

WIND ENERGY DEVELOPMENT AS A PART OF POLAND'S INDUSTRIAL DEVELOPMENT

by

Dagmara STOERRING and Frede HVELPLUND

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Poland as an European Union (EU) member state has to increase its share of renewable energy (RE) in gross domestic energy consumption from 2.4% in 2003 to 12% in 2010. This paper discusses perspectives for wind energy development in Poland as a part of the industrial development given the political system supports RE. It shows that the fulfilment of the EU's RE obligations could be used to the advantage of Poland's sustainable development. Wind energy development may create a new industry that involves spare capacity of traditional Polish industries and generates new work places. This may help to overcome Poland's main macro-economical problems: high unemployment and budget deficit. This paper concludes with recommendations on how to make wind energy development a part of the industrial development in Poland by introducing RE support mechanisms to improve the conditions for companies to develop wind technology in Poland.

Key words: *wind energy, renewable energy, sustainable development*

Introduction

The European Commission's *White Paper for a Community Strategy and Action Plan in the field of Renewable Sources of Energy* sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the European Union (EU), by 2010, from presently 6% to 12%. This document is also binding for the 12 new EU members of Central and Eastern Europe, including Poland. The renewable energy (RE) development is one of the infrastructure adjustments to the EU standards, which Poland will have to complete.

Risø National Laboratory (Roskilde, Denmark) measured the *European Wind Atlas* including the Northern part of Poland. According to these measurements the Polish Baltic Sea coast has wind conditions comparable to those of the Danish and Dutch ones. The rest of Northern Poland has wind conditions similar to central parts of Germany. This fact could incline that wind energy might become one of the most important RE in Poland, besides biomass, water, solar.

Already in the middle of the nineties Poland has been identified by the wind turbine producers as a country with big potential. However, the wind energy development has been very slow so far as well as growth in other RE sources.

The Polish government and parliament adopted in 2000 an official document, *Strategy for the Renewable Energy Development*, which should be a corner stone for “green energy” growth in Poland. The strategy has a very ambitious goal of 7.5% share of electricity from RE in the Polish energy balance in 2010. It is rather unrealistic that this goal will be achieved, as at the end of the year 2002, according to the most optimistic sources, this share has reached only 2.4%.

Poland still does not have a law for the RE. The promotional system for electricity from RE sources is based on very few preferential credits and subventions from two funds: the National Fund for Environmental Protection (NFOSiGW) and the Ecofund (Ekofundusz). The resources are very scarce and the lack of other supporting instruments, such as direct support of investment costs, fixed price for electricity from RE, tax incentives, *etc.*, hinders the RE development, hence also the wind energy development.

Experiences of other countries show that a RE growth in a country is almost impossible without governments’ support. In 2004 the Polish parliament, however, still had not decided which model of RE promotion should be used in Poland. That means that the future of wind energy will depend largely on future political decisions.

This paper discusses possibilities for wind energy development in Poland treated as a part of Poland’s industrial development that could give the government good reason to support wind energy. While most of the paper is based on research that was done in 2003, recent major developments have been accounted for as well.

The paper starts with examples of successful wind energy countries, Denmark and Germany. The next section presents the Polish RE regulations with regards to the EU’s RE law as of 2003, and introduces the wind energy development in Poland including its main problems. In the following, the authors show how wind energy development may be treated as a part of Poland’s industrial development with focus on employment effects. In the section *Major development since 2003* are presented some major developments since 2003, and the paper concludes with a recommendation on how to make wind energy development a part of the industrial development in Poland.

Wind energy development in Denmark and Germany

Employment and industrial development are important driving forces for the policies supporting RE. The examples of leading wind power nations, Denmark and Germany, illustrate positive effects of wind energy development on the country’s industrial development and economy. As renewables are more labour-intensive than fossil technologies, they are considered as potential opportunities for employment. This aspect is a part of the RE policy in the example countries Denmark and Germany, which are described in the following two subsections.

