates, CO2 should be achieved.

Diversification of energy sources and increased use of renewable energy sources is an element of the development strategy of Mazovia. Increased use of market's potential of RES is primarily bound to the development of small wind energy (a significant part of the region has favorable wind conditions) and solar energy - primarily for water heating, but also for the needs of farming and local production of electricity in photovoltaic. Biomass, which can be directly combusted or cofiredas well as used for the production of biofuels and biogas would be also important. According to forecasts, in 2023 the installed capacity of renewable energy sources in Mazovia region is expected to be 779.25 MW. An important element in RES development would be the support for distributed energy generation in low-power systems using local renewable sources.

1.2. Energy Efficiency (EE)

Energy efficiencyis a keyelement of the EU policyandany development strategyfor 2030-2050, including Europe 2020 Strategy. According to the above strategy, energy efficiency in Europe is expected to increase by 20%, and in Poland by 14% compared to 1990. Changes should cover the improvement of energy efficiency at the level of production, transmission and consumption in all sectors of economy (mainlyenergy, transport, housing and construction sectors), including a public sector(art.5 of Directive2006/32/EC on End-Ese EnergyEfficiencyand Energy Services) and end users.

Energy efficiency improvement can be achieved by reducing energy consumption and losses for either production, transmission, distribution and use. In the last 10 years in Poland energy intensity of gross domestic product fell by almost a third. This was due to the thermo-modernization, the modernization of street lighting and the optimization of industrial processes. However, the energy efficiency of the Polish economy is still about 3 times lower than in the most developed European countries and about 2 times lower than the EU average. This showsthat in Poland a huge potential for energy saving still exists.

The trend to zero-energy economy development (i.e. the economy development without the increase of energy demand) and constant decrease of Polish economy's energy intensityto EU-15 level are foreseen in current document *The Energy Policy of Poland 2030* in the area ofenergy efficiency improvement.

The Act of 15 April 2011 on energy efficiency (Journal of Laws No. 94, item. 551 with later amendments) defines the purpose of energy savings, taking into account the leading role of a public sector and establishes support mechanisms as well as the system of monitoring and collecting necessary data. The Actalso provides afull implementation ofEuropean directiveson energy efficiency, including provisions of Directive2006/32/EC onend-useenergy efficiency and energy services. The Act complies with EU guidelines savings target of final energy by 2016, in the case of Poland amounting a minimum of 9% average annual consumption of 2001-2005.Currently Poland is preparing for theimplementation of the Directive 2012/27 / EC of 25 October 2012 on Energy Efficiency, Concerted Action on Energy Efficiency Directive, CA EED.

Actiononenergy efficiencyalso takes into accountaims ofnational documentssuch as *TheSecondNational Action PlanforEnergy Efficiency* for Polandin 2011and *The NationalAction Planin the field ofrenewable energy.*InSeptember 2014, the Ministry of Economy publishedthe *thirdNational Action PlanforEnergy Efficiencyfor Poland2014.* The document's development and implementation was due to theobligationimposed onthe Minister of Economyon the basis ofArt.6paragraph. 1 of the Actof 15 April2011 ofEnergy Efficiency(Journal. Laws No.94, item. 551, as amended. D.) andis connected withreporting obligation tothe European Commissionon the progress in implementation of Directive2012/27/EUon Energy Efficiency.

The problem ofimproving energy efficiencyis crucial in national strategies. Challenges ofEEhave been includedinthe *National Development Strategy2020 -Medium-termNational Development Strategy(SSRK),* Report *Poland2030Development Challenges*-long-termNational Development Strategy. The energy efficiency improvement is a part of nationalsmartspecializationand smartspecialization of Mazovia region.The necessity ofeffective andrational use ofavailable resourceswasalsohighlightedin *The Strategy forEnergy Securityand Environment.*

Energy efficiencyplays a keyrole in the draft*The Energy Policy of Poland 2050*, not only toensure thesustainability andsecurity of energy supply, but also toincrease the competitiveness ofPolishenterprisesand the level ofwealth of the society.

Mazovia region

In the recent years in Mazoviaregion many actions have been taken to improve energy efficiency,among others invest in energy efficiency improvements were carried out, in particular, in the installation of heating systems and heat sources, as well as electric power transmission. This has enabled almost balance energy production and consumption in the region. Moreover the Mazowiecki Pact for Energy Savings (MPOE) was signed in 2012 by the President of Counties Convention of the Mazoviavoivodship, President of the Board the National Fund for Environmental Protection and Water Management in Warsaw, member of the Management Board of RWE Poland SA, President of the Board of Energa SA, Director of the Strategy Department of the PGNiG SA, Vice-Rector for research of the KazimierzPułaski University of Technology and Humanities in Radom, Marshal and Vice-Marshal of the MazowieckieVoivodship and President and member of the Board of the Mazovia Energy Agency (MAE). The aim of the MPOEis primarily to encourage public entities inMazowsze to take action aiming at improve energy efficiencyand effective use of local energy resources. In the frame of activities to improve the energy efficiency, municipalities of the Mazowieckieregion were required to develop energy strategies. Promotion and education campaigns as well as trainings on energy efficiency were carried out.

Projects aimed at improving the energy efficiency of Mazovia were financed by initiatives Jessica and the Regional Operational Programme of the MazowieckieVoivodship[5,12]. Their implementation will contribute to almost 389 000 GJ / year of energy savings.

Actiononenergy efficiency improvement will bealso takenin Mazovia region, wherethey aretheprioritised- similarly like at the national level.

