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Implementing Supply of Wind Energy – international comparisons of best practices and shortcomings

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Abstract

Wind energy is one of the fastest developing kind of green energy in Europe. The goal of this study is to provide an insight on implementing supply of wind energy. Analysis is based on PEST analysis and four case studies – two from German and two from Polish market. Above approach allowed to identification of best practices and shortcomings. Apart from this several drivers and barriers from macro and microenvironment of wind energy sector are described.

Keywords: green energy, wind energy, green business

Streszczenie

Wdrażanie energii wiatrowej – porównanie najlepszych światowych doświadczeń i wad

Energia wiatrowa jest jednym z najszybciej rozwijających sie rodzajów "czystej" energii w Europie. Celem artykułu jest poszerzenie wiedzy na temat wprowadzenia podaży energii wiatrowej. Analiza problemu oparta jest na analizie PEST oraz czterech studiach przypadku – dwóch z rynku niemieckiego i dwóch z rynku polskiego. Powyższe podejście umożliwiło identyfikację najlepszych praktyk jak i błędów. Oprócz tego zostały opisane czynniki makro i mikrootoczenia sektora energii wiatrowej wspierające jak i hamujące jego rozwój.

Słowa kluczowe: zielona energia, energia wiatrowa, zielony biznes

1. Introduction

In consideration of evanescent fossil resources and an increasing consciousness for the problems and environmental pollution caused by conventional sources of energy such as coal and oil the topic of renewable sources of energy is getting increasingly important. A possible future transition to a low carbon economy depends on the substitution away from fossil fuels towards new or renewable energy sources [13], [18]. While only a decade ago most of renewables seemed to be not efficient enough to cover substantial parts of the energetic mix and their use hence of rather hypothetic importance, some of them are already mature enough to contribute to the traditional energy-mix. Next to solar and hydro power, wind energy is already a mature technology that might be perceived as a real alternative to traditional sources of energy and that is gaining increasing importance.

Basically, renewable energy is energy which comes from natural resources such as sunlight, wind, rain, geothermal heat or tides but also from biomass such as wood or different other plants. Renewable energies also include the energetic potential of bio gas and bio ethanol. All of these energy sources have in common that they are naturally replenished and can provide a sufficient contribution to a country's domestic energy mix and energetic independence, since they are not relying on potentially raw materials, such as oil, coal or gas. Applying renewable energy sources, therefore is not only an issue of protecting the environment, it might also be perceived as a strategic resource and a mean of energetic independence, especially in times of diminishing raw materials and instable political coalitions. According to the International Energy Agency [20, s.9]: "Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen derived from renewable resources".

Number of studies have investigated historical energy transitions [11], [19], [14], [2], [12], [21], offering a rich understanding of their nature and implications. These historical shifts were largely stimulated by resource scarcity, high labor costs, and technological innovations. Today, renewable energy sources are mainly desirable because of identified global ecological threats and are deemed to replace traditional energy sources in several distinctive areas like electricity, heating, hot water, motor fuels and other rural energy services. Most important usage of renewable energies takes place in mainly three areas [23, s.15]:

- Power generation: Here, renewable energy sources already provide 19% of the generation of energy worldwide, mainly produced by wind, solar and water forces.
- Heating: main source is solar and hot water, produced by solar power, but also bio mass and bio gas. In some countries as for example Sweden, the use of bio mass for heating has already surpassed that of oil.
- Transport fuel: important volumes of oil can be saved by using bio fuels, mainly produced from ethanol. But the growing importance of electric cars enables the usage of other renewable energies for "fuelling" transport possible.

The goal of this study is to provide an insight on implementing supply of wind energy. Research is based on modified PEST analysis and four case studies – two from German and two from Polish market. The structure is as follows: after introduction, several opportunities and threats of wind energy sector will be presented. Than a general insight into wind energy sector in Germany and Poland will be provided. After that four case studies of wind energy project will be presented. The final conclusions on drivers and barriers in supply of wind energy are based on presented projects and PEST analysis.

