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Legal and administrative aspects of energy investments illustrated with an example of wind farms in Poland

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Abstract

The paper presents the main stages of energy investments in Poland illustrated with an example of wind farms. The article also presents the examination of problems investors may encounter and how to solve them rationally. One major problem is the impact of investments on environment protection and public interest. The article shows both positive and negative effects of wind on the environment. The article has been written on the basis of studies already made by research centres and the analysis of existing scientific literature and legal articles.

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Keywords
Wind power, environmental, farm locations, construction of a farm.

1. Introduction

Poland being a member of the European Union is obliged to promote the use of energy from renewable sources. According to ‚Energy Policy of Poland until 2030'[1], the share of renewable energy sources in the final energy consumption in Poland is expected to grow up to 15% in 2020 and 20% in 2030. The renewable energy sources do not emit dust and greenhouse gases into the atmosphere and using such sources is one of the ways of accomplishing the reduction plan in Poland.

As renewable energy sources, the Polish legislator in Article 3 section 20 of the Act on Energy Law[2] indicates sources which use: wind power, solar power, aerothermal and geothermal energy, sea wave, sea current and tidal energy or energy obtained from the fall of rivers and biomass energy, energy from landfill biogas as well as biogas produced in the process of sewage disposal and treatment or decomposition of plant and animal remains.

This article focuses on the energy from wind plants. For this study by using the concept of a wind power plant, the author means a device using wind power to produce electricity, i.e. air movement resulting from the pressure difference which affects the rotation of a rotor with blades, producing mechanical energy, which in the end is converted into electricity in a generator.

The environmental benefits of wind power installations are well known. There are also wide social benefits[3], based on the fact that the number of wind turbines and wind farms still increases.

[1] Appendix to Resolution No 202/2009 of the Council of Ministers of 10 November 2009.

[2] Journal of Laws of 2012, item 1059 consolidated version with amendments.

[3] More: R. Cowell, G. Bristow, M. Munday, *Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development*, Journal of Environmental Planning and Management Vol. 54, No 4, May 2011, p. 539–557.

Table 1. Power Renewable Energy Development in Poland

	2007	2008	2009	2010	2011	2012
Power [TJ]						
Wind plants	1,869	3,016	3,876	5,989	11,543	17,091
Total renewable energy	203,141	226,788	253,352	287,953	312,828	356,070

Data from website http://www.stat.gov.pl/gus/5840_3680_PLK_HTML.htm/, cited 11 December 2013.

The published data indicate that wind plants with total power of 2,341.312 MW[4] (30 September 2012) are installed in Poland. In line with the commitments Poland made by signing the Treaty of Accession to the European Union by 2010 7.5% of the balance of power in the national electricity consumption would come from renewable sources. Over the last two years, all sources of renewable energy generated about 9.3 TWh of electricity (25 January 2011), with the final electricity consumption of 155 TWh, which gives only a six percent share of renewable energy sources.

2. Location and energy potential of wind power in Poland

The first major stage of investment process is to select a suitable site for the location of a wind farm, taking into consideration wind speeds and their seasonal fluctuations in the area and the topography of land including the construction of a wind farm situated by the sea or inland. Wind speed is the result of several factors: air temperature, local equilibrium of the atmosphere, the type of land cover (roughness), the presence of water bodies and other obstacles (for example buildings, trees)[5].

The most important of all these factors is the type of land cover (roughness) since wind speeds and power obtained from a wind turbine

[4] Data from website of Polish Wind Energy Association, http://www.pwea.pl/pl/, cited 20 November 2012.

[5] R. Sadło, *Elektrownie wiatrowe w Polsce,* 2010, p. 1–13, cited 12 December 2012, http://www.awea.org/learnabout/publications/loader.cfm?csModule=security/getfile&PageID=5728.

depend on it. The best place is the area without any forests and buildings and the roughness factor of 0.5, in order to avoid wind turbulence, which can affect the efficiency of a turbine. The most preferred areas for the construction of power plants are meadows and fields, with the roughness coefficient of 0.03 and water coefficient of 0.0002[6].

Another important aspect to which attention should be paid during the construction of a wind farm is the form of surface. Wind turbines should not be built in river valleys and in areas of animal habitat. In the case of feeding animals a distance of 200 metres from a wind turbine should be kept in order to reduce the risk of negative effects on flora[7]. Similarly, the distance from the buildings should be minimum 500 metres due to the monotonous sound emitted by a working wind turbine.

In Poland, the area suitable for wind energy is the one with the annual average wind speed of not less than 6 m/s at 70 metres above ground level. The most favourable conditions for the construction exist in the northern part of Poland, mainly in Pobrzeże Słowińskie and Kaszubskie, and Suwałki region, where the wind speed is above 6 m/s.

Good conditions for energy investments (Mazowiecka Lowland, Wielkopolska and the Lake District in the Sandomierz Basin where wind speeds range from 3 to 6 m/s) result in the amount of wind power generated in these areas (Fig. 1). In 2010 there were 540 wind turbines in Poland (Fig. 1, 2).