Denmark’s wind energy development

The Danish government’s commitment to wind-derived electricity has been included in a succession of energy plans, where especially employment effects have been

an issue. In early 2002, the total installed wind power capacity of 2,600 MW (wind power installed on land) already supplied 18% of the country's electricity. Later development is expected to take place offshore. The growth of total installed wind energy capacity is shown in fig. 1.

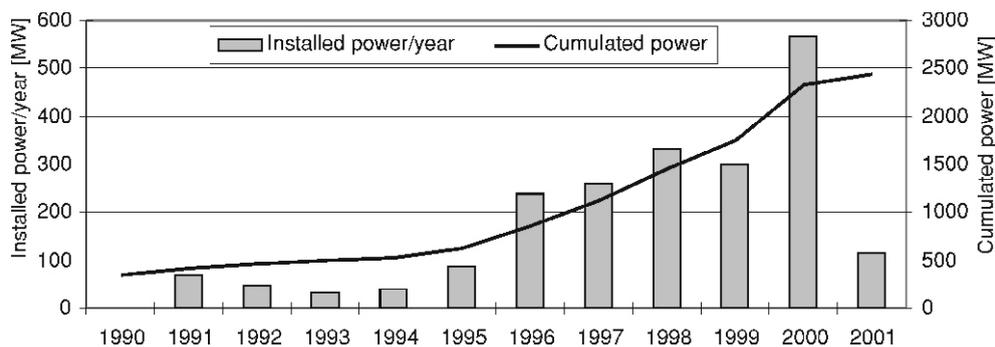


Figure 1. Annual growth (installed MW/year) and total installed wind power in Denmark

During the past 15 years changing Danish government coalitions have maintained a target of 10% wind energy for the year 2005, a target that was subsequently adjusted to 16% by 2003.

The basic reason why wind energy has had such a prominent place in Danish energy planning is the need to reduce greenhouse gas emissions. Denmark has a target of reducing CO₂ emissions by 22% between 1988 and 2005. More than one third of that target is being met using wind energy to replace coal-fired power generation [1].

Danish companies have 60% of the world's wind turbine manufacturing capacity. In 2002 about 2/3 of the production is exported. 20,000 Danes were employed in the Danish wind industry in 2001, 14,500 of these worked for Danish component suppliers.

In addition, another 4,000-5,000 jobs were created abroad through deliveries of components, and installation of Danish turbines. These figures do not include assembly work *etc.* done in foreign subsidiaries or licensees of Danish firms [2].

Danish companies have formed successful joint venture manufacturing companies in countries such as India and Spain, leading to a rapid transfer of wind energy technology to these countries. Altogether, the Danish wind industry had gross sales of around 3 billion € in 2001 [3].

Table 1 shows the employment numbers in the wind industry in Denmark according to the Danish Wind Industry Association. This is the most comprehensive study of the employment effects of wind power to date, in spite that it was published in 1996 [4]. The results cover three areas: the direct and indirect employment from wind turbine manufactures, the direct and indirect employment effects of installing wind turbines, and the global employment effects of the Danish industry's export business.

Table 1. Direct and indirect employment from wind power in Denmark

	Persons 1991	Persons 1992	Persons 1993	Persons 1994	Persons 1995
Wind turbine manufacturing	2,900	2,700	3,650	5,632	7,800
Installation of turbines	300	150	150	231	316
Research, <i>etc.</i>	200	200	250	300	300
Total (rounded figures)	3,400	3,100	4,100	6,000	8,500

According to this study, wind power created in 1995 some 9,000 jobs in Denmark, including jobs at Danish turbine component suppliers. The impact on global employment from the manufacturing process was approx. 12,000 jobs. The installation of Danish turbines worldwide created another 4,000 jobs. Given that Danish wind turbine manufacturing supplied approximately half of the total generating capacity in the world market, one may estimate worldwide employment in the wind power industry to be in the range of 30,000 to 35,000 jobs in 1995^{*}.