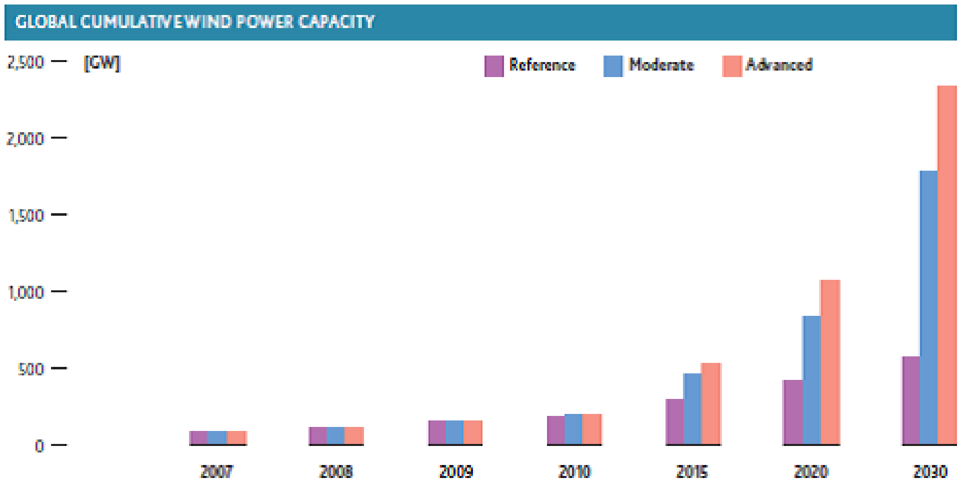
2. Opportunities and threats for the global wind energy sector

According to the Global Wind Energy Council (GEWEC) and Greenpeace [16], there are three possible scenarios for the development of the global wind energy sector: a reference scenario, a moderate scenario and an advanced scenario. Whilst the reference scenario is taking into account existing policies and some assumptions about the development of energy markets, liberalisations and gas market reforms until 2030, the moderate scenario also assumes that all goals, set by different countries and organisations are actually fulfilled. It also assumes the increasing implementation of further targets regarding energy security and pollution and carbon emission reductions. The advanced scenario at last is the most ambitious one and gives an outlook on how the energetic situation might look like, once countries are consequently promoting renewable energy and giving the highest importance to that aim.

Figure 2.1. gives an overview about the current and forecasted wind turbine capacities until 2030, broken down into the three different scenarios. It shows that capacities will constantly increase, even in the most careful assumption, the reference scenario.

To sum up, taking the reference scenario, the most pessimistic one, we will have forecasted capacities of 415 GW in 2020 and 572 GW in 2030. One precondition for this scenario would be a very slow development of newly-installed capacity, especially in big countries, such as China. So far, there is no indication for this event to happen, which makes the reference scenario seems to be unusually disconnected to the real developments. The moderate scenario sees installed capacities of 832 GW in 2020, followed by 1777 GW in the year 2030, which means that the forecast is about 100 GW more installations per year- during the course of the forecast- than the reference scenario. Of course, the advanced scenario gives even higher figures, having more than 1000 GW in 2020 and 2300 GW by 2030. This would mean an average annual growth in capacity of 120 GW by 2020 and about 185 GW by 2030.

