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Energy democratization?
Societal aspects of de-carbonization in the German and Polish energy sectors

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Abstract

Development of renewable sources of energy has not only a significant impact on the power system but also on society. It has the potential to replace the existing conventional sources of energy with never-ending renewable sources, while at the same time empowering the consumers of electricity and leading to the democratization of the power system. What are the impacts of energy transformation on the society and on the political system, and what are the socio-political impediments for an energy transformation to take place? Finally, what kind of energy/society relations do we want to achieve as a result? Tapping into the ongoing policy debate on "energy democracy", we try to conceptualize the societal aspects of energy transformation and renewable energy expansion. Departing from a conceptualization of energy policy that treats society not as the object but its subject, we put forth five levels of RES influence on society.

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1. Introduction

The modern power system, based largely on conventional sources of energy, faces a number of challenges. Air pollution increases the negative impact on public health, while greenhouse gas emissions into the atmosphere have an impact on the observed changes in the global climate. Fossil fuels are also not sustainable in the longer perspective, as even with the discovery of new sources, their global depletion is only a question of time. Supposedly clean and long-lasting nuclear energy sees increasing costs as illustrated by the ongoing construction at Hinkley Point (BBC News, 2013) in the United Kingdom, and risks related to reactor safety and resulting from the storage of the nuclear waste are also an important burden.

With all those challenges in mind, it is becoming clear that the energy sector requires a deep structural transformation towards a low-carbon and sustainable system based to an increasing extent on renewable energy sources (RES). De-carbonization of the energy sector, however, will be more than just a technical and investment challenge (Szulecki & Westphal, 2014). The decisive role energy plays in our economies and our lives and the scope of the changes that need to take place in the energy sector to make it more sustainable justify calling it energy *revolution*.

A major difference between the conventional and renewable sources of energy is the potential of the latter to empower local communities and individual consumers. Due to their scalability and distributed character, such sources of energy as photovoltaics or onshore wind allow individuals, cooperatives, small investors or local communities to invest and benefit from their development. As a result, over the last two decades these actors gained on importance as power producers in some countries. The move from a centralized, mostly fossil fuel-based power sector, towards a distributed energy system that includes a significant number of small and medium power producers, has to visibly affect the energy sector. A case in point is Denmark, where companies investing in renewables are obliged to involve local communities in their investment, or Germany, where more than half of power from renewables is generated by farmers and individuals (Agentur für Erneuerbare Energien, 2014).

Some non-governmental organizations, civil society groups and think-tanks have coined the term *energy democracy* either to denote the normative goal of de-carbonization and energy transformation or to describe the already existing examples of decentralized and mostly bottom-up civic energy initiatives (Kunze & Becker, 2014; Szwed & Maciejewska, 2014: 19). The emphasis in existing definitions of energy democracy is justice, fairness, access to energy and the redistributive aspects of energy production and consumption as well as environmental sustainability.

In this article we try to conceptualize the *societal aspects of energy transformation*. For this purpose we are countering a technocratic vision of energy policy, in which the society at large is excluded from even indirect decision making and participation. Instead we are assuming the society's role as subject and sovereign of energy policy. To do that we propose five dimensions determining the level of *energy democratization*. It is therefore an attempt at operationalizing energy democratization, understanding what it implies on different levels of energy-society interaction. Having established that conceptual framework, we look at two empirical examples. Germany, which is at the heart of European energy transformation with its ambitious RES expansion policy and increasing role of prosumers and communities involved in the energy sector, is compared to Poland, in which the trend towards ever larger generation units continues. Our framework allows us to describe the changes in the societal aspects of energy policy in

Germany, while in Poland it helps identify the impediments and obstacles for a wide and rapid energy transformation.

2. Society – the absent subject of a technocratic energy policy

The energy sector has traditionally been presented as an area reserved for technocrats, in which the role of society and social scientists should be limited to a minimum. Three different variants of this technocratic perspective can be distinguished. In the first one, which we call *polytechnic*, the analysis of the power sector concentrates on keeping the balance between the supply and demand on the energy markets with all the factors that contribute to this balance: production, consumption, transportation and storage. The second perspective – *economic* – focuses on the issues of price and allows for comparison of the costs of different options of energy production. Finally, the third perspective concentrates on the issue of energy security which means guaranteeing its constant deliveries and minimizing the risks of power failure. This last approach can be defined as *securitization* (Buzan, Waever & de Wilde, 1998).

None of these perspectives includes the societal aspects of energy. Although the goal of the polytechnic perspective is to provide electricity to the customers, it excludes any possibility that would allow them to decide about the structure of the power sector and its future development. In most Eastern European countries the division between the power sector and society – also visible in the case of environmental protection (Jehlička & Smith, 2007) – has been further strengthened by the decades of communist rule. One of the characteristics of the "Soviet method" of science was a strict division between the management of resources or landscape from all the issues that we could today call *political ecology*, namely relations between the society and its material and natural environment (Robbins, 2004). This perspective presents society merely as the source of demand without taking into consideration the possibility of co-ownership of the power generation units. Finally, although the goal of the securitization of the energy industry aims at protecting the society from the risks of energy deficiency, this goal is mainly achieved as a result of interstate negotiations and geopolitics, and society is presented as a passive object of a policy shaped and executed by the national government. An example of such a policy could be a decision to resettle thousands of people to build a lignite open-pit mine in order to increase the share of domestic resources in the energy generation and thus increase energy security. In this regard, such issues as energy poverty, air pollution or climate change, all of which influence the security of *individuals*, are not taken into consideration.

2.1 The functional dimension: Energy governance for the society

How would the perspective on the energy sector change if we looked at it from a societal point of view? In this section we shall conceptualize energy policy as an element of public policy. Subsequently the main dimensions of its societal impact will be listed and systematized. This theoretical framework will then be used in empirical analysis of Poland and Germany.

It is, however, first necessary to answer the question about the goal of public policy in general and of energy policy in particular. This necessitates putting society not as the object, but as the subject of public policy. Such perception is possible when public policy is understood as the result of (good) governance as defined by James Rosenau.

According to his definition, public policy is “systems of rule, as the purposive activities of any collectivity, that sustain mechanisms designed to ensure its safety, prosperity, coherence, stability, and continuance” (Rosenau, 2000: 171). Thus the goal of public policy is the creation of a common good of the society through an “effective, efficient, and reliable set of legitimate institutions and actors engaged in a process of dealing with matter of public concern” (Anheier, 2013: 13). This approach is complemented by employing the notion of *sustainable development*, which is understood as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987: 41). Such broader understanding of public policy extends its analysis beyond merely the impact on the current generation and employs a longer term perspective taking into consideration the wellbeing of the next generations. This is especially important in the case of energy policy, which due to its potential long-term impacts on the environment and utilization of limited resources can have negative impact on the “ability of future generations to meet their own needs”.

As in the other approaches to energy policy, also its functional understanding pays attention to the aspect of its security. But in this case security is understood in a much broader way and includes the notion of *human security* (e.g. Kaldor, 2013), which encompasses, among others, individual and political security, health, development, human rights and access to clean environment. This makes energy security a much more multifaceted notion than the one adopted by the polytechnic perspective on the energy policy (Karaczun, 2013).

This broader understanding of security adds an important element to energy policy. By contributing to climate change, energy policy heavily reliant on fossil fuels may actually limit energy security in the longer-term, even if it contributes to short-term energy security understood in the narrow sense. Thus the functional perspective on energy policy links it closely with climate policy. This link is especially clear in the case of renewable sources of energy, which can on one hand increase short-term energy security of current generations, while on the other be an important element of climate policy (Palmer & Burtraw, 2013; Manish, Pillai & Banerjee, 2006: 25-36).