Germany's wind energy development

Germany had in 2003 about 50% of wind power installations in Europe and a third of the installations worldwide. In particular, the last years of the 1990s have witnessed a tremendous growth in new wind power capacity, fig. 2. Since 1993, the average annual growth rate has been 58%. During a normal wind year, wind power produces 2%

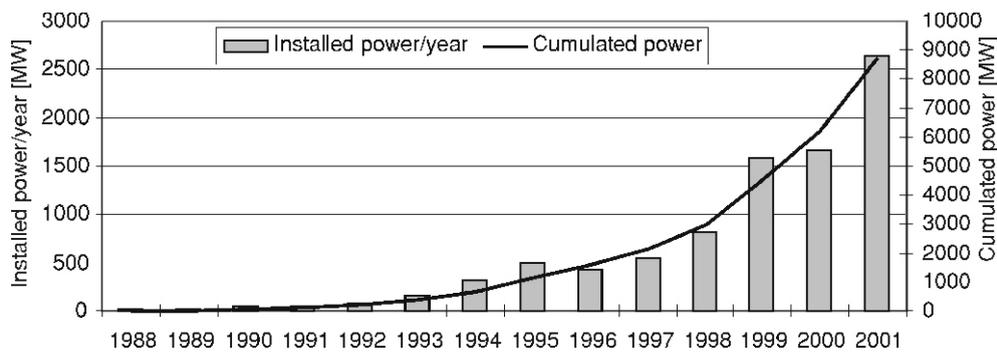


Figure 2. Annual growth (installed MW/year) and total installed wind power in Germany (Source: <http://www.dewi.de/export/Stat1200/>)

* As it was stated these numbers increased in the end of the 1990s due to the substantial growth in the installed capacity

(8.5 TW_h annually) of Germany's total electricity consumption. Some coastal regions in Northern Germany already cover more than 10% of their total electricity demand by wind energy.

In terms of employment, the wind industry has created approx. 25,000 new jobs in Germany. The industry's turnover in 1999 reached the record of 2 billion €, including exports which have grown to almost 20% of the total sales. The competitiveness of the industry is also reflected by the range of manufacturers represented on the German market, fig. 3.

This dramatic growth of wind power in the 1990s in Denmark and Germany originates in the introduction of supportive government policies in form of minimum price mechanisms.

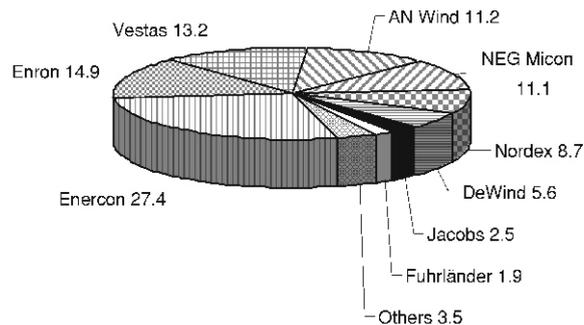


Figure 3. Shares of the suppliers on the German market in % of the installed rated power in 2000 (Source: Rehfeldt, Knud, Wind Energy Use in Germany – Status December 31, 2000)

Polish RE law in context of European Union's RE law

In this section Polish RE policy will be presented with regard to the EU's RE policy. A rough analysis of documents issued by the Polish government, *Energy policy guidelines for Poland until 2020*, *The common structural policy for rural areas and agriculture development*, and *The second ecological policy for Poland*, shows that Polish policy related to the RE is scattered between sectors, *i. e.* energy policy, environmental policy, agricultural policy. Due to this incoherence it is ineffective. There is no ministry or institution that is responsible for RE, which makes this sector a second category problem.

Although the Polish government adopted under the pressure of the parliament the first strategic document concerning RE development: *Strategy of Renewable Energy Sources Promotion*, with the ambitious target of 7.5% of the RE in the primary energy balance in 2010, no further action has been undertaken in order to achieve this target. The strategy obligated the government to prepare a draft of the RE law, which should define state policy concerning RE promotion. However, no draft of this law has been prepared yet, hence state policy concerning RE promotion remains undefined. There are only few indications on how this policy may be designed.

