A multilevel stakeholder analysis of drivers and barriers in Poland's renewable energy development

Olga Abramczyk

Master Thesis Series in Environmental Studies and Sustainability Science,
No 2014:035

A thesis submitted in partial fulfillment of the requirements of Lund University International Master's Programme in Environmental Studies and Sustainability Science (30hp/credits)

LUCSUS
Lund University Centre for Sustainability Studies

LUND
UNIVERSITY

A multilevel stakeholder analysis of drivers and barriers in Poland's renewable energy development

Olga Abramczyk

A thesis submitted in partial fulfilment of the requirements of Lund University International Master's Programme in Environmental Studies and Sustainability Science

Submitted: October 1, 2014

Supervisor: Mine Islar

Abstract

Living in a world, where constantly growing energy consumption and climate change are issues of increasing concern, it is necessary to decrease fossil fuel consumption and promote more sustainable ways of gaining energy, such as renewables (IPCC, 2007). Poland as a member of the European Union was obliged to comply with European policies and increase its share of renewable energy by 2020. However, this might be difficult, giving the fact that there is a strong tradition of coal in Poland with a dominating percentage in the energy structure (85%) supported by strong coal lobby.

Thus the main objective of this thesis is to provide an overview of the development of renewable energy in Poland, including key agents, main drivers and barriers for the development towards a more renewable energy generation mix, and finally providing ideas for improvement. Based on transition theory, in particular its multi-level perspective, the data was collected through conducting thirteen semi-structured, in-depth, expert interviews, which were combined with literature and policy review of several documents.

As result, the key agents include: the European Union; the Polish government and national governmental agencies; regional authorities; energy producers, transmission and distribution agents; research institutes; and civil society. Based on interviews with above-mentioned stakeholders, the main driver for renewable energy development in Poland is the European Union and its policies. The biggest barrier constitutes the lack of clear and reliable policy framework at the national level. Changes are necessary in order to assure long-term sustainability of the Polish energy sector.

Key words: Renewable energy, Poland, drivers, barriers, transition theory, multi-level perspective

Word count: 13'888

Acknowledgements

This thesis could not have been carried out without the support of several people, whom I would like to thank for their time and assistance.

First, I would like to thank all great lecturers, staff and classmates that were part of LUMES 2012-2014. In particular, I would like to thank my supervisor, Mine Islar, for her helpful advice and constructive feedback. Moreover, this thesis was inspired by the Energy course given by Berry Ness and was written using the knowledge provided in the Methods course given by Anne Jereneck, Kimberly Nicholas, Bodil Elmquist, Henner Busch, and Molly MacGregor, whom all I would also like to thank.

I wish to thank all the people I have interviewed, for their time, sharing of their knowledge and experiences, which were indispensable for this thesis.

Finally, warmest thanks go to my family and friends, who have always been there for me.

Table of Contents

Table of Figures

1. Introduction

"Averting dangerous climate change will require a global 'energy revolution' in favour of low-carbon energy sources" (Bruce, 2013: 18).

The planetary boundary of climate change has already exceeded the "safe operating space for humanity" (Rockström et al., 2009: 472). The increase in global average temperatures over the past 50 years is "very likely" to be caused by the increase of anthropogenic greenhouse gas concentrations (IPCC, 2007). With world's population increasing from 7 billion to 9 billion predicted in 2050 (Uniten Nations, 2013), the problem of increased energy consumption and decreasing reserves of fossil fuels is gaining on importance. Thereby, fossil fuel consumption is the primary driver, which accounts for 80% of global energy consumption (ibid.). Increasing the share of renewable energy can be seen as potential solution to this challenge. This type of green energy has the potential to considerably decrease carbon dioxide (CO2) emissions from energy consumption and thus contribute to a more sustainable future (ibid.).

With the implementation of the *Renewable Energy Directive* (2009/28/EC) by the European Union (EU), which aims to reach 20% from renewable sources in its gross final consumption of energy by 2020, renewables gained considerably on importance in Europe. Wind, solar, hydro-electric, geothermal or biomass energy enabled the EU to considerably cut greenhouse emissions and at the same time assuring fulfilment of all three priorities of European energy policy: sustainability, competitiveness and security of supply (European Commission, 2010). The member states of the EU are obliged to increase their share of energy from renewable sources in gross final consumption of energy till 2020 to the number they agreed upon during negotiations (ibid.). In order to reach the EU's target of 20% renewables by 2020 and a long-term sustainability of the energy sector, it is vital to implement policies at national level, which will encourage development towards renewable energy systems.

Such developments have been taking place in many member states. However, one country is facing particular difficulties in shifting towards renewable energy; Poland. Historically, Poland always has been strongly relying on coal, which makes it one of the most coal rich countries in Europe (Polska, 2014). Today, Poland is still continuing to use coal as its main source for energy production (see Figure 1). Considering that more than 85 per cent of electricity is produced out of coal, Poland is one of the biggest coal users in EU (CEE Bankwatch Network, 2013). After joining the EU in 2004, Poland became party to treaties of the EU and thereby subject to the privileges and obligations of EU membership. Thus, it was bound to comply with EU's regulations, such as the Directives 2001/77/EC *on the promotion of electricity produced from renewable energy sources in the internal electricity*

market and 2003/30/EC *on the Promotion of the use of biofuels and other renewable fuels for transport*, which were later amended by the Directive 2009/28/EC *on the promotion of the use of energy from renewable sources*. Consequently, Poland had to reorganize its energy system and change the national legislations in order to make it comply with European standards and policies.

However, a major discrepancy is noticeable. Poland is obliged by European law to increase its share of renewable energy to 15% in its gross final energy structure and 10% share of biofuels in the market for transport by 2020 (European Commission, 2009), but at the same time the country is strongly attached to its main source of energy; coal. This contradiction is visible even in the current policy strategy *Energy Policy for Poland until 2030* (p.9), which supports renewable energy, but at the same time "assumes using coal as the main fuel for the power industry in order to ensure an adequate level of energy security in the country" and even aims for "obtaining funds for development of the mining industry" (p.10). Moreover, according to CEE Bankwatch Network, the Polish government is supporting the coal lobby and "is determined to invest in climate damaging coal rather than focusing on renewable energy" (CEE Bankwatch Network, 2013: 1), despite its commitment to the EU renewable energy target. In addition, co-firing biomass in the coal-fired power plants is currently Poland's biggest and fastest growing type of renewable energy, which is labelled as "green" energy and thus receives subsidies from the government (Grzybowska, 2013). Still, the amount of renewable energy in the Polish energy supply has increased over the last decades, with renewables accounting for 11% of the electricity mix in 2014, as can be seen in Figure 1 (Graczyk, 2014).

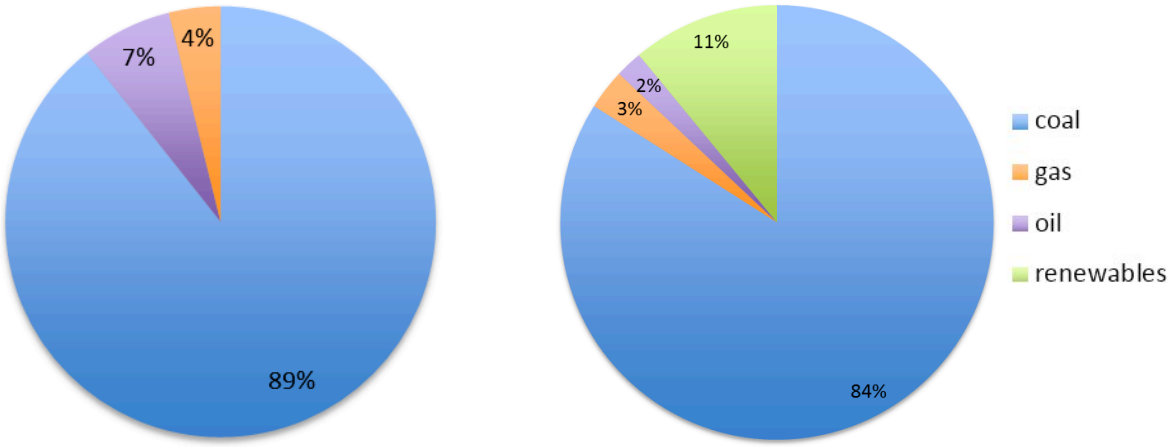

Figure 1: Sources of energy for electricity production in Poland in 1980 (to the left) and in 2014 (to the right) (own compilation based on data from GUS, 2012)

With such contradictory foundation, it is an even bigger challenge for the country to transform its energy sector towards more sustainable energy production. In sum, Poland constitutes an interesting

case study, especially as not much research (notably available in English) has been done on renewable energy development in Poland.

Thus, the main objective of this thesis is to provide an overview of renewable energy development in Poland, including key agents, main drivers and barriers for the development towards a more renewable energy generation mix, and finally providing suggestions for improvement. Thereby, the unit of analysis comprises all renewable energy technologies (e.g. wind, geothermal, hydro, solar, biomass), in order to display a broad picture of the renewable energy development in Poland, and focus on the **electricity** sub-sector, thus excluding from its scope, transportation, and heat. Furthermore, in order to get a deeper understanding of the transition from a fossil fuel based energy system towards an energy scheme based increasingly on renewable energy, I believe that it is not enough to solely focus on technical aspects, but also to include the social perspective. Therefore, stakeholders at micro, meso, and macro levels have been interviewed. This has served the purpose of presenting different points of view on the current energy system in Poland, which would complement each other, thus providing a comprehensive overview and consequently making this thesis scientifically and politically relevant.

This thesis is going to answer following research questions:

I. ***How can the development from a fossil fuel based energy system in Poland towards an energy scheme increasingly based on renewable energy be characterized?***
II. ***Who are the key agents involved in the development towards a less coal-dependent and more renewable energy sector in Poland? What is their role in this process?***
III. ***What are the main drivers and barriers for the development towards an energy sector increasingly based on renewable in Poland? How can these barriers be overcome?***

2. Transition Theory

Transition theory from *multi-phase* and *multilevel perspectives* will constitute the general frame for describing the development of renewable energy in Poland. Transition can be defined as a "structural social change that is the result of economic, cultural, technological, institutional as well as environmental developments, which both influence and strengthen each other" (Rotmans, 2005: 11). The transition theory can be described as an analysis of the dynamics of transition from multi-phase and multi-level perspectives (Geels, 2002, Rotmans, 2005).

Transition theory from a ***multi-phase perspective*** can be defined as "alternating phases of relatively fast and slow dynamics, which together form a strongly non-linear pattern where there is a shift from one dynamic state of equilibrium to the other" (Rotmans, 2005). This pattern (direction) is the consequence of shifting from one dynamic state of equilibrium to another, and comprises four main

phases, as can be seen in Figure 2. First is the *pre-development* stage where the marginal changes happen in the system's background and do not have any impact on the status quo, at the micro and meso level. Second is a *take-off* phase in which the structure of the system slowly starts to change. Third is an *acceleration* phase where the new pattern of the system becomes visible because of an accumulation of changes in the previous stages. Finally, there is a *stabilization* phase where the rate of fluctuation is minimal, and the net effect of any change is neutral. (Brugge & Haan, 2005; Rotmans et al., 2001). However, there can be different phases and trajectories of transitions. After pre-development and take-off there are various ways in how transitions can proceed. Some accelerate and stabilize whereas others get stuck in lock-in, reverse through backlash, or the system breaks down after take-off (Rotmans, 2005).

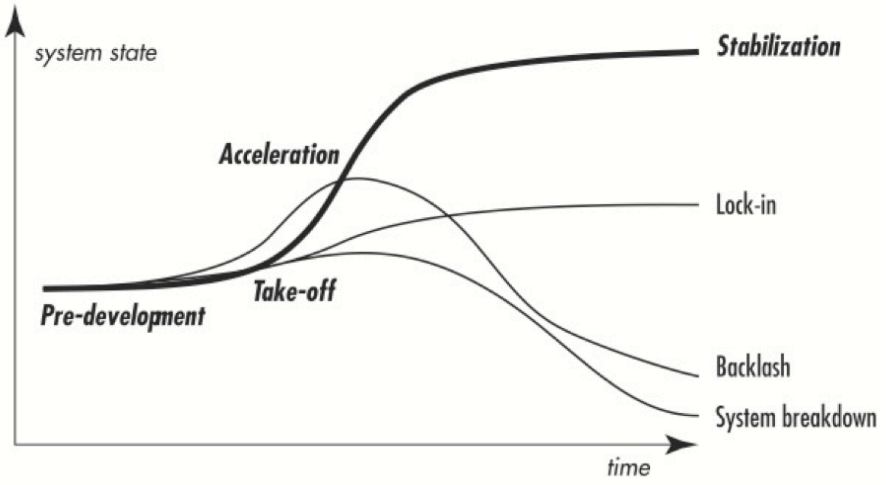

Figure 2: The different phases of a transition and different transition paths (Rotmans, 2005)

The second angle on transition theory is the ***multi-level perspective***. It analyses complex socio-technical system, composed by a wide array of agents and their relationships, which are affected by an equally broad range of change-inducing and change-blocking factors or mechanisms (drivers and barriers). The multi-level perspective distinguishes three levels of analysis: micro, meso and macro (see Figure 3) (Duitt et al. 2008: 311; Rotmans et al. 2001: 19). These three levels can be used as synonyms with niche, regime and landscape respectively, as presented by Geels (2002: 1261). The *niche* is a protective environment, where novelties like new technology can emerge (Geels & Verbong, 2006). The socio-technical *regime* consists of three interlinked dimensions: network of actors and social groups; formal, normative and cognitive rules; and material and technical elements (Geels, 2005). Regime can be change as a result of responses to niche pressure (Geels, 2002). Finally, the *landscape* consists of regimes in which niches are embedded (Rotmans et al., 2001). Developments at this level are relatively slow corresponding to the broad societal trends (ibid.).