2.2 The normative dimension: prosumers and citizens’ energy

Whereas the above elements only take into consideration the functional and material aspects of energy policy, a governance approach also requires keeping in mind the normative aspects of energy policy which contribute to its legitimacy. Good policy, which means more than merely an effective one, must be purposefully *democratic* and *inclusive*. Only in this way can it countervail increasing the distance between the ruling elites and society, which unavoidably leads to distrust and loss of legitimacy.

From a social perspective, good energy policy should also engage society, react to bottom-up stimuli and differentiate the needs of the consumers. By increasing transparency in the decision-making process it should also limit the trend towards technocratization and create the feeling of ownership of the decision-making process. This is not to say that energy should cease to be a domain of specialists. In every technical field the competences of engineers and scientists are crucial. What matters is the transparency of the decision-making process in an area that has a great influence on the common good, as well as the need to take into account the interests of various groups, which could be excluded should a technocratic vision dominate over the social aspects.

These requirements could hardly have been fulfilled by the power system based on conventional or nuclear sources of energy. The extraction of coal or the construction of a nuclear power plant requires huge upfront investments and – for the sake of efficiency – mass production of power without taking into consideration the impact of these investments on the society.

Already in the late 1970s Amory Lovins called this path of development the "hard energy path", as opposed to the "soft energy path" based on renewable, distributed generation units (Lovins, 1977). Lovins, as well as Alvin Toffler (1980), pointed to the potential of "prosumers" generating and producing their own energy in the form (heat, cold or power) and at the scale (individual, local or regional) they found most appropriate to their needs (Lovins, 1977: 38-39; Toffler, 1980: 205). But in the 1970s, when Lovins and Toffler were writing their books, the necessary technology was still lacking. Although distributed heat production in solar panels was already possible, not many options existed to produce power at a cost comparable with the subsidized fossil and nuclear power plants.

The significant cost decrease of renewable sources of energy over the last three decades made the idea of locally produced and consumed energy a reality in many countries and regions. By bringing demand and supply closer, renewables harbor the potential of not only completely changing the way the power system has been organized, but also of creating the foundations of a democratic power system. What would that mean in practice and how can we assess the degree and quality of energy democratization?

3. Societal aspects of an energy system: a systematization

As described above, due to its scalability, only power systems based on renewable sources of energy can fulfill the criteria of an inclusive energy policy, which satisfies the needs of the current generations without hindering future generations from satisfying their own needs. But this does not mean that any power system based on renewables is an example of a good energy policy. Below we define five elements, which allow us to assess the impact of a renewables-based power system on the society:

- Spatial organization of the power system
- Governance of the renewables-based power system
- Political economy of renewable energy
- Political ecology of renewable energy
- Broadly understood energy security

Spatial organization of the power system defines to what degree the system of power production is decentralized and linked with consumption. This can be assessed quantitatively by comparing the absolute number of installations and their average size with the number of installations and their size in the past or in different countries/regions. The smaller the average size of the installations, the higher the probability of direct involvement of the local communities or individual citizens in the decision-making process that led to the particular investment. This equivalence between the distributed power system and its democratic character is highly probable, but never certain. Therefore the following four determinants also need to be assessed.

The governance structure of the power system concerns the institutional, political and administrative organization of the renewable energy sector. The main questions that need to be asked to understand this determinant are: Who manages the power system and sets long-term development paths for renewable sources of energy? What are the main criteria in determining these development paths and whose interests are primarily taken into consideration? Also the questions about ownership understood broadly as the ownership of installations used for power production or distribution but also participation in the decision-making process, which leads to the investment, need to be clarified under the governance aspect. In this way the social legitimization of renewable energy policy can be assessed.

Political economy of renewables-based energy systems concerns especially the benefits and costs resulting from the development of renewable energies. This concerns the main goals of public policy, such as ensuring the welfare and cohesion of society. It must however be pointed out that this factor is not necessarily about the equal distribution of costs and benefits but about their allocation in a way that is perceived as just and fair. Especially the assessment of the distributional effects of the support mechanisms for renewable energies belongs to this category, but also the visual impact of some renewable energy installations, especially in the case of wind energy, need to be taken into consideration. Furthermore, the often ignored potential of local job creation resulting from RES development and impact of the new investment on the budgets of the local communities are included in this category.

Political ecology of renewable sources of energy concerns the changes in the way society influences biosphere around it by replacing conventional through renewable sources of energy. This category includes on one hand the relationship between the society and its surrounding environment at the local level, while on the other hand renewables' contribution to the fight against climate change and air pollution. Similarly to democracy in the traditional sense of its meaning, also in the case of the energy system, someone's choices shouldn't limit someone else's right to clean air and future generation's right to live on a hospitable planet. Therefore the impact of the power system on the environment is one of the most important measurements of how democratic the energy system is.

Finally, democratic power system has to take into consideration aspects that belong to the broad understanding of energy security. Overall energy security must be assessed at four different levels: national, regional, local and individual (Wiśniewski, 2011). In the traditional understanding of energy security the first, national level is given the most attention to by considering numerous "hard" elements, such as the impact of RES development on a country's balance of trade in energy resources or degree of energy dependency on foreign energy imports. Frequently the other three levels are treated as subordinate, even though many other, "soft" elements, such as health, stability of energy deliveries or energy poverty, have a direct impact on societies' standard of life. By not consuming finite, conventional sources of energy, renewables contribute not only to an increase of energy security at the local level, but also to the energy security of future generations.

4. Societal aspects of energy transformation in Germany

Although the term *Energiewende* has been increasingly often used in the recent years to describe the German transition towards renewable sources of energy, the idea of replacing nuclear and fossil fuel power plants by distributed, alternative sources of energy goes back to the anti-nuclear protests of the 1970s and the 1980s. German distrust towards nuclear energy and successful experiences with wind energy in neighboring Denmark led to the rise of the idea of citizens' energy: power could be produced and consumed locally by the farmers and cooperatives.

With the adoption of the Feed-in Law (Stromeinspeisungsgesetz) in December 1990 the powerful, regional energy companies were obliged to purchase electricity from local producers and pay them 90% of their average power price (Bechberger, Mez &

Sohre, 2008: 16). This was a major change, which benefitted mainly wind energy. But this mechanism did not take into consideration different costs of different kinds of renewables and their future development potential.

The support mechanism for renewable energies was significantly improved in the Renewable Energy Act (EEG) adopted in 2000 which included *differentiated* tariffs for different sources of energy (EEG, 2012). The main goal of this change was to create conditions that would allow for renewables replace nuclear energy after the phase out of this source of power had been decided earlier that same year (BMU, 2000). Although in 2010 the lifespan of the nuclear energy was extended beyond 2022 by the center-right government of Chancellor Merkel, the catastrophe in Fukushima in March 2011 led the return to the initial plan of nuclear phase out by 2022.

The removal of 8.4 GW of nuclear energy from the power network in 2011 (Morris & Pehnt 2012) led to a temporary increase in the CO_2 emissions from the power sector in the following years. At the same time a rapid increase in the installed capacity of photovoltaic – by 22 GW in the period 2010-2012 (Quaschning, 2015) – led to an increase in the costs of financing renewable energy development in Germany. However, for both factors the year 2014 was decisive: the renewables surcharge (*Umlage*) decreased from 6.23 eurocent per kilowatt-hour in 2014 to 6.17 eurocent in 2015. Also the share of energy coming from coal decreased significantly and the share of net power coming from renewables exceeded for the first time 30% (Burger, 2015).

At the same time, despite switching off nuclear power plants, Germany became the major power exporter in the EU: Its net exports increased from 3.8 TWh in 2011 to 34 TWh in 2014. That was more than 6.5% of the total the country's net power generation (Burger, 2012).