Undoubtedly, there is an enormous potential for renewable sources of energy in a perspective until 2030, but it is closely connected with an adequate amount of investments and political support. Given the assumption that those factors are beneficiary for green electricity, there are still threats which can hamper a further growth of this sector. These threats are linked to the technology itself and also have a close relation to some of the problems, which traditional energy sources, such as coal or oil, are facing, most of all the need for raw materials which are necessary for the production of RE's. In order to get an impression about these threats, one has to know that green technologies, such as solar panels or wind turbines, are using certain minerals, the so-called “rare earths”. The ambitious goal of achieving higher shares of renewable energy in the world energy-mix depends heavily on the availability of neodymium, dysprosium, indium, tellurium and gallium, metals that are in demand globally. Those metals are difficult to mine and to separate. Another problem is that countries, which are main suppliers of these metals, are mostly in strong need on their own, most important China. The country controls more than 90% of the world market for rare earths and has recently limited its export, in order not to threaten its own economic development. Shortages and limitations- a so-called “bottleneck”- of these materials could have a profound impact on the development of renewable energy that also threatens the ambitious climate changing plans of the European Union. A recent study states that five metals - dysprosium, neodymium, tellurium, gallium, and indium - are at the highest risk of supply “bottlenecks” from high demand, concentration of supply and “high political risks due to an extreme concentration of supply in China” [22].



	2007	2008	2009	2010	2015	2020	2030
Reference [MW]	93,864	120,297	158,505	185,258	295,783	415,433	572,733
[TWh]	206	263	347	406	725	1,019	1,405
Moderate [MW]	93,864	120,297	158,505	198,717	460,364	832,251	1,777,550
[TWh]	206	263	347	435	1,129	2,041	4,360
Advanced [MW]	93,864	120,297	158,505	201,657	533,233	1,071,415	2,341,984
[TWh]	206	263	347	442	1,308	2,628	5,429

Fig. 2.1. Global Cumulative Wind Power Capacity. Source: [16]

Another potential threat to wind energy could be the aging structure of electricity supply nets. Since renewable energy systems, such as wind or solar, are not generating power on a constant basis, but are subject to some volatilities, for example during periods of low wind intensity, it needs an intelligent management of electricity nets, in order to balance this variations. Modern nets should be able to absorb high amounts of power at some times, in order to not decrease the efficiency of green energy installations. The age of those nets- at least in some countries- has been identified as a possible problem on the road to more renewable energy [5].

3.Macroenvironmental forces of wind energy sector in Poland and Germany

Macroenvironmental variables of wind energy sector in Poland and Germany will be shortly presented with use of PEST analysis model. This model is an effective tool for analysis of macroenvironmental background with the purpose of using the information to guide strategic decision-making and planning [15]. The abbreviation of four letters stands for political, economic, social and technological factors respectively. All these factors affect directly the profitability of wind energy sector. Appropriate analysis of PEST factors is necessary to identify the potential risks, opportunities and changes of market [25]. In this paper the last – technological factor is omitted, as technology of wind energy is standardized across both analyzed countries.

3.1. Political framework in Germany and Poland

Starting with the political factors, it becomes obvious that there are already legal regulations in both countries, Germany and Poland, concerning wind energy sector. These regulations are partly created by legal framework of the European Union. Fostering the use of renewable energies for power generation is at the heart of the EU's long term energy policy [24]. The EU directive on the promotion of electricity produced from Renewable Energy Sources (RES) has established reference targets for the share of renewable electricity in each EU Member State's power supply. Most important instrument for the legal and political implementation of renewable energy in Germany has been the Renewable Energy Law (EEG), legislated in 2000 by the government under Gerhard Schröder. The act provided an enormous degree of planning security for producers, investors and operators of renewable energy facilities. The EEG promotes fixed remunerations for feeding electricity from renewable energies into the grid. This remuneration has to be paid to the operators. Production, construction and operation of a wind turbine are not financially supported. This led to a "boom" of these technologies, enhancing and fuelling Germany's leading position on the global RE sector. Since then, the EEG has been widely adopted by governments all over the world, since the success and development of the whole RE sector that has been initiated by it, was proven by Germany's leading global position.

