Sustainable Bioenergy Solutions for Tomorrow (BEST II)

Task 1.4 Bioenergy value chains for developing economies

Taking Finnish bioenergy solutions and knowhow beyond border

Internationalization: Poland

Deliverable 1.4.1a

Renewable Energy Policies and Trends in Biomass Market Development in Poland

Authors:

Prof. Paavo Pelkonen (paavo.pelkonen@uef.fi)

Karthikeyan Natarajan (karthikeyan.natarajan@uef.fi)

Anas Zyadin (anas.zyadin@uef.fi)

Work Address:

University of Eastern Finland/ School of Forest sciences

Borealis Building, Joensuu Campus, Yliopistokatu 2

P.O. Box 111, FI-80101 Joensuu, Finland

CONTENTS

FOREWARD

This report briefly presents the policies related to renewable energy and bioenergy development in Poland. It further demonstrate how policies have changed the bioenergy market through the quota obligation and the accompanying "*green certificates*" market-based mechanism. As of February 2015, the Polish Parliament has ratified new support mechanism to renewable energy projects through so called The *New Renewable Energy Sources Act* (**RES Act 2015**). It consists of new support mechanism pertaining to "*Auctioning*" system. The report explains such mechanism and provide insights from energy experts on the short and long term effects of such mechanism on the whole renewable energy sector in Poland with emphasis on the prospects of bioenergy market and development in Poland.

This report is divided into four main chapters; the first chapter is a **country profile**, the second chapter "**Current Policy Trends**" is dedicated to shed light on the two main renewable energy-related policies and the driving factors for their adoption. Special attention is paid for "*Polish Policy until 2030*", and "*National Renewable Energy Action Plan*". The report focus primarily on the quota obligation mechanism and the associated green certificate support scheme. The impacts of such policies on the Polish biomass market development and its collapse in late 2012 and early 2013 is also highlighted. The third chapter "**Future Trends**" is dedicated to the recently adopted "*New Renewable Energy Sources Act 2015"* also refer to as "New RES Act". The auctioning support scheme is presented and discussed. Its presumed advantages and disadvantages are presented from the various angles and through the eyes of different experts and analysts. Given the importance of mass media in presenting the debate around the newly ratified policies, chapter four "**Media Analysis**" is presented. It refers to the most influential Press news that contain articles and essays discussing the new policy. The content analysis of the articles highlights the trends in the Media- whether with or against such policy- and the main arguments behind such trends. The report has been prepared through deep and dictated literature review of various policy documents, policy analysis reports, peer-reviewed articles, and various internet-based sources and media press news. The aim is to provide the clearer image of the present biomass market in Poland and its future development. This report is a part of deliverables of the BEST project activities particularly within TASK 1.4.

Anas Zyadin, Joensuu, 25st of September 2015

KEY SUMMARY POINTS

- Poland's national energy and climate policies are formulated in adherence with the EU policies particularly the Renewable Energy Directive 2009/28/EC. Policy development and reform have created favourable conditions for renewable energy (RE) development, in particular, biomass has accounted for over 80% of the RE installed capacity. This trend was regarded as "unbalanced" and new policy reform would be needed to open up investment in other renewable energy technologies such as offshore wind and solar.

- There are 15 Polish legislations, regulations, and acts that support RE development with 32 incentives mechanisms. Certificates of origin (green certificates), guaranteed feed-in prices, and excise duty tax exemption are said to be the three most important support mechanisms.

- POLISH ENERGY POLICY UNTIL 2030 (EPP 2030) is the first uniform and comprehensive renewable energy policy aimed at promoting energy independence, diversity, and market competitiveness. The RE targets were 15% in primary energy mix and 10% in transportation. Tradable certificate of origin or "green certificates" was the main support mechanism especially for co-firing and co-generation technologies.

- To implement the provisions of Directive 2009/28/EC of the European Parliament, Poland had submitted the Renewable Energy Action Plan to the European Commission. The draft plan projects that 15% of gross final energy consumption will come from renewable energy by 2020. Biomass (including biogas, biofuels) is expected to remain the main renewable energy source for electricity (43%), however the biggest growth is expected to come from the wind energy (47%).

- The use of biomass for cofiring in coal-based power plants and CHP plants has led to higher demand for biomass and thus increasing the price of biomass. The increase in number of power plants using biomass has led to the oversupply of green certificates in the market thus resulted in a price drop of green certificates to about 24 Euros/MWh. By 2012, the biomass market has collapsed in Poland and there was a need for policy reform especially regarding the support mechanism.

- In February 2015, the long-waited RENEWABLE ENERFY RESOURCES ACT (RES ACT 2015) was adopted. It has introduced "electricity auctioning" as a new support tool for RES development. It allows and supports micro-scale electricity generation from the households but also limits the number of green certificates from co-firing and large-scale hydropower.

- There will be three designated types of auctions with the Ministry of Economy setting the volume of electricity to be auctioned and the Energy Regulatory Office determine the Reference price for each technology. The support for renewable energy projects is limited to 15 years. It is expected that this mechanism only favor ready-to-build and cost-effective projects.

- Evidently, coal will remain the dominant fuel in the Polish primary energy mix especially if nuclear power programme is not commissioned in the near future. Wind energy has experienced public opposition in some residential areas. Parliament elections coming in October will have an influence on renewable energy development especially wind energy if Law and Justice Party wins the election, for instance.

- Biomass potentials are very high in Poland, however, the new regulations may limit/reduce the use of biomass for co-firing and co-generation as the government seek to promote stand-alone biomass-based power plants up to 50MWe capacities.

- Field visit to Poland revealed that there is a political mistrust between the farmers and policymakers on one side, farmers and energy companies on the other side. Power and energy companies claim that farmers seek to increase prices of biomass and/or conduct scam in load weights adding stones and water.

- Farmers however are very much willing to engage in biomass-for-energy supply chain if favourable market conditions are created. Farmers are also willing to engage in energy plantations under favourable and attractive market conditions with buy back agreements with reliable energy companies.

- Polish mass media's focus is coal-related issues (miners' protests) mainly. Coal is frequently presented as the Polish "Black Gold" and it is crucial for Polish energy independence. According to Polish experts, nuclear power programme will face public opposition and therefore it will not be introduced in the energy mix in the foreseeable future. Furthermore, even if renewable energy targets are achieved, coal will remain key component in electricity generation until 2030 in Poland.

- According to Bartłomiej et al. 2015, the pace of development of the renewable energy sector in Poland depends largely on: the proposed legislation on renewable energy sources being adopted, legal regulations being made simpler, increased subsidies for development of the sector, introduction of guaranteed prices for green certificate, and educating the public, investors, developers and decision-makers.

1. CHAPTER ONE. COUNTRY PROFILE: POLAND

Poland is a European Country on the Baltic Sea and a European Union (EU) member state since 2004. It has also joined the Organization for Economic Cooperation and Development (OCED) since 1996, the International Energy Agency (IEA) since 2008 and recently in 2010 it has joined the OCED Nuclear Energy Agency (NEA). It has a total area of 312, 679 square kilometres with about 36% agriculture land and 30% forest cover. Its population, presumed ageing and account for nearly one-tenth of the EU's population, is estimated at 40 million of which about 5 million live and work outside Poland. Polish economy survived the economic crisis in 2008 and its economy is considered as the sixth largest with GDP 670 Billion US dollars. Poland is still the world's ninth-largest hard coal producer and it accounts for 62% of EU hard coal production and the third-largest lignite producer in the EU, after Germany and Greece (International Energy Agency, 2011).

Since the accession to EU, the demand for electricity has been growing due to mainly the consumers' income increase thus their ability to purchase more electric appliances, the industrial expansion, and the high demand for electricity from the service sector. For instance, between 2000 and 2010, Polish demand for electricity grew at an average 1.5% per year, service sector and household sector at 3% whilst the industrial demand grew at modest rate of 1.1% per year as a result of the shift from heavy industry to services and the use of more efficient technologies. It is noteworthy that electricity demand is higher in winter and lower in spring/summer (International Energy Agency, 2011). A very distinctive feature of Poland's energy is the enormous hard coal and lignite deposits found in three basins; Upper Silesian coal basin; Lower Silesian coal basin, and Lublin coal basin. For instance, the Polish Geological Institute (PGI) reports economic hard coal reserves of 43.2 billion tones, of which 17.0 billion tones are measured, and a further 24.5 billion tons of uneconomic reserves (PGI, 2009). It also estimate reserves of 40 billion tons of lignite. Poland has traditionally seen its domestic coal resources as the key pillar of energy security policy. The domestic coal production has peaked in 1979 reaching 201 million tons however coal production has started plummeting down to 77 million tons in 2010 due to lower demand for coal and the poor economic of mining hard coal in deep underground mines. More recently, imports from Russia, the Czech Republic and Ukraine have grown because they offer a competitive advantage over the domestic coal production. Poland has also imported small quantities of coal from the United States, Kazakhstan, Columbia, China and South

Africa (International Energy Agency, 2011). The Polish government had concern that domestic coal production would exceed domestic demand thus leading to low prices for domestic producers if the surplus could not be exported. However in 2008, domestic production was insufficient and imports surged drastically especially from Russia (International Energy Agency, 2011). Not just coal, the majority of natural gas and crude oil comes from Russian oil and gas with supplies cover 90% and 65% of domestic demand, respectively. Due to its transit role, Poland for a long time was able to receive energy supplies from Russia at a "reasonable price" as two of the main energy routes from Russia to Germany, the *Druzhba* and *Yamal* pipelines, ran through its territory (The Polish Institute of International Affairs, 2013).