Spatial organization of the power system

Despite the increasing popularity of the idea of a power system based on distributed installations owned by the local communities and farmers and the existence of support mechanism for renewables since the early 1990s, the concentration of the power sector in Germany increased steadily until 2002, when over 85% of the power generation was coming from five biggest companies (Grashof, 2014:6). Between 2002 and 2014, however, installed capacity of the wind power plants tripled and amounted to 36 GW, whereas the capacity of photovoltaics, in the early 2000s almost non-existent, exceeded 38 GW. In mid-2010s both sources of energy combined contributed over 16% of electricity produced in Germany in 2014. In addition to these two sources of energy, bioenergy, mainly biogas power plants, produced further 10% of electricity (Burger, 2015).

Decreasing costs and stable support for these three sources of energy allowed for an increased participation of local communities and individual citizens in the power sector. Investments in wind energy and biogas power plants are, due to much higher costs, conducted mainly by cooperatives, whereas photovoltaic installations are installed predominantly by individual home owners. Overall, in October 2013 more than 34 GW of installed capacity of renewable sources were owned either directly by individual investors or indirectly through participation in investment funds or cooperatives (Renews Kompakt, 2014).

The main reason for this distributed character of the new investments was the design of the support mechanism. Since the adoption of the Renewable Energy Law (EEG) in 2000 the height of the feed-in tariffs depended on the size of the installation: the smaller the installation, the higher the level of support. In the EEG's Novelization from August 2014 the feed-in tariffs for installations exceeding 10 MW were over 30%

lower than for the installations below 10 kW. In addition, owners of the latter were not obliged to pay part of the *Umlage*, which became the new obligation for the bigger units (EEG, 2014).

This clear preference for smaller installations led to a trend towards further decentralization. The average size of the PV plants installed until 2013 was 25 kW (BSW-Solar, 2014). In the first four months after the entry into force of the EEG novelization the average size of new installations decreased to 19.7 kW and more than 87% of these installations were smaller than kW (Bundesnetzagentur, 2014). With over 1.5 mln PV units installed in Germany by the end of 2014, an increasing number of Germans are involved in power production. Due to the significant difference between the price of electricity purchased from the grid (around 28 eurocent/kWh) and the price an investor receives for her or his electricity fed into the grid (12 eurocent/kWh), attempts are made to increase the share of electricity from own installations by installing batteries and increasing power consumption to those times of the day when the electricity is produced by the prosumers. Also, since over 70% of the installations are connected to low-voltage electricity network, it is mainly consumed by the local community (IEEE Spectrum, 2013).

However, the democratization of the power sector also creates the important problem that has to be dealt with by German authorities and operators of the electricity grid. The sparsely populated regions of Eastern and Northern Germany, with little energy-intensive industry, are also the regions with excellent wind conditions. This has led to a strong development of wind energy especially in the coastal regions of northernmost Schleswig Holstein. At the same time energy demand is mainly concentrated in the West and Southwestern regions of Germany. As a result it is necessary to build new electricity lines. However, the construction of the new power infrastructure progresses at a very slow pace, mainly due to the local opposition (Puka & Szulecki, 2014b).

The governance structure of the German renewable energy sector

For a long time German energy policy was strongly influenced by the four biggest energy companies: RWE, E.ON, Vattenfall and EnBW. Especially close were the connections between the biggest energy company RWE and the CDU/CSU party (Metz & Osnowski, 1996). The more surprising may seem that the *Stromeinspeisungsgesetz*, which introduced feed-in tariffs for renewables in 1991, was adopted exactly at the time when the CDU/CSU formed the government. However it seems that the potential of this support mechanism to empower new actors in the power sector was greatly underestimated by the incumbent energy companies (Bechberger, Mez & Sohre 2008).

But the major blow for the established energy companies was the aforementioned decision from 2000 of the SPD/Green government to phase out nuclear energy in Germany over the subsequent two decades. Although the decision took the form of an agreement between the government and the energy companies, it was clear that a decision to switch off all nuclear power plants in Germany was only a matter of time, with or without the consent of the energy companies. At the same time energy companies hoped that the decision to phase out nuclear energy would be reversed as soon as the CDU/CSU came to power again (Wen Wählen, 2005).

Indeed, in October 2010 the German Parliament decided to extend the life time of the nuclear power plants by on average 12 years. At the same time it was also decided that by 2050 at least 80% of German power would come from renewable sources of energy (Bundestag, 2010). However, less than six months later the catastrophe in the nuclear power plant Fukushima Daiichi led the government and the majority of German MPs to return to the initial plans of phasing out nuclear power plants by the end of 2022.

A respective law was adopted by the majority of 513 to 79 in July 2011 (Bundestag, 2011). This decision was adopted despite a strong opposition of the main energy companies and meant a significant change in the governance of the energy policy in Germany.

At the same time a number of new actors began to influence German energy policy. Companies and investors in renewables organized themselves in associations representing different kinds of renewables: i.e. BWE for wind energy, BSW for solar energy, BBE for bioenergy. Also energy cooperatives are represented by a separate representation of the German Association of Cooperatives (DGRV).

By producing their own electricity also millions of German citizens changed their roles from objects to subjects of the energy policy. Their empowerment resulted not only from the introduction of a mechanism which allowed them to sell their own electricity to the grid, but also from the technological developments in the area of power storage that enables them to become more independent from the intermittency of renewable sources of energy.

A relatively new trend is for the communes to take over the local electricity grid, which allows them to consume their own electricity produced in the nearby wind farms or biogas power plants. The decision to invest in the power grid results often from difficult relations with the previous operator of the grid and willingness to decide about where the energy consumed locally is coming from (Grüne, 2012; HNA, 2012). The latter argument played an important role in the campaign preceding the referendum in Hamburg concerning the remunicipalization of the power grid. In January 2014, only four months after the majority of Hamburg's citizens decided in favor of purchasing the electricity grid from Vattenfall (Statistisches Amt, 2013), a respective agreement between the energy company and the city was reached (NDR, 2014).

Overall a clear trend from the governance perspective on the German energy transition was the decreasing role of the four big energy companies and empowerment of German citizens, who either as prosumers or members of energy cooperatives became more the subjects than the objects of the energy policy. This change of roles has been expressed by the much more active participation in the decision-making process either through membership in the respective renewable energy association or in a referendum concerning local energy policy. The trend towards re-communalization of the electricity grid is an important instrument that transfers the competences in deciding about the local or regional energy policy from energy companies back to the citizens.

Political economy of the German energy transition

The changes in the German power sector described above have had an important impact on the distribution of costs and benefits between different actors. The major losers of the move from centralized to distributed power sector were the big energy companies. Their losses came from two directions. On the one hand in less than a decade they had to or will have to switch off their nuclear power plants, which in the past provided them with significant proceeds (Deutsche Welle, 2011). On the other hand, the priority access of electricity from renewables to the electricity grid and significant increase of electricity from photovoltaic installations especially during the mid-day peak hours, led to a decrease in the electricity prices at the stock exchange (IWR, 2015) and significant losses for the energy companies. Due to the writing-off of a number of gas and coal-fired power plants, in 2013 RWE registered the worst financial result in its history: € 2.8 bln loss (Handelsblatt, 2014). Because of the difficult market situation in December 2014 E.On announced a completely new energy strategy which included the sale of its conventional power generation assets and focus on renewables, distribution networks and customer solutions (Enerdata, 2014). At the same time lower energy prices at the stock exchange benefit large power consumers, who – due to the preferential treatment of the German government – are also exempted from paying the full renewables surcharge.

German energy transformation comes at a cost, which is clearly visible on every electricity bill: the aforementioned renewables surcharge is added to every kilowatt hour paid by the final consumers, except for a number of large companies which – according to the government – may lose their international competitiveness due to higher energy prices. Until 2014 the surcharge increased annually, to fall for the first time in 2015. Still, with the total cost of over € 23 bln. in 2014, the development of renewables was one of the most expensive investments in German history and paid mainly by final consumers and small and medium companies. These high costs are mainly due to the too high feed-in tariffs for photovoltaics in the past. Although the tariffs were decreased by over 75% between 2009 and 2014, those who invested in PV installations before this decline will benefit from the high tariffs until the late 2020s.