Speaking about political legislations, Poland introduced its Energy Law in 1997, providing the framework for the privatization of the electricity market and creating new conditions for the sector of renewable energies, enabling competition and third party access to the energy market. The energy law does also give some definitions of alternative and renewable energy sources, describing them as sources, which "do not use organic fossil fuels in the process of producing energy"[28]. The act does also define renewables as using energy from wind, sun, water and biomass [29]. On a local level, municipalities have been obliged to contain renewable energy sources, especially these available locally in the particular space management plans. According Energy Law act energy companies were obliged to consider the utilization of renewables within their portfolio. The Minister of Economy was commissioned to prepare an obligation for energy distributors to buy renewable energy. This resulted in the introduction of the Disposal of the Minister of Economy on the Obligation of Electricity and/or Heat Purchase from non-conventional Energy Sources, introduced in March 1999 [4].

By adopting EU 2020 strategy, Poland has agreed to increase its share of renewable energies at the community's gross consumption to a share of 15% until the year 2020 (Germany plans to satisfy 30%). This means, that both countries have to adopt some relevant national action plans and to report on progress on a regular basis. Directive 2003/54/EC, issued by the European Commission, obliges the particular member states to warranty priority for entities, intending to generate energies, using renewable sources. In addition to that, the Polish legislator added an "ex officio supplier" obligation, in order to extend the demands of the directive and to oblige these suppliers to purchase electricity, generated by renewable sources of energy. This procedure is comparable to a "green certificate" system. Conclusions of the European Council from 12 December 2008 assume that Poland will be granted a prolonged transition period, combined with an extended time to comply with the EU requirements, concerning greenhouse gas emissions until 2020.

3.2. Economic factor in Germany and Poland

German municipalities are having a high interest in attracting wind turbines and wind farms, since their operators are obliged to pay business taxes which makes those installations a convenient institution for most regions and municipalities. In 2009 the new regulation for the splitting of business taxes have been introduced in Germany, which states that 70% of the business taxes have to be paid immediately to the municipality where the wind turbine is located, and only 30% to the operators registered branch. This has been perceived as an important signal for the further development of wind energy in Germany since it increases the willingness of municipalities to offer areas for the construction of wind turbines. They have also the opportunity to bargain 100% of all taxes. Since wind parks are creating revenues on a level of several million Euros, the tax earnings are important arguments for operators and investors when searching for new localizations. In 2004, wind parks in Northern Germany alone had tax payments of 16 million Euro and this amount is increasingly growing. Other benefits result from the creation of jobs which are further increasing the taxable income within a municipality and hence improve the overall economic situation.

As mentioned earlier EEG promotes fixed remunerations for feeding electricity from renewable energies into the grid. The most important regulations, implemented on January 1st, 2009 are:

- Remunerations have to be paid for the duration of 20 years, excluding the year of initiation.

- The remuneration has a level of 50.2 ct/kWh (basic remuneration). During the first five years of operation, remuneration is even 9.02 ct/kWh. This period is prolonged for two additional months per 0.75% of the reference earnings, in case that the actual earnings go below 150% of the estimated reference earnings. The reference earning is the calculated (estimated) earning, dependent on the different localisations of a wind turbine. Weaker localisations are subsidised by some special benefits, in order to compensate for this geographical disadvantage.
- The initial remuneration for newly constructed wind turbines is decreasing at 1-1.5% each year (“digression”).
- The remuneration for off-shore turbines is 15 ct/kWh for wind farms, installed before 2015.
- The bonus for repowering measures is about 0.5 ct/kWh

The cost of renewable subsidies is met by EEG – Umlage which is a surcharge on energy users’ bill. Current level is between 13,5-19,5 cents per KWh which is not much higher than average wholesale market price for power to German households (in 2011 it was 13.95 cents per KWh) and twice much higher for industrial consumers with the heaviest usage (in 2011 it was 7.32 cents per KWh) [30].