Importantly, transition can take place when developments at niche (micro), regime (meso) and landscape (macro) levels move in the same direction (Rotmans, 2005).

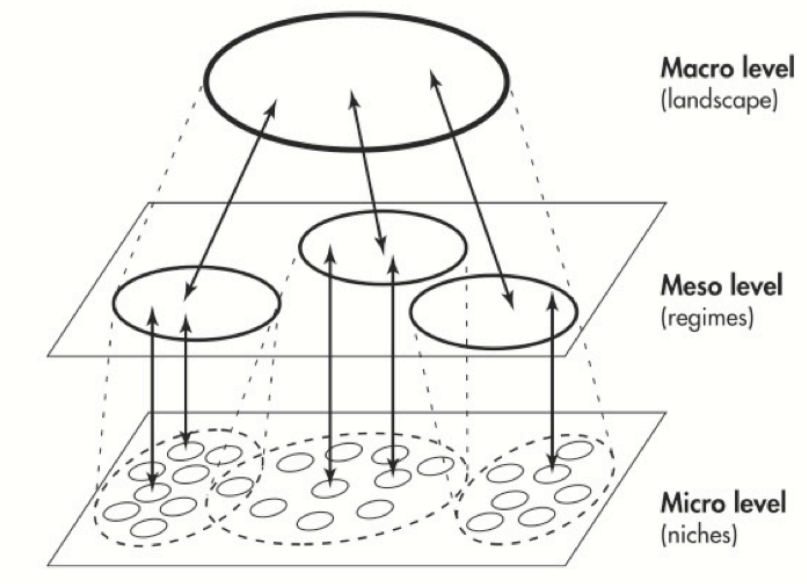

Figure 3: Multiple levels as a nested hierarchy (Geels, 2002)

Taking into account that "social actors can stimulate, slow down or even block a transition" (Rotmans at al., 2001: 25) it is necessary to consider their various perspectives in the analysis. Therefore, this thesis is based on points of view of diverse stakeholders important for the renewable energy development in Poland, in order to present the complexity of the changing energy system. Moreover, the multi-level perspective was used in this thesis to organize the agents at different levels: the EU represents the landscape; the Polish government, national governmental agencies, regional authorities (voivodeships, gminas, municipalities) are depicted as the regime; and energy producers (including micro-producers), transmission and distribution agents, as well as research institutes and civil society represent the niche.

3. Methodology

In general, there are three assumptions in research: ontological, epistemological and methodological (Bryman, 2008). Epistemology is closely related to ontology and methodology; "as ontology involves the philosophy of reality, epistemology addresses how we come to know that reality while methodology identifies the particular practices used to attain knowledge of it" (Krauss, 2005: 758).

The ontology and epistemology of this thesis is grounded in critical realism approach, which stress the fact that reality goes beyond what we can observe (Archer & Bhaskar 1998; Sayer 2000). This

perspective seeks explanations for a particular phenomenon at different depths of reality (Sayer, 2000).

The methodology consist of a qualitative study, which highlights that the social world can only be understood through an analysis of the interpretation of that world by its participants (Bryman, 2008: 366). The research strategy of this thesis is based on a single case study with a qualitative data collection process, combining in-depth interviews with literature and policy review, thus fulfilling the author's *triangulation* needs (Bryman, 2008: 183-184, 458). Triangulation refers to "the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings" (Bryman, 2003: 1142).

3.1 Ontology and Epistemology

Ontology focuses on the nature of the world and human being in social contexts (Bryman, 2008). Whereas epistemology is the philosophy of knowledge, which poses the following question: how do we know what we know? (Krauss, 2005). The ontology and epistemology of this thesis is grounded in ***critical realism*** approach. Critical realism "is committed to an explanatory framework which acknowledges and incorporates (a) pre-existent structures and as generative mechanisms, (b) their interplay with other objects possessing causal powers and liabilities proper to them in what in what is stratified social world, and (c) nonpredictable but none than less explicable outcomes arising from interactions between the above, which take place in an open system that is society" (Archer & Bhaskar, 1998: 377). According to critical realism approach, the world is a construct of various layers of realities (Archer & Bhaskar, 1998). The aim of the researcher is to explore the hidden relations and underlying mechanisms that construct these layers (ibid.).

3.2 Research Strategy - Single Case Study

The research strategy consists of a ***single case study*** aiming for in-depth description and analysis (Creswell, 2007) of Poland's development from fossil fuel based energy system towards more renewable energy. The case study was chosen as a research strategy because of its focus on contemporary, real-life phenomena, thus reflecting the exploratory nature of this research (Yin, 2013). Moreover, the case study allows examining dynamic relationships occurring over time (ibid.). Furthermore, this research strategy represents a unique strength, which is its ability to deal with a big variety of evidence (ibid.). Thus, this analysis uses a triangulation of data through combining literature and policy review with interviews, which increases this study's construct validity (ibid.). In order to assure reliability of this study, the methods of the data collection were precisely described, including an interview guide. This case study constitutes a good exemplification (Bryman, 2008: 56) and provides insight into sorts of challenges and strategic paths that a country being strongly

dependent on fossil fuels faces, when changing towards a more sustainable energy system. Despite the case-specific nature, the findings of this analysis will contribute to the general understanding of dynamics of energy systems development towards renewables, notably in eastern European countries, which resemble Poland in many aspects.

3.3 Qualitative Research Methods

In order to depict a holistic view on the development, the analysis will focus on the often neglected social perspective, by applying the qualitative research method of ***semi-structured, in-depth, expert interviews*** with different stakeholders at landscape, regime and niche level. The interviews were carried out in order to collect a broad spectrum of data, otherwise not available, and thus necessary for mapping out the renewable energy development in Poland, including e.g. (i) the interviewee's role in the process, (ii) their relationship with other key stakeholders in the process and (iii) critical factors that drive forward or block the energy development towards renewables, (iv) the interviewee's ideas on how to overcome these barriers. The qualitative research technique of in-depth interviews involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a given issue, what allows for in-depth exploration of the topic (Boyce & Neale, 2006). Semi-structured interviews were chosen in order to give the respondent the possibility to provide his/her own view on the topic without being restricted to pre-arranged answers (Kvale, 2008), and thus obtaining valuable insider information. An interview guide was developed for providing guidance during the interviews. The questions were developed based on three "major question that needs to be answered for a comprehensive account of transition dynamics" (Yucel, 2010: 21): When did it started? What happened? Why did it manifest itself in specific way? These questions were adapted to the context of Poland and several sub-questions were added. The research questions were adjusted during the research process.

A non-random sampling of experts from each stakeholder group (landscape, regime, niche) was conducted through applying *convenience sampling* and *snowball sampling* method (Bryman, 2008: 183-184, 458). The former method implies selection of interviewees based on the convenient accessibility and proximity to the researcher, and the later method generates potential interviewees through recommendations from already interviewed stakeholders (ibid.). Thereby, experts were defined as stakeholders, who have the technical and process-related knowledge on renewable energy in Poland. Altogether, 13 interviews, about 1 hour of length each, were conducted in Polish, representing all of the three different stakeholders groups. In order to follow ethical research standards (Creswell, 2007), interviewees were asked if they agree to be cited in this thesis with their names. The majority of interviewed stakeholders asked for anonymity while using their contributions

in this analysis, therefore no specific names were mentioned in this final report. However, the list of interviewed stakeholders can be found in the Appendix.

The interviews were conducted from April till June 2014 in Brussels as well as in Warsaw, and included in-person interviews, phone interviews, and email correspondence with key stakeholders. The interviews were audio-recorded and complemented with written notes, which included observations of both verbal and non-verbal behaviours as well as immediate personal reflections about the interview (Creswell, 2007). After collecting the data, it was analysed, subsequently categorized and coded based on the research questions (characteristics of the renewable energy development in Poland; key actors; drivers and barriers). As next step, pattern and connections within and between the categories have been identified. Finally, data was interpreted.

In general I have not faced many difficulties during the data-obtaining process. However, not all experts I have selected to conduct interviews with were willing to contribute to my study. I had to send a great number of requests, in order to find a sufficient amount of interviewees. However, doing internship in the Directorate General Environment and learning about the interrelations between the European Commission and other institutions helped me to find relevant and exalted actors.

A thorough ***literature and policy review*** was conducted for the purpose of understanding the context of renewable energy development in Poland, as well as for complementing evidence collected from interviews. The analysis included assessments mainly from national and European organizations working on energy matters, vital Polish and European policies and strategies in the field of energy, along with expert opinions from renowned online magazines and newspaper articles.

4. Case Study Context

4.1 Definitions

For the purpose of understanding the development from fossil fuels towards more renewable energy mix in Poland it is necessary to explain the basic definitions.

Natural resources are materials and energy in nature that are often classified as ***renewable resources*** (such as air, water, soil, plants, and wind) or ***non-renewable resources*** (such as coal, copper, and oil) (Miller & Spoolman, 2013: 8). The main difference between these two is that the former can be naturally replenished within days or several hundred years, the later exist in fixed quantity and thus are exhaustible (Miller & Spoolman, 2013). Thereby, nuclear energy is in itself not renewable as the resources need be mined and are finite (ibid.).

Renewable energy comes from those sources, which can be naturally replenished, as long as they are not used up faster than it is renewed (ibid.). Renewable energy sources include: wind, solar, biomass, hydroelectric, geothermal, wave, and tide.

Renewable energies have generally a much lower environmental and social impact than fossil or nuclear fuels (Boyle et al., 2003). Even if the system costs of renewable energy, including costs for transmission and distribution grids, balancing, grid instability etc., are currently higher that these of fossil fuels (Boyle et al., 2003), thanks to dynamic growth rates of renewables, which are driving down costs and spurring rapid advances in technologies, many of the renewable energy technologies are becoming more and more economically competitive with fossil fuels (Worldwatch Institute, 2014). While comparing price of fossil-fuels fired power to power produced from renewable energy, it is vital to include costs of externalities, such as extra costs for healthcare, negative environmental effects or extreme weather events related to climate change (ibid.). Including externalities in the calculations stresses additional benefits of renewable energy and makes it more competitive to fossil fuels. Moreover, renewables increase country's internal energy security, through making it more independent form fossil fuels imported from abroad.

4.2 Energy Situation in Poland

4.2.1 Basic Information about Poland

Republic of Poland is situated in Central Europe and bordered by Germany to the west; the Czech Republic and Slovakia to the south; Ukraine, Belarus to the east; and the Baltic Sea, Russia and Lithuania to the north. Poland has a territorial extension of approximately 312,679 square kilometres, what makes it the 9th largest country in Europe (Concise Statistical Yearbook of Poland, 2012). Moreover, it has a population of over 38.5 million people, thus being the 6th most populous member of the EU and the most populous post-communist member of the European Union (ibid.). Poland is a unitary state divided into 16 administrative subdivisions, so called voivodeships (see Figure 4), which prepare energy development strategy for its region and implement European and national energy policies (ibid.). The voivodeships are divided into 379 powiats, and the principal units of administrative division in Poland - 2459 gminas (ibid.). Powiats have rather limited powers, however, gminas support voivodeships in implementing energy policies on the local level.

Figure 4: The 16 voivodeships of Poland (GUS, 2004)

4.2.2 Non-Renewable Energy Sources in Poland

Poland belongs to the world's biggest producers of hard and brown coal (Polska, 2014). Its reserves of ***hard coal*** are estimated at 45.4 billion tons (ibid.). The main coalfield (Górnośląskie Zagłębie Węglowe) lies in the Silesian (Śląskie) Upland, in southern Poland, and is among the biggest hard-coal fields in the world (ibid.). With the annual production of 102 million tons (in 2000), hard coal can meet the country's energy demand for almost 500 years - twice as long as the world's average (ibid.). The brown coal reserves are estimated at nearly 14 billion tons and are located mainly in central Poland (Wielkopolskie voivodeship) and in its western part (Lubuskie voivodeship) (ibid.).

Coal has been the driving force of Poland's industrial development for decades (Hinc, 2013), thereby generating jobs, cheap fuel, but also water and air pollution (CO2, particulate matter (PM), nitrogen dioxide (NO2) and sulphur dioxide (SO2) emissions from coal burning). However, it becomes more and more difficult to access this fossil fuel (coal has to be extracted from deeper earth layers), consequently becoming more expensive (ibid.). This situation makes it increasingly profitable for energy providers to purchase coal abroad rather than domestically (ibid.). In regard of current events in Ukraine, the Polish government plans to resuscitate the coal industry in order to assure country's energy security (Easton, 2014).