They, as well as hundred thousands of those who invested in renewables afterwards, belong to the beneficiaries of the energy transition in Germany. Although the additional income from selling one's own electricity is relatively small, especially in the case of the newer, smaller installations, the main benefit results from savings on the costs of electricity purchased from the grid.

At the same time, however, it must be pointed out that not all German citizens can benefit from becoming prosumers. Excluded are those who rent an apartment (i.e. more than a half of Germans) or are not able to afford the investment in renewable energy installation. Still, by paying the renewables surcharge they contribute to sharing the costs for the development of renewable sources of energy.

However, there are also certain benefits which are shared by all German citizens. Stable support mechanisms for renewables led to the creation of a new branch of industry in Germany which in 2013 employed 371,400 people (Urlich & Lehr, 2014). More than a third of them produced installations for exports and thus contributed to improving Germany's balance of trade (BMWi, 2014). Although the number of jobs fell in the recent years due to increased imports of cheaper solar installations from China and lower installed capacity, the PV panels are installed and managed by German medium and small companies and a number of new opportunities are created in the area of power management, IT and power storage.

Political ecology of the German energy transition

Over the last three decades there were two main goals of renewables' development: replacement of the existing nuclear power plants and reduction of the CO_2 emissions from the energy sector. At different times these two priorities were given different weight. The extension of the lifetime of nuclear power plants and the decision to increase the share of energy from renewables to 80% by 2050, agreed in October 2010, was aimed at reducing German CO_2 emissions. But after the catastrophe in Fukushima-Daiichi nuclear power plant in March 2011, ensuring that a similar accident cannot happen in Germany was the main priority of German energy policy.

As mentioned earlier, removal of more than a third of the installed nuclear capacity in 2011 led to a higher utilization of the coal-fired power plants. In addition, the low prices of the CO_2 emissions and the costs of ramping the coal-fired power plants up and down led to a temporary increase in the CO_2 emissions from the power sector. As a result the overall CO_2 emissions from the German power sector increased from 292 mln tons in 2009 to 317 mln tons in 2013 (Statista, 2015).

However, an increasing production from renewables in 2014 and ramping down of coal-fired power plants due to power oversupply led to a decrease in power production from hard coal power plants by 10.4% and lignite power plants by 2.9%. Also the amount of power from much less environmentally harmful gas-fired power plants fell by 15.7% (Burger 2015). As a result German CO_2 emissions from the power sector decreased in 2014 by over 5% and were the lowest since the reunification – except for 2009, the year of the economic crisis (Agora Energiewende, 2015).

Despite this decrease, it will still be very difficult for Germany to achieve its target of reducing CO_2 emissions by 40% by 2020 compared to 1990. Therefore in early December 2014 German government adopted Climate Protection Action Program 2020 according to which further development of renewables and targeted switching off of coal-fired power plants should reduce emissions from the power sector by at least 22 mln tons annually (Die Welt, 2014).

By phasing out nuclear energy by 2022 and a gradual replacement of fossil fuels, the German power system is becoming more sustainable and its impact on the environment is decreasing. However it must be admitted that this progress is rather slow and more action is needed to implement the ambitious plans of the German government.

Broadly defined energy security

As mentioned earlier, the main difference between the traditional and the broader understanding of energy security is giving more attention to the impact of the energy system on individuals and local communities in the definition of the latter. Although any events that may threaten *national* energy security would sooner or later have an impact on the energy security of an *individual* consumer, often the security of an individual is threatened even if at the national level energy security is not under imminent threat.

The German energy transition has had mostly a positive impact on the broadly understood energy security of individual consumers. One of the major fears that did not come true was that of increasing blackouts resulting from an increased reliability on variable renewables such as wind and solar energy (Institute for Energy Research, 2013). As it turned out, the German power sector has become much more stable and the combined time of power outages longer than 3 minutes has decrease from over 21 minutes a year in 2006 to over 15 minutes in 2013. In this regard the German and Danish power grids belong to the most stable in Europe (Energy Transition, 2014).

At the same time, however, the development of renewables has also led to some issues affecting neighboring countries, e.g. Poland. The lack of strong connections between Northern and Southern Germany leads to the situation in which electricity flows through neighboring countries and thus clogs the power network (Puka & Szulecki, 2014a). Indeed the reduced predictability of the renewables-based power system creates new challenges such as providing the necessary back-up capacity that may be switched on in a matter of seconds, an issue that led to the creation of new power services (Bloomberg, 2014). Despite these challenges, the replacement of a centralized power system by a distributed one may reduce the probability of long-term, major blackouts, which so far have been caused by a large coal or nuclear power plants being switched of due to an accident or for safety issues (Fairley, 2014). It is difficult to imagine a situation in which thousands of wind turbines and millions of PV panels stop producing power all at once.

An area, in which broadly understood energy security may be negatively affected, is the increased cost of power for the final consumers resulting from adding renewable energy surcharge to the price of electricity. Taking into consideration the average power consumption of a German household at 4,000 kWh, the cost of renewables development amounts to around € 20 per month. Although this constitutes around 0.10% of the average income of a German household, it may still negatively affect financial security of some families. Therefore further efforts to spread the costs more evenly by reducing the number of enterprises exempted from paying the renewables surcharge, as well as actions promoting and encouraging energy efficiency, are necessary to limit the negative impact of energy transition on the broadly understood energy security.

The energy transition in Germany has had a positive impact on the energy security in its traditional, narrow understanding. The main imported sources of energy used in the power sector in Germany are hard coal and natural gas. Share of both sources of energy decreased significantly between 2012 and 2014: by 30% in the case of natural gas and 6% in the case of hard coal. At the same time, however, in its transition towards renewables Germany has become dependent on a number of valuable resources described as "rare earths". These are, among others, needed for some types of wind turbines. At the same time increasing efficiency of rare earths utilization and the possibilities offered by recycling have the potential to significantly limit this dependency (Öko-Institut e.V., 2011).

Finally, as mentioned in the definition of broadly understood energy security, it also includes health and the security of supply of future generations. In both cases German energy policy has had a positive impact. By reducing the consumption of fossil fuels and decreasing the probability of a nuclear accident, the move towards a renewables-based power system is having a positive impact on the welfare of the future generations. At the same time, however, it must be kept in mind that the environmental damage, especially in the form of climate change and air pollution has already been done and until the full transition towards renewables-based power system Germany remains the largest emitter of the CO_2 emissions in the EU.

Overall, the German energy transition has a positive impact on the citizen's participation in shaping energy policy. Instead of being merely object of the policy, they started to shape and influence it by producing their own energy and sometimes even managing their own electricity grid. The idea of prosumers mentioned over 30 years ago by Alvin Toffler and Amory Lovins has been introduced in Germany with millions of citizens becoming directly or indirectly active in supplying energy thus breaking the monopoly of the big four energy producers.

At the same time there are still numerous challenges ahead. Fairer distribution of costs and benefits is of great importance to keep the high level of acceptance for energy transition. Development of the grid is necessary to transport clean energy from the North of German to the major consumption centers in the Southwest without having negative impacts on the power grid of the neighboring countries. Finally, with over 9 tons of CO_2 emissions per capita, Germany has still a long way to go before it achieves levels that would help us avoid dangerous climate change.

5. Impediments of de-carbonization in Poland: a societal perspective

The reasons for the renewables development in Poland are very different from in Germany. With no strong opposition towards nuclear energy, the decisive factor which led to search for alternative sources of energy in Germany was lacking in Poland. Also the perception of the threat of climate change in Poland is slightly different from in Germany: according to a survey conducted in eight countries, 22% of Poles considered climate change as "definitely not" or "probably not" a severe threat to mankind: the highest level for all the participating countries (Global Challenges Foundation, 2014). Therefore, differently from in Germany, in Poland until relatively recently there was no strong bottom-up movement promoting development of renewables (Karaczun & Szpor, 2013). For their part, representatives of the government repeatedly underlined that renewables development is necessary due to Poland's membership in the EU, and not for the sake of environmental protection (WNP, 2013).