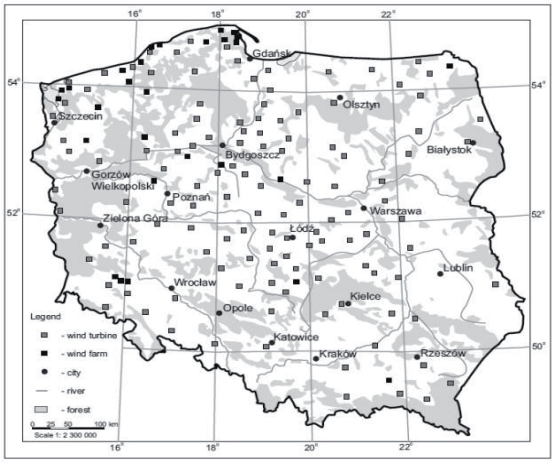
Another important factor is the location plan of wind turbines in a wind farm area. Each wind turbine data should apply to their own location and should be separated from the other location by 400 metres. In the case of short distances between turbines interference may appear so that the wind energy can disperse. Another element is the area in which a wind turbine is to be built, annual wind measurements and a detailed analysis of the amount of power that can be obtained, and how long it will take to get cost reimbursement[8].

[6] More: T. R. Oke, *Boundary Layer Climates,* Taylor-Francis E-Library, London 2002.

[7] Sadło R, 2010*, Elektrownie wiatrowe w Polsce*, p. 1–13, cited 12 December 2012. http://www.awea.org/learnabout/publications/loader.cfm?csModule=security/getfile&PageID=5728.

[8] M. Niedziółka, *Zielona energia w Polsce*, published by: D. Niedziółka, Wydawnictwo CeDeWu, Warszawa 2012, p. 179–212.

Fig. 1. Location map of wind turbines and wind farms



Source: Own study based on URE 2010

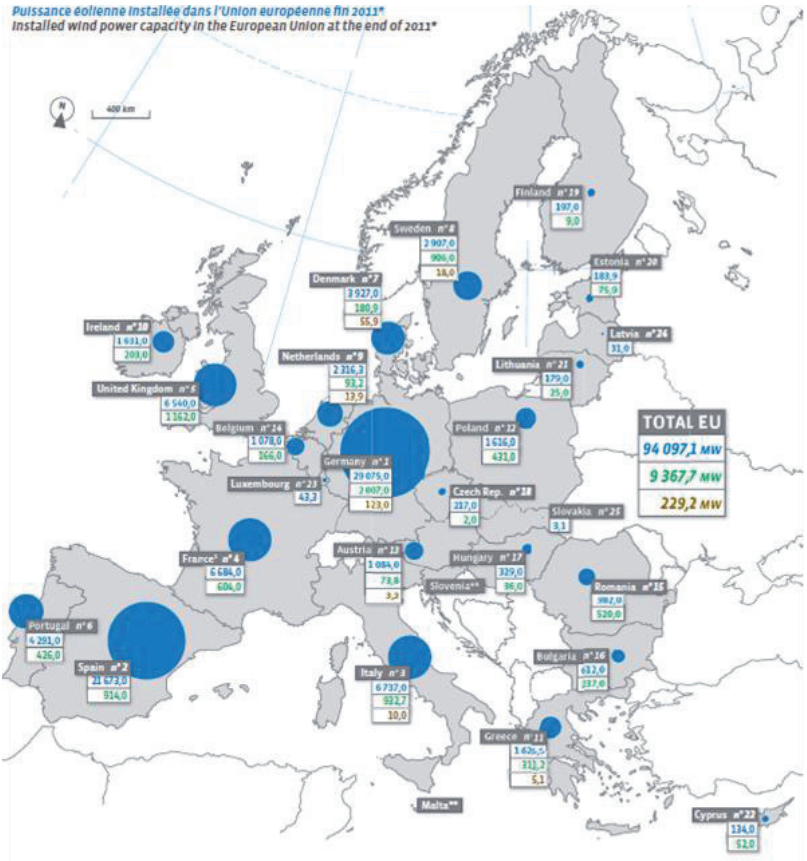
Fig. 2. Number of wind turbines in Poland

Source: Own study based on URE 2010

Most of the wind power is generated in the northern and central parts of the country, which results in the number of wind turbines in these areas.

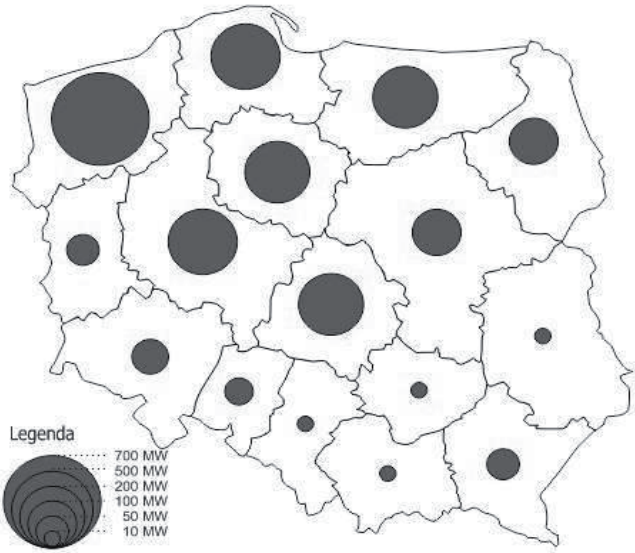
With regard to the production of electricity from a renewable energy source i.e. wind, Poland is currently producing 1,616 MW or about 12% of the total production of wind energy in the European Union (Fig.4).

Fig. 3. Power generated from wind turbines in the European Union.



Source: Energy & Natural Resources.

Fig. 4. Power generated from wind turbines in Poland. Prospects for the Central and Eastern European Electricity Market (2011)



Source: Own study based URE 2010

3. Stages of energy projects implementation

Basic legal acts governing the location, construction and operation of wind farms are: the Act of 27 march 2003 on Planning and Spatial Management[9], the Act of 3 October 2008 on Access to Information on the Environment and its Protection, Public Participation in Environmental Protection and on Environmental Impact Assessments[10] and the Act of 7 July 1994 on Building Law[11].