On the other hand, the polish energy sector, and particularly the electricity sector, is facing a number of contemporary challenges. First, Communist-era investments focused on coal-fired power generation and no real efforts were in place by the subsequent government to reform the coal-based sector. For some experts, Poland is considered trapped by coal since it relies heavily on domestic and imported coal which accounts for 55% of its primary energy supply and about 90% of electricity generation. The government, however, projects a decline in the share of coal because of the prospects of introducing nuclear power, and the growing share of renewables in the coming years due to policy reform and continuous support mechanism. There is also public opposition to grant new planning permissions for new opencasts mines through local governments (International Energy Agency, 201; Greenpeace Poland, 2014). Second, due to lack of investment in reform and investment, power plants are aging with about 70% over 30 years, 40% over 40 years, and 15% over 50 years (Greenpeace Poland, 2014, International Energy Agency, 2011). Third, electricity networks face similar challenges: nearly 80% of 400 kV lines and 99% of 220 kV lines are over 20 years old. Other challenges include the poor physical condition of the infrastructure and lack of grid development plans, and insufficient interconnections with other countries (International Energy Agency, 2011). At the political level, politicians and policymakers stress that domestic coal is strategic national resource for Poland energy independence and also to protect the "national interests" whilst renewable energy resources remain of "considerable importance". As a result, politicians and EU commission are, to date, bitterly negotiating over the emission reduction targets, commissioning new coal-fired power plants, and overall decarbonization and liberalization of Polish energy and power market. Poland is also keen to preserve its role as a transit zone for Russian gas and oil and thus opposes projects for

alternative transit routes such as the Nord Stream for gas and the Baltic-2 pipeline for oil International Energy Agency, 2011;The Polish Institute of International Affairs, 2013). A number of driving forces have actually led to drastic and comprehensive reform in Polish renewable energy policies; the accession to European Union in 2004 required adopting number of EU directives particularly the EU Directive 2009/28/EC that introduced a binding target for Poland to increase the share of renewable energy to 15% of gross final energy consumption (from 7.2% in 2005), the directive also set a separate target for the transport sector: 10% of energy use in transport must come from biofuels or other renewable energy sources by 2020. Poland also has a specific target for renewables-based electricity set by Directive 2001/77/EC: 7.5% in 2010. Other experts also suggest that in order to "greenwash" coal-based power plants and biomass being sufficient and recognized by the European Union as an environmentally-friendly source of energy, co-firing was supported with 1.7 billion euros between 2005 and 2012 through green certificates (Olszewski, 2014). Other factors include dynamic economic growth, new business development, wind energy resources, reduce urban wastes, and create micro-scale economic development in rural areas through biogas installations have been also fostering policy reform for renewable energy development in Poland. **Figure 1** below show the main support instruments for renewable energy in all the EU member states as of 2014.

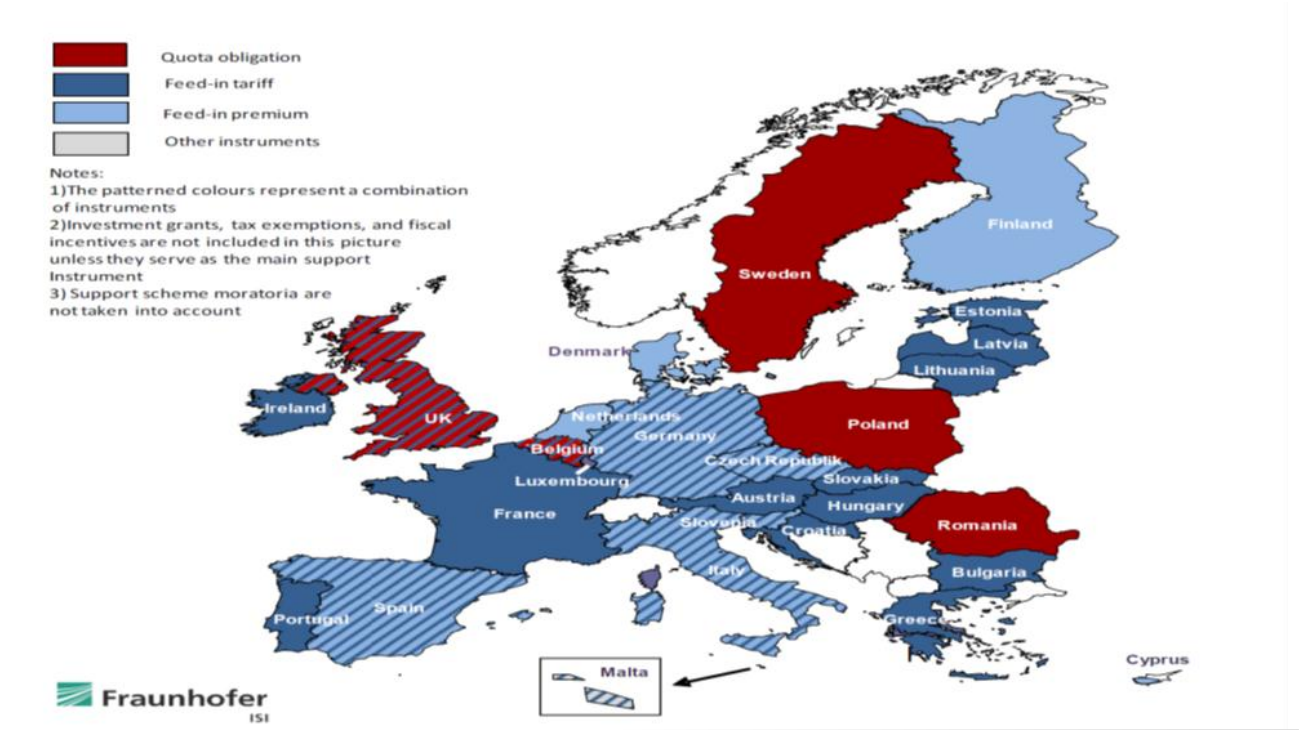

Figure 1. Main support instruments for RE in EU member states by the end of 2014 (Held et al., 2014)

2. CHAPTER TWO. CURRENT POLICY TRENDS

2.1. POLISH ENERGY POLICY UNTIL 2030 (EPP 2030)

To overcome the high demand for energy, insufficient domestic fuel supply, energy prices fluctuation and the growing urban pollution, the unfavourable political events, and the economic crisis swept over the EU countries and almost the whole world, Poland adopted in 2008-2009 the "*Polish Energy Policy until 2030"***.** The measures outlined in the strategy are designed to offer solutions to aforementioned challenges, and their implementation will help satisfy a growing demand for energy, develop generation and transmission infrastructure, and reduce dependence on external supplies of natural gas and crude oil as well as fulfil international obligations within the scope of environmental protection. The policy specifies six basic directions for the development of Polish energy sector:

- Energy efficiency improvement: (clean coal technology, power plants retrofits)
- Enhancement of competitive fuel, energy markets, and energy supply security
- Diversification of electricity generation mix by introducing nuclear energy
- Development of the use of renewable energy sources, including biofuels

These measures are highly complementary and largely correlated. For instance, boosting renewable energy development and the introduction of nuclear power in the final energy mix will add energy efficiency gains and also reduce urban pollution **(Figure 2).** Improving energy efficiency is one of the priorities of the EU energy policy, whose goal is a 20% reduction in energy consumption by 2020. Economic development, resulting from the use of new technologies, reveals a considerable increase in electricity consumption however accompanied by a relative decrease in the use of other energy forms (Paska and Surma, 2014). Security of fuels and energy supplies is understood as ensuring stable fuels and energy supplies at a level that guarantees meeting domestic needs at prices acceptable for the economy and the society, assuming the optimal use of domestic deposits of energy resources, and through diversification of sources and directions of supply of crude oil, as well as liquid and gas fuels. Domestic sources of conventional resources will be supported. It also includes extending natural gas storage capacities, access to natural gas resources by Polish companies operating outside Poland and producing gas from coal. The plans are in place to prepare and launch the use of new coal deposits by 2030.