At the same time the strong position of the state-owned energy companies in shaping Poland's energy policy has led to a situation in which support mechanisms for renewables have been designed in a way which would not create additional competition for the four biggest energy companies. This has a negative impact on the prospects of democratization of the power system in Poland.

Spatial organization of the power system

Although the current picture of the Polish and German power sectors is very different, from the perspective of the spatial organization of the power system both countries have many similarities. In both Germany and Poland the power system was concentrated around big hard coal or lignite power plants, such as Bełchatów, Niederaußem or Jänschwalde. In addition, in Germany already in the 1950s the government embarked on an ambitious nuclear power program, which led to the construction of 26 nuclear power plants in the subsequent three decades. Therefore in both countries a strong centralization of the power system could have been observed in the past. But whereas, as mentioned in the previous section, the situation in Germany has changed significantly, in Poland also the development of renewable sources of energy is done in a way which discourages decentralization of the power sector.

Differently from Germany, in 2005 Poland introduced a support mechanism based on quotas that energy companies had to fulfill. If they produced less energy from renewable sources than required by state legislation, they either had to purchase so called "Green Certificates" from producers of green electricity, or pay a replacement fee. The major issue with this mechanism was equal treatment of all sources of energy without taking into consideration their environmental impact or development potential. The energy coming from biomass co-fired in old coal-fired power plants and decades-old large hydro-power plants was rewarded in the same way as wind and solar energy. Since there was no differentiation depending on the source of energy and the size of the production unit, smaller installations, such as PV plants or wind energy had no or little chance to develop.

Another problem concerns the Polish electricity grid, which is much less developed than the German power network. Whereas the density of the grid in Germany is around 100 km per 1000 km^2, in Poland it is only 41 km. The bad state of the electricity grid and lack of strategic high-voltage power lines is often referred to as the main barriers for the development of distributed sources of energy. At the same time, however, distributed sources of energy can increase the energy security in some remote locations of Eastern Poland, where large power plants are lacking, and transport losses, due to long distances, are high (WNP, 2014).

Despite the issues with the support mechanism and weak electricity grid, initially renewable sources of energy developed in a dynamic way. Only in 2013 almost 900 MW of wind energy were installed in Poland. Total installed capacity by the end of that year reached 3,390 MW (EWEA, 2014). However, legislative insecurity and difficult access to the grid led to a significant reduction in the number of the new installations: in 2014 the new installed capacity in Poland increased by only 444 MW – less than half the amount from the previous year (EWEA, 2015). Although by 2012 the share of power from renewable sources in the energy consumption increased to 9.6%, over 55% of this energy came from biomass co-firing and further 14% from large hydro-power plants (GUS 2013: 61). In

September 2014 there were only 72 PV plants in Poland, compared to 1.5 mln in Germany, and 902 wind turbines compared with almost 25,000 in Germany (GUS, 2015).

Some legislative changes planned in the recent draft of the Renewable Energy Act may slightly improve the situation of prosumers in Poland. According to it, investors in small installations will receive the equivalent of the average power price at the stock exchange (Wysokie Napięcie, 2014). This is much less than larger investors, who can also benefit from the sale of the green certificates. But increasing energy prices may encourage some consumers to produce electricity mostly for their own consumption.

The Governance Structure of the Polish renewable energy sector

A number of actors play an important role in shaping Polish renewable energy policy. In the early 2000s the Ministry of Environment was instrumental in setting ambitious renewable energy targets for 2010 and 2020 (Ministerstwo Środowiska, 2000), however due to the opposition of the Ministry of Economy the instruments necessary to achieve these targets have never been implemented. Differences of opinion between the Minister of Environment, Maciej Nowicki, who called biomass co-firing "technological and economic nonsense", and Prime Minister Donald Tusk, led to Nowicki's resignation and ultimate transfer of competences to deal with renewable energy policy to the Ministry of Economy (Ancygier, 2013: 198-199).

In March 2012 a special Renewable Energy Department was created in the Ministry of Economy to deal with the implementation of the European renewable energy legislation in Poland. Already five months later a draft of a renewable energy law, which included the proposal to introduce feed-in tariffs for smaller installations and significantly reduce and ultimately completely abolish support for hydro-power plants and biomass co-firing, was presented by the Director of the Department (Ministerstwo Gospodarki, 2012). A year later, however, a completely new version of the draft of the renewable energy law was presented, without feed-in tariffs and with continuation of support for biomass co-firing and large hydro-power plants, even if at a lower level (Ministerstwo Gospodarki, 2013).

The opposition against limiting support for biomass co-firing came mainly from the Ministry of Treasure, which manages the state-owned energy companies: the Polish Energy Group (PGE S.A.), Tauron Polish Energy (Tauron), ENEA and ENERGA. (Portal Zielonej Energii, 2012). As pointed out by Grzegorz Wiśniewski, "in the apparent lack of other major market players, national energy companies are becoming the key recipient of energy policy" and "influential lobbies, linked to the energy companies, blend with the public administration. Steering the course of policy and regulation year after year, they keep drawing Poland away from an energy breakthrough and make even the evolutionary changes difficult. It seems that it is not the energy companies who implement the state's energy policy, but rather conversely – the state pursues the interests of the companies" (Wiśniewski, 2013).

The political economy of the Polish renewable energy policy

The design of the support mechanism for renewables in Poland determines the main winners and losers of the energy transition in Poland. Since, as mentioned earlier, big energy companies receive green certificates for energy produced in their decades old hydro-power plants and for burning biomass in coal-fired power plants, they belong to the main beneficiaries of the support mechanism. Only in 2012 all big energy companies received certificates worth € 423 mln for biomass co-firing. Further, over € 100 mln were received for the energy produced in the hydro-power plants (URE 2014). Decrease in the price of the green certificates and conflict with the National Energy Agency (URE), which declined to issue certificates for energy produced from biomass which doesn't fulfill the sustainability criteria, led to a significant decrease in the amount of energy produced from biomass co-firing in 2013 and 2014.

To some degree also large, mostly foreign investors in renewables benefitted from the instable, but relatively high support for renewable sources of energy, especially on-shore wind. In 2012 the combined profit from selling electricity and green certificates was 11.3 eurocent for each kilowatt-hour produced. In the case of Germany, the initial level of feed-in tariffs was below 9 eurocent in the same year (EEG, 2012). However the increasing legal instability led some of them, i.e. Dong Energy or Iberdrola, to sell their investments to the big energy companies and withdraw from Poland (Rynek Infrastruktury, 2013).

The costs of renewables development in Poland – just like in Germany – have been paid by the final consumers of energy. Due to the slower development of renewables in Poland and support for the cheapest or already fully amortized sources of energy, the costs of the support were much lower: around 0.7 eurocent per kWh (Gazeta Prawna 2011) – a ninth of the cost paid by the German consumer. Differently from in Germany, however, almost all of the money went to either big energy companies or large, foreign investors. Due to the complicated support mechanism, discrimination against prosumers and lack of any preferences for cooperatives, private, smaller investors have not been able to benefit from renewables development so far.

At the same time there is strong willingness to invest in renewables at the local level. According to a survey conducted among local authorities, for 69% of them investment in renewables means "chance for development" whereas for 61% renewables are associated with the "investment in the future". Furthermore for 59% of local authorities investment in green energy is beneficial for commune's budget. Still, 9% of them consider renewables as "insignificant addition for the commune's economy" (Ancygier & Szulecki, 2014). Such perception may result from the fact that investments are usually made by companies, not – like in Germany – the communities themselves. The former pay 2% real estate tax on only the less valuable parts of the wind turbine, namely the foundation and the tower, but not the wind turbine itself. This leads to much lower proceeds, than initially expected.

