CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
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CZECH
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DIPLOMA THESIS

Economic Analysis of Investment into Renewable Energy Project in the Czech Republic: Wind Power Plant

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DIPLOMA THESIS ASSIGNMENT

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International Energy Agency. Cities, towns . Paris: Organisation for Economic Co-operation and Development, 2009, 186 p. Available from: http://www.oecd-ilibrary.org/energy/cities-towns-and-renewable-energy_9789264076884-en

Power to the People: Electric Utility Restructuring and the Commitment to Renewable Energy
Michael K. Heiman and Barry D. Solomon
Annals of the Association of American Geographers , Vol. 94, No. 1 (Mar., 2004), pp. 94-116
Published by: Taylor & Francis, Ltd. on behalf of the Association of American Geographers
Article Stable URL: http://www.jstor.org/stable/3694070

Glover, Peter C. Energy and climate wars : how naive politicians, green ideologues, and media elites are undermining the truth about energy and climate. New York: Continuum, 2010, 256 s. ISBN 978-1-4411-5307-4 .

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Declaration

I declare that I have worked on the Diploma thesis of "Economic Analysis of Investment into Renewable Energy Project: Wind Power Plant" by myself. All quotations and resources of information which I used are mentioned in the references of this thesis.

In Prague, March 28th 2013 ……..............................

Bc. Zdeněk Rýpar

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Last but not least important, I owe more than thanks to my parents, my little sister and also my girlfriend for their support and encouragement through all these years.

Economic Analysis of Investment into Renewable Energy Project in the Czech Republic: Wind Power Plant

Ekonomická Analýza Investice do Projektu Obnovitelné Energie v České Republice: Větrná Elektrárna

Souhrn:

Tato diplomová práce se zaměřuje na specifickou pozici energie pocházející z obnovitelných zdrojů s hlavním zaměřením na energii větru. Hlavním cílem práce je zhodnotit investici do konkrétního projektu střední větrné elektrárny v České Republice. Doplňujícím cílem práce je zhodnotit podnikatelské prostředí oblasti obnovitelných zdrojů se zaměřením na energii větru. Práce je rozdělena na dvě hlavní části. Teoretická část vychází zejména z bohaté literatury a zaměřuje se na problematiku větru jako obnovitelného zdroje energie. Následně řeší podstatu investičních projektů, jejich specifika a rozhodovací procesy. Závěrem nabízí techniky hodnocení takových projektů.

Praktická část se věnuje již samotnému projektu střední větrné elektrárny současně s rozborem podnikatelského prostředí v České Republice. Vzhledem k tomu, že projekt prochází třemi různými vývojovými stádii, každá z nich je pečlivě analyzována. Praktickou část uzavírá samotné ekonomické zhodnocení investice s využitím hodnotících metod zmíněných v teoretické části. V závěru jsou shrnuty a vyhodnoceny poznatky získané z praktické části.

Klíčová slova: Obnovitelné zdroje energie, investiční projekt, větrná elektrárna, případová studie, hodnotící techniky

Summary:

The presented thesis investigates the specific position of energy generated from renewable resources, specifically the wind energy. Its main aim is to evaluate the investment into concrete medium wind power plant project in the Czech Republic. The subsidiary goal, which is closely related to primary one, aims to evaluate the entrepreneurial environment with regards to renewable wind energy market. This work is divided into two main parts. The theoretical part represents mainly the literature review. This part examines the position of renewable energies with the biggest interest placed on the force of wind. Concurrently it deals with specifics of investment projects and decision making process. Last section of first theoretical part is devoted to investment evaluation methods.

The practical part is focused on providing information about the project followed by the analysis of entrepreneurial environment in the Czech Republic. The project itself goes through three different stages when each of it is carefully analyzed. This is followed by economic evaluation of the investment based on the use of dynamic methods. At the end, the results obtained in the practical part are summarized and assessed.

Keywords: Renewable energy, investment project, wind power plant, case study, evaluation techniques

Content

1 Introduction

In today’s world most of the people cannot even imagine a life without electricity. The electricity that people use during routine lifetime activities. Yet, there is only minority of people who care about the source of just consumed energy and about the fact whether the production process leaves the planet Earth at the same conditions as it was inherited from our former generations. It is clear that humankind slowly but surely runs out of traditional energy sources. Coal, oil and natural gas are all commodities that require huge effort in order to be extracted and our planet Earth does not have their capacities for further generations. From the title of the diploma thesis it is obvious that renewable energy sources are ecologic alternatives to current fossil fuels.