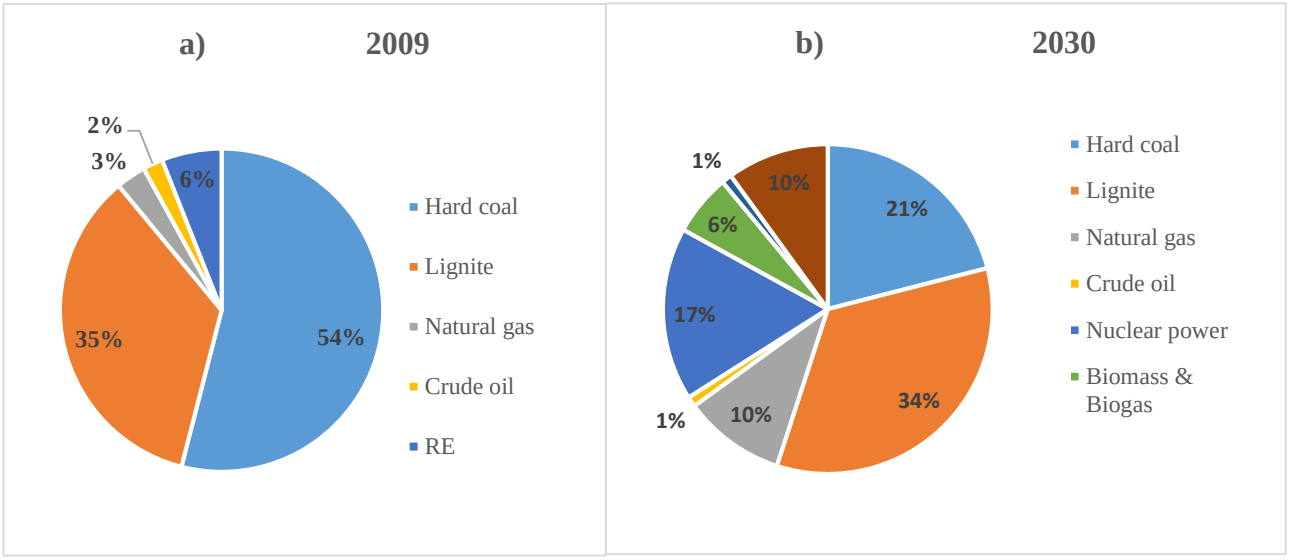

Figure 2. Structure of net electricity generation in Poland according to the (EPP 2030): a) 2009, b) 2030.

The main objective of energy policy in this field is the efficient and effective management of coal deposits located within the territory of the Republic of Poland. The new policy emphasizes the need for diversification of the electricity generation structure. It is planned to be achieved by introducing nuclear energy. The government's plan is to have at least 4 500 MWe of nuclear capacity in operation by 2030 (International Energy Agency, 2011). The exact capacity and number of units are likely to depend on the reactor technology chosen, and several options are being considered. According to the government's projections, nuclear will provide about 7% of electricity by 2022, rising to 17% in 2030. In a public opinion poll from August 2014, 64% of the population supported construction of a nuclear power plant in Poland (World Nuclear News, 2014). Among those 48% supported construction of a nuclear power plant in their neighbourhood expecting lower energy costs. 57% of supports gave independence from other countries as main reason. The maximum level of support previously recorded was 50% in 2009. The high level of public support is most likely caused by political events for example in Ukraine. Finally, EPP 2030 have adopted measures to reduce the negative impacts of industrial use of energy on the environment especially from harmful emissions on underground and surface water resources.

2.1.1 RENEWABLE ENERGY AND THE SUPPORT MECHANISM IN EPP 2030

In *EPP 2030* the aims are to stimulate various renewable energy technologies with particular attention to biomass. It sets the same objectives for renewable energy as the EU directive (15% of gross energy consumption, including 10% of transport sector fuels by 2020). Giving the importance of biomass (energy crops, firewood, wastes from agriculture, industry and forestry, biogas) the *EPP 2030* policy stipulates a doubling of electricity produced from highly efficient co-generation by 2020. To implement this ambitious target, the government has adopted a *Programme for the Development of Co-generation in Poland to 2030*. This programme aims at identifying the CHP potential and developing new mechanisms for CHP support (International Energy Agency, 2011).

In accordance with the EU Directive on (Combined Heat & Power) CHP, Poland set obligation for energy suppliers to ensure that a certain share of electricity sales comes from co-generation (at least 13.7% in 2005 and 16% in 2010). In this regard, electricity suppliers must either submit the requested amount of certificates of CHP origin (so called "**red/brown certificates**") to the Energy Regulatory Office, or pay a substitution fee equivalent to 68€/MWh. The idea behind the substitution fee is to enable fulfilment of the quota obligation in order to prevent sharp price increases. Suppliers can acquire the certificates of origin by generating their own CHP or buy them on the tradable certificates market. Additionally, heat suppliers have an obligation to purchase heat from CHP in the amount not exceeding the demand of consumers connected to the network. From 2009, the Energy Regulatory Office (ERO) is obliged to publish information on costs of heat produced by CHP and heat-only boilers (International Energy Agency, 2011). Companies or suppliers who fail to meet the requirements are subjected to penalties. The penalty is calculated by multiplying the substitution fee with the 1.3 factor, which is about **100€/MWh**. According to IEA, the existing mechanism appeared not very effective and have not stimulated significant investments in new co-generation. On the other hand, for coal-based power plants this mechanism was strong economic incentive has led to considerable increase in co-firing in large pulverized fuel (PF) boilers in Poland due to several reason. First, complete shift to biomass would require collecting biomass from vast areas which pose logistical challenges. Second, due to low energy and high moisture content of biomass, increasing the share of biomass in co-firing may decrease maximum boiler capacity and electricity production if the proportion of biomass exceeds 10% on energy basis. This drop in boiler capacity has a large negative impact on large power plants compared to small ones and also heating-only plants. Third, co-firing

of biomass entails a lower risk of corrosion and ash deposition problems than combusting biomass alone. Finally, PF boilers which dominate in Poland in terms of installed capacity, are inflexible compared to Grate and CFB boilers which can combust a relatively wide range of fuels in terms of particle size, composition, and moisture content (Lars et al., 2006; Ericsson, 2007; Oniszk-Pop et al., 2003). The co-firing power plants have provided an extra income in various ways: the selling of electricity at guaranteed price equivalent to an average price from previous year **35€/MWh**. The selling of "certificates of origin" bilaterally at an approximate price of **25€/MWh** or on the spot market at a price of about **50€/MWh**. The prices however fluctuated during the past years due to supply-demand nexus in the market. Other support mechanism include exemption from the excise tax of **5.2€/MWh**, which is levied on electricity production.

The EU emission trading scheme is another policy instrument that promoted co-firing. The scheme is relevant for boilers with thermal input of 20MW or more. These plants are allocated a certain amount of tradable emission allowances (EAs), for example between 2005 and 2007. The price of EAs varies according to the price of CO_2 per ton, however at **16€**/per ton CO_2 biomass provided **1.5 €/GJ (**Lars et al., 2006; Ericsson, 2007)**.**

According to the Energy Policy of Poland until 2030, in Polish conditions, the progress made in wind energy production, biogas and solid biomass production and in transport biofuels will be of decisive importance in the context of achieving the objective of 15% share of energy from renewable sources in the gross final energy structure by 2020. In 2020, these four areas will account in total for about 94% of consumption of energy from all renewable sources (Iglinski et al., 2011; Iglinski et al., 2014). The main instrument to support renewable electricity is the quota obligation system with tradable certificates of origin, so called "green certificates". It was introduced in October 2005. All electricity suppliers must ensure that a certain percentage of electricity sold to end-users comes from renewable sources. The system works similarly to the system of CHP certificates discussed above (Ministry of Economy, 2015). Other support measures include:

- Obligation to buy all electricity generated from renewable sources connected to the grid at a guaranteed price which is equal to the average market price in the previous year;

- 50% of the cost of connecting renewable sources to electricity grids are covered by a subsidy;

 Renewables-based facilities with a capacity up to 5 MW benefit from free licenses for the connection to the grid;

 Balancing rules for wind power plants are different from those for other power generation;

 Loans and grants for investments in renewable energy projects.

The *Action Plan of the EPP 2030* lists a number of measures to facilitate investment decisions on building offshore wind farms. It also tasks several ministries with the evaluation of possibilities of using the existing dams for hydropower generation (Ministry of Economy, 2015; National Renewable Energy Action Plan, 2010). As for the certificates of origin or so called "**green certificates**", energy companies selling electricity to final consumers must obtain and submit certificates of origin to the president of Energy Regulatory Office (ERO) or otherwise they must pay a substitution fee. The quota obligations for RES electricity generation has been defined in the *National Action Plan for Renewable Energy Sources* submitted to the European Commission in 2010. The quota for 2014 is 13% with 1% increase every year to reach 20% by 2021. The obligation also oblige the companies to purchase all electricity produced from renewable sources. The price of electricity is fixed and equal to average market price from previous year. Average market price is determined by the President of ERO and lasts till the end of every March of a given year. Similar to CHP concept, producers of electricity generate income from the sales of electricity with a guaranteed market price and on top of that the sales of "*green certificates*". The demand for green certificates is largely determined by the quotas obligation (Figure 3).