The legal insecurity and declarations of representatives of the Polish government indicating that Poland will not promote renewables if there will be no pressure from the European level (WNP, 2013) discouraged investors from investing in the production facilities in Poland. Therefore most of the wind turbines and PV panels come from imports. As a result the major benefit from renewables development in the form of job creation has largely been missed in Poland.

The political ecology of the Polish renewable energy policy

An attempt to increase the share of renewables in the power system at the lowest possible cost led to development of sources of energy, whose impact on the CO_2 emissions reduction was often doubtful. The increased share of energy coming from biomass co-firing led to a situation in which most of the biomass had to be imported. According to the estimates of the Ministry of Economy from 2012, in 2011 Poland imported 1.7 mln tons of biomass from over 50 different countries (Ministerstwo Gospodarki, 2012b). In some cases this biomass was imported from Siberia, Asia or Africa only to be burnt with low efficiency – burning biomass in installations which are not adequately prepared leads to their abrasion, therefore biomass is mostly burnt in the older, less efficient power plants (Forbes, 2012).

The Polish power industry does not only belong to the most CO_2-intensive – second only to Estonia – but the speed of improvement is also one of the slowest in the EU. Overall, between 2005 and 2011 emissions per kWh of power generated in Poland decreased by 4.7%. The average decrease in the CO_2 emissions per unit of electricity in the EU-27 in the same period was 9.1% (IEA, 2013:110).

Broadly defined energy security

Despite security being one of the priorities of Polish energy policy, Polish renewable energy policy did not significantly contribute to increasing the security of energy consumers either in the narrow, or in the broader sense. By contributing to a significant import of biomass, which was only in 2011 worth almost € 200 mln (Ministerstwo Gospodarki, 2012b: 26), Polish renewable energy policy increased Poland's energy dependency. The lack of long-term development goals for renewables discouraged investors from developing production capacity and thus create new jobs. Thus the potential to increase the economic security of Polish citizens has not been utilized. Finally, the slow development of renewables and continued reliance on fossil fuels – increasingly coming from imports – had a damaging impact on the prospects of future generations to rely on fossil fuels in their transition towards low-carbon economy.

6. Conclusions

Polish and German governments took very different paths is their development of renewable sources of energy. Whereas in Germany the monopoly of the big energy companies was significantly reduced and some of them; i.e. E.ON, are changing their profiles to support the process of democratization of the power sector, in Poland energy policy was used to strengthen the dominance of the state-owned energy groups to the detriment of individuals and local communities.

But both countries are also facing important challenges on the development paths chosen. In Germany an increasing share of renewables led to a significant price decrease at the stock exchange which limits the profitability of conventional sources of energy. This leads energy companies to close some of them, which may lead to power shortages when, due to atmospheric conditions, the power demand will not be covered by the changeable renewable sources of energy. A solution to this, and some other problems, i.e. the aforementioned issue of "loop flows" (Puka & Szulecki, 2014a), is the development of the power grid and new technologies of power storage. Also the introduction of incentives that would increase the flexibility of the biomass power plants could increase the stability of the electricity grid.

For Poland the centralization of the power sector and continued strong reliance on the fossil fuels brings with itself numerous political and environmental issues. With the popularity of the renewables and the willingness to have a stronger impact on the energy policy at the local level increasing, current energy policy is facing a strong democratic deficit. At the same time, with the adoption of the ambitious climate targets for 2030, the Polish power sector will have to modernize and invest in low-carbon energy alternatives. With the delays and high costs of nuclear energy, which the Polish government presented in the past as Poland's way of reducing CO_2 emissions, renewables – with all their challenges – offer the only viable option.

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References:

Agentur für Erneuerbare Energien (2014), Eigentumsverteilung an Erneuerbaren Energien-Anlagen 2012 [Division of ownership of renewable energy installations]. Retrieved from http://www.unendlich-viel-energie.de/mediathek/grafiken/eigentumsverteilung-an-erneuerbaren-energien-anlagen-2012.

Agora Energiewende (2015). Die Energiewende im Stromsektor: Stand der Dinge 2014. [Energy transition in the power sector. Developments in 2014]. Retrieved from: http://www.agora-energiewende.de/fileadmin/downloads/publikationen/Analysen/Jahresauswertung_2014/Agora_Energiewende_Jahresauswertung_2014_web.pdf.

Ancygier A., & Szulecki K., (2014) Does Local Energy Mean Renewable? 'Does Local Energy Mean Renewable? Report from a Survey on the Acceptance for the Development of Renewable Energy Sources Among Polish Local Authorities'. *ESPRi Report* No 1, May 2014. DOI: 10.13140/2.1.1019.0727

Anheier, H. K., (2013). Governance – What are the issues?. In: Hertie School of Governance, *The Governance Report 2013*, Oxford: Oxford University Press, pp. 11-31.

BBC News, (2013, October 21), UK nuclear power plant gets go-ahead. Retrieved from http://www.bbc.com/news/business-24604218. According to the agreement between EDF and the British government the French company is going to receive 92.50 GBP for every megawatt hour of power produced in the new reactor for 35 years. This is almost twice the average electricity price in the UK and around 20% more than the feed-in tariffs for large photovoltaic installations in Germany for 20 years.

Bechberger, M., Mez, L., & Sohre, A. (2008). Windenergie im Ländervergleich. [Comparison of wind energy development in different countries]. Berlin.

Bloomberg (2014, July 30). German Utilities Bail Out Electric Grid at Wind`s Mercy. Retrieved from: http://www.bloomberg.com/news/2014-07-24/german-utilities-bail-out-electric-grid-at-wind-s-mercy.html.

BMU (2000). Vereinbarung zwischen der Bundesregierung und den Energieversorgungsunternehmen vom 14. Juni 2000 [Agreement between federal government and energy companies from 14 June 2000]. Retrieved from: http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/atomkonsens.pdf.

BMWi (2014). Bruttobeschäftigung durch erneuerbare Energien in Deutschland im Jahr 2013. [Employment brutto in renewable energy sector in Germany in 2013]. Retrieved from: http://www.bmwi.de/BMWi/Redaktion/PDF/B/bericht-zur-bruttobeschaeftigung-durch-erneuerbare-energien-jahr-2013,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf.

BSW-Solar (2014). Statistische Zahlen der deutschen Solarstrombranche (Photovoltaik) [Statistical data from the German power sector (photovoltaics)]. Retrieved from: http://www.solarwirtschaft.de/fileadmin/content_files/Faktenblatt_PV_Okt09.pdf.

Bundesnetzagentur (2015) Photovoltaikanlagen: Datenmeldungen sowie EEG-Vergütungssätze. [Photovoltaic installations: Registrations and EEG feed-in tariffs.]. Retrieved from: http://www.bundesnetzagentur.de/cln_1412/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/ErneuerbareEnergien/Photovoltaik/DatenMeldgn_EEG-VergSaetze/DatenMeldgn_EEG-VergSaetze_node.html#doc405794bodyText2.

Bundestag (2010). Laufzeitverlängerung von Atomkraftwerken zugestimmt [Extension of the lifetime of nuclear power plants adopted]. Retrieved from: http://www.bundestag.de/dokumente/textarchiv/2010/32009392_kw43_de_atompolitik/203098.

Bundetsag (2011). Die Beschlüsse des Bundestages am 30. Juni und 1. Juli. [Decisions oft he Bundestag from 30 June and 1 July]. Retrieved from: http://www.bundestag.de/dokumente/textarchiv/2011/34915890_kw26_angenommen_abgelehnt/205788.