Lately, deposits of ***natural gas*** and ***oil*** have been discovered in Wielkopolskie, Podkarpackie and Małopolskie voivodeships, as well as in the Baltic shelf (Polska, 2014). However, the already explored reserves of both sources are small and not sufficient to meet Poland's energy needs (ibid.). Nevertheless, the exploration of new deposits is still ongoing (Hinc, 2013).

Currently, Poland does not have any **nuclear power** plants, however, according to the document *Energy Policy of Poland until 2025* (Ministry of Economy, 2010), this source of energy will be developed in future, as it reduces CO2 emissions, but also increases energy security of the country. Thus, two nuclear plants are planned to be built in Śląskie and Pomorskie voivodeships (southern and northern Poland) and be functional in 2021 and 2025 (ibid.).

The increasing coal prices and energy security issue could provide important incentives for the Polish government and investors to spend money on renewable energy instead of fossil fuels.

4.2.3 Renewable Energy Resources in Poland

Not only the share, but also the dominant kind of renewable energy has been changing during the time (see Figure 5) (GUS, 2012). In 2002, energy from hydroelectric power plants was the main renewable energy source (82,4%), followed by biomass (13,7%), wind (2,2%) and biogas (1,7%) (ibid.). However, due to policies promoting renewable energy on European and national level, in 2012 the energy produced from biomass has become the dominant renewable energy (53,02%), followed by wind (24,3%), hydro power (15,5%), biogas (4,2%), geothermal (2%), biofuels (1%) and solar (0,08%) (ibid.). Thus, adding to the renewable energy mix also biofuels, geothermal and solar energy (GUS, 2012).

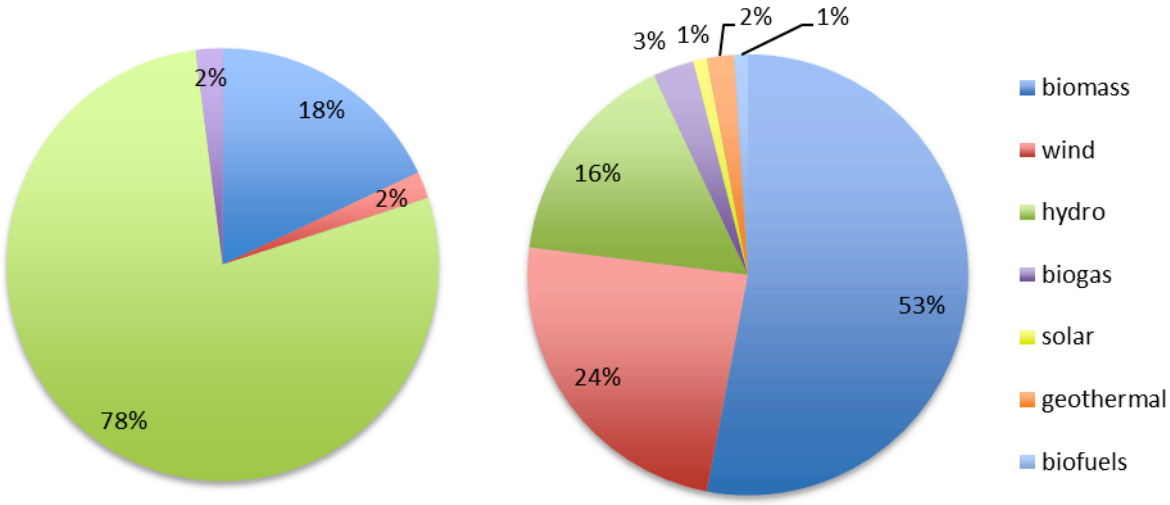

Figure 5: The percentage of renewable energy sources in the production of electricity in Poland in 2002 (to the left) and 2012 (to the right) (own compilation based on data of GUS, 2012)

Biomass is currently the dominant renewable energy in Poland. It is produced from burning waste wood (e.g. wood chips, pellets, waste wood from forestry, furniture and paper industry) as well as wood grown on plantations for the purpose of energy production (e.g. fast growing trees, perennial grasses, corn), and organic residues from agriculture and horticulture (e.g. waste from the

production of horticultural, livestock manure, straw) (GUS, 2012). The economic potential of biomass energy from perennial plantations is the greatest in the voivodeships: Lubelskie, Mazowiecke, Podkarpackie, and the smallest in Opolskie and Lubuskie (Wisniewski et al., 2011).

Wind energy is Poland's second biggest source of renewable energy (GUS, 2012). The technical potential of wind energy is significantly dependent on the spatial distribution of open areas, like arable land, which have a low complexity of ground and should not have any objects disturbing airflow (Wisniewski et al., 2011). The economic potential of wind energy in Poland is the largest on the north-east coast of the country: in Zachodnio-Pomorskie voivodeship (14 GW) (ibid.). However, the use of energetic potential depends on market conditions and policies in place (ibid.). Taking these into consideration, during the years 2014 to 2020, most of the wind turbines will be located in voivodeships: Zachodnio-Pomorskie, Pomorskie, Wielkopolskie, Kujawsko-Pomorskie and Podlaskie. It should be stressed that this situation might change if the system of support for wind energy will be altered (ibid.). There is also a potential of small wind turbines development in Poland, in paricular in Małopolskie, Mazowieckie, Podkarpackie, and Lubelskie voivodeships.

Hydropower constitutes the third biggest renewable energy source in Poland (GUS, 2012). Poland is a country with scarce water resources (Majewski, 2013). Thus, reserves of hydroenergy in Poland are not high (about 50 petajoule per year) and are the lowest reserves of all renewable energy sources in Poland, nevertheless, hydropower in Poland is relatively well developed (Gawlik et al., 2012). The construction of new big hydropower plants is rather not expected in the nearest future, as the potential of waters that is suitable for big power plants have already been used up (Wisniewski et al., 2011). Still, hydropower micro installations could be further developed in the future, if supporting policies would be adopted (ibid.).

Biogas is a gas consisting mainly of methane and CO2, obtained in the process of anaerobic digestion of biomass (ibid.). It has a share of 4.2% in the Polish energy mix (GUS, 2012). Most of the biogas in Poland is produced from sewage sludge (over 50 percent) and landfill gas (almost 40 percent). The remaining part of biogas is produced from other feedstock (e.g. energy crops, plant and animal wastes, animal production and plant production wastes) (Zochowska et al., 2012). Assessment of the potential of agricultural biogas usage in Poland shows the leading position of Mazowieckie and Wielkopolskie, followed by Podlasie and Kujawsko-Pomorskie voivodeships (Wisniewski et al., 2011).

Poland possesses also reserves of ***geothermal*** energy, which are available for use for heating purposes in the housing sector (Zochowska et al., 2012). This type of energy was proven to have the greatest potential among all renewable sources accessible in Poland (Kempinska, 2003). Moreover, Poland is regarded to have one of the largest low-enthalpy geothermal potentials in Europe, what

makes the energy more accessible (ibid.). The potential of use of geothermal energy is comparable across the whole country (Zochowska et al., 2012). Still Poland is just in the beginning of developing its geothermal energy use (ibid.).

Biofuels are the third type of energy produced from biomass. In recent years, there has been an increasing trend in biofuels production and consumption in Poland (Zochowska et al., 2012). However, it has still a very small share in Poland's energy mix of about 1% (GUS, 2012). There are two kinds of biofuels in Poland: bio-ethanol, which is made mainly form cereal (rye and wheat) and from corn; and biodiesel, which is made from rapeseed (ibid.). Due to the fact that consumption is rising significantly faster than production, the lacking bio-components have to be covered by an increase in imports (ibid.). In 2011, there were 20 producers of biodiesel and 13 for bio-ethanol registered in Poland (ibid.). The biofuels plants are situated all over Poland, however, most of the biodiesel plants are located in Dolnośląskie and Opolskie voivodeships and the bio-ethanol producers are mainly situated in Wielkopolskie, Śląskie and Małopolskie voivodeships (ibid.).

So far, ***solar*** energy has the lowest percentage in the Polish energy mix, only (0.1%) (GUS, 2012). The reserves of solar energy in Poland are relatively high, however, the solar radiation is highly irregular (best radiation from April till September), which makes the utilization of this energy source very difficult (Zochowska et al., 2012). For this reason, energy from solar collectors is mainly used in households for water (flat collectors) and house heating (vacuum tube collectors) (ibid.). However, the total market potential of solar thermal energy was estimated for more than 19 000 TJ (ibid.). The voivodeships with the greatest potential include: Mazowieckie, Śląskie, Małopolskie and Wielkopolskie, whereas the smallest: Lubuskie, Opolskie, Świętokrzyskie and Podlaskie (ibid.). Nevertheless, the diversity of market potential in case of solar energy is not high (ibid.). The development of solar energy in subsequent years depends on policy development, especially, on the content of the new Renewable Energy Act (ibid.).

Poland is rich in various renewable energy sources, which differ not only nationwide, but also in the scale of regions. However, as it will be shown in the analysis part of this thesis, there are several limitations, which hinder their effective use. These limitations are contingent among others on available resources and environmental constraints in the given regions (IEO, 2007).

After providing necessary definitions and the case-study context, this thesis will continue with a detailed analysis of the renewable energy development in Poland, in order to gain valuable insight about its key players and their role in the process; the characteristics of the development; the main drivers and barriers for the development towards renewable energy mix; as well as possible improvements of the current situation.

5. Analysis

This chapter will present the results of the analysis. However, before processing the data gathered in this study, it is important to precisely define the unit of analysis (Bergek et al., 2008). Firstly, the technological field boundary comprises all renewable energy technologies (e.g. wind, geothermal, hydro, solar, biomass), in order to display a broad picture of the renewable energy development in Poland (Bergek et al., 2008: 412). Secondly, the sectorial boundary includes the electricity sub-sector, thus excluding from its scope, transportation, and heat. Finally, the spatial boundary was set by analysing Poland as a case study. Taking into account that technology adoption and diffusion is often influenced by international dynamics (Bergek et al., 2008: 409), the European dimension will also be taken into account.

Each section of the analysis focuses on answering one of the research questions. Thus, section 5.1 provides an answer to the first research question about the current characteristics of the development of Polish energy sector from fossil fuel towards more renewable energy mix. The section 5.2 answers the second research question by naming the key agents and their role in the development towards more renewable energy generation in Poland. The sections 5.3 and 5.4 provide a reply to the third research question, which looks into the main drivers and barriers for further development of renewable energy in Poland and also propose solutions, which could facilitate this development and ensure long-term sustainability of Polish energy sector.

5.1 Outline of Legislative Changes and Their Impact on Renewable Energy Development in Poland

The first and foremost Polish legislation on renewable energy was the *Energy Act* of April 10, 1997 (Kancelaria Sejmu, 1997). This Act regulates, inter alia, issues such as the state energy policy rules, the terms and conditions for supply and use of fuels and energy, policies for energy companies and the authorities competent in matters of fuel and energy (ibid.). This regulation was a result of the initiative taken by the EU to promote renewable energy in Europe through elaboration of the White Paper of the European Commission *Energy for the future: renewable sources of energy* (European Commission, 1997), which described how the energy production from different renewable sources should develop in the future and obliged the member states to contribute to this development (ibid.).

In 2010, the first national legal regulation on renewable energy sources has been introduced - *the Regulation of the Minister of Economy of December 15th*, which obliged distribution companies to purchase electricity and heat from unconventional and renewable sources (Ministry of Economy, 2010). It was the first national legal regulation on renewable energy sources (ibid.). In 2003, some

changes in the Energy Act have been introduced: an obligation to purchase renewable energy for all electricity-trading companies, which are required to ensure the relevant share of energy from renewable energy sources in electricity sales volume, was imposed (ibid.). In result, in 2010 a share of 7.5% of energy from renewable energy sources was achieved (ibid.). On the 23th of August 2001, the parliament of Poland has adopted the resolution on the *Development Strategy on Renewable Energy Sector* (ibid.).

At the time Poland became a Members State of the EU in 2004, the country had to fully adjust its national renewable energy legislation to EU principles, especially provisions of *Directive 2001/77/EC on the promotion of the electricity produced from renewable energy sources in the internal electricity market*, setting the share of electricity produced from renewable energy sources in total Community electricity consumption by 2010 (European Commission, 2001). As a result, on 2nd of April 2004, amendments to the Energy Act passed, resulting in significant changes to the subsector of renewable sources in electricity (Ministry of Economy, 2010). The biggest novelty was the of Tradable Green Certificates system in 2005, which was confirming that a certain amount of electricity would be generated from renewable sources, irrespective of electricity sales (ibid.).