Among renewable resources it is possible to include hydro energy, biomass burning, geothermal energy, solar energy, wind energy and ocean flow energy. The electricity production from renewable resources might be seen as a technology with almost infinite possibility of repeating. This is due to their relative inexhaustibility.

However from the technological point of view the renewable resources are more demanding and for this reason also more expensive. Thus at present their position in market economy would be hard without support of state or other public institutions. One fact that plays against renewable energies is their effectiveness. Some of them cannot be as effective as traditional sources. On the other hand the renewable energy technologies are at their boom right now and the development in this particular field is fast enough to change its position.

Mainly at the time of unpredictable price of oil and natural gas, huge environmental issues, natural disasters and war conflicts motivated just by energy commodities, the renewable energy environment is an opportunity for investors all around the world.

Conditions for building renewable energy projects in the Czech Republic are not purely bad but mainly due to geographical characteristics of our country, some natural forces are limited at their possible use. Due to the fact that Czech Republic has announced the commitment to reach 13.5 % energy production from renewable resources in 2020, necessary steps regarding legal environment were made. At past these legal changes together with guaranteed feed-in tariffs have attracted lot investors because of easily guaranteed profit.

However the price policy set on electricity coming from wind energy has never been purely generous and this fact made this particular field less attractive. That might be negatively supported by public opinions talking about myths of wind power plants that in many cases cause that certain wind energy investment projects cannot be realized.

“Of all the forces of nature, I should think the wind contains the largest amount of motive power – that is, power to move things.”

Abraham Lincoln

2 Objective and methodology

2.1 Objective of the thesis

The main objective of this diploma thesis is the economic analysis of investment into the renewable energy project of wind power plant in the Czech Republic. This covers furnishing comprehensive information about the renewable energy development, the examination of entrepreneurial environment of renewable energy market specifically wind energy, simulation of funding scenarios for chosen project and then final decision about its acceptance on the basis of different evaluation investment methods. This entire diploma thesis works with the hypothesis that the guaranteed supportive policy makes the investment into wind power plant project in the Czech Republic profitable.

2.2 Methodology

During the methodological preparation and literature review of information resources it was found out that there was a sufficient amount of appropriate Czech and foreign monographs as well as articles related to this issue. During the review, the library of the Czech University of Life Sciences and the National Library of the Czech Republic together mainly with full text databases of ProQuest and JStore were mostly used. Hence, methods used in theoretical part were mainly abstraction, deduction, and comparison.

Another very important source of reliable data and knowledge was the consultation with experts in wind energy systems. This fact helped with choosing the appropriated wind turbine for selected project.

Practical part deals with specific methods of PEST analysis and Porter's five forces analysis. These are supported mainly by dynamic financial methods of Net Present Value, Profitability index, Internal Rate of Return and Discounted Payback Period. At the end of the diploma thesis the method of synthesis is used. For calculations in the practical part MS Excel 2007 was used.

The diploma thesis is divided into two main parts. The first part is divided into two sub-categories. The first one is focused on theoretical background of renewable energy with emphasis on force of wind. The second sub-category of the first part deals with the nature of investments in general, stages of investment projects and investment evaluation methods.

The second part of the diploma thesis uses knowledge gained in the theoretical part and covers a practical conception of concrete investment project. The first sub-category of the analytical part is focused on wind energy environment in the Czech Republic. This is followed by macro-environment analysis based on processing politic, economic, social and technological factors that highly influence the field of wind power plants. The analysis of micro-environment is done by using the Porter's five forces model. Next subcategory deals with outlining of concrete 100kW wind power plant and its location. Subsequent sub-category of analytical part is the investment evaluation based on using mainly dynamic methods of evaluation. In the final analytical part the environmental analysis is conducted because of knowledge gained in the theoretical part.

The last part of the diploma thesis is supplemented by recommendation based on results of the analytical part.