Burger, B. (2012). Stromerzeugung aus Solar- und Windenergie im Jahr 2011. [Power generation from solar and wind energy in 2011]. Retrieved from: http://www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/vortragsfolien-stromproduktion-aus-solar-und-windenergie-im-jahr-2011.pdf.

Burger, B. (2013). Stromerzeugung aus Solar- und Windenergie im Jahr 2012. [Power generation from solar and wind energy in 2014]. Retrieved from: http://www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/stromproduktion-aus-solar-und-windenergie-2012.pdf.

Burger, B. (2015). Stromerzeugung aus Solar- und Windenergie im Jahr 2014. [Power generation from solar and wind energy in 2014]. Retrieved from: http://www.ise.fraunhofer.de/de/daten-zu-erneuerbaren-energien.

Buzan, B., & Waever, O., & de Wilde J. (1998), *Security. A New Framework for Analysis*. Boulder-London.

Deutsche Welle (2011). German energy companies worry about their nuclear 'money machines'. Retrieved from: http://www.dw.de/german-energy-companies-worry-about-their-nuclear-money-machines/a-14922368.

Die Welt (2014, December 3). Regierung verabschiedet Maßnahmen für mehr Klimaschutz. [The government adopts measures for climate protection]. Retrieved from: http://www.welt.de/newsticker/news1/article134983413/Regierung-verabschiedet-Massnahmen-fuer-mehr-Klimaschutz.html.

EEG (2012). Retrieved from: https://www.clearingstelle-eeg.de/eeg2012.

EEG (2014). Retrieved from: https://www.clearingstelle-eeg.de/eeg2014/urfassung/material.

Enerdata (2014). E.ON reviews its energy strategy, spins off conventional power assets. Retrieved from: http://www.enerdata.net/enerdatauk/press-and-publication/energy-news-001/eon-reviews-its-energy-strategy-spins-conventional-power-assets_30841.html.

Energy Transition (2014, August 25). German grid more stable in 2013. Retrieved from: http://energytransition.de/2014/08/german-grid-more-stable-in-2013/.

EWEA (2014). Wind in power. 2013 European statistic. Retrieved from: http://www.ewea.org/fileadmin/files/library/publications/statistics/EWEA_Annual_Statistics_2013.pdf.

EWEA (2015). Wind in power. 2014 European statistic. Retrieved from: http://www.ewea.org/fileadmin/files/library/publications/statistics/EWEA-Annual-Statistics-2014.pdf.

Forbes (2012, December 3) Polski absurd: biomasa [Polish absurd: biomass]. Retrieved from: http://www.forbes.pl/polski-absurd-biomasa,artykuly,135335,1,1.html.

Gazeta Prawna (2011, December 19) Nie tylko zielone certyfikaty podnoszą rachunki za prąd. [Not only Green Certificates increase electricity bills]. Retrieved from: http://serwisy.gazetaprawna.pl/ekologia/artykuly/577082,nie_tylko_zielone_certyfikaty_podnosza_rachunki_za_prad.html.

Global Challenges Foundation (2014). The Pulse on International Sentiment. Retrieved from: http://globalchallenges.org/wp-content/uploads/pdf/The-Pulse-of-International-Sentiment.pdf.

Grashof, Katherina, et al. (2014) Monopole, Liberalisierung, Energiewende- (Dis-)Kontinuitäten im Strommartdesign. [Monopols, liberalization, energy transition – (dis-) continuity in the design of the power market.] Presentation held during the FVEE-Jahrestagung on 7 November 2014.

Grüne.de (2012, September 20). Selbst ist der Strom. Retrieved from: http://www.gruene.de/themen/atomausstieg-energiewende/selbst-ist-der-strom.html.

GUS (2013) Energia ze źródeł odnawialnych w 2012 r. [Energy from renewable sources in 2012]. Retrieved from: http://old.stat.gov.pl/cps/rde/xbcr/gus/se_energia_zrodla_odnawialne_2012.pdf.

GUS (2015). Mapa odnawialnych źródeł energii, [Map of renewable sources of energy]. Retrieved from: http://www.ure.gov.pl/uremapoze/mapa.html.

Handelsblatt (2014, March 12). Der nächste Energieriese schwächelt. [The next energy giant weakens]. Retrieved from: http://www.handelsblatt.com/unternehmen/industrie/gewinneinbruch-bei-eon-der-naechste-energieriese-schwaechelt/9604222.html.

HNA (2012) Neun Städte und Gemeinden kaufen Stromleitungen zurück [Nine cities and communes buy electricity grid]. Retrieved from: http://www.hna.de/lokales/fritzlar-homberg/neun-staedte-gemeinden-kaufen-stromleitungen-zurueck-2356417.html.

IEA (2013) CO_2 emissions from fuel combustion. 2013 edition, International Energy Agency. Retrieved from: http://www.iea.org/publications/freepublications/publication/co2emissionsfromfuelcombustionhighlights2013.pdf.

IEEE Spectrum (2013, March 16). German Renewables Reach 25 Percent. Retrieved from: http://spectrum.ieee.org/energywise/green-tech/solar/german-renewables-reach-25-percent.

IEEE Spectrum (2014, August 22). Nuclear Shutdowns Put Belgians and Britons on Blackout Alert. Retrieved from: http://spectrum.ieee.org/energywise/energy/nuclear/nuclear-vulnerability-sends-belgians-scrambling-for-winter-power-supplies.

Institute for Energy Research (2013, February 23). Germany`s Green Energy Destabilizing Electric Grids. Retrieved from: http://instituteforenergyresearch.org/analysis/germanys-green-energy-destabilizing-electric-grids/.

IWR (2015) Strompreise sinken 2014 um 13 Prozent. [Electricity prices decreased in 2014 by 2014]. Retrieved from: http://www.iwr.de/news.php?id=27888.

Jehlička, P., & Smith, J. (2007). Out of the Woods and into the Lab: Exploring the Strange Marriage of American Woodcraft and Soviet Ecology in Czech Environmentalism. In: *Environment and History* 2007, No. 2(13).

Kaldor, M. (2013) *Human Security*, Cambridge: Polity Press.

Karaczun, Z. & Szpor, A. (2013) 'Klimat dla innowacji, innowacje dla klimatu. W poszukiwaniu nowego impulsu modernizacyjnego dla Polski [Climate for innovations, innovations for climate. In search of new modernization impulse for Poland]', Warszawa: Niskoemisyjna Polska 2050 [Low-carbon Poland 2050].

Karaczun, Z. (2013). Refleksje nad polską prezydencją w Radzie Unii Europejskiej. Energia i klimat [Reflections about Polish Presidency of the European Council. Energy and Climate] Retrieved from: http://www.pl.boell.org/downloads/Refleksje_nad_polska_prezydencja_Z.Karaczun.pdf.

Kunze, C. & Becker, S. (2014) *Energy democracy in Europe. A survey and outlook.* Brussels: Rosa-Luxemburg-Stiftung.

Maciejewska, B. & Szwed D. (2010). *Zielone Miasto Nowej Generacji* [Green City of New Generation]. Toruń.

Manish, S., Pillai, I. R. & Banerjee, R. (2006). Sustainability analysis of renewables for climate change mitigation. In: *Energy for Sustainable Development* 2006, Nr 4(10),

Metz, L. & Osnowski, R. (1996). *RWE. Ein Riese mit Ausstrahlung* [RWE. A radiant giant.] Kiepenheuer & Witsch.

Ministerstwo Gospodarki (2012) Ustawa o odnawialnych źródłach energii, projekt ustawy z dnia 26.07.2012. [Renewable energy law. Draft from 26 July 2012]. Retrieved from: http://www.mg.gov.pl/files/upload/16573/ustawa%20-%20OZE%20-%2027.07.2012%20-%20konferencja.pdf.