Tab. 3. Planned indicators to improve energy efficiency in Mazovia region

Indicator	Measure Unit	Base Value	Base year	Target Value (2023)	Data source	Measurement frequency
Total greenhouse gases emissions in carbon dioxide equivalent	Kilotonne	89 312	2011	81 506	GUS	annually
Estimated decrease in greenhouse gases emissions	Tonnes of CO2 equivalent	0	2014	90	SL 2014	annually
Reduction of energy consumption in public buildings	Tonne	0	2014	48 871 000	SL 2014	annually

Itis planned to support comprehensive thermo-modernization of public buildings and residential buildings, reduction of energy consumption of small and medium-sized enterprises (SMEs) as well as building new or adjusting existing units into high efficient cogeneration units.

1.3. Funding sources for RES and EE

Implementationof energy andclimateobjectivesin Polandfrom the2020 Strategyhas been financed and will be financed with funds fromfinancial perspectiveof 2007-2013 and 2014-2020, mainlyby the Infrastructure and Environment Operational Programme and Innovative Economy Operational Programme(2007-2013), IntelligentDevelopmentOperational Programme(2014-2020)and theNorwegian Financial Mechanismand theFinancial Mechanismof the EuropeanEconomic Area.

According toEC guidelines,the transitiontoalow-carbon economyin a currentfinancial perspective has far greaterimportancein comparison with previous programming period.Poland should spend about 20% of allocated funds for the implementation of measures leading to a low carbon economy, including the increasing use of renewable energy sources and improving energy efficiency. The 2014-2020 funding depends on compliance with *the ex ante* requirements, that is, fulfilling certain initial conditions enabling the effective implementation of co-funded European programmes. These conditions included the adoption (by the government) of the Innovation and Economy Efficiency Strategy, transposition of the Directive 2006/32/EC, the adoption of a package of energy acts and transposition of the Directive 2009/28/EC.

Support of the development of renewable energy and energy efficiency improvement is also financed from national funds mainly implemented by the National Fund for Environmental

Protection and Water Management. National Fund finances mainly trans regional projects and regional funds - regional level projects. The funding system is regulated by the Environment Protection Law.

Sources:

1) National Strategy for Smart Specialisation
2) Energy Policy of Poland unit 2050 - project
3) Determination of energy potential of Polish regions in frames of renewable energy sources, applications for the Regional Operational Programmes for 2014-2020 programming period
4) MazowieckieVoivodeship Development Strategy until 2020
5) Regional Operational Programme for MazowieckieVoivodeship 2014-2020 – project, version 1.3
6) Operation Programme Infrastructure and Environment 2014-2020 – project approved by the Council of Ministers in January 2014
7) Programming of the 2014-2020 financial perspective 2014-2020 – strategic issues
8) Information Material concerning Programming of New Financial Perspective 2014-2020, taking into account priorities of the Ministry of Economy
9) Partnership Agreement 2014-2020
10) Energy Policy of Poland unit 2030
11) www.mg.gov.plf
12) MazowieckieVoivodeship Development Strategy until 2030
13) The development and use of renewable energy sources - the NIK report

2. METHODOLOGY

For the analysis phase of the existing situation a planning template can be elaborated on the basis of earlier assessments of regional energy management conditions carried out in CEP project. The template should contain:

2.1. Assessment of recent energy demand of the concept region (from the total energy consumption and the final direct consumption),

Demand for energy in Mazovia region is estimated for users of industrial, public transport and households sectors.

The energy demand of the industrial sector covers a total demand of all legal entities pursuing an economic activity in agriculture, manufacturing, retail, i.e.

- consumption of natural gas for heating and for heat production necessary for industrial processes possibly in the combined heat and power production in industrial plant,
- consumption of petrochemical products (fuel oil, diesel oil) used for heating and to generate the heating system processes,
- consumption of heat from the heating system,

- use of renewable energy sources (solar energy, geothermal energy and biomass) for heating and for heat required in the production process possibly in the combined heat and electricity production in industrial plant,
- consumption of electricity produced from renewable energy sources (mainly photovoltaic and water installations), and natural gas fired cogeneration units,
- consumption of electricity drawn from local or national electricity grid.

Table 4. Final energy consumption in MasoviaVoivodeshipin 2011 year[GWh][25]

Item	Hard coal	Natural gas	Liquid gas	Fuel oil	District Heat	Electricity	Total
Industry and construction	7780,78	16551,01	8924,00	8688,81	18158,40	7721,00	67824,00
Transport	238,72	2765,82	0	71,06	222,40	412,00	3710,00
The sector of small customers	11361,58	10249,86	3864,00	1539,56	9155,37	11750,0	47920,38
Agriculture	1618,82	0	322,00	187,87	0	239,00	2367,69
Households	9758,04	7426,77	3128,00	225,01	8388,37	4535,00	32461,20
Other customers	984,72	2823,09	460,00	1148,75	767,00	6976,00	13159,56
Total	30742,66	39816,55	16698,00	11861,07	36691,55	31633,0	167422,83

1. Consumption without vehicles.
2. Consumption of Heavy Fuel Oil and Light Fuel Oil.

Energy demand in a public sector includes a total demand of municipalities and public institutions for heat, natural gas, refined petroleum products and electricity produced locally from renewable energy sources or from the national electricity grid.

The source of data for the calculation of final energy demand in the industrial sector and the public sector have been surveys that were distributed to all municipalities and statistical data published by the Central Statistical Office (GUS).