A draft of the Wind Energy Development Programme, prepared by the EC BREC (European Commission's Baltic Renewable Energy Centre) for the Ministry of

Environmental Protection in autumn 2001, gives some information on the shape of the future wind energy/RE policy in Poland. The authors of this document assume the introduction of a “green certificates” system combined with a minimum price mechanism.

From the governmental executive documents, the two *Disposals of the Minister of the Economy on the Obligation of Electricity and/or Heat Purchase from non-conventional Energy Sources* from March 1999 and from December 2000, respectively, are the most important. These documents introduced obligations to purchase the electricity from RE by utilities. The latter disposal from December 2000, which presently regulates the RE market in Poland, only worsened the situation for RE producers. In comparison to the first disposal, the new one has unclear rules concerning “green energy price”. People involved in wind energy production say that the new disposal moved decisions about the price to the individual officials in utilities. The disposal introduced a requirement that every utility has to show a certain share of the electricity from the RE in the annual total electricity sale without imposing sufficient penalties for not fulfilling this obligation. In consequence this disposal did not lead to an increasing interest of the utilities in purchasing energy from wind turbines, though turbine owners counted on an increasing demand during the whole year 2001.

EU policy concerning RE is very important for the RE development process in Poland. Poland is aspiring to join the EU in the first wave of enlargement and is obligated to adjust its law to the EU *acquis communautaire*. As an applicant country, Poland is already involved in the Research and Development programmes, and has access to financial resources in form of pre-accession funds (ALTENER, PHARE, SAPARD, ISPA, etc.).

In the Commission’s report *Applicant countries and the Community acquis* from 2001 it is stated that the promotion of RE sources in Poland has still been sidetracked: “The scope of those problems is recognised in the government programmes, but financial commitments need to be included in the national budget if any genuine progress is to emerge” [5]. Poland has no executive programme concerning RE promotion and will have to introduce mechanisms in form of RE governance systems as an EU member state. According to the *Directive on the promotion of electricity from renewable sources*, adopted in September 2001, the member states have to set national indicative targets. The 7.5% target introduced by the Polish *Strategy of Renewable Energy Sources Promotion*, completes this obligation, though it is far from the EU global indicative target of 12% in 2010. In the field of the environmental protection Poland will get a transitional period to adjust to the EU’s standards. However, Poland will have to introduce full EU standards and presently Polish RE utilisation is far from the 14% target of the White Paper in the field of Renewable Sources of Energy for the year 2020.

Present wind energy development in Poland – main problems

In 2002 Poland has in total 57.7 MW installed wind turbine capacity. This is a rudimentary number compared to over 500 MW annual installed capacity in Denmark

and over 1000 MW in Germany during its most dynamic development. Even this tiny number of turbines was installed with difficulties, primarily concerning financing and connecting to the grid. After the turbines had been built, problems with electricity sale to the grid occurred so that the investments are unprofitable in some cases.

In spite of these problems, a massive interest in wind energy projects has been noticed in the last two years (measured by applications for connections to the grid in utilities) that was mainly caused by expectations that the disposal of the Minister of Economy from December 2000 would force utilities to buy RE energy.

The owner structure of the projects is very varying. There are some small private investors, few bigger companies, and a very small number of municipalities. The biggest wind farm of 30 MW was installed in 2002 by foreign investors (Danish company Elsam). One can presume that big companies and foreign investors have the biggest potential because of their financial resources. However, if the price for wind energy remains on the present unremunerative level, it may discourage people and companies to invest in wind energy and this could stop the wind energy development in Poland.

The following problems of the wind energy sector in Poland may be identified.

- (1) Very high costs of wind energy installations (around 1 million \$ per 1 MW installed capacity) and in consequence a high price of electricity from wind turbines are the biggest obstacles for wind energy development in Poland. For two reasons the wind electricity price is much higher than the traditional fossil fuels' electricity price. Firstly, the traditional energy sector is still subsidised by the government. Secondly, the fossil fuels electricity price does not include the environmental and social costs. The price offered by the utilities to wind electricity producers – between 200 and 250 Polish Zloty (approx. 48 and 60 €) per 1 MWh is not enough to cover investment costs.
- (2) Expensive credits in commercial banks is another problem for wind energy investors in Poland.