On the 4th of January 2005, the Council of Ministers has passed the strategy *Energy Policy of Poland until 2025*, which provided monitoring and development of renewable energy support mechanisms, in order to increase the application of market principles in the national energy sector (Ministry of Economy, 2010). Further changes to the Energy Act were introduced based on the Act of the 4th of March 2005: energy companies selling electricity to end consumers were obliged to obtain and present for cancellation certificates of origin or pay so-called substitution fee; reduction of the fee for connection to the grid, determined based on actual outlays incurred for installing the connection for renewable energy sources with total installed power not exceeding 5 Megawatt (MW) and cogeneration units with power not exceeding 1 MW; special principles of wind farm balancing; additional support to small renewable energy sources (below 5 MW) producing electricity (for instance: exemption from stamp duty for issuing the licence and certificates of origin) (Habczynska-Pilarek, 2011). Implementation of the new system accelerated the development of renewable energy sources in Poland in years 2006-2008 (ibid.). Investments in renewable energy were attractive, also because of available financial support provided in form of grants and investment loans bearing low interest rate: from public funds, including EU funds within financing of Operational Programme (Infrastructure and Environment and Regional Operational Programmes); from regional funds, including from the budget of the European Union, within the scope of support to investment projects pertaining to renewable energy sources; from funds of the National Fund for Environmental Protection and Water Management (Narodowy Fundusz Ochrony Srodowiska i Gospodarki Wodnej);

from funds of the Eco-Fund that provided co-financing for investments in solar, wind, biomass and biogas energy, and highly efficient co-generation in the years 2005-2009; from resources of the European Economic Area, including the Norwegian Financial Mechanism that provided co-financing for, inter alia, projects increasing the use of renewable energy sources in the years 2004-2009 (Ministry of Economy, 2010). In 2009, the strategy *Energy Policy of Poland until 2030* was adopted, which describes the goals for development of renewable energy in Poland in the context of energy security and sustainable development.

Since 2010, the national renewable energy policy has been focused on implementation of 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 aiming for 20% share or renewable energy by 2020*, including in particular preparation and adoption of necessary normative acts (European Commission, 2009a), as well as the *Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity* (European Commission, 2009b) and the *Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas* (European Commission, 2009c). This package of three directives is also called the "energy three-pack" (ibid.). As a response to the new legislations, on the 7th of December 2010, the Polish Ministry of Economy has published the *National Action Plan* in the field of renewable energy (Ministry of Economy, 2010), which sets national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020. It takes into account the impact of other policy measures relating to energy efficiency on final consumption of energy, and adequate measures to be taken to achieve national overall targets of 15% for the share of renewables in gross final energy structure and 10% share of biofuels in the market for transport till 2020 (ibid.). The document also defines the cooperation between local, regional, and national level, the estimated surplus of energy from renewable sources, which could be transferred to other member states, a strategy to develop existing biomass resources and mobilize new biomass resources for different uses, and the measures to be taken to fulfil the relevant obligations under the Directive 2009/28 (ibid.).

It is remarkable that, since 2010, the progress on renewable energy legislation has considerably slowed down in Poland (personal communication, EU representative, 2014). Moreover, the deadline for the introduction of the regulations implementing these directives expired on the 3rd of March 2011 for the first two Directives and on the 5th of December 2010 for the third one and therefore, European Commission has initiated proceedings before the EU Court of Justice to impose a fine on Poland for failing to implement the Energy and Gas Directive (ibid.). Surprisingly, "in the face of the real threat of fines, work on the three-pack instead of speeding up has almost ground to a halt"

(Balicki, 2013: 1). Although there have been several drafts, both directives still have not been implemented into the Polish legal framework. The reason behind this situation is above all the lacking political will to encourage further development of renewable energy in Poland, as well as the strong position of coal lobby (see section 5.3.2).

However, lately, some progress has been made - on the 10th of June 2014, the Polish government has adopted the draft for the new *Renewable Energy Act*, which should implement changes required by the Directive 2009/28 (Ministry of Economy, 2014). The new draft provides support to maintain the current system based on green certificates for existing renewable energy installations (ibid.). Furthermore it introduces an auctioning system, which will be operational from 2015 (ibid.). Existing producers will have the choice whether to join it or remain in the system of certificates (ibid.). The new legislation will be favourable for small-scale energy producers (ibid.). Moreover, financial support for co-firing biomass in the coal-fired power plants was reduced by half (ibid.). Still, the legislative act has to be notified by the Polish parliament and the European Commission, thus possible changes to the draft can be introduced, and in result, it will come into force in late 2016 or even early 2017 (Rynek Infrastruktury, 2014).

The above outlined legislative changes indicate two important points. First of all, it becomes clear that the main impetus for change towards more renewables in Poland was provided by the EU's legislation, with which Poland as a member state had to comply with. The EU and its legislative acts have been seen as the main driving force by all interviewees (personal communications, EU, national, niche representatives, 2014). Especially crucial was the need to comply with European legislative acts in the area of energy in the perspective of Poland's accession into the EU (personal communication, EU representative, 2014).

Secondly, the legislative deadlock constitutes a significant hindrance for further development of renewable energy in Poland (personal communications, EU, national, niche representatives, 2014). Regulations and stable operating conditions in the energy sector are necessary and should be introduced as soon as possible, in order to secure large, expansive, and often long-term investments in the energy sector (personal communication, energy producer representative, 2014). Not knowing how the energy sector in Poland will develop in the future (e.g. which technologies will receive state funding) has caused stagnation in renewable energy investments since 2011 (personal communication, EU representative, 2014). The regulations included in the new draft of the Renewable Energy Act are of vital importance for the direction of Polish energy sector development (ibid.). This issue will be discussed in more detail in the chapter 5.3.

Moreover, coming back to transition theory, the development of the Polish energy sector can be

described by multi-phase and multi-level perspectives. Based on Rotmans' (2005) four main transition phases, and on information collected during interviews, renewable energy development in Poland, after pre-development and take-off stage, is now stuck in a ***lock-in*** situation, due to a lack of national regulations and stable operating conditions in the energy sector (personal communications, landscape and niche representatives, 2014). Consequently, the stabilization phase has not yet been reached.

From the multi-level perspective, all three levels (landscape, regime, niche) have been involved in the process of increasing support for renewable energy in Poland. Moreover, stakeholders from these levels were interacting with each other. Agents, which were important in this process, as well as the relationships between them, are described in more detail in the following section 5.2.

5.2 Definition of Key Agents for Renewable Energy System in Poland and Their Interrelations

Based on the conducted interviews and literature review, following agents are relevant for the development of renewable energy system in Poland:

European Union: the European Commission provide legislation, which (with approval from the European Parliament and European Council) is binding for all member states, including Poland, thus providing the impetus for further development of renewable energy technologies in Europe (personal communication, EU representative, 2014).

Government and national government agencies: the Polish government and the Ministry of Economy, which is responsible for renewable energy, play a very important role, as they are responsible for implementing European laws, adopting national regulations and providing favourable conditions and incentives for investment in renewable energy in Poland (personal communication, Ministry of Economy representative, 2014).

Regional authorities (voivodeships, gminas, municipalities): the local authorities are responsible for implementing national regulations and overseeing the development of communities and territories in their region, at the same time being contact points for example for local renewable energy producers. It is their responsibility for example to keep a balance between small-scale producers and big energy companies (personal communication, national-level representative, 2014).

Energy producers (including micro-producers), transmission and distribution agents: these actors are necessary for the production, transmission and distribution of energy to the consumers. Conducting investments in renewable energy technologies, they all are influenced by the international trends and national legislation in the field of energy (personal communication, energy producer representative, 2014).

Research institutes: they provide the needed knowledge on renewable energy and foster innovation in this sector (personal communication, research institute representative, 2014).

Civil society: non-governmental organizations represent diverse interests and wide range of activities. Some promote renewable energy in order to promote environmental protection (e.g. decreased CO2 emissions), others emphasise the disadvantages of these technologies (e.g. windmills on bird migration pathways, unsustainable biomass). It is crucial that opinion of the civil society is included in decision-making and policies on RE, in order to provide different perspectives and include issues, which otherwise could be left out, thus lead to biased decisions or regulations (personal communications, civil society representatives, 2014).

Figure 6 visualises the various agents, levels at which they have been categorised and interactions between the different levels, which are marked with arrows.

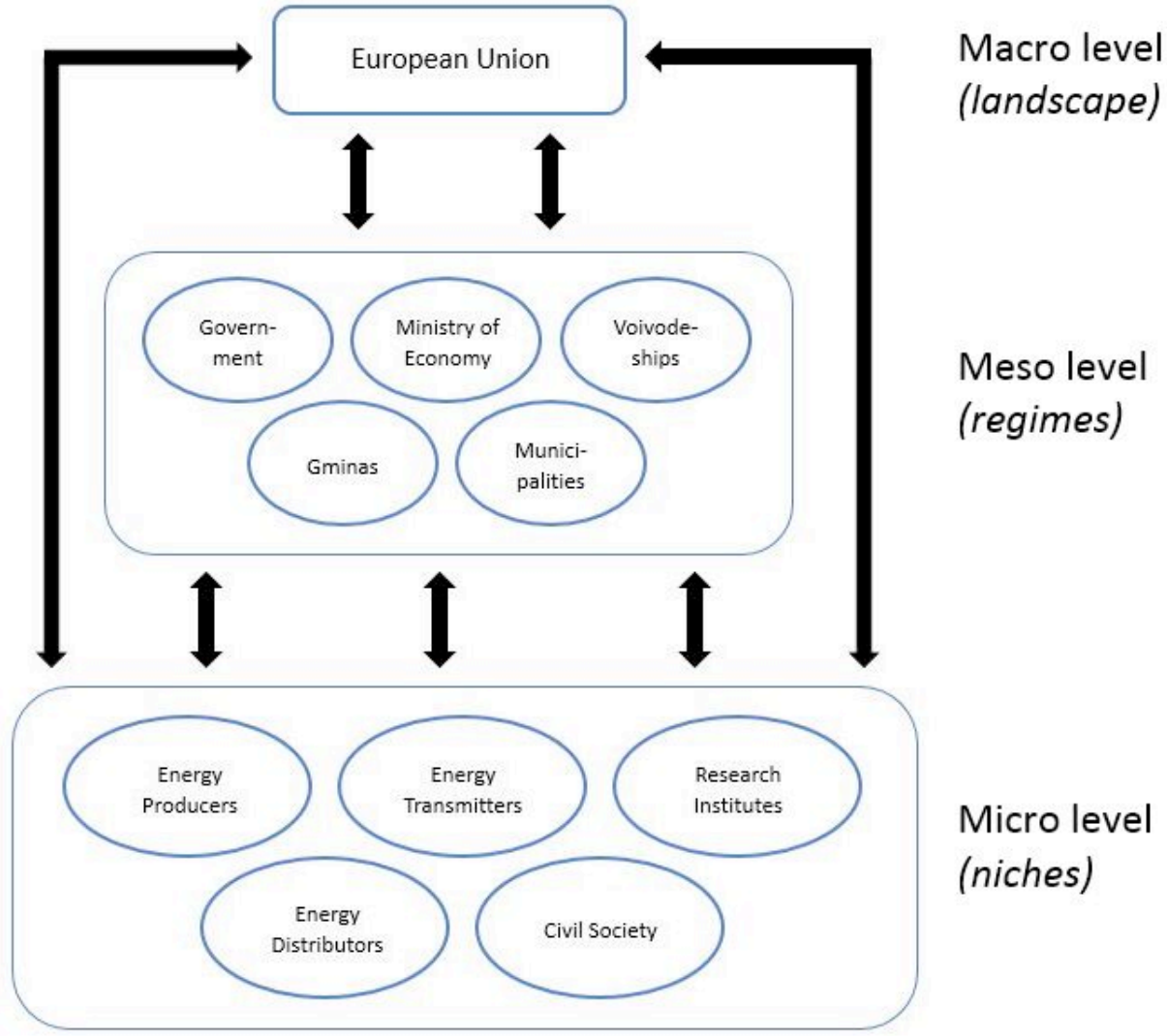

Figure 6: An overview of agents and their interactions important for renewable energy development in Poland (own compilation based on Geels's (2002) multiple levels model).

Considering, that these actors act at different levels, the multi-level perspective was used to organise them into three main categories: landscape, regime and niche. The landscape level is represented by the EU, depicting the international context. The Polish government, the national governmental agencies, regional authorities (voivodeships, gminas, municipalities) describe the regime. Last but not least, the niche comprises energy producers (including micro-producers), transmission and distribution agents, as well as research institutes and civil society.

All these agents were given the possibility to take part in the consultation process of the new Renewable Energy Act, thus improving the draft of the legislation, which will impact the future development of renewable energy in Poland (personal communication, Ministry of Economy representative, 2014). However, apparently not all stakeholders were taken into account to the same extent (personal communication, civil society representative, 2014). According to an interviewee (personal communication, civil society representative, 2014), the national government has been favouring big energy companies and the coal lobby. Moreover, even though some of the comments from the civil society were included in the first draft of the Renewable Energy Act, it was not accepted by the Ministry of Finance and other opposing parties (ibid.). The second draft of the new legislation was prepared by the national government without the consultation procedure, thus not including opinion of civil society (ibid.). This development might lead to policies being implemented, which aim to maintain the status quo with a strong coal industry, and do not benefit the environment and small-scale renewable energy producers (ibid.).