3 Literature review

3.1 Renewable energy resources

3.1.1 Concepts of renewable energies

Energy is the primary force in the universe. Energy defines the Earth's biomes and sustains life. All life from single-celled microbes to blue whales, exists in a continuous process of consuming, using and storing energy. The concept of renewable versus nonrenewable resources provides the cornerstone of sustainability. Renewable resources are replaced by natural processes over time, but even these must be conserved so that they are not used up faster than nature can replace them (Maczulak, 2010). From the term itself, it is obvious that renewable energies are that kind of energies that can be used again and again. In this possible renewability can be found their huge positivism in contrast to fossil fuels which have been transformed from organic matter for thousands of years and its consumption is a subject to many relevant discussions.

At present, renewable resources represent a hot topic. The reasons that have caused this are mainly because of reports on exhaustion of conventional fossil fuels, increasing the self-sufficiency of individual states to satisfy the energy needs, increasing energy requirements and climate protection by decreasing CO_2 and other greenhouse gases.

RER are seen as an alternative way and possible replacement for non-renewable resources. In principle, there are two opinions regarding their usability. First principle says that developed industry which is highly dependent on fossil fuels has a negative impact on the planet Earth and therefore it is necessary to take certain steps that will stop deploying it. Followers of this first principle fights for changes that lead to restrictions and hence repairing the damage caused by using fossil fuels. One of those steps might be the decreased production of greenhouse gases.

On the other hand, there is a completely different principle which states that even with the usage of current technologies; people are not able to confirm that. It is even hard to tell, whether those ongoing changes in our climate are something that extraordinary or just parts of a natural cycle that our planet has been going through lately. In other words, it is quite hard to find a strong correlation between the changing climate and man work. Scientists and economists all over the world think it is not our climate that is threatened, but our freedom is. Therefore it is not possible to determine if the changes in our climate will have a negative impact on the humankind existence.

At least but not last I would like to mention a third opinion which is slightly related to the topic but it is discussed mostly in the hypothetical sense. It says that just because a natural resource is renewable does not mean it is inexhaustible. Depending on the property rights of the resource and environmental factors affecting net growth rates and resulting biomass levels, a natural resource may tend to flourish or to fade (Herrmann, Herrmann, Kelly, 2002). The statement is applicable only for particular RER.

The true is that at present, the first attitude is getting more attention. This is demonstrated by the fact that many international agreements have been signed in order to diminish the usage of traditional fossil fuels and to encourage the field of renewable resources in general. Main areas that are supported are the solar energies and wind energies.

Crucial documents in the field of renewable energies are UN Framework Convention on Climate Change, Kyoto Protocol, Directive 2009/28/EC of the European Parliament and of the Council and many more conventions, guidelines and laws that have been approved by national states in order to encourage the position of renewable energy.

3.2 UN Framework Convention on Climate Change

This framework convention (UNFCCC) together with the Kyoto protocol is considered by many respected scientists to be the cornerstones of the worldwide environment legal protection. Due to the fact that Czech Republic has signed both documents, it is obliged to fulfill their necessary criteria. The UN Convention is based on five main principles:

1. protection of the climate system by the Parties for the benefit of present and future generations
2. consideration of specific needs and special circumstances of developing country
3. undertaking precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects
4. the right of Parties to promote sustainable development

5. cooperation by Parties to promote a supportive and open international economic system that would lead to sustainable economic growth and development for all parties (United Nations, 1992)

As was said above, the UNFCCC sets out a series of concepts, principles and obligations. Its main executive body is the Conference of Parties, which meets every year to analyze, evaluate, define new paths and to draw up agreements on main issues related to the Convention's goals.

Now, it is time for explanation of mentioned principles. The precautionary principle states that where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. However, it is envisaged that such measures should be cost-effective so as to ensure global benefits at the lowest possible cost.

The principle of intergenerational equity provides that the Parties should protect the climate system for the benefit of present and future generations of humankind on the basis of equity and common but differentiated responsibilities and respective capabilities.

The principles of equity and common but differentiated responsibilities and respective capabilities reflected the general acceptance by developed countries of their greater historical contribution to the accumulation of GHG emissions, in addition to their relatively greater resource capacity to develop and take remedial action (Parliament of Australia, 2010).

3.3 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major characteristic of the Kyoto Protocol is that it defines binding targets for 37 industrialized countries and the European community for reducing greenhouse gas emissions. This amount should have been decreased by an average of five per cent against 1990 levels over the five-year period 2008 - 2012.