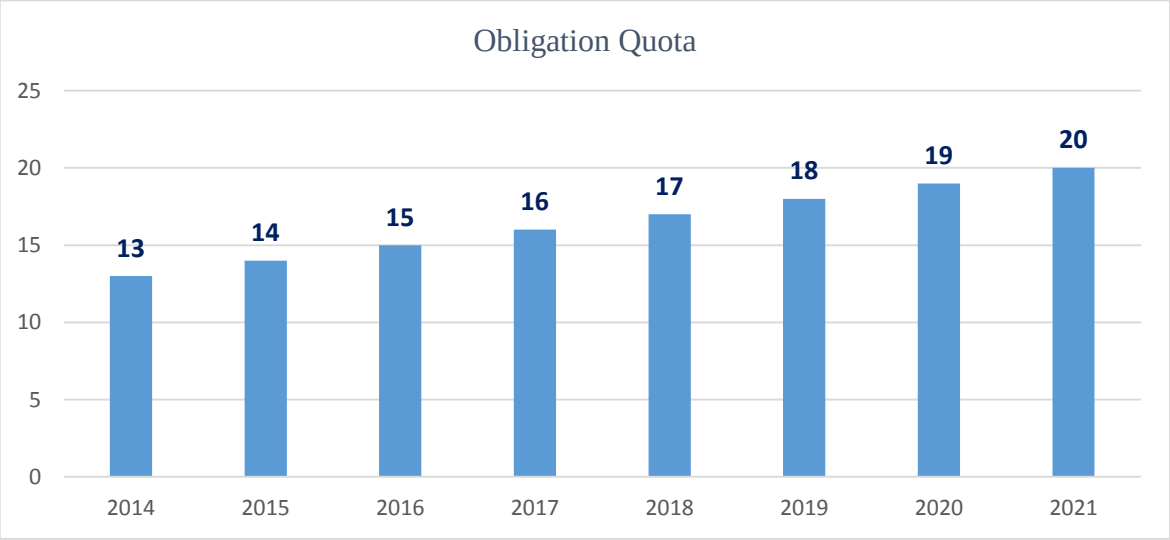

Figure 3. The scope of RES electricity obligations as defined in the NAP 2010 (Paska and Surma, 2014)

Figure 4. Maximum price (income) from the support scheme for electricity PLN/MWh (Paska and Surma, 2014)

Maximum price of green certificates is determined by the substitution fee (Figure 4). The level of substation fee is calculated according the following formula:

$$O_z = 240 \times (E_0 - E_u)$$

Where (E0-Eu) refer to extent to which obligation is not fulfilled, the factor 240 PLN/MWh is updated every year since 2006 and according to the national inflation rate. For 2014, it is **300.03 PLN/MWh**. Any funds generated from the substitution fees are directed to the National Fund for Environment and Water Management which then used for further support RES development projects. In 2012, the costs of green certificates reached 4.5 billion PLN. Although the prices of green certificates has been fluctuating due to mainly oversupply in the market, however, in 2014, the support schemes for electricity generation from RES generates revenue at a level equals to 100 EUR/MWh. These costs are then directly distributed to final customers and included in their energy bill. As a result, capacity installation of RES has increased from 1028 MW in 2004 to almost 6000 MW in the beginning of 2014. **Figure 5** also show that electricity generation has increased from 2.8 TWh in 2004 up to 17 TWh in 2012 especially from biomass and wind. The support for co-firing has led to over 40 power plants using co-firing technology in Poland generating 45% of RES electricity generation (Paska and Surma, 2014).

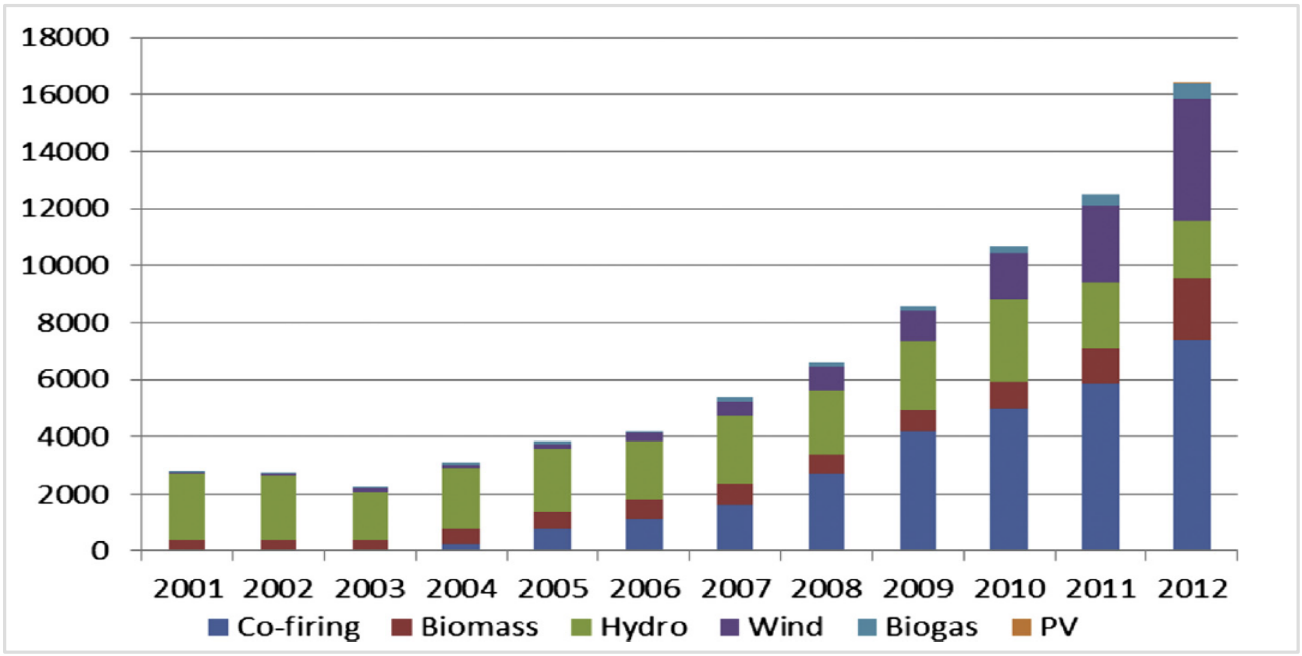

Figure 5. Electricity generation from RES in Poland up to year 2012, GWh.

2.2. NATIONAL RENEWABLE ENERGY ACTION PLAN 2010 (NREAP)

To implement the provisions of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources, Poland had to submit a Renewable Energy Action Plan to the European Commission by the end of June 2010. The draft plan projects that 15% of gross final energy consumption will come from renewable energy by 2020. Biomass (including biogas, biofuels) is expected to remain the main renewable energy source for electricity (43%), however the biggest growth is expected to come from wind energy (47%) (**Figure 6**). The rest comes from hydro (10%) and about 1% from PV. In its National Renewable Energy Action Plan, Poland has set a number of policy assumptions for future RES development: (National Renewable Energy Action Plan, 2010).

1. Producers of energy from renewable sources will enjoy support, in order to satisfy requirements of Directive 2009/28/EC.

2. RES targets will remain as set in accordance with Energy Policy of Poland until 2030.

3. Special focus on elevating Polish energy efficiency targets.

4. It has been assumed that in 2010, no new or additional forms of financial support to RES will be introduced. Certificates of origin will remain in force until further notice.

5. Maintaining so-called co-firing as RES form to be used in Poland is expected until 2020, taking into account limitations with respect to forest biomass firing.

6. It has been assumed that electricity exchange balance with neighbouring countries would be equal to zero.

7. Taking into account the development of RES with respect to the transport sector, a growth in the share of biofuels and bio-components in transport fuels has been primarily expected.