The commercial interest rate for investment loans is around 16%. The electricity price offered by utilities for wind energy is too low to make the investment profitable with this interest rate. These prices are only reasonable if an investor gets preferential credits. Another problem is that it is impossible to get a contract with utility for selling wind energy for more than two years, which makes it very difficult to get a commercial credit.

- (3) In the situation of an increasing number of wind energy projects, the possibilities for preferential financing are decreasing. The following calculation based on information collected by the authors illustrates this problem.

In the period June 2000 – June 2001, when a large part of the Polish wind energy capacity was installed, approximately 48.8 million Polish Zloty (approx. 11.6 million €) of preferential credits together with subsidies were granted by Polish funds (NFOSiGW, Ecofund, and Bank of Environmental Protection). Assuming that 100% of all wind turbine investments should be financed from these sources, it enables the installation of about 12.2 MW wind capacity. Theoretically, investments have to involve at least 30% of own capital resources. Under this condition only 20 MW could have been installed. In fact only 15 MW wind capacity has been installed in this period due to informational barriers, as described below.

(4) Old fossil fuels companies have a very strong position in Poland because they are still mostly owned by the state. Although the privatization process of the energy sector has been initiated, it is very slow. In this situation, the wind energy is in an unprivileged position in comparison to the old fossil fuels companies. Moreover, old fossil fuels electricity producers have a strong lobby in the Polish parliament (because of traditional strong position of the coal miners trade unions) that can oppose any ecological movements.

It should be mentioned that present regulations concerning RE make utilities responsible for bearing costs of RE development. If they buy expensive electricity from wind energy, their profits automatically decrease. This may be a reason, why they are not interested in purchasing electricity from wind turbines. This problem could be only resolved by amendments to regulations concerning sales to the grid.

(5) Finally, informational barriers for wind turbine investors should be mentioned. There is not sufficient information on the wind resource in Poland, as no official measurements of wind resource have been conducted. It is very difficult to find information on the investment preparation process, companies employed in the sector, and wind turbine producers. Furthermore, there are no studies on social and ecological advantages of wind energy projects. The informational barriers could be easily overcome, if there were financial resources for information and education campaigns.

All above-mentioned issues concerning the wind energy sector in Poland lead to the conclusion that a lack of sufficient economical mechanism, which would convince investors to invest in wind energy in Poland, is the major problem of wind energy development in Poland. These instruments can only be implemented by the Polish government, thus, wind energy development in Poland is not possible without governmental support.

The next section shows that wind energy development may enhance industrial development, given there is appropriate governmental support.

Wind energy development as a part of Poland's industrial development

The old fossil fuels industry in Poland will need substantial investments in the nearest future. Many power plants need refurbishment and upgrading. According to the World Bank almost 50% of the generating capacity is over 25 years old and needs to be refurbished or even replaced in order to meet stricter environmental standards and growing energy demand. The International Energy Agency estimates that upgrading and renovation of the existing power plants as well as the introduction of replacement capacity will require investments of 8,000 million \$. Several new power and co-generation plants are being adapted for the utilisation of the natural gas and the RE may be another alternative.

The present economical situation in Poland is difficult, mainly characterised by a high unemployment rate (19% in February 2003). As it was already shown by examples

of Denmark and Germany, wind turbine investments create new work places. Wind turbine producers such as Vestas would be willing to move production to Poland, if there was a market for wind energy in Poland (in fact it is a part of Vestas strategy – they did so in India, Spain).

If we consider a production of wind turbines in Poland, it would create a new industry, which may also involve spare capacity of Polish traditional industries. Wind turbine factories can be located in regions with particularly high unemployment rates, as for example in Southern Poland's old coal mining regions. This may give employment to ex-coal miners. Wind energy development may become a part of the energy sector's restructuring process.