These acts regulate issues related to procedures of obtaining necessary permits and administrative decisions to build wind power stations. An investment process connected with building is long and usually takes

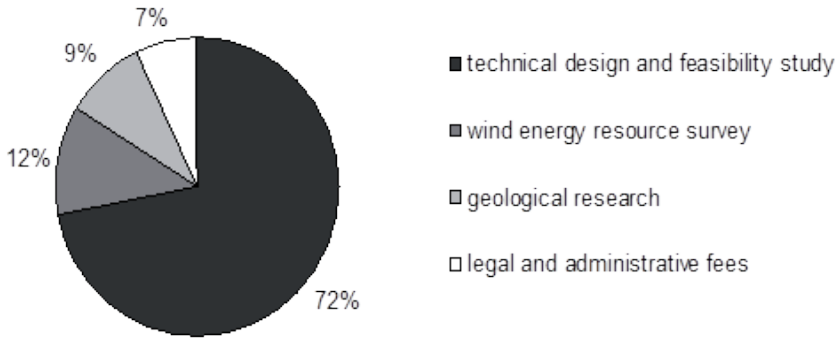
[9] Journal of Laws of 2012, item 647 consolidated version with amendments.
[10] Journal of Laws of 2013, item 1235 consolidated version with amendments.
[11] Journal of Laws of 2013, item 1409 consolidated version.

a few years. It is characterized by some stages of execution, among others obtaining a location for an investment and a building permit, environmental impact assessment, network connection or obtaining a license.

3.1. The pre-investment process

The first stage of an investment in energy is environmental impact assessment (Fig. 5).

Fig. 5. Pre-investment costs



Source: Own study based on PSEW 2010.

Among the tests that should be carried out are technical projects and feasibility studies. They account for 72% of total costs that have to be borne in a pre-investment process. Other costs such as research costs related to wind energy sources (9%) as well as payments related to legal and administrative fees constitute more than what enables to start the investment (7%). Pre-capital costs before capital shall not constitute 2–3% of total capital costs.

3.1.1. The impact of wind farms on the environment

Installations using electricity from wind power with a total nominal power of not less than 100 MW belong to projects likely to have a significant impact on the environment. Additional systems using wind energy to produce electricity are among the projects which have the potential

to have significant effects on the environment[12]. For both types of projects it is necessary to obtain a decision on environmental conditions. The decision sets out environmental determinants of the project.

Wind turbines can have negative influence on birds and bats because of fatal collisions with wind turbines, direct habitat loss and fragmentation, creating a barrier, loss or change of flight paths of birds, destruction of feeding and hiding places[13].

The cause of bird collisions with wind turbines is probably the speed of turbine blades which can reach linear speed of 300 km/h. The blades can be invisible for flying birds from short distance of 30–40 metres. Another problem is the transformation of bird habitats that occur during the construction of roads to turbines. The construction of such roads has an impact on the terrain, changing the surface and run-off patterns in the landscape and provides open space trails colonization by invasive plants such as reeds or willow thickets[14]. In the case of bats, the night marking, i.e. a clear white light which attracts bats, is the cause of collisions[15]. According to a study by A. Graczyk[16], significantly more birds are killed in collisions with vehicles or buildings than with wind turbines. Among 10,000 observations, conducted in 2008, only 0.1% were collisions with wind turbines and 55% of the cases were fatal bird collisions with buildings and windows.

The impact of wind farms on the surrounding landscape decreases with distance from a given project. A lot of research and analysis on that problem have been conducted. It was found that in order to reduce negative impact on the landscape similar size of wind turbines should be defined. The colour

[12] Regulation of the Council of Ministers of 9 November 2010 concerning types of investments with potential material impact on the environmental, Journal of Laws of 2010, No 213, item 1397 with amendments.

[13] More: M. Stryjecki, K. Mielniczuk, *Wytyczne w zakresie prognozowania oddziaływań na środowisko farm wiatrowych.* Generalna Dyrekcja Ochrony Środowiska 2011.

[14] P. Chylarecki *Zasady lokalizacji farm wiatrowych na obszarze Zielonych Płuc Polski – uwarunkowania ornitologiczne.* In: Zasady lokalizacji elektrowni wiatrowych na obszarze Zielonych Płuc Polski, Fundacja Zielone Płuca Polski 2011, p. 53– 64.

[15] S.M. Grodsky, M. J. Behr, A. Gendler, D. Drake, B. D. Dieterle, R. J. Rudd, N. L. Walrath, *Investigating the causes of death for wind turbine-associated bat fatalities*, Journal of Mammalogy October 2011, Vol. 92, Issue 5, p. 917–925.

[16] A. Graczyk, *Ekologiczne aspekty rozwoju energii odnawialnej*, paper and date presented on Conference, http://energia.pwr.wroc.pl/panel/ prezentacje/ 4/p_Alicja_Graczyk.pdf, cited 8 September 2012.

of turbines should be bright (beige, grey, white) or similar to the surrounding environment. Additionally, rotors should consist of three blades[17]. The impact of an investment on plants during the construction phase is limited to the removal of soil cover and the fauna from the construction area of a turbine. The impact on flora is also associated with increased traffic and construction vehicles on the building site, which may influence the status and abundance of species of terrestrial flora, despite the fact that most projects are not connected with destruction or removal of trees and shrubs. The maximum extent of the impact zone covers less than 100 metres[18].

Positive indirect effects of a wind farm on the state of air quality associated with production of 'clean energy', is the replacement of an equivalent amount of energy produced in a conventional manner, thereby reducing the consumption of non-renewable resources and emissions into the air from the combustion process[19].