Based on findings from section 5.1, the development towards a more renewable energy mix in Poland can be described by the ***top-down approach***. This means that the EU and its legislative acts are the driving force influencing the national level, which, through its national policies (e.g. subsidies for renewable energy technologies), has in turn mobilised the investors at the niche level to invest in renewable energy in Poland. Despite the European level being the main driving force, there are more interrelations between the various levels (regime-landscape, national-regime, regime-niche and landscape-niche). The European Commission is drafting legislations, which however have to be approved by the European Council (member states representatives) by the qualified majority, thus giving the member states possibility to modify or even dismiss the legislative proposal. Another interrelation exists between the national and niche level: while drafting legislations, the government provides consultation possibilities for the civil society to provide their input, thereby enabling the niche level to influence the regime. Moreover, large energy companies can influence European as well as national polices through lobbying activities. According to Corporate Europe Observatory (2011), a watchdog organization, there are 15-30'000 lobbyists targeting EU decision makers in Brussels, what matches nearly the 31'000 staff employed by the European Commission, at the same

time making it second only to Washington in the concentration of those seeking to affect legislation. For example, the Central European Energy Partners (CEEP), which are supported by Polish government, "lobbies the European Commission to not further tighten environmental policy and instead promote energy from coal" (CEE Bankwatch Network, 2014).

5.3 Identification of Inducement and Blocking Factors for Further Development of Renewable Energy in Poland

Based on the interviews with stakeholders from landscape, regime and niche level, several inducement and blocking factors for the further development of renewable energy in Poland have been identified. Through interviewing a broad spectrum of relevant actors, various points of view have been included, hence complementing each other and presenting a comprehensive overview of drivers and barriers.

5.3.1 Drivers for Further Development of Renewable Energy in Poland

All interviewed stakeholders have agreed that the most important driving force for development towards more renewable energy in Poland are the **European Union policies** (personal communications, EU, national, and niche-level representatives, 2014). The European Commission is continuously preparing new strategies and directives on renewable energy, thereby pushing for more ambitious targets. The most important European strategies include, the 2020 Climate and Energy Package, (which aims for a 20% reduction in EU greenhouse gas emissions from 1990 levels, 20% share of EU energy consumption produced from RE, and a 20% improvement in the EU's energy efficiency), and the new 2030 Framework for Climate and Energy Policies (which goal is to reduce EU domestic greenhouse gas emissions by 40% below the 1990 level, increase the share of renewables to at least 27% by 2030, and continue to improve energy efficiency) (personal communication, national-level representative, 2014). In case of non-compliance with European law, the Commission has powers to try to bring the infringement to an end, but also may refer the case to the European Court of Justice, which in turn can impose financial penalties on the member states.

Increasing amount of **national and regional policies** on renewable energy in Poland constitutes another important driver. Legislations at the national level are an assurance that the government will continue with its policy promoting renewable energy, hence providing vital precondition for future investments (personal communication, national, energy producer & civil society representative, 2014). The national policies were described in chapter 5.1. Particularly important is the Tradable Green Certificates system, which entered into force in Poland in 2005, and aims for achieving the specified renewable energy goal, while at the same time ensuring cost-efficient development of renewables in a liberalised energy market (personal communications, national level representatives,

2014). However, not only national, but also local policies are of high importance (personal communication, national-level representative, 2014). Each voivodeship in Poland has its own strategy on how it wants to develop in the coming years in the field of energy, which has however to be in line with the national strategy and legislation (ibid.). It was stressed, that regional, smart development of renewables is very important (ibid.). Whereby, "smart" means that the right renewable energy technology (e.g. wind mills) is chosen for the right location (region rich in wind), or that not only big energy producers are promoted, but also small-scale energy production receives support (ibid.). Especially the regional authorities have recognised the benefits of renewable energy (e.g. energetic independence, innovation etc.) and are actively promoting "green" energy in their regions (personal communication, civil society representative, 2014).

Investments in renewable energy are also driven by the **financial incentives** offered by the national government (personal communication, national and energy producer representative, 2014). Financial support for investments in renewable energy is provided in form of grants or borrowings and investment loans bearing low interest rate coming from public and regional funds, including EU funds, as well as funds from the National Fund for Environmental Protection and Water Management (Narodowy Fundusz Ochrony Srodowiska i Gospodarki Wodnej); funds of the Eco-Fund that provided co-financing for investments in solar, wind, biomass and biogas energy, and highly efficient co-generation in the years 2005-2009; and resources of the European Economic Area, including the Norwegian Financial Mechanism (Ministry of Economy, 2010). In addition, other investment incentives include for example: 50% reduction of the fee for connection to the grid; obligation to purchase energy produced from renewable sources imposed on energy sellers; exemption from stamp duty for issuing the licence and the certificate of origin (in case of power < 5 MW); and exemption from the duty to pay annual fee to the state budget for obtaining the licence for energy generation (in case of the producer's power < 5 MW) (ibid.).

Taking into account Europe's energy dependency from Russia's gas and the current military conflict in Ukraine, the **energy independence and security** has gained on importance (personal communication, Ministry of Economy representative, 2014). Extending the share of renewable energy in the Polish energy mix, will allow to be less depended on fossil fuels, as oil and gas, imported from outside the EU, like for example Russia (Wisniewski et al., 2011). Fossil fuel prices have been constantly growing and the supply became increasingly uncertain, thus investments in renewables assure energy independence and security.

Furthermore, Poland has a **high potential in renewable energy** (personal communication, national-level representative, 2014). There is a big variety of renewable energy sources in Poland available for energy generation (see chapter 4.2.3). From the perspective on technical potential, the solar and

geothermal energy have the highest potential, while the lowest one is hydropower (Wisniewski et al., 2011). Taking into account environmental concerns (e.g. air pollution, biomass imports from abroad etc.), energy from biomass is the most limited renewable energy (ibid.).

Renewable energy is also promoted through **research institutes**, which provide useful data and advice (personal communication, national-level representative, 2014). For example the Świętokrzyskie Centre for Innovation and Technology Transfer (Świętokrzyskie Centrum Innowacji i Transferu Technologii) works mainly on research transfer, at the same time being an information and advisory centre for medium and small enterprises, and offering trainings on renewables (ibid.). Thus, by providing research and support to investors, which often lack the knowledge in the field of renewables or administrative processes, the institute directly contributes to an increased investment in renewable energy in Poland (ibid.).

Also **bottom-up initiatives** and **entrepreneurship** in the field of renewable energy have to be taken into account (personal communication, civil society representative, 2014). Through the simplified transfer of information, investors who have seen the development of renewable energy in other countries, bring these ideas to Poland (ibid.). Considering bottom-up initiatives, it is worth mentioning the Climate Coalition (Koalicja Klimatyczna), which is an alliance of NGOs in Poland interested in activities to protect the global climate. It coordinates joint activities of the organization included in the coalition, monitors the media and politics, organizes conferences, debates, workshops, training etc.

An overview summarizing all the driving factors for renewable energy development in Poland can be found in Figure 7.

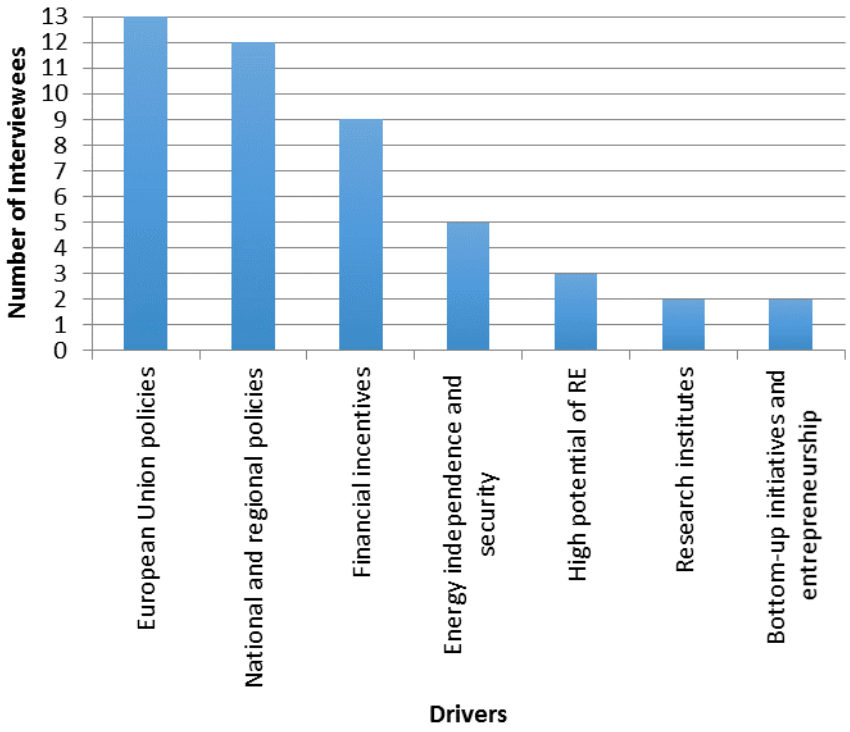

Figure 7: Overview of drivers for renewable energy development in Poland (own compilation)

5.3.2 Barriers for Further Development of Renewable Energy in Poland

All interviewed stakeholders mentioned the ***lack of a clear and reliable policy framework***, which manifest itself in the substantial delay of implementation of the new Renewable Energy Act, as the most important barrier for further development of renewable energy in Poland (personal communications, EU, national, and niche-level representatives, 2014). Long-term commitment, stability and reliability of the policy framework are vital precondition for any investment in renewable energy (ibid.).

The delay of the Renewable Energy Act was caused by a very long consultation process and inclusion of the comments into the legislative draft (personal communication, ministry of economy, 2014). However, according to civil society representative (personal communication, 2014), the national government has been favouring big energy companies and the coal lobby, and the latest draft of the new legislation was prepared by the national government without any consultation procedure, thus not including opinion of civil society (ibid.). There is no clarity about the cause for this legislative delay.

Furthermore, the newest draft of the Energy Act has more drawbacks then just the implementation delay (personal communication, civil society representative, 2014). Most importantly, the new document aims for 15% of renewable energy in Poland's gross final energy structure and 10% share

of biofuels in the market for transport by 2020, but does not aim for further increase of renewable energy in the future (ibid.)! The Energy Act does not include a long-term strategy for renewables - its goal is just to keep the same level of renewable energy in the coming years (ibid.). In addition, biomass co-firing will continue to be promoted (under a different name) (ibid.). Taking this into account, the latest legislative draft seams to aim for keeping the "status quo" (personal communication, civil society representative, 2014). According to another civil society representative (personal communication, 2014), the latest Energy Act draft will continue to promote big-scale renewable energy production as well as co-firing with biomass in coal plants. Thus, it appears that the political will to increase the share of "green" energy in Poland is missing at the national level.

A strong position of the coal lobby is another important barrier for further development of renewable energy (personal communications, EU, national and niche-level representatives, 2014). Poland has a long-standing tradition of coal, which, since centuries, provides cheap energy as well as work for thousands of miners (personal communications, national-level representatives, 2014). Thus, mining and burning coal is not only important because of the tradition, but also because of workplaces and possible unemployment in case of reduced coal production (ibid.).

Coal in Poland, as put by a niche-level representative (personal communication, 2014), is seen as a "holy cow in India" - it is part of Polish tradition and no one will oppose it. The support for coal industry is visible in several documents and national strategies, as for example *Energy Policy for Poland until 2030 (2009), National Renewable Energy Action Plan (2000), Strategy for Sustainable Development of Poland until 2025 (2000).* For example, the current policy strategy *Energy Policy for Poland until 2030* (p.9), supports renewable energy, but at the same time "assumes using coal as the main fuel for the power industry in order to ensure an adequate level of energy security in the country" and even aims for "obtaining funds for development of the mining industry" (p.10). Moreover, a new coal plant, which will be one of the largest in Europe, is planned to be built in Pomorskie voivodeship (personal communication, national-level representative, 2014). Not governmental organisations (NGOs) have created a homepage with information on how destructive the new coal plant would be for the region, thus mobilising citizens to act against this plant - several demonsrtations have already taken place (StopEP, 2014).

According to a national-level representative (personal communication, 2014), Slaski voivodeship, which is the main producer of coal, cannot completely give up on coal, but instead tries to balance the use of renewable energy with energy produced from coal. The region invests in solar panels, biogas energy as well as hydropower (ibid.). In addition, money is spent on clean coal technologies, in order to reduce CO2 emissions from burned coal (ibid.).

Furthermore, majority of the big companies on Polish energy market is under control of the treasury, thus having little incentives to invest in renewable energy and continue to base their activities mainly on coal (personal communication, 2014). Considering that more than 85% of electricity is produced out of coal, Poland is one of the biggest coal users in EU (CEE Bankwatch Network, 2013), it is and will be a challenge to change current energy patterns.

Another factor hindering further development of renewable energy is its ***high investment costs*** for the state as well as for private companies (personal communications, national-level representatives, 2014). According to estimates (Graczyk, 2014), the Polish state will have to pay between 5 and 13 billion Polish Zloty (around 1.5 to 3.5 billion Euro) per year, in order to reach compliance with the target set by the EU (15% renewable energy in Poland's gross final energy structure and 10% share of biofuels in the market for transport by 2020). The investments are high, because new infrastructure for renewable energy has to be built and old energy plants have to be modernized (personal communication, national-level representative, 2014). Moreover, if Poland would have more time to implement the European directives, the cost would be much smaller (Graczyk, 2014). However, new workplaces and reduced costs due to a reduction of CO2 emissions should also be taken into account (personal communication, civil society representative, 2014).