The establishment of wind turbine production in Poland will bring budget income for the government in form of taxes and new work places. On a local level, Polish municipalities are already interested in hosting wind turbine investments on their territory because of property tax, which could make up a considerable part of a local budget.

Poland's potential for wind turbines production

Polish companies could produce most of the parts of the modern turbines. This conclusion can be drawn because wind turbine industry operates on the basis of many traditional industries, such as steelworks and metallurgy industry (construction of towers, nacelles, rotor hubs), mechanical industry (generator, gearbox, clutch, brake, *etc.*), and aviation industry (rotor blades) that are some traditional Polish industries. However, although modern wind turbines have adopted a number of classical tools, components are gradually becoming more specialised, and expert knowledge and experience is necessary to start the production of wind turbines. Wind turbine industry in the EU was created during more than 35 years of extensive research conducted thanks to substantial financial help from governments.

Starting the production of wind turbines in Poland would give Polish companies that lost orders from other industries (example of Nowomag that tried to find new products and constructed a 160 kW wind turbine in the beginning of 1990s), the possibility for continuing production, thus, saving work places.

Simulation of wind turbine manufacturing in Poland

In the authors' interview with representatives of Vestas-SWT it has been stated that Vestas Wind Systems A/S may move its production to Poland, if there was a reasonable market for wind turbines in the country*.

In the following a calculation of effects of wind turbine manufacturing in Poland is presented. Table 2 shows employment effects and budget VAT revenues of an annual

* Vestas Wind System A/S might move some of its production to Poland, if there was a reasonable market for wind turbines or for logistical reasons due to Poland's geographical position. However, such a task will require thorough investigation through a standard feasibility study carried out by the Technology Transfer Department of Vestas Wind System A/S (comment from Vestas Wind System A/S)

production of 30 and 100 MW, respectively, capacity in factories in Poland. It is impossible to produce all the components in Poland from the beginning, hence, moving production would be a gradual process. In the calculation the production is assumed with a decreasing share of import in the following years. Furthermore, it is estimated that all the components are produced for the local market, therefore it does not include eventual exports, due to which employment effect could be even bigger.

For the purpose of this estimate, Danish figures (1995) for employment are used. These show that over 17 man-years are created for every MW of wind energy manufactured. With an average price per MW of installed wind power at 1 million € in 2001, these employment figures can be related to monetary value, showing that over 17 job-years are created by every 1 million € manufactured.

Table 2. Employment effects and budget revenues from VAT (22%) of 30 and 100 MW, respectively, wind turbine capacity manufacturing

Year	Share of production in Poland [in %]	Production of 30 MW annual		Production of 100* MW annual	
		Persons	VAT [million €]	Persons	VAT [million €]
1	30	111	1.386	370	4.620
2	40	145	1.848	493	6.160
3	50	185	2.310	616	7.700
4	60	222	2.772	739	9.240
5	70	259	3.234	862	10.780
6	80	296	3.696	986	12.320
7	90	333	4.158	1,108	13.860

* 30 MW annually and 100 MW in the next two, three years time was a minimum to move production to Poland given by Vestas-SWT in the interview

The calculation shows that if 1000 MW capacity were produced in Poland, over 10,000 new work places would be created. In the present situation of high unemployment, every thousand new work places are valuable.

Because of the insignificant role RE has played in the Polish government's energy policy, it is difficult to find governmental documents containing socio-economic feasibility studies of energy policy.

The authors of this paper know only about one document containing a study of employment effects, carbon dioxide emissions, and government revenues connected with implementation of the RE in Poland. In the year 2000, the Ministry of the Environmental Protection initiated a project: *Different scenarios for RE development in Poland according to the SAFIRE model* [6]. The tool used here is the SAFIRE package (the Strategic Assessment Framework for Implementation of Rational Energy). As far as wind energy is concerned, the SAFIRE model simulation allows to presume that in the most favorable

circumstances, *i. e.* if all installed wind turbines were produced in Poland, it should create 3,500-10,500 new jobs until year 2005 and 7,100-24,800 until 2010. In this analysis, 700 MW installed capacity until 2005 and adequately 1,770 MW until 2010, are assumed [7].