3.1.2. The impact of wind farms on human health

Wind turbines during operation may affect human health because of infrasound, noise arising during operation of a wind turbine and because of a danger of being hit by dropped parts of wind turbines (for example shovel), or icicles falling from the blades in winter.

The noise created during operation of the plant is monotonous and can lead from sleep disturbances especially when noise levels exceed 40 dB[20]

[17] More: M. Stryjecki, K. Mielniczuk, *Wytyczne w zakresie prognozowania oddziaływań na środowisko farm wiatrowych.* Generalna Dyrekcja Ochrony Środowiska 2011.

[18] More: M. Majchrzak., G. Brzostek, J. Sosnowski, E. Kalicińska, M. Glubowski, J. Hajduk., J. Skoczyńska, I. Kołakowska, *Raport o oddziaływaniu na środowisko przedsięwzięcia polegającego na budowie zespołu elektrowni wiatrowych wraz z niezbędną infrastrukturą towarzyszącą na obszarze gminy Lgota Wielka* (w okolicy miejscowości: Lgota Wielka, Wola Blakowa, Woźniki i Długie), published by W. Domka, Warszawa 2011, p. 1–141.

[19] More: M. Majchrzak., G. Brzostek, J. Sosnowski, E. Kalicińska, M. Glubowski, J. Hajduk., J. Skoczyńska, I. Kołakowska, *Raport o oddziaływaniu na środowisko przedsięwzięcia polegającego na budowie zespołu elektrowni wiatrowych wraz z niezbędną infrastrukturą towarzyszącą na obszarze gminy Lgota Wielka* (w okolicy miejscowości: Lgota Wielka, Wola Blakowa, Woźniki i Długie), published by W. Domka, Warszawa 2011, p. 1–141.

[20] More: L. D. Knopper, Ch. A. Ollson, *Health effects and wind turbines: a review of the literature,* Environmental Health 2011, http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf, cited 10 December 2012.

to an increase in blood pressure and heart rate[21]. Infrasound is a low-frequency sound which does not cause any auditory sensations in addition to affecting fatigue, deterioration of hearing and sight, and the emergence of a sense of fear and anxiety[22].

Actually rapid development of technology makes it possible to reduce the noise that arises during the operation of a plant so that it is not disruptive to people living near the plant. To reduce the sound a gondola insulation is used, which reduces mechanical noise to the resulting aerodynamic noise intensity to 10 dB[23].

K. Pawlas[24] conceded that infrasound which occurs during operation of a plant is a common phenomenon in nature, and infrasonic noise is common near roads and in urban areas. Noise emitted by wind turbines decreases with distance from the wind turbine. For human security, in the event of technical failure and for a better quality of life, it was found that a wind turbine must be located at a distance of 500 metres from inhabited places, or in a place where noise is low.

According to a study[25,] the noise emitted by wind turbines does not pose a risk of deterioration of hearing loss because sound power plants emit less than 85 dB, above which hearing loss is possible. It also showed that anxiety, depression, insomnia, headaches, nausea and problems with concentration, which local residents pointed out during the project, are symptoms commonly occurring in every human being and there is no evidence that their incidence rises significantly among people living near

[21] K. Dworak (with cooperation with: H. Domańska, J. Paciej) *Hałas środowiskowy a zdrowie*, p. 1–16 http://www.srodowiskoazdrowie.pl/wpr/Aktualnosci/Czestochowa/Referaty/Dworak.pdf?f27ba39e183cc4811d3754669e5fce7a=2e14ac812bc0c4b3b75492dfe191a8ab, cited 8 July 2012.

[22] K. Dworak, *Hałas środowiskowy a zdrowie*, p. 1–16, 2005, http://www.srodowiskoazdrowie.pl/wpr/Aktualnosci/Czestochowa/Referaty/Dworak.pdf f27ba39e183cc4811d3754669e5fce7a=2e14ac812bc0c4b3b75492dfe191a8ab, cited 8 July 2012.

[23] E. Pedersen, KP. Waye, *Perception and annoyance due to wind turbine noise – a dose – response relationship, The Journal of the Acoustical Society of America* No 116, p. 3460–3470.

[24] K. Pawlas, *Lekarze badają wpływ energetyki wiatrowej,* 2011, http://nowa-energia.com.pl/2011/11/30/lekarze-badaja-wplyw-energetyki-wiatrowej/, cited 7 August2012.

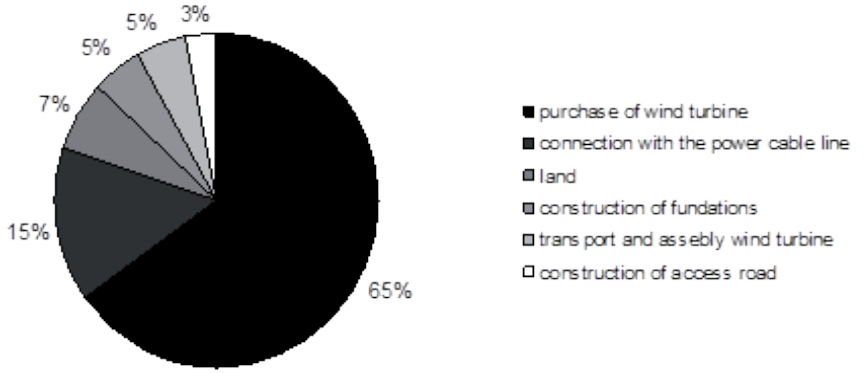
[25] D. W. Colby, R. Dobie, G. Leventhall, D. M. Lipscomb, R. J. McCunney, M. T. Seilo, B. Sondergaard, *Wind Turbine Sound and Health Effects*, An Expert Panel Review, 2009, p. 1–85, http://www.canwea.ca/pdf/talkwind/Wind_Turbine_Sound_and_Health_Effects.pdf.

wind farms (causing so-called 'wind turbine syndrome'). The occurrence of such symptoms is associated with negative attitude and lack of acceptance toward wind turbines.