Assessment of final energy consumption in sector transport and household sectors was based on the Central Statistical Office's data.

The methodology of estimating the demand for energy in Mazovia region was based on the analysis of many documents, studies, interviews with experts and analysis of the Mazovia Energy Agency, the National Energy Conservation Agency and the Institute of Power Engineering. Data on local and national socio-economic conditions have been collected as a result of the study "desk research" involving analysis of data mainly from GUS / WUS and ARE publications.

The analysis of thedocuments and surveyindicatespositive changesin waste managementanda significant increasein thesortingof wastein the Mazovia municipalitiesas well as theincreased interestin use of gas to heat production in the Mazovia Region.

The data used comes from Table 4 and the report "Demand assessment of energy sector in Mazowsze" (Report 3.1.3).

2.2. Assessment of the structural distribution of direct energy demand by main energy consuming sectors

2.3. Assessment of the structural distribution of the different energy sources – also including renewable energy sources - used to satisfy the direct final energy demands.

The final energy consumption in Mazovia region has been steadily growing in recent years and in 2011 reached 167443 GWhwhere 67824 GWh (42,7%) was used by industry, construction and transport , 47920 GWh (28,6%) by SMEs and 32461 GWh (32,46%) by households in 2011. The above full assessment is described in the Report: "Demand assessment of energy sector in Mazowsze" (Report 3.1.3).

2.4. Assessment of potential conditions (theoretical, convertible, sustainable and realisable potentials) of the different local energy sources that is potential energy supply that may serve the energy demand of the concept region and beyond.

This is described in the Report "Demand assessment of energy sector in Mazowsze" (Report 3.1.3).

2.5.Regional balance of supply and demand for fuel and energy for Mazovia region, and the supply side presentation prepared using the methodological approach describedin Report 4.1.2.

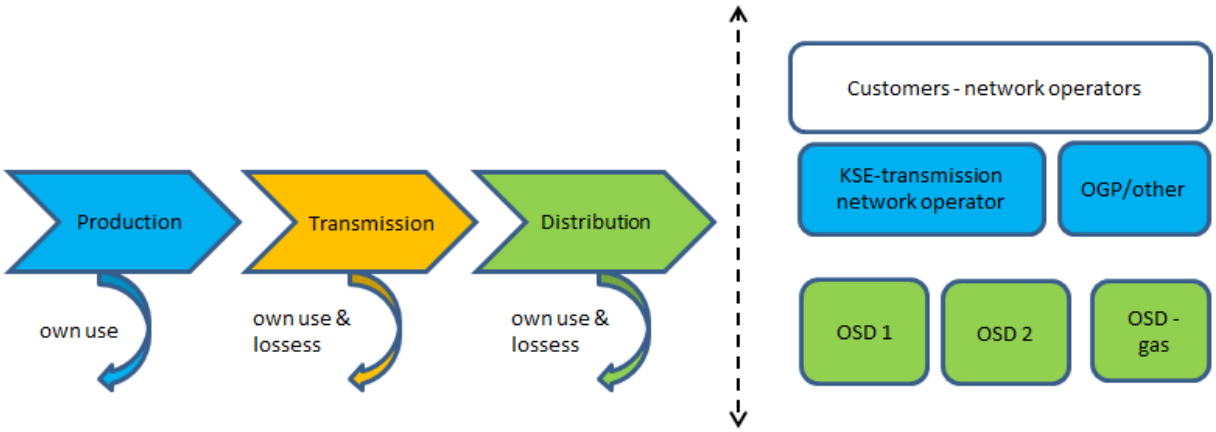

Fig. 3. Ideograph of the methodology applied for analysis of supply and demand for fuel and energy for Mazovia region and the supply side description

The three phases of energy carriers value chain creation, i.e. production, transmission and distribution of fuels and energy were taken into account. The grid customers have been indicated - in this case, network operators including:

- transmission system operators - the power (KSE)and gas (OGP)
- distribution system operators – electricity, gas and heat.

Grid systems operators are usually responsible for the organization of wholesale energy trading markets. In the case of electricity, this is the national transmission system operator –

the company of State Treasury PSE S.A., and in the case of natural gas - gas pipeline transmission system (OGP) operator - the company of State Treasury - Gaz-System S.A.

Regarding heating systems having essentially local nature, heat transfer has not been distinguished from the distribution of heat carrier, which was justified by practical considerations and long-term pragmatics of sector's functioning.

In accordance with the adopted methodology, the energy produced in the source of energy was reduced by own consumption necessary in the production process. Then it was delivered to the transmission system (high voltage or the highest pressure) in which own needs and loss of energy also occur. Thenreducedenergy streamwas introducedintothe distribution system. In this step own consumption and loss of energy also occur, what strongly depends on the voltage level to which installations of end users groups are attached.

Producers of RES can be connected directly to the distribution system, bypassing the transmission system. This is the advantage of distributed sources and implies shortening of the supply chain from producer to customer as well as avoiding certain transmission losses generated at higher voltages.

The energy supply side of Mazovia region is presented in the report "Assessment of the supply side of the energy sector in Mazovia region". The report estimates the potential of different types of RES in Mazovia region, according to data from the evaluation of the use of RES in 2011 and presents a forecast of the three scenarios for 2020.