In Poland, under the “Energy Law Act”, those energy enterprises which are acting as “ex officio suppliers” are obliged to purchase electricity made from renewable energy sources connected to networks that are located within the territory of the “ex officio supplier”. This regulation allows some amount of financial certainty to the operators of wind farms. The government also issues “Green Certificates” for trade after requesting to open a business for the creation of renewable energy. Those certificates are offering an additional source of income for operators. There are public subsidies for wind energy, although one important instrument, the Action 9.4 of the Infrastructure and Environment Operational Program, is already almost exhausted. Nevertheless, investors still may benefit of non-subsidy wind energy instruments, namely preferential loan programs. Main program is offered by the National Environmental Protection and Water Management Fund (NFOŚiGW). It is also planned to support investments into the connection of renewable energy sources into the power grid.

Another economic factor is the job creation. In Germany, 300.000 people are working in the field of renewable energies, 100.000 of them in the sector of wind energy. According to estimations [3], this number could increase to 500.00 until 2020, thanks to the high amount of exports and the increasing global demand for wind turbines “made in Germany”. Germany still benefits from being first mover in technology but it rivals, US and China continuously deploying wind and solar power. Germany’s strong commitment to withdrawal from involvement in nuclear energy engineering may pay off in developing pioneering renewable technology and occupying first place in world renewable energy market. Today, the share of exports in the German wind energy industry is at 80%, which underlines the importance of this sector. The side-effects of this development are secure jobs in various industries- producers of wind turbines, their suppliers and related industries, such as technicians, maintenance, service- , a higher purchasing power and more taxable income and tax revenues for cities and municipalities. In 2008, producers and suppliers were offering 37.000 direct jobs. Including the industrial preparation, installation and infrastructure plus service and operation, the total amount of jobs reached the number of 100.000, as mentioned above. Producers, suppliers, service providers, planning bureaus, assessors and consultants are making their living thanks to clean energy. The sector is not only limited to high-technology companies, but also includes traditional firms from the area of craftsmanship, steel or construction.

According to Greenpeace estimations [17] effective realization of renewable energy development scenarios in Poland would result creation of additional 155 thousand of job places till year 2020 and almost 190 thousand jobs till year 2030. When it comes about wind energy sector it is assumed that more than 30 thousand jobs till year 2020 and Over 45 thousand jobs till year 2030 can be created. Above estimations do not include multiplier effect connected with indirect jobs.

3.3. Social acceptance in Germany and Poland

Implementation of wind energy has a great social impact. This impact might be not only positive – through for example new job places and cleaner air but also negative through destruction of local landscape and noise. The successful implementation of wind energy requires acceptance and support within the society. According to surveys of three independent polling firms Allensbach [1], Emnid [8] and Forsa [10], the majority of Germans has positive attitudes towards renewable energies, especially to solar and wind energy. Two thirds of all respondents are in favour of wind energy as the main source and even 71% would like to see stronger efforts in the exploitation of off-shore wind turbines. Main reasons for these positive attitudes towards wind energy are fears of being dependent on fossil forms of energy, the expectation of new jobs in the ascending renewable energy sector and the expectation, that renewables are less harmful for the natural environment. It is remarkable that the acceptance for wind turbines is especially high in areas, which are already housing a number of them. 95% of all Germans are in favour of a further expansion of renewable energies, mainly by wind and solar energy. Two third of all the recipients opt for the further development of wind energy, even 71% perceive the construction of off-shore wind turbines as positive. The remarkable phenomenon in Germany is involvement of private citizens into renewables. By the end of 2010, largely through energy cooperatives, owned 40 percent of the country's total of 53 GW installed renewable energy capacity [30].

Poland is still highly dependent on fossil energy, mainly black and brown coal. Nevertheless, Poles are willing to accept the use of renewable sources of energy to a high extent, as surveys of the Eurobarometer [9] are showing. In this particular survey, Poles showed mainly positive attitudes towards renewable energy sources. The numbers of wind energy are especially high: 82% of all Polish respondents stated that they were in favour of this technology, 13% had balanced views about this topic, which means that they weren't in a particular favour to any of them.