8. The use of coal will decrease while other energy carriers will increase until 2020.

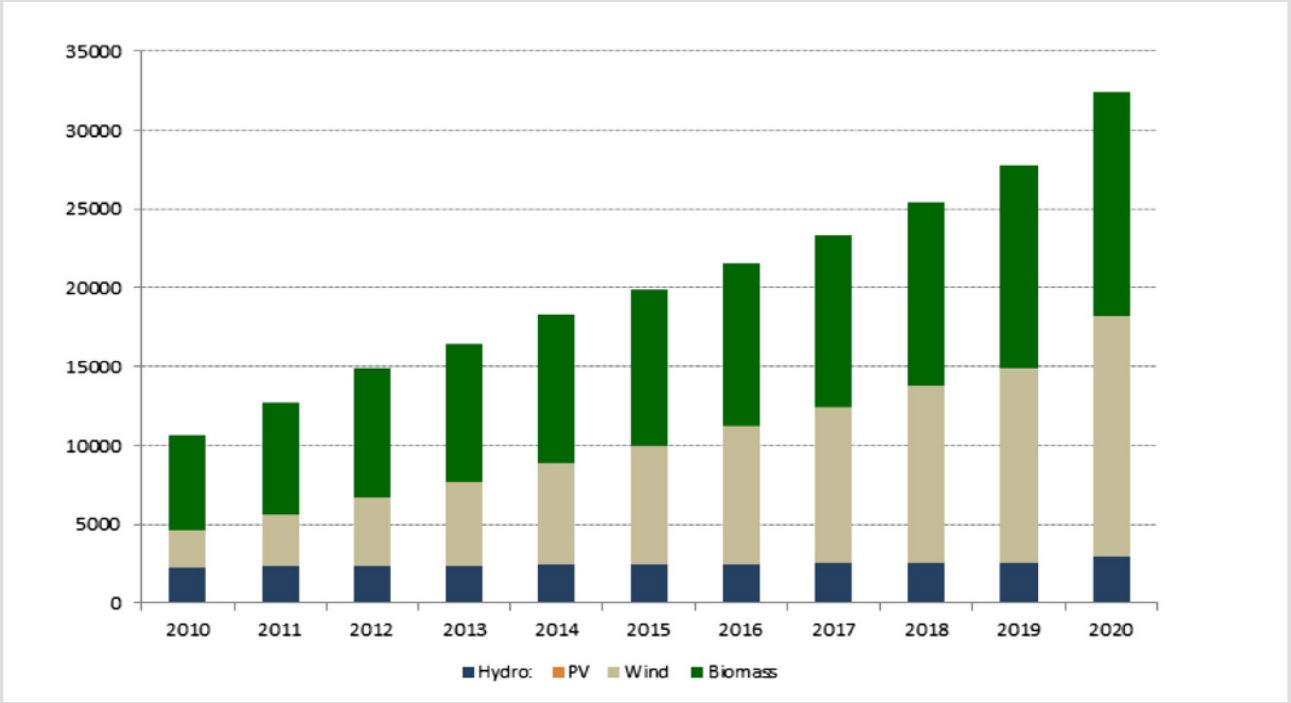

Figure 6. Forecast of RES electricity generation between 2010-2020 based NREAP 2010, GWh (Paska and Surma, 2014).

Table 1 presents the targets from RES. The progress in wind energy production, biogas and solid biomass production and in transport biofuels will be of decisive importance in the context of achieving the objective of 15% share of energy from renewable. Until 2020, renewable technologies would account in total for 25.4% of total generation capacity (22.6% in 2030).

A drop in this percentage share in the years 2020-2030 will primarily be due to the inclusion of 4800 MW nuclear energy, which is to be introduced in Poland after 2020.

Table 1. Demand for gross final energy from RES by types of energy (ktoe) as set in NREAP 2010

	2006	2010	2015	2020	2025	2030
Electricity	370.6	715	1,516	2,686	3,256	3,396
Solid Biomass	159	298	503	892	953	995
Biogas	13.8	14	31	141	345	556
Wind	22	174	632	1,178	1,470	1,530
Water	176	211	240	271	277	277
Photovoltaics	0	0	0	0.1	1.1	2.1
Heat	4,313	4,482	5,046	6,256	7,0449	7,618
Solid biomass	4,250	4,315	4,596	5,406	5,871	6,333
Biogas	27	72	256	503	750	800
Geothermal	32.2	80	147	221	298	348
Solar	3.6	14	47	125	129	137

Other Polish legislations that support the implementation of the national policy to promote the use of energy from renewable energy sources include:

1. Energy Act of 10 April 1997 (Journal of Laws of 2006 No 89, item 625, as amended).

2. Act of 2 July 2004 on freedom of economic activity (Journal of Laws of 2007 No 155, item 1095, as amended).

3. Act of 6 December 2008 on excise duty (Journal of Laws of 2009 No 3, item 11, as amended).

4. Environmental Act of 27 April 2001 (Journal of Laws of 2008 No 25, item 150, as amended).

5. Regulation of the Minister of Economy of 14 August 2008 on detailed scope of obligations in respect to obtaining certificates of origin and submitting them for cancellation, payment of a substitution fee, purchase of electricity and heat from renewable energy sources, as well as the obligation to confirm the data on the amount of electricity produced from a renewable energy source (Journal of Laws No 156, item 969, as amended).

6. Regulation of the Minister of Economy of 4 May 2007 on detailed conditions for the electricity system functioning (Journal of Laws No 93, item 623, as amended).

7. Regulation of the Minister of Economy of 2 July 2007 on detailed principles for defining and calculating tariffs and principles for settlements in electric energy trading (Journal of Laws No 128, item 895, as amended).

8. Regulation of the Minister of Economy of 3 February 2009 on granting public aid for investments involving construction or extension of units producing electricity or heat from renewable energy sources (Journal of Laws No 21, item 112).

9. Energy Policy of Poland until 2030 (with appendices) adopted by the Council of Ministers on 10 November 2009 and announced by the announcement of the Minister of Economy of 21 December 2009 on the national energy policy until 2030 (M.P. of 2010, No 21, item 11).

10. Act of 26 October 2000 on commodity exchanges (Journal of Laws of 2010 No 48, item 284, as amended) together with the Act of 29 July 2005 on public offer and the conditions for introducing financial instruments to the organized trading system and on public companies (Journal of Laws of 2009 No 185, item 1439, as amended), as well as regulation of the Council of Ministers of 22 December 2009 on special procedure and conditions for introducing property rights to trading on the exchange (Journal of Laws of 2010 No 6, item 30) issued based thereon.

11. Regulation of the Minister of the Environment of 2 June 2010 on detailed technical conditions for qualifying a part of energy recovered from heat treatment of municipal waste (Journal of Laws of 2010 No 117, item 788).

12. Regulations of the Commodity Energy Exchange and the related document Conditions of trading of property rights to certificates of origin for energy produced from renewable energy sources issued by the Commodity Energy Exchange

13. Regulations of the Register of Certificates of Origin kept by the Commodity Energy Exchange issued by the Commodity Energy Exchange

14. Operating and Maintenance Instructions of the Transmission Grid drawn up and published by PSE Operator S.A.

15. Financial priority programme of the National Fund for Environmental Protection and Water Management titled Energy use of geothermal.

2.3. IMPACT OF ENERGY POLICIES ON BIOENERGY MARKET IN POLAND

The adoption of renewable energy policy has certainly created positive impact on RE capacity installation as we referred to above. The main gains however came largely from the co-firing of biomass in coal-fired power plants and co-generation in CHP plants. The policy effectiveness observed for electricity generation based on the combustion of solid and liquid biomass-based is highest for countries with an advanced deployment status including Estonia, Finland, Denmark, Belgium and Poland (Held et al., 2014). In Poland, co-firing accounted for 42% of electricity generation and biomass accounted for over 80% of final renewable energy mix. This trend was considered "unbalanced" by the International Energy Agency and urged the Polish government to adopt more measures to facilitate the development of other renewables such as off-shore wind energy and climate protection measures (International Energy Agency (IEA), 2011). According to Held et al., (2014) the support granted by EPP 2030 and NREAP for wind offshore appears to be sufficient for the lower cost potentials however the support to make solar PV projects profitable appeared insufficient.

By 2007, Poland has adopted all EU regulations regarding market liberalization and security of supply relatively quickly, compared to some other countries that started market transformation earlier (IEA 2011). In 2009, 95% of the total renewable energy supply came from biomass and waste, and smaller amounts came from hydropower (2.9%), wind power (1.3%). Biomass supply has been growing at an average rate of 4.5% per year between 1998 and 2009 (IEA 2011). In line with the government's "*Programme for the Power Sector*" adopted in 2006, Combined heat and power (CHP) has become relatively well developed in Poland with more than 15% of total electricity and over 60% of heat comes from co-generation. Moreover, the average efficiency of coal-fired plant and CHP plants has increased up to 41% due to accelerated use of CHP plants.

Due to the adoption of the above mentioned programme, the power sector has also gone through restructuring and consolidation processes. As a result the electricity market has become controlled by four large, vertically integrated, state-owned corporations: generation, transmission, distribution and trading of electricity. The four key players are: Polska Grupa Energetyczna (PGE), Tauron Polska Energia, Energa and Enea – which were created in 2007. As shown in Figure 7, the use of biomass has substantially increased from local resources and also due to imports of pellets and other raw

biomass materials. Biomass use peaked in 2012 with power industry consumed 7.1 Mt of biomass (Falkowicz, 2013).