Interviewees have also mentioned ***public acceptance*** as an important hindering factor (personal communications, European, national and niche-level representatives, 2014). Renewable energy infrastructure, as windmills or solar panels, are facing reluctance of local communities, which claim that renewable energy is "destroying" their landscape. There are several factors influencing public acceptance: personal (age, gender, class, income); social-psychological (knowledge and direct experience, perceived impacts, environmental and political beliefs, place attachment) and contextual (technology type and scale, institutional structure and spatial context) (Devine-Wright, 2007). The attitude of people living in an area were renewable energy installation are planned to be built is of great importance, as they have to provide a planning permission for the project (personal communication, national-level representative, 2014).

Lack of knowledge is another constrain for further development of renewable energy in Poland (personal communications, national and niche-level representatives, 2014). Based on conducted interviews, three different types of knowledge were mentioned, which all are (to a high extend) missing. First, it is basic knowledge about what renewable energy is and how it is produced. Second type, is more detailed knowledge about how to install and manage a renewable energy technology and what administrative procedures are needed. Third, is knowledge about possibilities of receiving additional funding, for example from the EU. According to studies (GUS, 2012), the knowledge about renewable energy is on average very low in Poland. Every third Pole does not know any renewable

energy source (ibid.). In case of Poland, where an average citizen does not know much (or nothing at all) about this "green" type of energy, it is much more difficult to promote renewables. The pressure put on the government coming from the society (mainly NGOs) is very limited, thus being not sufficient in order to enforce political changes: decrease coal use in favour of renewable energy. People are also used to traditional patterns energy production (coal) and reluctant towards changes, thus they might show negative attitude towards new technologies like renewable energy (personal communication, niche-level representative, 2014). Considering the second type of knowledge (RE management & administrative formalities), there is a lack of information for potential investors submitting application for authorization, certification, and licensing (personal communication, national-level representative, 2014). Finally, the knowledge about possible funding for example from the EU is also limited (personal communication, national-level representative, 2014). Potential investors do not know where to look for information as well as whom to contact (ibid.).

Poland has an ***insufficient grid regulation and infrastructure*** for renewable energy, which hinders the expansion of "green" energy technologies (personal communications, national-level representative, 2014). There is a clear need for a more spread network and better quality of grid infrastructure, however, this is a very costly project (ibid.). Enlarging the grid infrastructure would allow to connect it with more renewable energy installations (ibid.). Currently, the grid development does not keep abreast of the fast growing amount of new biogas installations (personal communications, national-level representative, 2014). An interviewee representing civil society (personal communications, 2014) has pointed out that networks operators play a decisive role, as they can decide if they will or will not connect the renewable energy producer to their grid. This puts energy producers in a disadvantageous position.

In addition, the current Tradable Green Certificates system is facing the problem of oversupply, thus causing a ***price drop of green certificates*** (personal communications, landscape level representative, 2014). In February 2013, the price of certificates has fallen to one third of the face value (ibid.). As a result, those who have invested in renewables, especially in biogas, wind and hydropower, have lost their ability to repay loans taken for renewable energy projects (ibid.). This development has decreased investments in renewables (ibid.).

Moreover, the ***lack of sufficient support for small-scale producers*** of renewable energy is another factor hindering further development of renewable energy in Poland (personal communications, national and niche-level representatives, 2014). Energy produced in small installations is more expansive than produced in big power plants, nevertheless, it is necessary from the environmental point of view, as well as for achieving the 15% renewable energy goal (personal communication, niche-level representative, 2014). According to newest studies (IEO, 2014), 45% of Poles would like to

install renewable energy technologies in their homes. Thus there exist great potential, which cannot be released because of missing regulations in this field (personal communication, niche-level representative, 2014). The new Renewable Energy Act is partly reducing the legislative and administrative formalities, what should encourage small-scale renewable energy production (Ministry of Economy, 2014). It is vital to encourage potential investors with a system of transparent and foreseeable guaranteed fixed tariffs, however, it is unknown if such measures will be included in the new Renewable Energy Act (personal communication, niche-level representative, 2014).

Intermittency of renewable energy, like wind or solar power, creates the need of using existing power stations on standby, which creates additional costs (personal communications, national level representatives, 2014). The use of small amounts of intermittent power has little effect on grid operations (ibid.). However, while using larger amounts of intermittent power an upgrade or redesign of the grid infrastructure might be necessary (ibid.).

Environmental concerns were mentioned as another barrier for renewable energy development (personal communications, landscape and niche-level representatives, 2014). First of all, it is not allowed to build windmills on bird migration routes, because of the increased risk of bird injuries (personal communication, niche-level representative, 2014). Secondly, renewable energy installations are not permitted on areas protected by *Natura 2000* (personal communication, landscape-level representative, 2014). Natura 2000 is an ecological network of protected areas in the EU (ibid.). Currently, areas protected under this network in Poland amount for 20% of the country, thus considerably decreasing possible locations for renewable energy installations (ibid.). Finally, there are environmental concerns in regard to biomass (personal communication, niche-level representative, 2014). The market for biomass production in Poland is developing well, however, there is not enough biomass available in order to meet the demand (ibid.). Therefore, increased imports of biomass, for example from Africa and Russia, have occurred (ibid.). Importing wood pellets from abroad is not sustainable, at the same time offsetting a positive effect of renewables, by making Polish energy producers dependent on imports from abroad.

Spatial constraints constitute a barrier for locating renewable energy installations (personal communication, national-level representative, 2014). The conditions for a given renewable energy technology vary depending on the region (see also section 4.2.3). Therefore, it is vital to know what is the potential for renewable energy sources in a given region and what technologies would be most appropriate (personal communications, national-level representatives, 2014). Investing in a wind farm in an area where there is little wind would not be a smart investment. Moreover, while planning renewable energy installations it is necessary to take into account local development plans and other important aspects, as for example Natura 2000 protected areas (ibid.). Thought, many gminas do not

have their local development plans, what makes it even more difficult to effectively locate renewable energy installations (ibid.).

Moreover, there is ***no differentiation of financial support for various types of technologies*** (personal communications, national and niche-level representatives, 2014). The current regulations do not distinguish electricity generation technologies, because financial support is only dependent on the amount of generated energy (personal communication, niche-level representative, 2014). More than half of support goes to big, amortized installations (e.g. co-firing biomass with coal), thus being a hindrance to a significant rise of installed capacity in renewable energy sources (ibid.). At the same time, renewable energy technologies, which generate large amounts of energy, like for example biomass, get more funding and are thus better developed than other technologies, like solar and wind (ibid.).

Finally, ***administrative burden*** was mentioned as another hindering factor for further development of renewable energy in Poland (personal communication, national-level representative, 2014). Obtaining all the documents needed for investment in renewable energy can take from 1.5 year to 3 years and not many companies can wait so long (ibid.). Moreover, the procedures are often very complex, include various institutions and are expansive (high taxes) (ibid.). The process of obtaining a permit often faces difficulties with validation of the environmental impact studies of the planned investments (ibid.). Interestingly, administrative burden was mentioned as a problem in several articles and documents, however, according to the interviewees this factor was rated as least important.

An overview summarizing all the factors hindering the renewable energy development in Poland can be found in Figure 8.

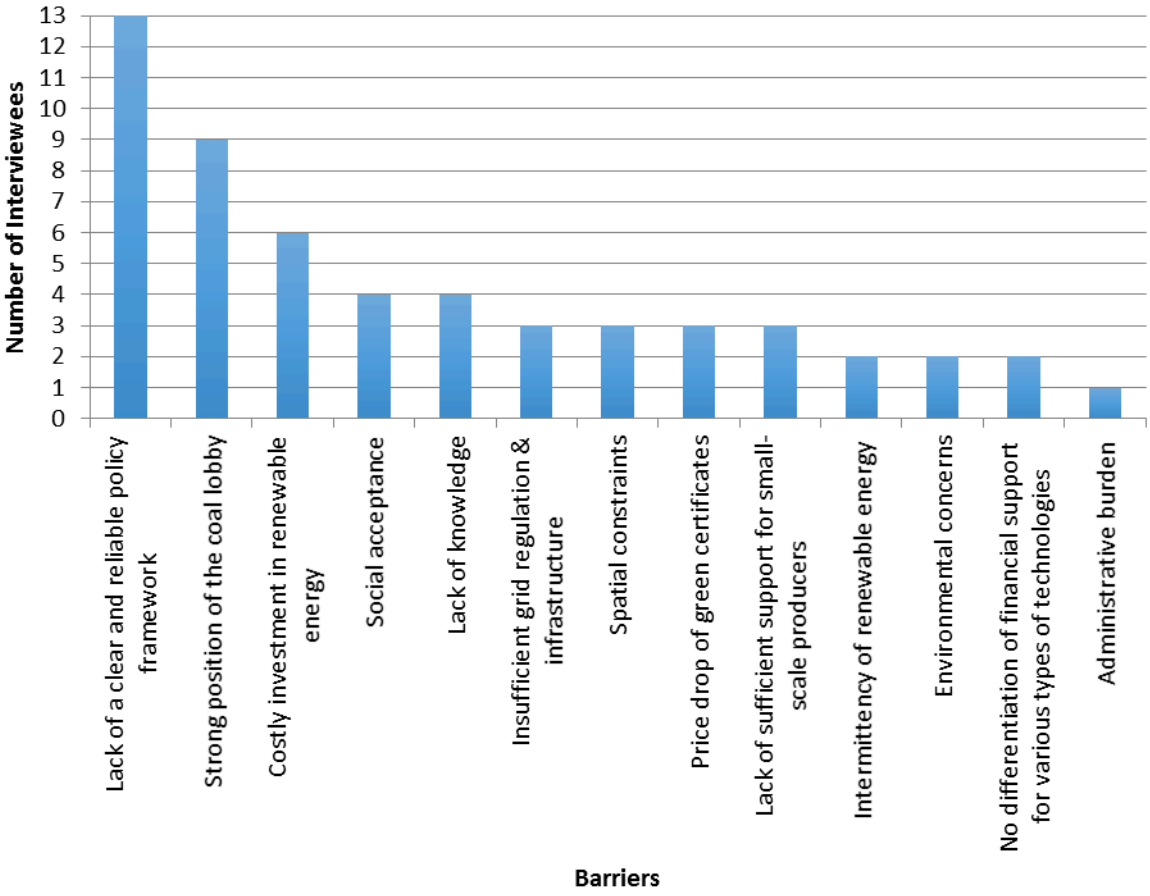

Figure 8: Overview of barriers for renewable energy development in Poland (own compilation)

5.3.3 Barriers for Particular Renewable Energy Sources

For the reason that previous chapters of the analysis focused rather on renewable energy in general, this section will discuss particular renewable energy sources in more detail. The potential drivers, as for example high availability of a given renewable energy source in Poland, were mentioned in chapter 4.2.3. Therefore, this section will focus only on the barriers, which are hindering further development of each of the renewable energy sources in Poland.

Producing energy out of ***biomass*** seems reasonable, especially as there is a "huge potential to increase energy crops plantations" (Gawlik et al., 2012). However, the absence of support for plantation under the Common Agricultural Policy will make it "extremely difficult to use solid biomass production potential from perennial plantations" (Wisniewski et al., 2012: 13). The regions are faced with the dilemma if they should continue to invest in biomass, the global trend, or maybe not, because of the biomass deficit in the country, the impact of strong demand on the price, as well as inconsistent government policies at national and European level (personal communication, national level representative, 2014). In addition, it was shown that if Poland would like to use all its

biomass potential, there is not enough arable land for this purpose, making imports of biomass inevitable (IEO, 2012). Sustainability of the biomass energy in Poland can be questioned. First of all, energy crops take arable land, which could be used for food production (IEO, 2012). Secondly, due to insufficient amounts of biomass produced in Poland, biomass (often in form of pellets) is imported from abroad (e.g. Russia and Asia), thus contributing to increase in CO2 emissions (Grzybowska, 2013). In addition, it is common in Poland to burn biomass together with other fossil fuels or waste and selling it as "green" energy afterwards (personal communication, civil society representative, 2014). Finally, burning biomass emits less CO2 emission, however, it produces more air pollutants (notably Particulate Matter (PM)) that cause severe health impacts, reduce crop yields, cause acidification and eutrophication. These factors might constitute a barrier for further development of biomass in Poland.

Poland has 18 million hectares of arable land, which constitutes 59% of total area of the country, and, theoretically, could be used for the purpose of ***wind*** energy production (IEO, 2011). However, according to some studies (IEO, 2011: 43), only 4% of the arable land in Poland can be used for this purpose, mainly because of the widespread NATURA 2000 protection areas, which forbid any kind of such activities (e.g. wind farms). Another barrier is the lack of social acceptance towards wind turbines (personal communications, national level representatives, 2014). People are afraid that these might cause noise and vibrations, as well as human health problems, or claim that wind turbines "destroy" the landscape (ibid.).

Hydropower also has its constraints: building new big hydropower plants might be difficult in the future, as "the potential of waters that is suitable for big power plants have already been used up" (Wisniewski et al., 2011: 36). Nevertheless, there is potential for micro hydropower installations (Wisniewski et al., 2011). Unfortunately, this kind of installation faces high administrative barriers and has still very high investment costs (personal communication, local government representative, 2014).