3.2. The investment process

The second major phase of an investment is the construction of a wind turbine. The implementation consists of the purchase of a wind turbine, its connection to the network, the change of use of the area in which we plan to build a power plant, the lease, the construction of access roads to power plants, etc. (Fig. 6). The largest capital cost is the purchase of a wind turbine (65%). However, the connection to the transmission network, the fee for the lease, the construction of foundations and the transport of a wind turbine generate 35% of total capital costs borne by an investor.

Fig. 6. Investment costs of Wind Power Plant 1MW



Source: Own study based on PSEW 2010.

3.2.1. Tenure of land

Condition which must be fulfilled in order to commence a wind farm construction is to obtain a tenure of land. A right to use a real property may be obtained not only by the purchase of land but also by the right of perpetual usufruct, usufruct, transmission easement, land easement or land tenancy. It should be stressed that the period of exploitation of a farm is about

25–30 years. After this period liquidation or renovation is performed. A person interested in the project must possess a title for such period (if a person is not the landlord).

According to Article 6.2 of the Planning and Spatial Management Act[26], everybody has a right to manage the land in which he has a title, consistently with conditions determined in a local plan or in the decision on conditions if it does not infringe public interest covered by the law or third parties rights[27].

3.2.2. A study of land use conditions and directions

The enactment of a management plan is preceded by preparation of a study of land use conditions and directions of a gmina (hereinafter referred to as a Study). A Study is prepared by a wojt, town mayor or city mayor taking into account the rules determined in the conception of the National Spatial Management, arrangements of the strategy of development and the Spatial Management Plan for a voivodeship and the strategy of a development of a gmina if the gmina enacted such a plan. Detailed issues of the project of a Study are determined in the Regulation of the Minister of the Infrastructure of 28 April 2004 on the scope of a study of land use conditions and directions of the gmina[28].

According to article 9.5 of the Act on Planning and Spatial Management, a Study is not a bye-law. Nevertheless, its provisions are binding for the bodies of a gmina while enacting Local Spatial Management Plan. Provisions of a Study do not influence directly the legal situation of citizens

[26] Within the limits of Acts: Water Law, Geological and Mining Law, preparation and implementation of investment in nuclear power facilities and associated investment, construction law, particularly the principle of preparing to invest in the anti-flood construction, Real Estate Management, Nature Protection, Investing in Regasification terminal LNG in Swinoujscie, Specific rules for the preparation and implementation of investment in the public-use airports, Specific rules for the preparation and implementation of investment in public roads, Environmental Protection Law, protection of farmland and forests, Merge and exchange of land, protection of monuments and care of monuments, the Civil Code (Articles 140 – 154).

[27] The act of 27 March 2003 on Planning and Spatial Management, Journal of Laws of 2012, item 647 consolidated version with amendments.

[28] Journal of Laws of 2004, No 118, item 1233.

but they influence indirectly the sphere of the right and obligations of an individual.

After enacting a resolution on commencing of the preparation of a Study, a wojt, town mayor or city mayor announces in local press the resolution by the way of a declaration and in the customary accepted way in a given place, determining the form, place and date of issuing motions. The project is widely scrutinized with the bodies indicated in articles 11.5–8 of the Act on Planning and Spatial Management.

3.2.3. Spatial Management Plan

The procedure for drawing up a Local Spatial Management Plan is similar to the procedure for a study of land use conditions and directions, following the announcement of a resolution of a gmina on the preparation of a Plan, reporting observations and conclusions, as well as public consultations. In the absence of a local plan, an investor is not able to turn directly to the gmina council for preparation of a Local Spatial Management Plan. A resolution on the commencement of preparation of a plan to the Council of a gmina shall be drawn up on its own initiative or at the request of a wojt, town mayor or city mayor. An interested investor can only take informal initiatives or as indicated by T. Bąkowski, provided in Chapter VIII of the Code of Administrative Procedure may refer to the authority of a gmina to propose this resolution[29].

The gmina shall bear the preparation costs of a local plan[30]. The preparation costs of a study shall be charged to the budget of the gmina as well. Although in some cases investors are willing to finance the preparation of planning acts they do not have clear legal basis for it[31]. In the case when it comes to financing or financial assistance by another entity than a gmina, it raises problems and often puts a gmina in negative light. However, as indicated

[29] More: T. Bąkowski, *Ustawa o planowaniu i zagospodarowaniu przestrzennym. Komentarz*, Kraków 2004.

[30] Different regulation for the cost of preparation of the local plan for the realization of public investment: Art. 21.2 on Planning and Spatial Management (Journal of Laws of 2012, item 647 consolidated version).

[31] Town Council Protocol No XLIV/ 10 in Suraż, 25 May 2010. http://bip.um.suraz.wrotapodlasia.pl/4126335d674/42bfb6f7ef0/b6f325f9a9c4ba6/prot_z_xliv_sesj_rady.htm?m=search&typeSearch=2, p. 2, cited 3 August 2012.

by the District Administrative Court in the Judgement of 29 October 2008[32] covering the costs by another entity is an internal issue of gmina. The Court pointed out that, in a situation when the procedure is maintained, the question of funding may not cause the annulment of a resolution. Nevertheless, the lack of clear rules concerning the financing plans for the study causes confusion.