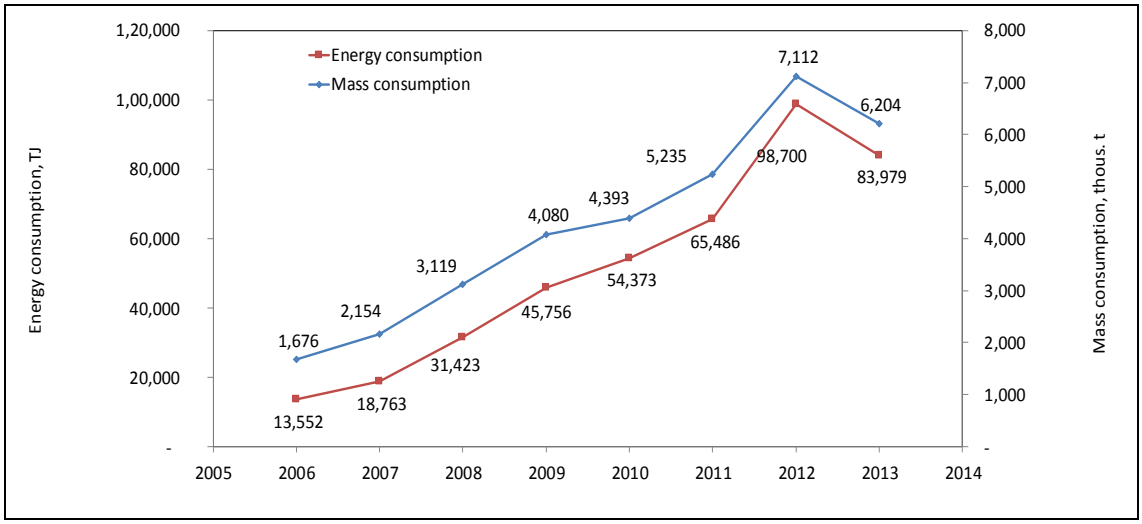

Figure 7. Use of biomass in the power plants due to policy reforms (Falkowicz, 2013)

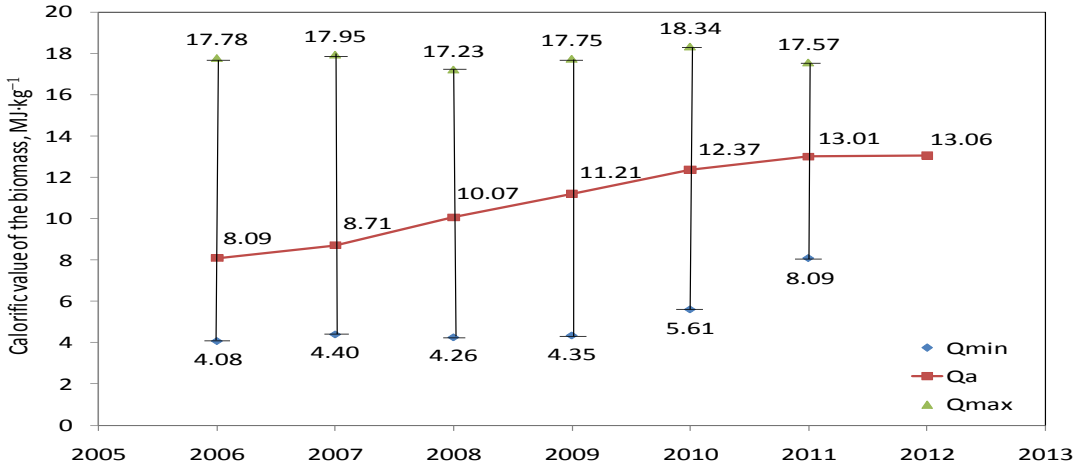

Figure 8. Calorific value of biomass consumed in power plants (Falkowicz, 2013)

Between the years 2005–2012, the increased use of biomass resulted mainly from investments carried out. Higher growth rate of biomass resulted from the use of fuels with higher calorific value in the form of pellets and briquettes (**Figure 8**). Several dozen of this type manufacturing plants generate jobs for about 4 500 people and for a further 6 000 at cooperating units. Growing demand for biomass was strongly correlated with its price increase **(Figure 9).** From 2006–2011 its price increased from €36.0/ton to €74/ton (or by 106%), while the price of coal was at €48/ton (Falkowicz, 2013).

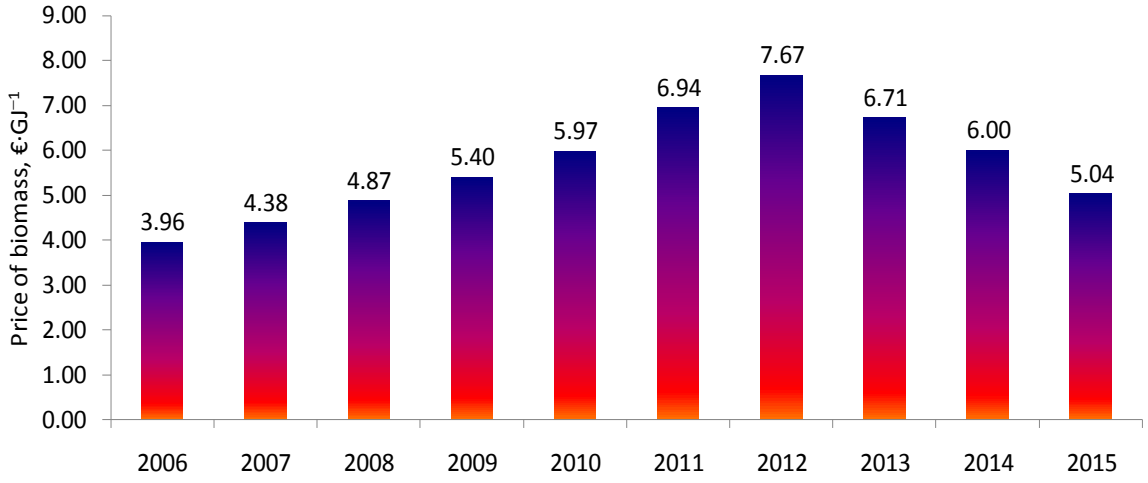

Figure 9. Price of biomass in power plants (loco plant) (Falkowicz, 2013)

Due to the support mechanism for mainly co-firing and the high prices of green certificates, the number of biomass-based power plants have increased and also the number of coal-based power plants implementing co-firing of biomass **(Figure 10).**

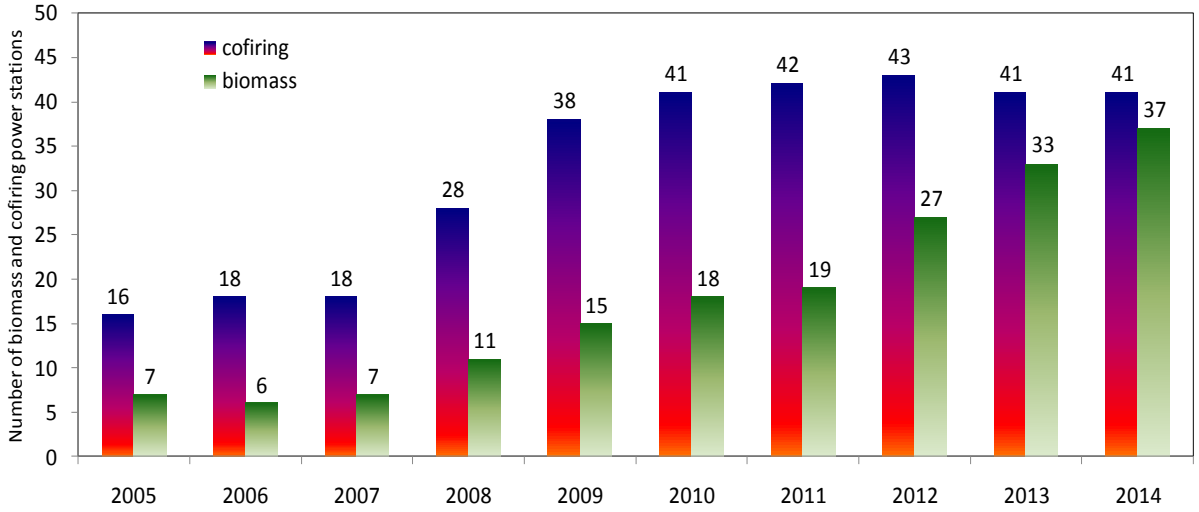

Figure 10. The number of biomass-based and biomass co-firing power plants (Falkowicz, 2013)**.**

As result of high biomass prices, the biomass market have experienced a series of changes:

- Increase share of non-forest biomass in the fuel mix (the use of agro-biomass, biomass from apple tree orchards).
- Higher import of biomass from Asia and the surrounding countries due to competitive price.
- Increasing costs of production due to the necessity of processing biomass into pellets and/or briquettes.
- The legal obligation to obtain certificate of origin especially from forest biomass.