4. Research Method and Data

The research method was based on articles about building theories from cases [6], [7] and case study research [26], [27]. Building theory from case studies is a research strategy that "*involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence*" [6]. According to other authors case studies are: "*rich, empirical descriptions of particular instances of a phenomenon that are typically based on a variety of data sources"* [26]. As the population and selection of cases is crucial it cannot be random because it controls extraneous variation and defines the limits for generalizing the findings. The goal of this method is to replicate or extend the emergent theory. This stay in contrast to traditional hypothesis testing method, where researchers randomly select the cases from population. The goal of this type of studies is to obtain accurate statistical evidence on the distributions of variables within the population. In reaching closure the issue on when to stop adding cases is crucial. According to Eisenhardt [6] a number between 4 and 10 cases usually works well. With fewer than 4 cases, it is often difficult to generate theory with much complexity and empirical grounding is rather unconvincing. With more than 10 cases it becomes difficult with the complexity and volume of the data. Among strengths of this method is its likelihood of generating novel, testable and empirically valid theory. Apart from strengths this method has also a few weaknesses like overloading with data and built theory can be narrow and idiosyncratic.

This method does not need to be based on fragmented and contradictory literature or empirical evidence. Building theory from cases is especially useful for studying new area of longitudinal change processes, which the development of wind energy sure is.

4.1. Case studies

Examples of particular projects in Germany and Poland include both, on-shore and off-shore wind farms and shall give an impression of the implementation of wind energy on a practical level. The following projects have been chosen:

- Alpha Ventus (Germany)

- Butendiek (Germany)

- Golice (Poland)

- Suwałki (Poland)

The choice of above cases was dictated by the accessibility, richness of theoretical and empirical data and appropriate topic.

4.1.1. Alpha Ventus:

Alpha Ventus is the first German project in the range of off-shore wind energy, carried by several different partners, including energy companies and public authorities.

The request for a building permission has been submitted in 2001 by the German company PROKON Nord GmbH and the permission has been granted in the same year by the Federal Authority for Shipment and Hydrography (BSH). Four years later, PROKON sold its exploitation and operational rights to the newly founded “Stiftung Offshore Windenergie” (Foundation for off-shore wind energy) that carries the operational rights until today and also has some coordinative functions.

In June 2006, three energy companies, E.ON, Vattenfall and EWE formed the “German Offshore Testfield and Infrastructure GmbH& Co. KG” (DOTI), in order to operate the wind farm together. Each of the companies is allowed to operate 4 own wind turbines with a capacity of 5 MW each. In general, this will sum up to an overall capacity of 60 MW for the whole wind farm. The DOTI leases the operational rights from the “Stiftung Offshore Windenergie”. The participation of the Federal Agency for Environmental Protection and the Secretary of Environment prepared the foundation for a connection to the electronic power grid and construction work for the wind farm started in 2007. A consortium of different European construction companies and suppliers, such as Areva, Bilfinger-Berger or Hochtief Construction was employed for the construction work and REpower made the pitch for the supply of six 5MW wind turbines and generators. The construction work for the first wind turbine has been finished in July 2009 and only a month later, first energy has been transferred into the power grid. In November 2009, the construction works have been finished and the Alpha Ventus wind farm was officially opened in April 2010. Since then, it is successfully producing energy and helps to gain valuable knowledge about offshore wind energy and the effects on the environmental surroundings.

Alpha Ventus has not only been the first offshore wind farm under German guidance, but is also special in some other areas. Due to the strict environmental protection policies in Germany, the wind farm could not been constructed in the shallow water in direct neighbourhood to the coast line, because this is home to the “Wadden Sea”, an environmental preservation are with unique conditions for flora and fauna. Therefore, Alpha Ventus is located in an area in the open sea, 45 km north of the island of Borkum. This location is connected with extreme climate conditions, such as strong winds, waves with heights of several meters and even ice. The exclusive location and the 30m deep water are additional challenges for construction and maintenance of the wind farm and every construction work needs to involve detailed planning work and scheduling, since the turbines can only be reached by boats or helicopters.