When discussing the issues of investors it should be noted that a significant part of construction projects of wind power stations is implemented by the company (including a majority of the capital of mixed capital with the majority of foreign capital). However, in Poland, gminas, monasteries and natural persons are investors. A wind turbine in Rytro is an example of private investment[33]. It is a wind power station consisting of one wind turbine with maximum power of 350 kW and height of 30 metres. It is the second investment of this type in Rytro. The investors have fulfilled all the requirements necessary for obtaining permits, including preparation of a plan evaluating impact upon the environment and preparing a report on the influence on the environment for the planned investment.

If a planned investment is consistent with the local plan, an investor may apply for a building permit without the obligation of obtaining a Decision on Land Development and Management Conditions. Before obtaining a building permit, a decision on acceptance of building project, a decision on allowance of continuing building works and a decision on the environmental conditions are rendered. If an investor has already obtained the building decision he can commence building works.

3.2.4. Decision on Land Development and Management Conditions

In the case of lack of a local plan, before applying for a building permit, it is necessary to obtain a Decision on Land Development and Management Conditions (hereinafter referred to as a decision on conditions), which will indicate what kind of object and on what conditions can be constructed

[32] The Judgement of District Administrative Court of 29 October 2008, II SA/Gd 799/07.

[33] Obwieszczenie wójta gminy Rytro o wydaniu postanowienia, GKŚ- 7630/6/10 http://www.rytro.pl/pl/2557/25371/Decyzja_srodowiskowa-elektrownia_wiatrowa. html, cited 5 August 2012.

on this real property. The purpose of the decision on conditions, as stressed by the District Administrative Court in Poznan in its Judgement of 5 May 2011[34], is to declare about the compatibility of the envisaged investments with the provisions of the Act on Planning and Spatial Management. It should be emphasized that in accordance with article 10. 2a of the Act on Planning and Spatial Management, in the case of plans to build devices generating energy from renewable sources with a capacity exceeding 100 kW, their location must be established in the study referred to in Section 2.3. of the article.

Article 61.1 of the Act on Planning and Spatial Management indicates the conditions which must be satisfied cumulatively, to render a decision on conditions. Section 3 of this article disables the application of section 1 in relation to railway lines, linear objects and devices of technical infrastructure. The Act on Planning and Spatial Management does not define the term 'technical infrastructure'. The answer to the question whether wind power stations belong to technical infrastructure in given by the court judgement. Based on the rules of law interpretation, especially on language interpretation (referring to language definition of 'technical infrastructure') it should be considered that wind power stations belong to technical infrastructure[35].

3.2.5. Public discussion and social consultations

The project of a Study in the way determined in the Act must be exposed for public scrutiny and published on web pages of a gmina for the period of at least 21 days. During this time, public discussion on arrangements determined in the project on a Study is organized. Legal entities and natural persons may make comments on the project of a Study. In this place the significance of consultations should be stressed. The example of a commune, where wind generators can be found is the gmina of Widminy in the area

[34] Judgement of the District Administrative Court in Poznan, IV SA/Po 147/11.

[35] See, for example: The Judgement of the Supreme Administrative Court of 3 March 2011, II OSK 2251/10; The Judgement of the Supreme Administrative Court of 21 April 2010,. II OSK 310/10, Judgement of District Administrative Court of 27 May 2009, II SA/Po 1000/08; Judgement of District Administrative Court of 17 November 2010, IV SA/Po 762/10; Judgement of District Administrative Court of 1 December 2010, IV SA/Po 763/10.

of Mazury. These generators are still subject of tempestuous discussions. Wind power stations cause a lot of emotions among Mazury society[36].

A dialogue with the local society can lessen a number of protesters. Although the global benefits are known, building wind power stations must highlight the local benefits because it is possible to meet pro-ecological people saying 'not in my back yard'[37]. It should be stressed that in many cases investors try to cooperate with a local society. Increasingly, apart from carrying out necessary analyses and research (especially concerning protection of the environment), obtaining permits, social consultations concerning planning arrangements and reports on impact on the environment they organize informational meetings which aim[38] to explain and introduce mechanism of renewable resources and influence of wind stations on human health.

3.2.6. Wind power station and definition of a public-purpose investment projects

During investment process the matter of whether a wind power station is a public-purpose investment project appears. The point of view in which this type of investments should be considered as public-purpose has its supporters[39]. It should be stressed that article 6 of the Act on Real Property Management[40] in enumerative way indicates types of activities which can be considered as public-purpose projects. Projects in devices for energy production from wind power cannot be found in such catalogue[41]. The Supreme Administrative Court in its Judgement of 15 May 2008 pointed out that the list of public-purposes cannot be expanded by the

[36] Local development plan for wind park precinct Radzie- dz. Reg. no.40/2.

[37] B. Evans, J. Parks, K. Theobald, *Urban wind power and the private sector: community benefits, social acceptance and public engagement,* Journal of Environmental Planning and Management 2011, Vol. 54, No. 2, March 2011, 227–244.

[38] A dialogue with a local society about wind farms KROBIA. http://www.krobiawind.pl/, cited 8 August 2012.

[39] Judgement of District Administrative Court in Wroclaw of 6 December 2006, II SA/Wr 315/06.

[40] Journal of Laws of 2010, No 102, item 651 consolidated version with amendments.

[41] Amendment of the 2010 to public-purposes catalogue introduced: the construction and maintenance of pipelines and devices of distribution of liquids, steam, gas and electricity, as well as other facilities and equipment necessary for the use of these cables and devices.

way of interpretation[42] so wind power constructions cannot be considered public-purpose investment projects.