Major development since 2003

As it was mentioned above, the preceding sections were based on research that was done in 2003. This section presents some of the major developments since 2003.

In early 2007 the installed capacity in Poland is 216 MW [8] that mean 160 MW in four year or 40 MW/year. This corresponds to 0.1% share of wind generation in domestic consumption of electric energy.

In [9] it is reported that the *Wind Energy Development Programme 2002-2005* [7], which was completed in 2002, has not been adopted due to political reasons – allegedly the policy would mainly support foreign manufacturers.

As common in other EU countries, Poland has still no ministry or institution that is responsible for RE. This shows that there are no major improvements during the last four years from Polish political perspective – at current prices RE electricity is still not economically interesting [10]. The EU structural funds, however, may be a source of financing RE investments in the near future.

Conclusions

The two main problems of the Polish macro-economic situation are a high budget deficit and a very high unemployment rate. In this situation it is difficult for the Polish government to allocate resources to support RE development. On the other hand, increase in the RE utilization is unavoidable for Poland as an EU member. Therefore, it was the intention of this paper to show how wind energy development may stimulate industrial development.

The examples of Europe's wind power leading nations, Denmark and Germany, demonstrated the positive effects of wind energy development: creation of new work places, budget revenues, and an increase in wind turbine export. In the case of Danish producers, these effects concern not only Denmark but they have even expanded to other countries through the establishments of joint venture manufacturing companies *e. g.* in India and Spain. This led to a rapid transfer of wind energy technology to these countries. This is a very important fact, as the same may take place in Poland under better political conditions.

In Denmark and Germany energy plans including socio-economic analyses of employment effects of RE projects resulted in supportive RE government policies. These policies triggered the dramatic growth of wind power in the 1990s in these countries. This may be an indication for Poland that precise socio-economic analyses should be conducted before implementing a RE law.

This paper has focused on the employment effects of wind energy development. A simulation of wind turbine manufacturing in Poland showed that the production of 1000 MW capacity in Poland would create 10,000 new work places in Poland. This simulation clearly points out that the number of jobs created by wind turbine manufacturing depends on the annual capacity installed in Poland. Wind turbine manufacturers need a certain amount of wind projects per year to decide to move their production to Poland. As in Denmark and Germany it is the task of the Polish government to initiate this process. Potential investors will only invest in RE if it is in their economic interest. However, in the present situation it is not profitable to produce wind electricity in Poland. Unclear political regulations characterized by lack of a RE law makes the situation even more pessimistic.

It is the role of the policy to convince wind turbine producers to move their production to Poland through introduction of wind energy supporting mechanisms, *e. g.* minimum price mechanisms, rebates, green pricing mechanisms. The establishment of wind turbine production in Poland should be based on cooperations with experienced EU wind turbine producers. They would bring specialist know-how and educate Polish workers and engineers. Furthermore, the establishment of research collaborations between Polish and international companies/institutions should be supported by the RE governance system. This would enhance the technological development in Poland. Finally, the old fossil fuels industry in Poland will need substantial investments in the nearest future. Why should these investments not partially be used for wind energy, instead of building new coal power plants, causing high CO₂ emissions?

The authors would like to emphasize that this paper did not investigate which wind energy promotion mechanisms should be implemented in Poland which is a necessary next step. Furthermore, possibilities of research in wind energy technology by Polish research institutions were not analysed but are assumed to be present.

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Authors' addresses:

D. Stoerring

Department of Business Studies
Aalborg University,
4, Fibigerstraede, DK-9000 Aalborg, Denmark

F. Hvelplund

Department of Development and Planning
Aalborg University
13, Fibigerstraede, DK-9000 Aalborg, Denmark

Corresponding author D. Stoerring

E-mail: ds@business.aau.dk

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