Table 5. Estimation of potential of renewable energy sources used in 2011 in Mazowsze[25]

Installations	Time of work in one year [h]	Power	Value	Production [MWh]
Wind	1645	MWe	110,20	181279
Large hydropower	3415	MWe	20,00	68300
Small hydropower	2126	MWe	2,41	4346
Photovoltaic panels	1000	MWe	0,11	110
Biogas	934	MWe	11,0	10275
Solar panels	1000	m2	7000	.
Biomass		TJ	7500	.
Geothermal	4380	MWt	2,7	.

According to the analysis for Mazovia region, the most rapid development of wind and solar energy (thermal panels) was observed in the considered period while a very large regression in hydroenergy production (hydroelectric power plant in Dębe) was noticed. A number of objects having RES license increased from 110 in 2006 to 169 in 2011. The installed capacity of electric power has increased nearly 5 times, and the production of electricity increased approx. 2.6 times. Heat capacity increased approx. 40%, heat production from biomass approx. 50%, and thermal utilization of solar energy has increased nearly 6 times.

The most utilized potential includes:

a. biomass energy - approx. 3.6% unusedresources remained

b. wind energy - approx. 22% unused resources remained

c. hydro energy - approx. 56% unused resources remained(the increase due to a sharp drop in production in Debe hydro power plant).

The solar energy, and geothermal resources of Mazovia were used in 2011 in a minimal extent. By 2020, a dynamic growth is expected in the use of solar energy, particularly photovoltaic panels.

Comparison ofnumerical values projectionscenariopresentedin the report"Assessmentof the supply sideof the energy sectorinMazovia" to values accepted in the National Renewable Energy Action Planare shown in Table6.

Table 6. Renewable Energy Sources potential estimation on Mazovia to 2020[25]

Renewable Energy Sources	Power	Year 2011	Scenario 1 2020	Scenario 2 2020	Scenario 3 2020	NREAP 2020
Wind	MWe	110,2	385	250	200	615
Large hydropower	MWe	20,0	20	20	20	101
Small hydropower	MWe	2,4	45	5	1	14,2
Photovoltaic panels	MWe	0,1	500	300	200	1000
Biogas	MWe	11,0	103	20	15	98
Solar panels	m2	7000,0	500000	100000	50000	1920000
Biomass	TJ	7500,0	15000	8000	6000	775
Geothermal	MWt	2,7	5	2,7	2,7	12,2

2.6. Already a century ago there has beenthe need of a common European economy – and within this energy cooperation initiated the need of establishing major international energy network systems and energy trade between countries of better and worseenergy potential. Mainly by the gradual construction of crude oil, natural gas and electricity transmission systems. The potential conditions and long-term enhancement necessity of these are described in Report 3.2.34, in which also the demand for and practices of renewable energy transfer appear (e.g. solid biomass trade).

2.7. In order to assess recent conditions territorial data are indispensable:

1. *Statistical yearbook Mazoviavoivodeship,* The Statistical Office in Warsaw, Warsaw. Mainsource of statistical data, in detailscharacterizing Mazovia Region.

2. Statistical yearbook of voivodeship, The Central Statistical Office of Poland, Warsaw. This Yearbookcontains statistical datacharacterizing socio-economic situation in regions,

counties and communities, as well as in sub-regions. Dataallow analysis andcomparison ofMazovia Region with other Polish regions and inrelation toaverage valuesfound in the European Union countries.

3. *Population, vital statistics and migration in Mazoviavoivodeship in 2012,* The Statistical Office in Warsaw, Warsaw, May 2013. This publications describes detailed data characterizing demographic situation inMazovia Region (divided into urban and rural), with the separation of Warsaw municipalities and counties. "Statement - statistics of Warsaw", labour market, no 4, the Statistical Office in Warsaw, Warsaw, May 2013. This document complements previous publication, and presents information about the structure of employment, wages and salaries, unemployment rate and other information describing labour market in Warsaw.

4. *Statement on socio-economic situation of Mazoviavoivodeship in April 2013*, Warsaw, May 2013. This report presents statistical data characterizing processes taking place in Mazovia Region, among others, in the field of labour market, agriculture, industry, construction, trade and prices, published Statistical Office in Warsaw.

5. *The economic situation and business tendency in May 2013*, The Central Statistical Office of Poland, Warsaw, 2013. The study contains information on financial situation and general business tendencies in industry, construction and retail trade on Mazovia Region.

6. Valuable data onMazoviavoivodeship were also obtained from web portals including: Gates of Mazovia (www.wrotamazowsza.pl), portal ofMazowieckie Province Governor in Warsaw (www.mazowieckie.pl).

7. Statistical data characterizing Polish energy system, ie. energy balances, generation of electricity and heat in public power plants and renewable energy sources can be obtained from the following publications:

- Statistical data of the Energy Regulatory Office,

- Energy statistics for years 2010, 2011, Statistical information and elaborations, the Central Statistical Office of Poland, Warsaw, 2012,

- Polish electric power statistic 2011, The Energy Market Agency, Warsaw 2012

8. *Data about RES installations* in Mazoviavoivodeship were published by the Department of Environment of Marshal's Office, 2012. The publication contains detailed information characterizing renewable energy sources located in Mazovia Region.

9. Environmental policies, strategies and trends in terms of environmental protection inMazovia Region, necessary investments and costs of their implementation are presented in *Mazoviavoivodeship's environmental protection program for 2011- 2014 years including the perspective up to 2018*. The Marshal Office of Mazoviavoivodeship, Warsaw, 2012.