Constructing such an ambitious project involved several necessary preconditions, including tight cooperation with authorities, local groups, experienced operators and a wide range of European suppliers. The high precision of this planning work enabled the wind farms successful construction and operation.

4.1.2. Butendiek:

The Butendiek wind farm project has been planned as a co-operative project, financed by private investors and operated by private parties in the region of Schleswig-Holstein. The project aimed to obtain the complete financing of the planning phase and the construction, as well as a large amount of the equity capital on a private basis. It is located in the Northern Sea, 34km westwards of the island of Sylt.

Once finished, the wind farm will include 80 Vestas wind turbines with a combined overall maximum capacity of 240 MW. Hub height will be about 80m and the rotor diameter 90m. Approval for the construction work was given in December 2002 by the Federal Office for Shipping and Hydrography and the planning phase was scheduled to be finished in 2005. Due to problems with raising enough equity capital, the beginning of the construction works was re-scheduled until 2006, although the completion of the wind farm has been scheduled for the year 2007.

Due to financial problems, increasing prices and changing political support, the plans for a pure private operation and financing of the wind farm had to be given up and the Scottish & Southern Energy company joined as a partner. After realizing that this was not enough to grant an efficient construction work, both partners decided to sell the project to the German wpd, a company located in Bremen, which is ought to complete the project. It has not been decided yet whether the initial private investors will re-join the project at a later stage or not.

4.1.3. Golice:

The Golice wind farm is located near the Golice and Lisow villages in the Slubice commune, close to the state border of Germany. The project includes 19 wind turbines with a capacity of 2 MW each and a maximum overall capacity of 38MW in total. Besides the wind turbine, the Golice wind farm will also feature a transformer station, located outside of the farm, cables for the connection to the power grid and an optical telecommunications network. Each tower will have a height of 100m, in combination with the 3 blade rotor this height will increase to 142.5m.

The wind farm is planned and operated by the company Golice Wind Farm Sp. z o.o. which is a subsidiary of Acciona Energia, a Spanish player on the global market for renewable energies.

The planning work started when the local development plan for Golice and Lisow has been approved in March 2007, providing sufficient spaces for the usage for wind energy. Five months later, in August 2007, these areas have been approved for the construction of middle-voltage power networks, transformers and power cable connecting transformer stations as well, what provided the necessary conditions for the project. After a phase of surveys about the environmental impacts of the project, the mayor of Slubice finally granted the environmental consent on March 20th, 2008. In November of the same year, the Construction Permission was granted for the project, consisting of the construction of 19 wind turbines and surrounding technical installations, mentioned before. These construction permits were valid for three years and initiated the start of construction works that ended with the official commissioning in December 2011. Since then, the wind park is generating 80 gWh annually, which is enough to provide electricity for more than 40,000 households.

One can state that planning and construction work of the wind park went very well and without any bigger problems or delays. Although the operator is a Spanish company, the co-operation with the local authorities and other influential stake-holders worked out and contributed to the short period of planning and construction.

4.1.4. Suwałki:

Preparation works for the Suwałki wind farm, located in the North-East of Poland, was carried out in the period 2000-2002 by the Suwałki county authority and the United States Trade and Development Agency. The goal was to find the best and most eligible localisation for the construction of a wind farm with an overall capacity of 50MW, beginning with a study about the feasibility of such an investment. Besides the site identification, the study also included monitoring of the wind speed, wind resources, environmental impact and financial calculations.

After measuring and calculating these figures, next goal was the co-operation with important stake-holders, such as public authorities, but also with factors such as legal and political regulations, environmental areas and spatial plans. This stage also included polls and surveys about the degree of acceptance among the local population, which was mainly positive. The operators also undertook educational trainings and organized meetings with the locals, in order to get feedback about the construction process.