3.2.6. Connection to the network

One of the stages of the investment in a wind power station building is obtaining the conditions for connection to power network. The conditions of connection determine technical requirements connection of energy source to the network and constitute a guarantee of punctual connection of a wind farm. Such conditions depend on the condition of a network, power already transferred. This stage of investment is strictly formalized and requires completing a lot of documents obtained during previous stages of realization.

3.2.7. License for production of energy in wind power stations

According to article 32 of the Act of 10 April 1997 on Energy Law[43] conducting a business in the scope of energy production from renewable resources requires obtaining a license. It means that production of energy for personal use will not require obtaining a license[44]. Only business activity is licensed. Obligation of obtaining a license for energy production from renewable resources and cogeneration is imposed on all energy enterprises producing this kind of electric energy[45]. The power of the installed source or the amount of produced energy in such kind of a source do not affect such an obligation.

[42] The Judgement of the Supreme Administrative Court of 15 May 2008, II OSK 548/07.

[43] Journal of Laws of 2012, item. 1059 consolidated version with amendments.

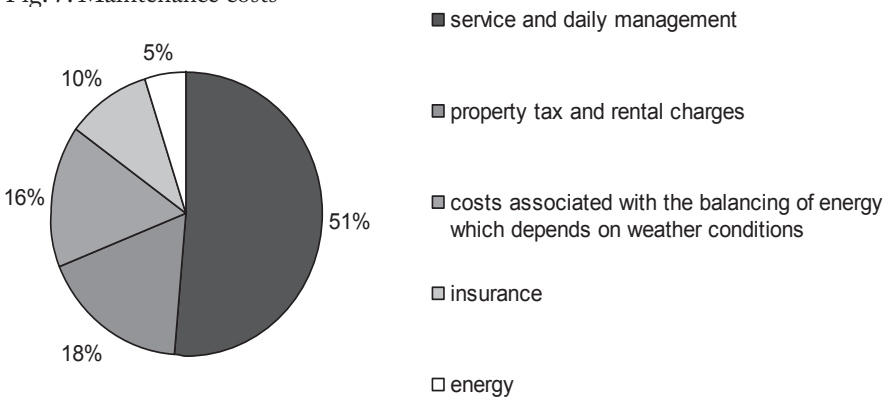
[44] More: M. Pawełczyk, P. Sokal, R. Walczak, *Prawo Energetyczne Komentarz*, edited by Pawełczyk, Iuris, p.533 and next pages.

[45] Z. Muras, M. Swora, *Prawo energetyczne. Komentarz,* edited by Z. Muras, M. Swora, elektronic publishing LEX, 2010, komentarz do art. 31 ustawy Prawo Energetyczne.

3.3. The Maintenance process

The process consists of operating costs associated with the maintenance of a wind turbine through service and ongoing management, which is the highest share among all the costs (51%) followed by property tax and rental charges which constitute 18% of cost of operating plants. Another element of operating costs associated with energy balancing, depends on the fluctuating weather conditions, insurance and energy costs (Fig. 7).

Fig. 7. Maintenance costs



Source: Own study based on PSEW 2010.

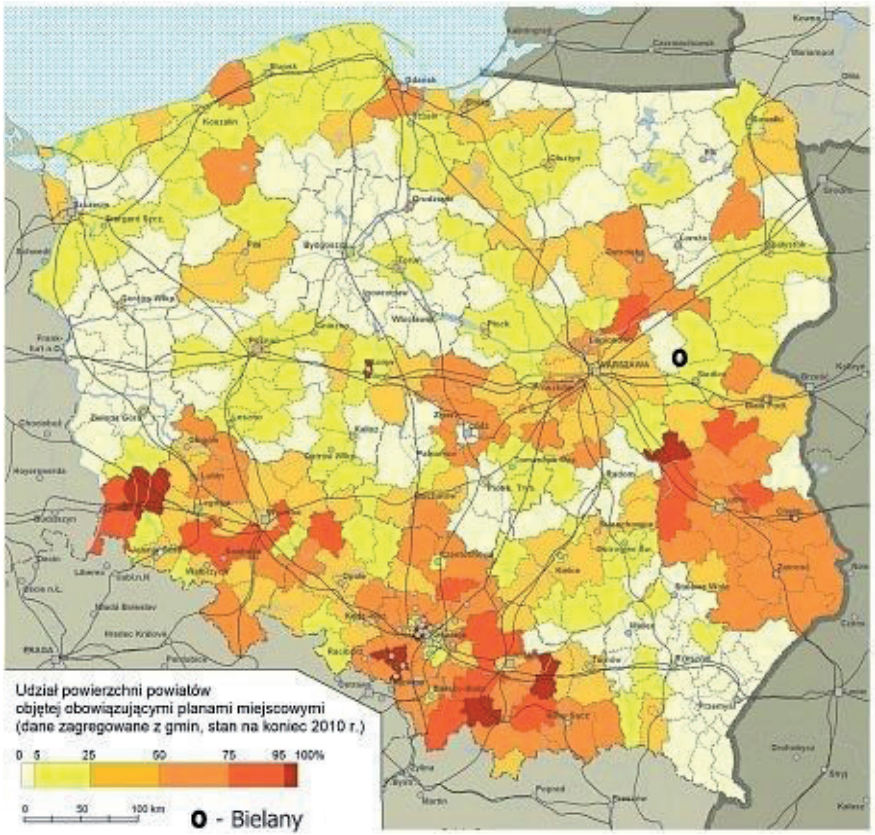
The maintenance costs are characterized by relatively low operating costs, and constitute only 2 to 3% of investment costs.