The high prices of biomass led to the following:

- Decrease profitability of biomass and reduced co-firing technology competitiveness in the market, and even reduced investment in this area,
- Limiting the availability of biomass for individual heating purposes and return to coal combustion boilers in individual households and ensuing increase in low emissions.

Overall, the increasing use of biomass in co-firing led to oversupply of green certificates in the market. This coincided with chaos with issuing certificates of origin (CO) by the Energy Regulatory Office (ERO) due to the new requirements of the ME for proving the origin of forest biomass. Oversupply in the system of certificates is estimated at more than 12 TWh, which is approximately. 75% of demand was projected for 2014. Consequently, the prices of green certificates dropped to about 24 Euros /MW and the demand for biomass in co-firing has also decreased (Falkowicz, 2013). The overall consequences of such market trend was the collapse of biomass in market in late 2012 and early 2013. In an attempt to fix the situation the government introduced limits for co-firing and large hydropower and came into force from mid-2016 and continuation of the current policy of ERO on the surveillance of the biomass origin – the gradual easing approach. The new policy reform regarding the support mechanism has been adopted in the Renewable Energy Resources Act (RES Act) which we discuss below.

3. CHAPTER THREE. FUTURE POLICY TRENDS

3.1 The Renewable Energy Resources Act (RES ACT 2015)

This analysis is largely based on articles by: Rogozinski and Katarzyna, 2015; Ziecina and Bobrzynski, 2015; Muszynski, 2015; Krasnodebski, Tomasz, and Motylewski, 2015; Ancygier, 2014.

On January16, 2015, and after 5 years of legislative discussions, the Sejm- the lower house of the Polish Parliament- adopted the long-waited Act on Renewable Energy Sources "RES Act". On 11 March 2015 the president of Poland signed the new act and the RES Act will enter into force beginning of 2016. Experts believe that this Act aim at developing the perceptions of RES developers by offering support mechanism for a relatively long period. Others believe that the goal is to prevent in electricity prices from increasing, some believe it helps stabilise the State budget by reducing the State aid to RES which amounted to over 4.5 billion PLN in 2012. Bioenergy experts believe that this Act also seek to stabilise the oversupply of green certificates and the associated low prices by placing a cap on the number of tradable certificates and fixing the price of green certificates at 72 Euros/MWh.

The main outcome of such Act changes to the issuance and trade in certificates of origin or "green certificates" issued for producers of renewable energy. The main provisions of RES Act are:

1. The creation of newly state-owned entity called: Renewable Energy Settlement Operator (in Polish= OREO). It will be financed by a special fee added to electricity bill issued to the final customer.

2. Existing installations that have started before the adoption of the RES Act will continue to benefit from "green certificates" support scheme or they can also choose to enter the auctioning system (discussed below). The support is only for 15 years from when the project has started production.

3. Any new installations starting after the adoption of RES Act will have no choice but to enter the auctioning process. However, biomass installations exceeding 50MW of electrical power or 150MW of CHP heat and power will be exempted from this alternative. Existing and operational installation will have their dedicated auction to avoid direct competition between existing and the newly planned investments.

4. The Act also gave incentives to households to invest in renewable energy. Solar panels with power less than 40KW will not require public permit and local energy operators are obliged to acquire all the surplus energy generated by such installations at a guaranteed price equivalent to the wholesale price.

5. A feed-in tariff system for micro installation of up 3 KW, and over 3 KW up to 10 KW was also introduced for the first time.

6. Separate auctions will be held for installations with capacities below 1 MW and for those with more than 1 MW.

7. Only ready-to build projects that have acquired the biding construction permits, secured interconnection rights, and passed the pre-qualification criteria for auctions are eligible to participate in the new auctioning system.

8. The substitution fee will be frozen at the level of 2014, i.e. PLN 300.03 (ca. 72 EURO). However only purchasing and redeeming of certificates will be organized by ERO as long as the average market price of certificates remains below 75% of the substitution fee.

9. Support for RES will be limited by duration and scope. Only 15 years for existing installations and maximum up to 2035.

10. Support for all biomass co-firing will be capped by volume to the equivalent of average biomass generated electricity between the years 2011-2013.

The basic rule of the newly introduced auctioning system is that new investments, project developers are now bidders and therefore compete for the state support based on a type of contract-for-difference (CfD) granted through auctions organized by the Energy Regulatory Office (ERO). The CfD contract is signed by the successful bidder and the OREO and meant for installations over 500 KW. Under CfD the balance between the average market price and bid price is settled and paid by the OREO to the bidder or the producer. The shortfall payments will be distributed each month however OREO will not cover any shortfall below the weighted average price available at the Power Exchange for a particular day. The power Exchange is therefore obliged to publish the weighted average price each day.

Each year the president of the ERO will announce the amount of electricity to be purchased from the producers and the Ministry of Economy will set a "reference price" to put a cap on the auction bids. The first budget and electricity volume for 2016 will be set by 31 May 2015. The first reference price will be determined by December 2015. First auction to be announced by 30 March 2016. Bidders (energy producers) will have to offer a certain amount of electricity and a price per MWh. The bidder must pay PLN 30 for each Kw in the proposed bid volume as a deposit to ERO. The price must fall below the "reference price". Reference price is set for 18 different groups (technologies) including five groups of biogas, three groups of biomass installations including CHP. The winner of the auction is the bidder with the cheapest price for a specific group and project must deliver electricity within 24 months for solar-based project and 72 months for off-shore wind projects. Successful bidders must deliver at least 85% of the volume offered in the bid otherwise will be subjected to penalties e.g. half of the bid price. The pre-qualification phase is required to ensure that all bidders are ready and financially well-prepared for the auction. They include compliance with local development plan, holding right for grid connection, environmental permit, and financial statement, and provide timely plan for the construction phases of the project. The ERO will accept or reject the pre-qualification phase within 30 days of submission.

3.2. ADVANTAGES AND DISADVNATGES OF RES ACT 2015

For many experts the new RES Act is considered a comprehensive support mechanism for RES development to meet the EU requirements. For the first time, it has also provided income opportunity for micro-instalments and at the household level. It is expected that this Act will promote PV installations at the household level which currently in its infancy in Poland. It may also stabilise the green certificates market and maintain generous income for large-scale energy producers with minimum 85 Euros/MWh generated. Furthermore, the act possibly will encourage off-shore wind energy development giving the scale of support and the timescale to construct and commission the project (72 months). The Act also seek to encourage the creation of new market for less-than-one MW capacity projects; the new law requires that 25% of power covered by the support mechanism must be produced by projects with one MW capacity or less.

A number of challenges however are put in place on this Act:

1. RES Project developer must spend substantial fund to get the project to the bidding stage. This is however entitled a risk of no-return if the bidding was not successful. Yet again, only ready-to-build projects with clear financial and construction road map will be competing and with relatively enough time to commission the projects (up to 72 months for wind).

2. The reference price is only announced two months before the auction date. For some projects the reference may appear too low to become economically feasible to enter the auction.

3. The government published guidelines in setting the reference price per technology and consider "reasonable actual project costs" to maintain at least 85% of the projects profitable. However, some experts believe the language of these guidelines leaves a room for manoeuvring.

4. Since the winner is the cheapest price, then the Act seem to favour projects with low capital investments or with low-cost technology or investors expecting lower returns on their investments. Expensive technologies may be outcompeted from the market.

5. Experts believe that prosumers (producers and consumers of electricity) will further support energy companies through feeding the grid with subsidies electricity and further get subsidies from the State.

6. Experts also believe that the Act supports large-scale installations however with no previous experience such through pilot projects. Therefore, big energy companies will continue to dominate the market with no opportunities for cooperatives.

7. CHP plants will have designated number of certificates and lower than before. Such change may stabilises the green certificates prices to an acceptable level. However, the demand for biomass will be reduced thus biomass prices drops further.

8. Parliament elections is going to be conducted in October 2015. Law and Justice Party (PiS) currently the biggest opposition party. Experts believe that if PiS win the elections it may endanger the future of renewables in Poland; the PiS is considered opponent to wind energy. In some occasions, they claim to dismantle wind turbines within km of residential areas.

9. Prime Minister Ewa Kopacz seek to initiate a transition pathway toward a more sustainable, low carbon economy but experts believe- just like many other politicians- she won't give up on coal overnight.

This brief makes clear that fossil fuels will remain the chief energy source for Poland. As stated above the share of renewable energy is to reach at least 15% of energy total production by 2020, but then only increase by one percent until 2030. At the same time nuclear energy is to reach 12% of final energy demand by 2030. The remaining 74% will still come from sources producing CO_2 mainly coal and lignite. For instance Poland plans to add over 11000 MW of coal power by 2020 while the renewable energy sources will have around 2500 MW of power. One planned coal-fired power plant in the northern Poland will have 2000 MW power thus almost the same as the RES.