10. Mazoviavoivodeship development strategy until 2030, InnovativeMazovia, Draft, published by Mazovia Regional Planning Office, Warsaw, 2012, p. 31. Strategy is the most important document of Mazoviavoivodeship's self-government. The draft presents forecast of the development of Mazovia region in the 2030 horizon, determines goals and necessary steps for supporting economic activity and achievements of Mazoviavoivodeship and competitiveness of the region.

Basic documents regulating the development of renewable energy include:

11. Act on Energy Law, of 10 April 1997, with implementing regulations. Energy Law, main legal act that establishes and regulates rules of energy policy, as well as conditions of supply and use of energy in Poland. The Act defines principles of development of state energy policy, principles and terms of supply and use of fuels and energy, and operation of energy enterprises, as well as determines organs in charge of fuel and energy economy.

12. Act on environmental protection, dated 27 April 2001.

13. Act about trading rights of greenhouse and other substances gases emission into air, dated 28 April 2011.

14. *Act on supporting thermo*-modernization and *repairing* of exploited buildings, dated *21 November 2008.*

15. Energy efficiency act, and act (draft) on renewable energy sources - project dated October 2012 is currently in a final phase of consultations carried out by the Ministry of Economy.

3. ASSESSMENT OF ECONOMIC - FINANCIAL INCENTIVESENVIRONMENT NECESSARY FOR THE REGIONAL ENERGY CONCEPT

For the preparation of optimal regional energy utilisation concept that builds on the regional energy demand and supply conditions and source potentials described in the situation assessment, it is indispensable to know the RES incentive/support system of the country in question and possibly other countries as well so as to propose and apply good practices.

3.1 It is expedient to identify and propose RES supply investments along a systemic economically justified approach, for which guidance has been prepared (Report 4.4.1).

3.2 It is also important to identify and assess RES investors along a systemic approach, for which also guidance has been prepared (Report 4.4.2).

3.3 So as to collect and assess information on RES incentive/support systems of various countries, a questionnaire and guidance (Guidance for Report 4.5.1) was prepared and then circulated among the various countries of the project partners.

3.4 Responses were processed and various RES incentive systems and instruments of 8 countries (and if information was received, particularly of their regions) were listed and compared resulting in Report 4.5.1. When outlining mid-term RES investment proposals (for Report 4.4.1 as described above), the RES incentives environment has also to be taken into account.

3.5 A summary report of recommendations to improve national and regional RES incentive systems was also prepared (Report 4.5.2.).

3.6 The last guidance titled „How to do it well" – also including Polish exemplary and innovative RES utilisation related cases - summarises and gives recommendations related to an ideal regional RES concept elaboration process based on the CEP project (Guidance 4.6.1).

4. RECOMMENDATIONS

Recommendations in the field of national and regional incentives.

- Legislative and law rules should be stable and harmonized and should support sustainable development of RES.
- Administrative procedures for RES and EE projects shouldbe simplified.
- incentives and support systems should be established for a period ensuring investors a return on invested capital. These time terms and conditions should be kept.
- Distributed energy production as well as the renewable energy sources of the greatest potential in the regions should be supported. Prosumption should be supported and implemented.
- Support R & D on RES and EE.
- Implementation of solutions in the field of energy efficiency and renewable sources ought to starts from public units, especially units responsible to funds implementation. This gives an example and leads to energy savings and therefore funds savings. The saved funds may be directed for other energy saving initiatives.
- Systems for real time measuring of energy generation, flow and consumption should be established and on the basis of these data energy systems ought to be managed.
- Proven examples and best practices should be implemented.
- The society should be educated in the matter of sustainable and environmental energy generation and use from the very early age. Pro-environmental behaviourshould be promoted. The advantages and benefits of such behaviour should be emphasised

Renewable energy sources and energy efficiency support on the national level

- Funds or loans for RES and EE investments - The National Fund for Environmental Protection and Water Management (NFOSiGW) and its provincial, county and municipal subsidiaries offer support for the construction, development or redevelopment of the installation of RES and CHP installations. The support is also offered for the development of distributed, renewable energy sources, improvement of efficiency through the advancement of smart grids, the implementation of energy efficiency measures in public buildings, subsidized loans for the construction of energy-efficient houses, energy efficiency investments in small and medium-sized enterprises. Financing that supports the development of RES and EE can be granted both by national and structural funds as well as European ones.
- Preferential loans granted by the Bank of Environmental Protection in cooperation with NFOSiGW and commercial banks
- Coloured certificates system
  - ✓ Using the support system based on mandatory purchase of electricity generated from renewable sources and issueing of certificates of energy origin, for energy produced from renewable sources so called green certificates, which in the form of property rights can be traded on Polish Power Exchange. It is planned to

introduce the so-called correction factors for adjusting the support for different types of renewable energy sources and their installed capacity. In the case of non-fulfilment of obligation to buy / manufacture RES, the company is obliged to pay a substitute fee, which is NFOSiGW's income. Green certificate system has been in force in Poland since 1 October 2005 and has been regulated with the act of Energy Law, Art. 9a paragraph 9a, paragraph 1-5 and 1-18.

- ✓ White certificates concerns energy efficiency. They are obtained for carrying out or planning pro-efficiency action, which result in annual energy savings not less than 10 tonnes of oil equivalent (toe), or for a group of actions with total effect of more than 10 toe. Certificates have been introduced with the Act of 15.04.2011, according to which the mechanism of white certificates will operate until 31.03.2016. The system of white certificates operates on the same basis as green certificates.