4. Case Study – Bielany Farm

In previous chapters procedures have been described which must be followed by investors, who are planning to make an investment. In this chapter, these procedures will be verified by presenting the use of them in a particular case. The overview of procedures for this particular example has allowed to determine whether they help or hinder the realization of an investment and how investment and operating costs estimated by Polish Wind Energy Association align to the actual costs bore by a presented investor.

Polish Wind Energy Company (PEW) has undertaken the construction of a wind farm in the Sokolowski region near the town of Bielany, it is in the central-eastern part of Poland (Fig. 8). The investors assumed that the total nominal power of the project will have 40.8 MW. The investment consists of 17 wind turbines with installed capacity of 2.4 MW each. According to the calculations of investors, average annual production of electricity by single power plant shall be 6 210 MWh, which gives a total annual production of electricity around 99 360 MWh.

Fig. 8. Coverage of local area plans for Poland



Source: www.sejmometr.pl, cited 24 November 2012.

As described in this article, at the beginning the company had to acquire land for the construction of a wind farm. In this case, the investor signed

17 agreements for lease for 30 years. The annual cost of the lease in this area is about PLN 18,000 net for each. However before signing a lease contract, at this stage it should be checked what the purpose of the land is. It is usually described in two documents: the study of land use conditions and directions of the commune and Local Spatial Management Plan[46].

Unfortunately Bielany, the area where investors planned to build a wind farm, did not have a Study of land use conditions and directions prepared by the commune. The Local Spatial Management Plan did not include mentioned land for this planned investment (Fig.8). In this case, investors had to apply for a change of usage of agricultural land to land with the possibility of building a wind farm[47].

The construction of a wind farm is associated with the measurements of wind power at place where a wind farm is going to be built. Wind conditions were measured throughout the period from 1 March 2010 to 28 February 2011. As a result of this process, the calculations were made for 17 wind turbines in two options. The investor pondered a Fuhrlander turbine with a capacity of 2.5 MW, about 100 metres tower height and rotor diameter of 100 metres and a Nordex N117 turbine with a capacity of 2.4 MW, a 91 metres tower height and rotor diameter 117 metres. The average annual wind speed for this area at a height of 62 metres was 5.45 m/s. The analysis found that the level of energy production is more favourable for the turbine NORDEX N117.

The next stage was to obtain the investment decision on environmental conditions, therefore, PEW signed two agreements: the Specific Work Contract on an annual pre investment monitoring of birds and bats, and a contract to create an environmental impact report for that project.

The essential stage of the preparation process for the construction of a wind farm is to obtain conditions for electricity network connection and sign a contract for connection to the grid (this procedure is described in Section 3.2.7. of this article). In this particular case the fee was determined on the level of 50% of the actual expenditure incurred for the implementation of the connection and it was PLN 1,427,653 net. The fee was spread over three instalments. The first instalment had to be paid within 14 days of signing the contract, the second instalment within 14 days after

[46] These acts have been discussed in Section 3.2.2 and 3.2.3 of the article.

[47] M. Niedziółka, *Zielona energia w Polsce*, D. Niedziółka (red.) Wydawnictwo CeDeWu, Warszawa 2012, p. 179–212.

the building permit delivery and the third instalment before the physical electricity network connection.

For the planned 'Bielany project' capital expenditure estimation calculations were made and compared with a similar calculation made by the Polish Wind Energy Association for the hypothetical farm (Table 2).

Table 2. The structure of the Bielany wind farm capital expenditure

Category of investment costs	An example of the investments structure (PWEA)		Bielany wind farm capital expenditure structure	
	Expenditure in PLN/ 1MW	The share of total expenditures in %	Expenditure in PLN/1MW	The share of total expenditures in %
Wind turbines	5,450,000	79	4,617,729	89
Roads and foundations	510,000	7	305,499	6.4
The costs of grid connecting	410,000	6	34,991	0.7
Project costs	250,000	4	48,774	0.9
Financing costs	100,000	1	50,000	0.9
Internal power network	100,000	1	94,156	2
Insurance and other costs	100,000	1	6,250	0.1
TOTAL	6,920,000	100	5,157,399	100

Source: Analiza opłacalności farm wiatrowych, Niedziółka, 2012.

The investment costs omitted the VAT, therefore, the amount of calculations are net. The revenues for the analysed case are expected to be received from 2014, because the investment period is defined from the first quarter of 2010 to the fourth quarter of 2013.

5. Conclusions

The main purpose was to establish the implementation steps of energy investments and possible problems which may occur during an investment process. One of the problems is caused by a conflict with the public fear of people living in the area designated for the construction of a wind power plant regarding the harmful effects on human health and the environment.

The analysis of scientific literature and studies led to the conclusion that wind farms do not affect human health negatively, do not cause hearing loss and other disorders. Similarly, the number of birds killed in collisions with wind farms is much smaller than with other barriers constructions. However, investing in wind power at any cost can lead to technocracy[48].

Wind turbines are the least harmful source of electrical energy generators. The current procedure is a long-term project and requires some patience from investors. It should be noted that wind farms, which are a venture like any other projects, may have an impact on the environment. However, taking into consideration the concern for the environment and human health during construction can reduce the potential negative impact.

[48] M. Wolsink, S. Breukers, *Contrasting the core beliefs regarding the effective implementation of wind power. An international study of stakeholder perspectives*, Journal of Environmental Planning and Management 2010 Vol. 53, No 5, July 2010, p. 535–558.