Investments in ***biogas*** in Poland involve high uncertainty about whether this type of energy will continue to be promoted and subsidised by the government in the future (personal communication, national representative, 2014). Moreover, with the increase in power demand, the demand for biogas substrates will also grow, which in turn might be associated with logistical difficulties and the risk of increased surface monoculture (ibid.) In addition, construction of biogas plants is associated with a risk of changes in commodity prices and electricity prices (ibid.). Furthermore, there is strong resistance from the society (Zochowska et al., 2012). Local inhabitants, communities and ecologists claim that biogas plants will cause bad smell, might contaminate water and arable land, cause land prices to decrease or lower chances for agro-tourism development (ibid.).

Biofuels are promptly being developed in Poland. However, as consumption is higher than production, much of the lacking bio-components has to be imported from abroad (Zochowska et al., 2012). In 2012, almost 70% rapeseed oil or rapeseeds that was used for the production of biofuels in Poland, was imported (Forbes, 2013). Moreover, as in the case of biomass and biogas, arable land, which could be used for production of cereals or corn for biofuels, is limited in Poland (Zochowska et al., 2012). Taking into account to not harm food production, there are 0.6 million hectares of cereals available for bio-ethanol production and 0.4 million hectares, which could be used for production of rapeseed for biodiesel (ibid.). In addition, cultivation of limited kinds of crops (cereals, corn and rapeseed) bears the risk of increased surface monoculture and problems connected with that (e.g. reduced biodiversity, lower resistance of the crops on diseases etc.).

Concerning ***solar*** energy, the biggest barrier for big scale photovoltaic installations is that the solar radiation is unevenly distributed throughout the year, photovoltaic panels are expansive and finding the right location for the installations is a difficult task (IEO, 2012; Zochowska et al, 2012). The development of solar energy in coming years depends especially on the state support and promotion of solar energy in the new Renewable Energy Act (ibid.).

Reserves of ***geothermal*** water occur in many regions of Poland (IEO, 2012). Poland is situated outside the areas of modern tectonic and volcanic activity, therefore, the usage of deep steam for the purpose electricity production is currently uneconomical (Zochowska et al., p.19). The biggest barrier for further development of both shallow and deep geothermal waters is the missing coherent national policy concerning use of geothermal waters, as well as unfavourable and insufficient law (e.g. high fees and taxes put on geothermal installations) (personal communication, national representative, 2014).

5.4 Possible Improvements for Moving Towards a more Sustainable Energy Mix in Poland

The development of renewable energy in Poland is currently stuck in a lock-in situation, where it is difficult to move forward. The analysis has pointed out several factors, which need to be overcome for the purpose of an increased share of renewable energy in the Polish energy mix.

Evidently, the lack of clear and reliable policy framework, which manifests itself in the substantial delay of implementation of the new Renewable Energy Act, constitutes the biggest barrier. It is thus necessary to implement the European directives as soon as possible, in order to provide investors with long-term commitment, stability, and reliability. However, more than one third of the interviewed stakeholders, all representing civil society, do not support the latest draft of the Renewable Energy Act and would like to modify the document (personal communications, niche-level representatives, 2014). They claim that the latest draft will preserve the support for co-firing

with biomass, will reduce the development possibilities for other renewable energy technologies, like wind, especially for small-scale installations, make renewables unprofitable and increase the investment risk (ibid.). One possible solution could be to keep the system of green certificates, but distribute the financial support according to the needs. Another option could be to introduce correction factors, which would provide opportunities for support for solar, biogas, geothermal energy as well as small installations (personal communication, niche-level representative, 2014). All five stakeholders were in support of providing additional incentives for small-scale installations, as well as removing support for co-firing with biomass in coal plants (personal communications, niche-level representatives, 2014). It is also important to decrease the financial support over time, in order to promote efficiency and innovation in a long term (personal communication, niche-level representative, 2014). According to the government representatives, the new Renewable Energy Act will promote better financial support and sustainable development of renewable energy in Poland (personal communications, regime-level representatives, 2014).

Furthermore, it is vital to decrease the role of coal lobby in Poland's national energy policy (personal communications, niche-level representatives, 2014). This will be a difficult task, due to the tradition and the size of the coal industry in Poland. However, the civil society, green initiatives and campaigns explaining coal's environmental and health impacts play an important role in increasing citizens' awareness, thus paving the way towards more sustainable future. Moreover, efforts could be done to introduce new technologies reducing polluting emissions in coal plants and the sector could be gradually decreased in favour of other, more sustainable energy sources, like for example renewables.

Moreover, it is important to tackle also other barriers mentioned in section 5.3. High investment costs could be reduced through appropriate financing support provided by the government and other institutions like the EU. Social acceptance and knowledge about renewable energy could be increased by information campaigns, participatory planning and establishment of trustful relationship between the investor and local residents. It is also important to improve the grid regulation and infrastructure. Funding for these purposes could come from reduced support of the coal industry or European funds. More effort should be made to establish local development plans in gminas. Polish government should work more closely with administrative bodies at various levels as voivodeships and gminas, thus providing needed incentives for, among others, preparation of local development plans. Legislative changes are needed for bringing the prices of green certificates into balance. For example the certificates' price should be increased and the scheme should exclude coal plants, which are co-fired with biomass (personal communication, niche-level representative, 2014). The new Renewable Energy Act should provide more support for small-scale producers, include

differentiation of financial support based on renewable energy technology and aim for reduced administrative procedures. Environmental concerns have to be taken into account and should be reflected in national legislations and strategies.

According to the interviewees, the target of 15% renewable energy in Poland's gross final energy structure and 10% share of biofuels in the market for transport by 2020 will be reached without any bigger effort (personal communications, European, national and niche-level representatives, 2014). "The set target was not ambitious enough" - the aimed percentage goal of renewable energy would be achieved anyways, without any bigger legislative changes (personal communication, European-level representative, 2014). Furthermore, Poland will, most likely, not achieve more than the aimed 15% renewable energy in its gross final energy structure (ibid.). A higher percentage of renewable energy would require more initiative on the side of the government (ibid.). According to another civil society representative (personal communication, 2014), Poland will manage to reach the target, however, this will happen mainly through co-firing with biomass. Moreover, Polish legislations and strategies are not aiming for long-term development of renewable energy (ibid.). The latest draft of the Renewable Energy Act does not plan a further increase of renewable energy after 2020 (ibid.). After this date, the government's goal is just to keep the same level of renewable energy (around 15%) in Poland's gross final energy structure in the coming years (ibid.).

6. Discussion

This section is divided into two parts. The first one will focus on the limitations of this case study (section 6.1). The second part will present renewable energy from a more critical point of view (section 6.2).

6.1 Limitations of the Case Study

The specific aim of this study was to present a comprehensive analysis of renewable energy development in Poland and this was done through the use of semi-structured, in-depth, expert interviews combined with literature and policy review. Due to timeframe constraints, the analysis presented in this thesis could not encompass more than one case study. However, it would be interesting to compare the Polish case study with performance assessment of renewable energy development in other countries. Comparing different cases would allow making some scientific generalizations (Yin, 2002: 10). However, this would not allow such in-depth analysis as it was done in this single case study (Creswell, 2007: 76). In order to increase the reliability of the case study (Yin, 2002: 18), more experts could have been interviewed. Furthermore, this study has its time limitations in respect to the transition analysis. This thesis has only looked into the last 10 years

(2004-2014) - the beginnings of the renewable energy development in Poland, thus could not capture the entire transition process, which is still ongoing. In order to analyse the Polish transition towards renewable energy, a longer time span (going behind 2015) would be necessary.

6.2 Renewable Energy from Critical Point of View

In general, renewable energy reduces CO2 emissions and is constantly being replenished, thus being infinite, it has a much lower environmental impact than conventional energy technologies, and increases the countries energy security. However, while promoting renewables, it is important to mention also some pitfalls of this alternative type of energy.

First of all, ***focusing only on reduction of CO2 emissions***, neglects other pollutants as for example Particulate Matter (PM), Sulphur dioxide (SO2), Nitrogen dioxide (NO2), and Volatile organic compounds (VOCs), which cause health impacts and pollute the environment. This is especially the case with energy produced out of biomass: burning wood or other biological material causes air pollution (Grzybowska, 2013). Nevertheless, biomass is promoted as "the" solution to climate change, without mentioning any of its downsides. Another example where renewable energy is presented mainly from the viewpoint of reduced CO2 emissions is hydroelectric power. In order to create large-scale hydroelectric dams, land for water reservoir has to be flooded, thus destroying forests, wildlife habitat, and agricultural land.

Secondly, renewable energy as wind and solar faces the problem of ***intermittency***. While using this type of alternative energy, it is necessary to keep existing power stations on standby, which creates additional costs (personal communications, national level representatives, 2014).

Moreover, ***scarce earth metals are needed for production*** of green technologies (Jones, N., 2013). In addition, while many rare earth metals, like copper or gold, are generally available, they are seldom found in sufficient amounts to be extracted economically (ibid.). As a consequence, it can be challenging to develop renewable energy technologies on a big scale, when dealing with scarce availability of rare materials inevitable for their production.

It is also questionable whether renewable energy coming from ***biomass imported from abroad*** is ecologically sustainable. Transport of biomass, for example in form of pellets from East Russia or Asia, causes CO2 emissions, what might at the end produce more pollution than conventional fuels (Grzybowska, 2013).

Moreover, in the case of biofuels, biomass and biogas, ***arable land***, which could be used for production of food is instead ***used for energy crops production*** (Zochowska et al., 2012). In addition, cultivating limited kinds of energy crops, as cereals, corn and rapeseed, bears the risk of increased

surface monoculture and problems connected with that like for example ***reduced biodiversity***, ***increased food prices***, ***lower resistance of the crops on diseases***.

Finally, in my opinion more attention should be paid to the reduction of energy use and energy efficiency, instead of looking for solutions how to continue with status quo without changing our behaviour. Thereby, raising ***citizens' awareness*** on these issues is essential. This is especially important considering the widespread lack of knowledge about renewable energy mentioned in section 5.3.2.

7. Conclusion

With the accession to the EU in 2004, Poland has become subject to the privileges and obligations of EU membership, including Directives 2001/77/EC, 2003/30/EC and 2009/28/EC promoting renewable energy in Europe. Thus, Poland was obliged by European law to increase its share of renewable energy to 15% in its gross final energy structure and 10% share of biofuels in the market for transport by 2020 (European Commission, 2009). However, there are several factors hindering the development of renewable energy in Poland.

The aim of this thesis was to provide an overview of the renewable energy development in Poland, including key agents, main drivers and barriers for the development towards a more renewable energy generation mix in Poland, and finally providing ideas for further improvement of the current situation. This was done through conducting thirteen semi-structured, in-depth, expert interviews, which were combined with literature and policy review of several documents. The key agents included: the EU; the Polish government and national governmental agencies; regional authorities (voivodeships, gminas, municipalities); energy producers, transmission and distribution agents; research institutes; and civil society. Based on interviews with the above-mentioned key stakeholders, diverse factors, important for further development of renewables in Poland, were discovered. These factors include social, economic as well as environmental perspectives and thus present a holistic approach. The main drivers for renewable energy in Poland include (starting from most to least important): EUs' policies; national and regional policies; financial incentives; energy independence and security; high potential of renewable energy; research institutes; and bottom-up initiatives and entrepreneurship. The main factors hindering the development of renewables in Poland comprise (starting from most to least important): lack of clear and reliable policy framework; strong position of coal lobby; high investment costs; social acceptance; lack of knowledge; insufficient grid regulation and infrastructure; spatial constraints; price drop of green certificates; lack of support for small-scale producers; intermittency of renewable energy; environmental concerns; no differentiation of financial support based on technology; and administrative burden. In

order to overcome these barriers, it is foremost important to implement the European directives as soon as possible through the Renewable Energy Act, which should incorporate amendments provided by the civil society and thus better promote renewable energy technologies. Strong political will to encourage further development of RE, which the Polish government is missing, is thus unavoidable. Moreover, the citizens' awareness on renewable energy and energy efficiency should be increased through information campaigns and education in schools, in order to provide "bottom-up" force pushing the government for more sustainable policies. In addition, it is necessary to decrease the role of coal lobby in Poland and restructure the coal industry in favour of cleaner technologies. Taking into account that Poland is an important member state of the EU, and that decisions in the field of energy are taken in the EU by unanimity, Poland can block ambitious European Commission's legislations to come into force, thereby not only impeding a long-term sustainability of its own energy sector, but also hindering renewable energy development in Europe.

References

Archer, M. S. & Bhaskar, R. (1998). *Critical realism: Essential readings*. Routledge.

Balicki, A. (2013). *What next with the Polish energy package?* British Polish Chamber of Commerce. Available at: http://contact.bpcc.org.pl/issue08/energy/what-next-with-the-polish-energy-package Accessed: 28.06.14.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., and Rickne, A. (2008). *Analyzing the functional dynamics of technological innovation systems - A scheme of analysis*. Research Policy, No.37, pp. 407-429.

Boyce, C. & Neale, P. (2006). *Conducting In-depth Interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input*. Pathfinder International Tool Series.

Boyle, G., Everett, B. & Ramage, J. (2003). *Energy Systems and Sustainability.* Oxford University Press. Oxford.