- Tax reliefs and tax exemptions - under provisions of the Energy Law tax reliefs, mainly exemptions from excise tax are entitled to producers of renewable energy.
- Educational campaigns - promotion of renewable energy sources and energy efficiency performer through national and European funds as well as targeted programs raising the eco-friendly awareness of investors, policy makers and local communities about benefits of increasing shares of renewable sources in energy produced balance and energy savings
- Other RES support schemes also apply to payment exemption from sources up to 5 MW:
  - ✓ stamp duty for issuing licenses and certificates of origin,
  - ✓ annual concession fee,
  - ✓ for the entry into the register of origin certificates.
- Guaranteed reception of energy for RES producers. The obligation to purchase electricity produced from RES rests on the so-called assigned seller, on whose area of activity the action of joining RES unit to network took place. The obligation to purchase heat from RES rests with the energy enterprise which is engaged in heat energy and sells that heat. In addition, RES profit the priority in provisioning services of electricity transmission produced from RES
- Labels with energy efficiency characteristics of electrical appliances and buildings (residential, commercial).

4.1. CASE STUDIES

Renewable energy sources and cogeneration in Warsaw

In Warsaw's public utility buildings some solutions have been implemented that annual energy savings at the level of 7518.94 GJ.

The project included

1. the technological system of cogeneration and combination of two types of renewable energy sources - solar energy (solar panels) and geothermal (heat pumps) at the Holy Family Hospital of Gynecology and Obstetrics. These solutions is an technological innovation widespread in the world below 15%. Cogeneration will consist of electricity generation in gas-powered generators and using exhaust heat from the engine cooling and exhaust gas for heating (central heating, ventilation, hot water) and cooling (chilled water for air conditioning).
2. the construction of renewable energy source, and repair and central heating installation to heat pumps in Junior Secondary School No. 37, 5 Niska Street in Warsaw;
3. the construction of solar collectors in the building of Primary School No. 32, 2 Lewartowskiego Street, Nursery 18 Strumykowa Street, 112 Primary School, 31 Berensona St in Warsaw.

The use of selected energy production techniques will improve the air quality and the energy safety in Warsaw, increase the buildings energy efficiencyand reduce the cost of the facilitiesmaintenanceand energy losses.

The project was co-funded from the Operational Programme Infrastructure and Environment 2007-2013, Action 4.3. Air protection, energy. The project value was over 9.89 million PLN, of which 6.85 million PLN have been covered from the Programme, and 3.04 million PLN from the Capital City of Warsaw.

The use of renewable energy through the application of solar installations and heat pumps to improve the environment in Myszyniec community

393 individual buildings and major public utility buildings in Mszyniec community have been equipped with installations using renewable energy sources - solar panels. Public utility buildings have been additionally equipped with photovoltaic systems and heat pumps. The following villages have been supported: BiałusnyLasek, Charciabałda, Cięćk, Drężek, Gadomskie, Krysiaki, Myszyniec, Myszyniec-Koryta, MyszyniecStary, Niedźwiedź, Olszyny, Pełty, Świdwiborek, Wolkowe, Wydmusy, Wykrot, Zalesie, Zdunek.

The project was implemented due to the co-finance from the Regional Operational Programme of the MazowieckieVoivodship2007-2013, Action 4.3. Air protection, energy. The project value was over 5.19 million PLN.

Ecological NowyDwór Mazowiecki – solar panels for residents

146 solar panels have been installed in households in NowyDwór Mazowiecki. The main objective of the project was to reduce the cost of hot water production due to the use of solar energy. Properly sized and selected solar installation can save up to 90% of hot water cost during summer and up to 60% of the calculated yearly average costs.

Construction of photovoltaic and wind installation with a cogeneration system for the Provincial Specialist Hospital in Radom

In the Regional Specialist Hospital in Radom photovoltaic and wind installation with a cogeneration system has been built. The value of the investment exceeds 6.7 million PLN.

Electric power of a cogeneration system is 1166 kW and thermal power is 1150 kWt. The energy source is gas. In addition, photovoltaic cells have been placed on the roof of one of the hospital's facilities. Windmill generator is used for the external illumination of the hospital. According to calculations the investment should turn to for 3.5 years and generate savings of up to 1.5 million PLN per year. Expected annual electricity savings are 4146 MWh / year, thermal - 33 984 GJ / year, and fuel savings - 586.9 tons / year.

Sunny municipalities in eastern Mazovia

1400 households in the municipalities Korczew, fernery, Przesmyki and Repki obtained funding for the purchase and installation of solar systems. The total power of collectors is 4434 kW and annual savings will be 11.07 GJ of thermal energy yearly. The total net area of the collectorsis 6 339.6 m2 and their power - 4 434 kW. Reduction of major air pollutants emission is estimated on 1 357.1 tons per year.

Building of the second stage heat recovery from geothermal water in Geothermal plant in Mszczonów

Installation of secondary heat recovery from geothermal water consist of a compressor heat pumps and associated equipment. Installation enables to acquire additional thermal energy by lowering the temperature of geothermal water after the first heat recovery - from 27℃ to 15℃.

The environmental effect obtained was calculated based on the results of the production of thermal energy from the second cycle of recovery in the period from January to April 2012 (4 088.0 GJ) and on the data on the amount of heat produced in the last three years (the amount of the annual heat production from secondary recovery). The amount of natural gas saved thanks to the recovery of additional geothermal energy is 203 968 m3 / year and allows for the emissionreduction as follows: sulfur dioxide - 0.0041 Mg / year, carbon monoxide - 0.055 Mg / year, carbon dioxide - 400.6 Mg / year and nitrogen dioxide - 0.392 Mg / year.