After this quite intensive period of preparations, the actual process of constructing began, including 18 Siemens SWT-2.3-93 turbines with a capacity of 2.3MW each, summing up to a total capacity of 41.4MW. In the meantime, the wind farm has been taken over by the German RWE electricity company, which is trying to enter the Polish market for wind energy.

The wind farm has already been completed and is now generating 80 million kWh per annum, which is enough electricity to provide about 40,000 households with electricity.

Besides the positive effects on the tax situation, the increasing number of wind turbines is also assumed to become a magnet for tourism and further development in the Suwałki region.

4.2. Best practices and shortages in setting up and running wind energy farm

Careful analysis of presented case studies allowed to identify several conditions which are necessary in order to achieve success in wind energy sector. In all cases companies were working within stable political framework with fixed compensations, regulations and incentives for investment and operation of wind turbines. All four farms generated new direct and indirect jobs not only in energy sector but also, as in Suwałki case, in tourisms. Both in Germany and Poland stable and flexible power grids with a high capacity and intelligent grid management were offered. In all cases there was strong co-operation of political, economic and private stake-holders in the field of construction, operation and planning. All presented projects we success because we supported by social acceptance combined with a broad level of participation on private, political and economic stages and education about the positive impact of RE’s on the environment.

A factor that is missing in the Polish regulations is efficient financial support for repowering and grid connection. It is strongly connected with political support, which in Poland, is much smaller than in Germany. It is not surprise if taken into consideration that around 2 mln polish citizens are directly and indirectly involved into energy market which is still heavily dependent on fossil sources - mainly hard coal. What is more in September 2011, the Polish president signed an amendment to the Energy Law, allowing energy enterprises the right of refusal to examine applications for connection of renewable energy sources to the grid.

5. Conclusions

The aim of this paper was to provide an insight into implementing supply of wind energy. Analysis was based on PEST analysis and four case studies – two from German and two from Polish market. Above approach allowed to identification of best practices and shortcomings. Key to success in implementing supply of wind energy is stable political framework, intelligent grid management, co-operation of political, economic and private stakeholders and high degree of social acceptance. Factors that may hamper the implementation of wind energy is insufficient financial support, political unwillingness and outdated power grid. If Poland would like to follow German path towards successful implementation of wind energy it must meet several conditions.

The Polish government should file a political and legal act that is similar to the German Renewable Energies Act, including fixed regulations about the financial remuneration and the obligation for electricity companies to buy this electricity that has been produced by renewable energy sources. This legal act will create a safe framework which is necessary to attract investments into the field of RE in general and WE in particular and it will give a positive input into the further development of the whole sector by increasing its financial attractiveness. It will also fuel the further development of wind technology and electric power grid and might enhance the WE industry in Poland.

Once having a stable framework and- as a result- the opportunity to make long-term schedules, the government should attempt to enhance the domestic WE sector by several means. This could include education, by supporting academic research and the implementation of eligible curricular at university and the support for the creation of RE jobs, also by tax and fiscal means. There should be an attractive network of educated graduates, workers and companies, providing qualified workers and employees for domestic WE companies.

Securing availability of sustainable energy, while limiting carbon emissions and protecting the environment is a "holy graal" of 21st century. Wind energy still requires high promotion among all actors of energy market. High natural gas and oil prices are likely to weaken incentives for renewable energy generation in fossil fuel exporting countries. On the other hand rising global prices of energy and supply disruptions from traditional suppliers have clearly put pressure on efficiency in energy-importing countries. The role of education is crucial in promoting wind energy. Academic research on renewable energy should be better supported because only then ecological awareness among all actors of energy market will increase. Appropriate educated politicians will provide attractive for investors political framework, managers will understand all benefits of responsible investments and society will accept green energy sources.

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