Bruce, S. (2013). International law and renewable energy: facilitating renewable energy for all? Melbourne Journal of International Law. Vol. 14.

Bryman, A. (2003). *Trilangulation. Encyklopedia of Social Science Research Methods.* SAGE Publications.

Bryman, A. (2004). *Triangulation and Measurement.* Department of Social Sciences, Loughborough University Loughborough, Leicestershire. Available at: http://www.referenceworld.com/sage/socialscience/triangulation.pdf Accessed: 01.05.2014

Bryman, Alan (2008). *Social Research Methods*. Oxford: Oxford University Press.

Carlsson, B. & Stankiewicz, R. (1991). *On the nature, function, and composition of technological systems.* Journal of Evolutionary Economics, No.1.

Chronmy Klimat (2013). *Odnawialne zrodla energii w Polsce w 2011 roku.* Available at: http://www.chronmyklimat.pl/energetyka/odnawialne-zrodla-energii/15308-odnawialne-zrodla-energii-w-polsce-w-2011-roku Accessed: 29.03.2014

CEE Bankwatch Network (2013). *Coal-fired power plants in Poland*. Available at: http://bankwatch.org/our-work/projects/coal-fired-power-plants-poland Accessed: 29.03.2014

Central Statistical Office (Poland) (2012). *Concise Statistical Yearbook of Poland.* Available at: http://stat.gov.pl/cps/rde/xbcr/gus/as_concise_statistical_yearbook_of_poland_2012.pdf Accessed: 11.05.2014

Creswell, J.W. (2007*). Qualitative Inquiry & Research Design. Choosing Among Five Approaches*. Sage Publications, Inc. 2nd ed.

Corporate Europe Observatory (2011). *Putting Brussels' lobbyists on the map.* Available at: http://corporateeurope.org/power-lobbies/2011/09/putting-brussels-lobbyists-map Accessed: 36.05.2014

Devine-Wright, P. (2007). *Reconsidering public acceptance of renewable energy technologies: a critical review.* University of Manchester. Available at: http://geography.exeter.ac.uk/beyond_nimbyism/deliverables/Reconsidering_public_acceptance.pdf Accessed: 08.08.2014

Duitt, A., and Galaza, V. (2008). *Governance and Complexity - Emerging Issues for Governance Theory*. Governance: An International Journal of Policy, Administration and Institutions, Vol. 21(3).

Easton, A. (2014). *Poland to resuscitate coal for energy security on Ukraine crisis.* Available at: http://www.platts.com/latest-news/coal/warsaw/poland-to-resuscitate-coal-for-energy-security-26783300 Accessed: 31.05.2014

European Commission (1997). *Communication from the Commission – Energy for the future: renewable sources of energy. White Paper for a Community strategy and action plan.* COM(97)599 final. Brussels.

European Commission (2009a). *Directive on Renewable Resources.* COM(2009)28 final. Brussels.

European Commission (2009b). *Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity.* COM(2009)72 final. Brussels.

European Commission (2009c). *Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas.* COM(2009)73 final. Brussels.

European Commission (2011). *Energy 2020 - A strategy for competitive, sustanable and secure energy.* COM(2010)639 final. Brussels.

Eurostat (2013). *Share of renewable energy in gross final energy consumption*. Available at: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&plugin=1&language=en&pcode=tsdcc110 Accessed: 29.03.2014

Forbes (2013). *To koniec biopaliw jakie znamy?* Available at: http://www.forbes.pl/czas-na-biopaliwa-ii-generacji,artykuly,160001,1,1.html Accessed at: 15.06.2014

Gawlik, L., Mokrzycki E., Uliasz-Bochenczyk, A. (2012). *Current state and prospects of electricity generation in Poland until 2030.* Mineral and Energy Economy Research Institute. Available at: https://www.min-pan.krakow.pl/pliki/pracownie/pzr/s1-35-en.pdf Accessed: 14.06.2014

Geels, F. W. (2002). *Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case study*. Research Policy, No.31.

Geels, F. W. (2005). *Technological Transitions and System Innovations: A Co-evolutionary and Socio-technical Analysis.* Edward Elgar Publishing. Cheltenham.

Geels, F. and Verbong, G. (2006). *The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004).* Energy Policy, No.35.

Graczyk, M. (2014). *Odnawialne Źródła Energii – szanse i koszty*. Available at: http://www.euractiv.pl/energia-i-srodowisko/spis_linie/odnawialne-roda-energii--szanse-i-koszty-000020 Accessed: 29.03.2014

Grzybowska, P. (2013). *Największym problemem jest złe wykorzystanie biomasy.* OZE. Available at: http://www.oze.pl/biomasa/najwiekszym-problemem-jest-zle-wykorzystanie-biomasy,328.html Accessed: 29.03.2014

GUS (Glowny Urzad Statystyczny) (2004). *Ogólnopolskie Ośrodki Specjalizacyjne.* Available at: http://old.stat.gov.pl/gus/regionalna_PLK_HTML.htm Accessed: 18.05.2014

GUS (Glowny Urzad Statystyczny) (2012). *Energia ze źródeł odnawialnych w 2011 roku.* Available at: http://stat.gov.pl/cps/rde/xbcr/gus/se_energia_zrodla_odnawialne_2011.pdf Accessed: 09.06.2014

Haas, R., Eichhammer, W., Huber, C., Langniss, O., Lorenzoni, A., Madlener, R., Menanteau, P., Morthorst, P.-E., Martins, A., Oniszk, A., Schleich, J., Smith, A., Vass, Z., & Verbruggen, A. (2004). *How to promote renewable energy systems successfully and effectively.* Energy Policy 32 (2004). IPCC (2007). Climate Change 2007: Synthesis Report. IPCC.

Habczynska-Pilarek, J. (2011). *Jakie dokumenty prawa polskiego poruszają kwestie OZE?* Rynek Energii Odnawialnej. Available at: http://www.reo.pl/jakie-dokumenty-prawa-polskiego-poruszaja-kwestie-oze Accessed: 28.06.2014

Hinc, A. (2013). *Let us make use of this summit!* Demos Europa. Available at: http://www.demoseuropa.eu/index.php?option=com_content&view=article&id=1385%3Awykorzystajmy-ten-szczyt-&catid=145%3A2013kom&Itemid=170&lang=en Accessed: 31.05.2014

International Economic Development Council (2011). *Powering Up: State Assets & Barriers to Renewable Energy Growth A Survey of Economic Development Leaders*. International Economic Development Council.

IEO (Institute for Renewable Energy) (2014). *Polacy chcą produkować energię z OZE – wyniki najnowszych badań zawartych w raporcie: „Krajowy Plan Rozwoju Mikroinstalacji Odnawialnych Źródeł Energii".* Available at: http://www.ieo.pl/pl/aktualnosci/679-polacy-chc-produkowa-energi-z-oze-wyniki-najnowszych-bada-zawartych-w-raporcie-krajowy-plan-rozwoju-mikroinstalacji-odnawialnych-rode-energii.html Accessed at: 09.08.2014

Jacobsson, S., & Johnson, A. (2000). *The diffusion of renewable energy technology: an analytical framework and key issues for research.* Energy Policy, No.28.

Jones, N. (2013). *A Scarcity of Rare Metals Is Hindering Green Technologies.* Available at: http://e360.yale.edu/feature/a_scarcity_of_rare_metals_is_hindering_green_technologies/2711/ Accessed at: 26.08.2014

Kancelaria Sejmu (1997). *Prawo energetyczne.* Dz.U. 1997 Nr 54: 348. Warsaw

Kempinska, B. (2003). *Geothermal energy development in Poland.* Geothermal resources and utilization in Poland and Europe Reports 2003, No.2, p. 45-62.

Krauss, S. E. (2005). *Research paradigms and meaning making: A primer.* The Qualitative Report. Vol.10(4). Available at: http://www.nova.edu/ssss/QR/QR10-4/krauss.pdf Accessed at: 10.03.2014

Lichocka, H. (2013). Problemy z energia odnawialna w Polsce. Jedynka Polskie Radio. Available at: http://ogrzewanieelektryczne.blogspot.se/2013/07/problemy-z-energia-odnawialna-w-polsce.html Accessed: 29.03.2014

Majewski, W. (2013). *The development of hydro power in Poland. The most important hydro engineering facilities.* Acta Energetica 3/16 (2013) p. 45–53. Available at: http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-c6de0836-654f-455e-ab79-f2ceb9c25278/c/Majewski.pdf Accessed: 14.06.2014

Ministry of Economy (2009). *Energy Policy of Poland until 2030.* Warsaw.

Ministry of Economy (2010). *National Renewable Energy Action Plan.* Ministry of Economy. Warsaw.

Ministry of Economy (2014*). The Renewable Energy Act (draft).* Warsaw.

Ministry of Environment (2000). *Strategia Zrownowazonego Rozwoju Polski do Roku 2025*. Ministry of Environment. Warsaw.

Mol, A., Spaargaren, G., (1993). *Environment, modernity and the risk- society: the apocalyptic horizon of environmental reform.* International Sociology 8 (4).

Sayer, R. A. (2000). *Realism and social science*. Sage Publications Ltd.

StopEP (2014). *Pomorze tak, wegiel nie*. Available at: http://www.stopep.org/ Accessed: 08.08.2014

The World Bank (2013). *Electricity production from coal sources*. Available at: http://data.worldbank.org/indicator/EG.ELC.COAL.ZS Accessed: 29.03.2014

Polska (2014). *Natural Ressources*. Official promotional webside of the republic of Poland. Available at: http://en.poland.gov.pl/Natural,Resources,310.html Accessed: 29.03.2014

Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin, III, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, & J.A. Foley (2009). *A safe operating space for humanity*. Nature, 461, 472-475, doi:10.1038/461472a.

Rotmans, J., Kemp, R., and Van, A., M. (2001). *More Evolution than Revolution - Transition Management in Public Policy*. Foresight, Vol.03(1).

Rotmans, J. (2005). *Societal Innovation: Between Dream and Reality Lies Complexity*. Erasmus University Rotterdam.

Rynek Infrastruktury (2014). *Ustawa o OZE: Najwcześniejszy realny termin wejścia w życie ustawy to koniec 2016 r.* Available at: http://www.rynekinfrastruktury.pl/artykul/64/1/ustawa-o-oze-najwczesniejszy-realny-termin-wejscia-w-zycie-ustawy-to-koniec-2016-r.html Accessed: 29.06.2014

Yin, R. (2013). *Case Study Research - Design and Methods*. Thousand Oaks, Sage Publications. Vol. 5.

Yucel, G. (2010). *Analyzing Transition Dynamics - the Actor-option Framework for Modelling Socio-technical Systems.* Delft University of Technology.

United Nations (2013). *World population projected to reach 9.6 billion by 2050.* Available at: http://www.un.org/en/development/desa/news/population/un-report-world-population-projected-to-reach-9-6-billion-by-2050.html Accessed: 12.07.2014

Wisniewski, G., Michałowska-Knap, K., Oniszk-Popławska, A., Więcka, A., Dziamski, P., Kamińska, M., Curkowski, A. (2011). *Określenie potencjału energetycznego regionów Polski w zakresie odnawialnych źródeł energii - wnioski dla Regionalnych Programów Operacyjnych na okres programowania 2014-2020.* Ministerstwo Rozwoju Regionalnego.

Worldwatch Institute (2014). *Renewables Becoming Cost-Competitive With Fossil Fuels in the U.S.* Available at: http://www.worldwatch.org/renewables-becoming-cost-competitive-fossil-fuels-us%20 Accessed: 24.05.2014

Zochowska, M., Kingsbury, A., Kobuszynska, M. (2012). *Renewable Energy and Bio-fuel Situation in Poland.* USDA GAIN report (1235). Foreign Agricultural Network.

ANNEX

List of interviewees:

Landscape: EU-level
- Olechnowicz Pawel, Directorate General for Regional Policy (REGIO), European Commission
Regime: Polish government; national agencies; regional authorities
- Janusz Pilitowski, Direktor of the Renewable Energy Department, Ministry of Economy
- Maciej Kolaczek, Economy and trade national expert (expertise renewable energy), Polish Representation to the EU
- Krzysztof Wojcik, Head of Office, Office of the Świętokrzyskie Region (Poland) in Brussels
- Grzegorz Orawca, Director of the Department of Regional Policy Marshal's Office, Office of the Świętokrzyskie Region (Poland)
- Natalia Matyba, EU Policy Officer at Regional Office of Silesia in Brussels, Office of the Śląskie Region (Poland)
- Ewa Guzek, Regional Marshal's Office of the Łódzkie Region in Brussels
Niche: civil society; energy producers, transmission and distribution agents; research institutes
- Łukasz Bilski, Chairman of the Board, Świętokrzyskie Centre for Innovation and Technology Transfer (Świętokrzyskie Centrum Innowacji i Transferu Technologii)
- Robert Rybski, Lawyer (specialized on renewable energy), Client Earth
- Jakub Frejlich, Deputy director, PGE (Polish Energy Group, largest power producing company in Poland)
- Tobiasz Adamczewski, Climate and Energy Expert, World Wide Found for Nature (WWF) Poland
- Urszula Stefanowicz, Project coordinator, the Polish Climate Coalition
- Piotr Trzaskowski, South east Europe associate, European Climate Foundation