Thanks to the realisation of the project in Mszczonówthe production of energy from renewables was increased by 1 MW. The project was financed from the European Union funds (Action 4.4, air protection, energy), loan granted by the National Fund for Environmental Protection and Water Management and from own resources.

Biomass combustion in Mazovia CHP plants

Biomascofiring has been or will be implemented in following energy/ CHP plants:

Translate

- Ostroleka–the plant has biomass-fired fluid boiler with a capacity of 35 MW. biomassismainly used in the form of bark and wood chips. The structure of fuels and other primary energy sources used to generate electricity in 2013 was as follows: biomass - 19.22%, coal- 80.63% other - 0.15% [23].

- Siekierki - in the power plant there is an ongoing project of K1 dust boiler OP-230 reconstruction which was designed for pulverized coal combustion and is to be adjusted for biomass combustion.The boiler is expected to start work in April 2015. The preferred fuel will be forest biomass in the form of wood chips and agricultural biomass in form of pellets. Approx. 350 000 tonnes of biomass per yearis planned to be burnedin this boiler. This will reduce CO2 emissions by more than 365 000 tonnes per year and produce nearly 240 000 MWh of green energii[16].

- Kozienice - Installation for biomass co-firing for 200 MW blocks was built in 2007. Wood, energy cropsand residues of agricultural products processing industry in the form of wood chips, shavings, sawdust, pellets and briquettesis combustion in the installation. The maximum mass share of biomass is 10%, but the actual share is about 8%. In 2012approx. 200 thousand. tons of biomass with a predominance of agro and forest biomass was burned. In majority it was a domestic biomass. Currently, biomass is co-fired in all eight200 MW-blocks. Power capacity of each of them varies from 215 to 225 MW[24].

Fig. 4. Kozienice Power Plant

- Płońsk – CHP plant „PEC w Płońsku” in the north – west part of Mazovia Region. The owner of the company "PEC Plonsk" is the Municipality of Plonsk.Modernisation of Płońsk heat plant included adjusting it to combine heat and power generation and installed capacity reduction. Cogeneration unit consists of biomass fired boiler of power 10,3 MW and steam turbine of 2,1 MWe. The basic fuel used in the unit includes wood chips, also energy crops. 67% of produced thermal power and 100% electric power comes from biomass.

Main benefits

-emission reduction
-reduction of soot and nitrogen oxides thanks to precise excess air coefficient control
-minimizing of carbon and nitrogen oxides emission
-reduction of dust emission

-avoided costs of coal purchase
-energy carriers diversification
-environmental protection

Applied solutions have contributed to the limitation of carbon dioxide emission by 77% ,other gases, including SO2 by 63,8%, NOx by 63,3% and dusts by 76,7%[10].

As the result of modernisation the amount of solid waste (slag and ash) was reduced by 51%.

Fig. 5. Płońsk CHP

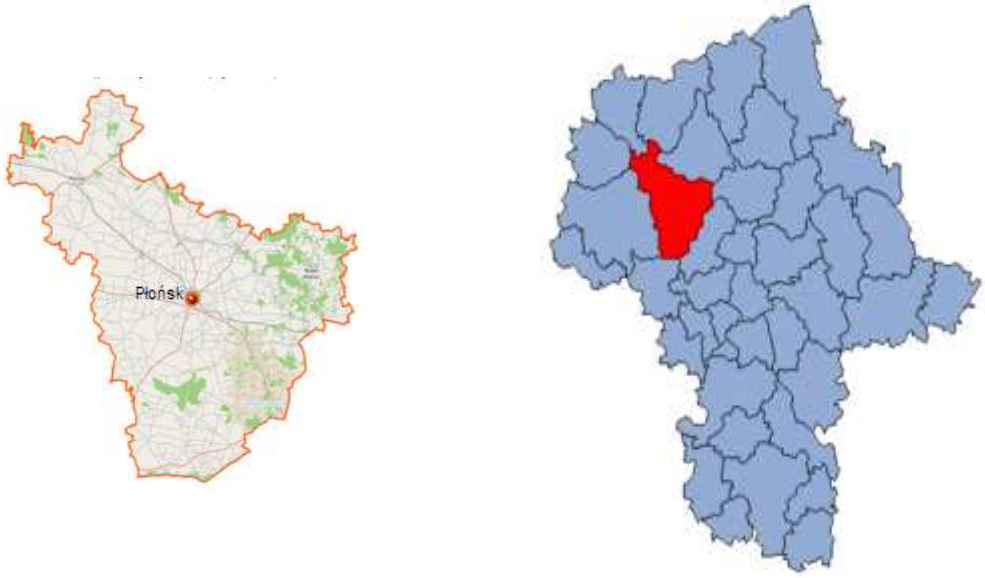

Fig. 6. MazoviaVoivodeship, with indicated Płońsk district

Innovative technological solutions contributed to the increase of energy production efficiency, reduction of heat transfer losses, matching heat production with instantaneous demand of recipients.

Renewable energy from municipal waste

Communal Solid Waste Treatment Plant (ZUSOK) has been modernized thanks to which 300 tons of solid waste is used for heat and electricity production for Warsaw.

Thermal waste conversion in ZUSOK is conducted in an environmentally safe way, in accordance with Polish and European Union norms.