In mass media government shows its involvement in maintaining big share of coal as source of energy. Coal is perceived as Poland's "*black gold*" and the European climate and energy policies are often perceived as endangering the Polish national interests. Polish government seek to receive free CO_2 emission allowances for coal power plants about 700 million. Media and government sources emphasize also nuclear energy as good substitute for coal and renewable energy sources. The main reasoning for coal and nuclear based power is independence of the energy system from other countries. Nuclear power is shown as "clean" alternative to coal. Some of the sources related to polish coal industry bitterly blaming the government because of complying with EU climate policies and Kyoto agreement. The same source argues that coal is a cheap and efficient energy source and every country in the world except Poland increases amount of coal mining. Although the government emphasizes energy independence by using coal, however, coal imports remain a key challenge. Most of the imported coal is bought by individual consumers.

4. CHAPTER FOUR: ENERGY AND POLICIES IN POLISH MEDIA

Usually, energy-related topics are not common in Polish mass media. Bigger interest in energy problems occurs usually at the same time with elections (for example in 2014 to EU parliament) or in case of coal miners' protests. As coal mining industry employs many thousands of people, any plans to close down some mines or lay off employees receive the biggest media attention.

Similarly, renewable energy topics appear in media in case of some protests, for example by people unsatisfied with location of wind power plant. There is website (http://stopwiatrakom.eu/) that contains information on bad influence of wind power plants on people living in the area because of noise and about dangers to the environment. Basically every type of renewable energy has some organization that protests against it. For example, organization protesting against small hydropower plants and there were protests against biogas plants (one example: There is similar situation in case of coal power plants and nuclear power plants though. Local communities do not protest against usage of biomass for production of energy as such. Probably it is because it is used mainly in small scale for heating buildings on farms. The other site shown in media are protests organized by producers of energy. For example, the producers are unhappy with the policy of government towards use of biomass. Nevertheless, there is no discussion about biomass in mass media. Energy policy of the country is mainly discussed in media during political campaigns before elections. However, it is not main topic. Politicians present then different views. Below are some examples of opinions of politicians presented in media (the quotes are not direct translations, but summary of the short talks given in front of cameras):

"*Safety of the country in terms of energy is very important*"

"*Poland should not invest in sun energy as there is not enough sunshine*"

"*The most important for Poland is having enough energy produced from local resources such as coal, wind and biomass*"

"*Biomass is cheap, but it can't be used for producing energy without co-firing it with coal*"

"*Care for environment should be based on clean energy production from coal. Wind and biomass should be used as addition tough*"

Analysts of the energy situation often criticize government in media for minimalistic approach to renewable energy and treating it more as a thing they are forced to use.

During field trip, the UEF BEST team visited a number of pellet factories and also talked with few Polish farmers. The general notion is that farmers do not neither trust energy companies nor the governmental policies. Energy companies on other hand also blame the farmers for high biomass and

do not very much trust the quality of the biomass loads coming to the facility (in some cases, farmers were adding sand, water or even stones). There are some examples of biomass-based facilities went bankrupt due to drop in biomass prices and green certificates. Farmers showed interest in energy plantation under ideal market conditions and clear long-term support. Meaning, low-risk from policies uncertainty. In this regard, and according to Bartłomiej et al. 2015, the pace of development of the renewable energy sector in Poland depends largely on: the proposed legislation on renewable energy sources being adopted, legal regulations being made simpler, increased subsidies for development of the sector, introduction of guaranteed certificate prices, and educating the public, investors, developers and decision-makers.

ACKNOWLEGDMENT

This Report was prepared by the School of Forest Sciences, University of Eastern Finland (UEF), under the research project titled "**Sustainable Bioenergy Solutions for Tomorrow**" Working PHASE II, Task 1.4 Bioenergy Value Chains for Developing Economies - Case Poland, jointly coordinated by the Finnish Bioeconomy Cluster (FIBIC) and the Cluster for Energy and Environment (CLEEN), with funding from the Finnish Funding Agency for Innovation (TEKES). The authors would like to thank **Prof. Aleksander Lisowski** from Warsaw University of Life Sciences for his contribution and inputs to this report.

REFERENCES

Andrzej A. The 2030 targets: A game changer for Poland? http://www.euractiv.com/sections/energy/2030-targets-game-changer-poland-309589

Arkadiusz K, Janas T, Motylewski M. New Act on Renewable Energy Sources. http://www.mondaq.com/x/382160/Renewables/New+Act+on+renewable+energy+sources

Ericsson K. Co-firing—A strategy for bioenergy in Poland? Energy 32 (2007) 1838–1847. doi:10.1016/j.energy.2007.03.011

Falkowicz M. 2013. Biomass revolution. Energy Market Agency.

Green Peace Poland, 2012. Poland: trapped by coal? http://www.greenpeace.org/eu-unit/en/Publications/2012/Poland-briefing/

Held A, Ragwitz M, Boie I, Wigand F, Janeiro L, Klessmann C, Nabe C, Hussy C, Neuhoff K, Grau T, Schwenen S. Assessing the performance of renewable energy support policies with quantitative indicators – Update 2014. Assessing the performance of renewable energy support policies with quantitative indicators (DIA-CORE) Project.

Igliński B, Buczkowski R, Cichosz M, Plaskacz-Dziuba M. SWOT analysis of the renewable energy sector in Poland. Case study of Wielkopolskie region. Journal of Power Technologies 95 (2) (2015) 143–157.

Iglinski B, Iglinska A, Kujawski W, Buczkowski R, Cichosz M. Bioenergy in Poland. Renewable and Sustainable Energy Reviews 15 (2011) 2999– 3007. doi:10.1016/j.rser.2011.02.037

Iglinski B, Piechota G, Buczkowski R. Development of biomass in polish energy sector: an overview. Clean Techn Environ Policy, 2014. DOI 10.1007/s10098-014-0820-x

International Energy Agency (IEA). Energy Policies of the IEA Countries: Poland. Available At: http://www.iea.org/publications/freepublications/publication/poland2011_web.pdf

Lars J. Nilssona, Marcin Pisarekb, Jerzy Buriakc, Anna Oniszk-Popawskab, Pawe" Buckoc, Karin Ericssona, Lukasz Jaworski Energy policy and the role of bioenergy in Poland. Energy Policy 34 (2006) 2263–2278. doi:10.1016/j.enpol.2005.03.011

Ministry of Economy, Poland. Energy Policies Until 2030. Available at: http://www.mg.gov.pl/files/upload/8134/Polityka%20energetyczna%20ost_en.pdf

Ministry of Economy, Poland. NATIONAL RENEWABLE ENERGY ACTION PLAN 2010.

Muszynski I. New Economics for Renewable Energy in Poland. http://www.chadbourne.com/New-Economics-for-Renewable-Energy-in-Poland_projectfinance/

Olszewski, M. A Polish appetite for biomass. http://energytransition.de/2014/09/polish-appetite-for-biomass/

Oniszk-Pop A, Rogulska M, Wisniewski G. Renewable-energy developments in Poland to 2020. Applied Energy 76 (2003) 101–110. doi:10.1016/S0306-2619(03)00051-5

Paska J, Saeka M, Surma T. Current status and perspectives of renewable energy sources in Poland. Renewable and Sustainable Energy Reviews 13 (2009) 142–154. doi:10.1016/j.rser.2007.06.013

Paska J, Surma T. Electricity generation from renewable energy sources in Poland. Renewable Energy 71 (2014) 286-294. http://dx.doi.org/10.1016/j.renene.2014.05.011

PGI (Polish Geological Institute – Państwowy Instytut Geologiczny) (2009), Bilans Zasobów Kopalin i Wód Podziemnych w Polsce (Mineral and Groundwater Resources of Poland), PIG, Warsaw, Poland, www.pgi.gov.pl

Rogozinski M, Terlecka K. Poland: New Support Scheme for Renewable Energy Sources Already Adopted, 2014. http://www.schoenherr.eu/knowledge/knowledge-detail/poland-new-support-scheme-for-renewable-energy-sources-already-adopted/

The Polish Institute of International Affairs. German and Polish Energy Policies: Is Cooperation Possible? No. 49, January 2013. Available at: https://www.pism.pl/files/?id_plik=12692

Wohlgemutha N, Wojtkowska-Lodejb G. Policies for the promotion of renewable energy in Poland. Applied Energy 76 (2003) 111–121. doi:10.1016/S0306-2619(03)00052-7

World Nuclear News. Polish public supports nuclear plan. Available at: http://www.world-nuclear-news.org/NP-Polish-public-supports-nuclear-plan-2608147.html

Ziecina L, and Bobrzynski M. Poland's New Act on Renewable Energy Sources. http://www.ceelegalmatters.com/index.php/legal-analysis-energy/item/2399-poland-s-new-act-on-renewable-energy-sources