Ministerstwo Gospodarki (2012b) Uzasadnienie do projektu ustawy o odnawialnych źródłach energii. [Justification for the draft of the renewable energy law]. Retrieved from: http://www.mg.gov.pl/files/upload/16573/2012.07.26_Uzasadnienie%20OZE%20wersja%20na%20konferencje%20w%20dniu%2027%20lipca%202012%20r.%20-%20ostateczny.pdf.

Ministerstwo Gospodarki (2013) Ustawa o odnawialnych źródłach energii. Projekt ustawy z dnia 12.11 2013. [Renewable energy law. Draft from 12 November 2013]. Retrieved from: http://www.consus.eu/pliki/ustawa_o_oze_z_dnia_2013-11-12.pdf.

Ministerstwo Środowiska (2000). Strategia rozwoju energietyki odnawialnej. [Development strategy for renewable energy sector]. Retrieved from: http://www.pga.org.pl/prawo/strategia-OZE.pdf.

Morris, C., & Pehnt, M. (2012). *Energy Transition. The German Energiewende.* Retrieved from: http://energytransition.de/2012/09/i-sub-2-1/.

NDR (2014, January 16) Hamburg kauft Stromnetz von Vattenfall [Hamburg buys electricity grid from Vattenfall]. Retrieved from: http://www.ndr.de/nachrichten/hamburg/Hamburg-kauft-Stromnetz-von-Vattenfall,netzrueckkauf169.html.

Öko-Institut (2011). Seltene Erden – Daten & Fakten. [Rare earths. Data and facts]. Retrieved from: http://www.oeko.de/fileadmin/pdfs/oekodoc/1110/2011-001-de.pdf.

Palmer, K. & Burtraw, D. (2004) Electricity, Renewables, and Climate Change: Searching for a Cost-Effective Policy. Retrieved from http://www.rff.org/rff/Documents/RFF-RPT-Renewables.pdf.

Portal Zielonej Energii (2012, October 16) Ministerstwa Skarbu i Gospodarki spierają się na temat współspalania. [The Ministries of Treasure and Economy argue about co-firing]. Retrieved from: http://gramwzielone.pl/bioenergia/4101/ministerstwa-skarbu-i-gospodarki-spieraja-sie-na-temat-wspolspalania.

Puka, L., & Szulecki, K. (2014a) Beyond the „Grid-Lock“ in Electricity Interconnectors. in Electricity Interconnectors: The Case of Germany and Poland', *DIW Discussion Paper* No. 1378, DIW: Berlin.

Puka, L. & Szulecki, K. (2014b) 'The politics and economics of cross-border electricity infrastructure: A framework for analysis', *Energy Research and Social Science*, 4: 124-34. DOI: 10.1016/j.erss.2014.10.003

Quaschning (2015). Installierte Photovoltaikleistung in Deutschland. [Installed photovoltaic capacity in Germany]. Retrieved from: http://www.volker-quaschning.de/datserv/pv-deu/index.php.

Renews Kompakt (2014, January 29). Großteil der Erneuerbaren Energien kommt aus Bürgerhand [The majority of renewable energy comes from the citizens]. Retrieved from: http://www.unendlich-viel-energie.de/media/file/284.AEE_RenewsKompakt_Buergerenergie.pdf.

Robbins, P. (2004). Political ecology: a critical introduction. Oxford 2004.

Rosenau, J. N., (2000). Change, complexity and governance in globalizing space. In: J. Pierre (ed.), *Debating governance: Authority, steering and democracy*, Oxford: Oxford University Press, pp. 167-200.

Rynek Infrastruktury (2013, February 19]. Dong Energy wycofuje się z Polski. Projekty OZE przejmą Energa i PGE. [Dong Energy withdraws from Poland. Renewable energy projects will be overtaken by Energa and PGE]. Retrieved from: http://www.rynekinfrastruktury.pl/wiadomosci/dong-energy-wycofuje-sie-z-polski-projekty-oze-przejma-energa-i-pge-21142.html.

Statista (2015). Höhe der CO2-Emissionen durch die Stromerzeugung in Deutschland in den Jahren 1990 bis 2013. [CO2 emissions from the power sector between 1990 and 2013]. Retrieved from: http://de.statista.com/graphic/1/38893/co2-emissionen-durch-stromerzeugung-in-deutschland-seit-1990.jpg

Statistisches Amt (2013). Volksentscheid über die Energienetze am 22. September 2013. [Referendum about the electricity network on 22 September 2013]. Retrieved from: http://www.statistik-nord.de/wahlen/wahlen-in-hamburg/volksentscheide/2013/.

Szulecki, K. & Westphal, K. (2014) 'The cardinal sins of European energy policy: Non-Governance in an uncertain global landscape', *Global Policy*, 5(s1): 38-51. DOI: 10.1111/1758-5899.12153

Szwed, D. & Maciejewska, B (2014) *Demokracja energetyczna*, Warszawa: Zielony Instytut.

United Nations, (1987). *Report of the World Commission on Environment and Development: Our Common Future*, New York: UN.

URE (2014). Ilość energii elektrycznej wytworzonej w OZE w latach 2005-2014 potwierdzonej świadectwami pochodzenia. [The amount of energy confirmed with certificates of origin]. Retrieved from: http://www.ure.gov.pl/pl/rynki-energii/energia-elektryczna/odnawialne-zrodla-ener/potencjal-krajowy-oze/5755,Ilosc-energii-elektrycznej-wytworzonej-w-OZE-w-latach-2005-2014-potwierdzonej-sw.html.

Urlich F., & Lehr, U. (2014). Erneuerbar beschäftigt in den Bundesländern: Bericht zur aktualisierten Abschätzung der Bruttobeschäftigung 2013 in den Bundesländern. [Renewables create jobs in the states: Report about the brutto employment in the states in 2013]. Retrieved from: http://www.gws-os.com/discussionpapers/EE_besch%C3%A4ftigt_bl_2013.pdf.

Wen Wählen (2005). Thesen: Pro und Kontra Kandidaten [Statements: Candidates for and against]. Retrieved from: http://www.wen-waehlen.de/kandidaten/begruendung_2.html.

Wiśniewski, G. (2011). Bezpieczeństwo energetyczne. Indywidualne, lokalne i regionalne czynniki europejskiego bezpieczeństwa energetycznego opartego na wykorzystaniu odnawialnych źródeł energii. [Energy security. Individual, local and regional factors influencing European energy security based on renewable sources of energy]. In: Wiśniewski, G. & Karaczun, Z. Potencjał wykorzystania odnawialnych źródeł energii dla wzrostu bezpieczeństwa energetycznego w Europie [The potential of renewable sources of energy to increase European energy security]. Warsaw.

Wiśniewski. G., (2013) 'Energy revolution and counter-revolution', *Kultura Liberalna*, No. 22/229. Retrieved from: http://kulturaliberalna.pl/2013/05/28/kemfert-jakobik-wisniewski-patocka-liberty-climate-electricity/#3

WNP (2013, March 26). Tusk: cel dla OZE chcemy osiągnąć jak najtańszym kosztem dla odbiorcy. [Tusk: we want to achieve the renewables' target at the lowest cost for the consumer]. Retrieved from: http://energetyka.wnp.pl/tusk-cel-dla-oze-chcemy-osiagnac-jak-najtanszym-kosztem-dla-odbiorcy,193753_1_0_0.html.

WNP (2014, September 24). Dla Polski Wschodniej dobra energetyka odnawialna [For Eastern Poland renewable energy is good]. Retrieved from: http://energetyka.wnp.pl/dla-polski-wschodniej-dobra-energetyka-odnawialna,234632_1_0_0.html.

Wysokie Napięcie (2014, November 21) Ustawa o OZE: Wyższe ceny za prąd wytwarzany w domu [Renewable energy law. Higher prices for electricity produced at home]. Retrieved from: http://wysokienapiecie.pl/wiatraki/528-ustawa-o-oze-wyzsze-ceny-za-prad-wytwarzany-w-domu.