Fig. 7. ZUSOK Warsaw

Example of smart grids implementation in Poland

Hel Peninsula, Smart Grid pilot project - SmartLAB

The Institute of Power Engineering together with Energa Operator is conducting the project Intelligent Peninsula on the area of Hel Peninsula[6,7,8]. The aim of the project was the construction of an Intelligent network – Smart Grid, energy consumption optimization, distribution losses reduction and energy security increase on Hel Peninsula.

In frames of this project the construction of first in Polish energy sector smart grid installation of pilot area was built and Advance Metering Infrastructure (AMI) was implemented.

Pilot project consists of building of model control system and Smart Grid implementation within distribution network, it particularly includes:

- 10 000 end users
- 200 km of medium voltage line
- 150 km of low voltage line 0,4 kV
- 150 transformation stations 15/0,4 kV.

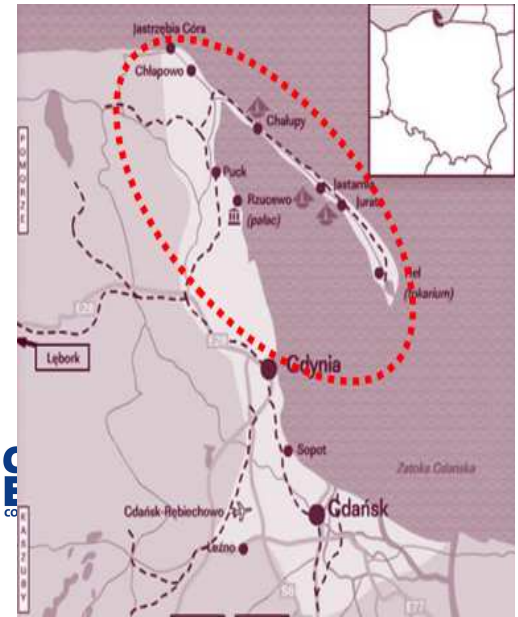

Fig. 8.Pilot Smart Grid - SmartLABproject area

AMI project includes 2.5 million Individual consumers with tariff G and 290 thousand of business consumers with tariff C1. AMI implementation was introduced on 3 stages: implementation of smart metering, implementation of telecommunication solutions (depending on location PILC, GPRS, WiMAX technologies) and information systems implementation. Currently the third stage of the project – testing of implemented solutions - is ongoing.

Sources:

1) Energy Supply Assessment Report Mazovia Region 4.1.2, MAE, November 2013.
2) Potential renewable energy source assessment Mazovia Region 4.1.2, February 2014.
3) Demand assessment of energy sector in Mazowsze. 3.13. July 2013.
4) Bartoszewicz-Burczy H, Soliński J, Wykorzystanie biomasy leśnej w energetyce – stan i perspektywa do roku 2030 i dalej – do 2080 roku. Uwarunkowania ekonomiczne, organizacyjne techniczne, rola instrumentów wsparcia. Narodowy Program Leśny, 2013.
5) Dobre klimaty dla klimatu www.ingmina.pl,
6) PEC w Płońsku: http://www.pecwplonsku.li.pl/instalacje.htm
7) Olszewski, Pilotażowy projekt Smart Grid - SmartLAB, Rozwój sieci inteligentnej w ENERGA-OPERATOR SA, Warszawa 2012.
8) Widelski G, Noske S, W kierunku Smart Grid – pilotażowy projekt „Inteligentny Półwysep". ENERGA-OPERATOR SA
9) Babś A. Automatyzacja sieci rozdzielczych jako podstawowy element sieci inteligentnych. www.ePISMO-AeZ.Pl.
10) WikimediaCommons, Wiesław Z. / fotopolska.eu CC-BY-SA-3.0
11) Wikimedia Commons, Hiuppo, CC-BY-SA-3.0-migrated
12) Wikimedia Commons, Hiuppo, CC-BY-2.5
13) www.ingmina.pl,
14) http://www.pecwplonsku.li.pl/instalacje.htm
15) http://www.e-czytelnia.abrys.pl/?mod=tekst&id=4395
16) The Mazoviavoivodeship environmental protection program for 2011- 2014 years including perspective up to 2018 year. The Marshal Office of Mazoviavoivodeship, Warsaw, 2012.
17) Mazoviavoivodeship development strategy until 2030, Innovation Mazovia, Draft, Mazovia Regional Planning Office, Warsaw, 2012.
18) http://www.energa.pl/

19) http://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/
20) http://stat.gov.pl/sygnalne/komunikaty-i-obwieszczenia/
21) http://www.mg.gov.pl/node/20480
22) http://www.mg.gov.pl/node/20480
23) http://www.energaostroleka.pl/index.xml
24) www.reo.pl
25) Report „Ocena strony podażowej sektora energetycznego na Mazowszu”

Abbreviations

AMI - Advance Metering Infrastructure

ARE – The Energy Market Agency

B+R+ I – research and development and innovations

CHP – Combined Heat and Power

EC – European Commission

EE – Energy Efficiency

EU – European Union

GUS - Central Statistical Office of Poland

KSE – National Energy System

MAE – Mazovia Energy Agency

MPOE -the Mazowiecki Pact for Energy Savings

NFOSiGW - The National Fund for Environmental Protection and Water

NIK - the Supreme Audit Office

NREAP - National Renewable Energy Action Plan

OGP – Gas Transmission Operator

PEC – Heat power plant

PLN - Polish National Currency

RES – Renewable Energy Sources

SME – Small and Medium Enterprises

WUS – Voivodeship Statistical Office

ZUSOK - Communal Solid Waste Treatment Plant

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Fig. 8. Pilot Smart Grid - SmartLAB project area