There is a major correlation between the Convention on Climate Change and the Kyoto protocol. The distinction is based on the fact that while the Convention encourages states to stabilize the green house gases emissions, the Protocol binds them to do so.

Table 1: Countries included in Annex B to the Kyoto Protocol and their emissions targets

Country	Target (1990 - 2008/2012)
EU-15, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%
US	-7%
Canada, Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	+1%
Australia	+8%
Iceland	+10%

Source: United Nations, 2010

However, those figures above are not valid for the year 2013. The reason is that the Protocol had been due to expire at the end of 2012. Nevertheless, the conference held by UN in Doha has made a deal, agreed by nearly 200 nations, to extend the Kyoto protocol to 2020. At the time this diploma thesis was written, new figures have not been stated yet. Still, it has shifted in principle but few genuine cuts in greenhouse gases.

Thus, the second commitment period for the Kyoto agreement begins this year. Under a 2001 deal made by environment ministers from several nations who have ratified the Kyoto Protocol, if countries emit more gases than allowed under their targets at the end of 2012, they will be required to make the cuts, and 30 percent more, in the second commitment period, which start in 2013. The ministers rejected the idea of a financial penalty (Chestney, 2012).

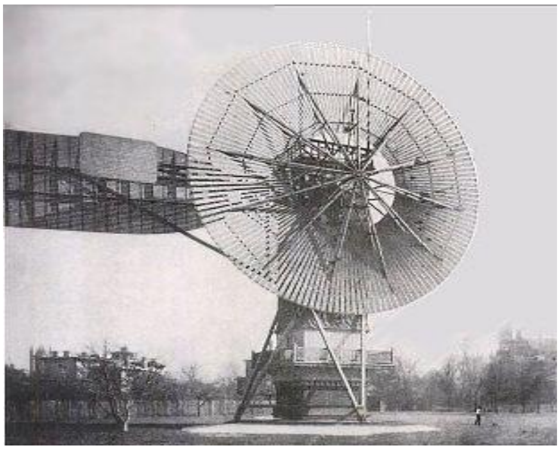
There is a procedure how states may fulfil their obligations. This is based on three mechanisms:

1. **International Emissions Trading:** permits countries to transfer parts of their allowed emissions. One country buys the right to emit from a country that has already reduced its emissions sufficiently and has "spare" emissions reductions.
2. **Joint Implementation:** allows countries to claim credit for emission reductions that arise from investment in other industrialized countries. This results in a transfer of emissions reduction units between countries.
3. **Clean Development Mechanism**: allows emission reduction projects that assist developing countries in achieving sustainable development and that generate certified emission reductions for use by the investing countries or companies. Developed countries fund clean (alternative energy) technologies, such as wind and solar power, in the developing nations and thereby earn credits to offset their Kyoto targets. Countries can also claim credits for planting trees (which serves as carbon sinks) in the developing world (Environ Business, 2006).

3.4 Characteristics of wind energy

This chapter is focused more deeply on the position of the wind energy. The development and history of wind power plant technologies is examined. This is followed by the analysis of the current situation regarding European continent. The last subchapter deals with the Czech environment and wind energy market as one of renewable energy segment.

Picture 1 - The Brush postmill (1888)



Source: Own processing of picture available at telesnet.com

3.4.1 Historical development

The history of using the energy of wind as a source of natural element shows a systematic evolution from the use of simple, light devices driven by aerodynamic drag forces through heavy, material-intensive drag device to the increased use of light, material-efficient aerodynamic lift devices in the modern era. The sail boat which is the earliest known use of wind power, represents a technology that had a significant impact on the further development of sail-type windmills. It was the ancient sailors who understood lift and used it every day, even though they didn't have the particular physics knowledge to explain how or why it worked (Dodge, 1996). Windmills have been used for at least 3000 years, mainly for grinding grain or pumping water, while in sailing ships the wind has been an essential source of power for even longer. From as early as the thirteenth century, horizontal-axis windmills were an integral part of the rural economy and only fell into disuse with the advent of cheap fossil-fuelled engines and then the spread of rural electrification (Burton and team, 2001).

The meaning of wind energy has started to culminate at the end of sixteenth century. At the beginning of eighteen century, a huge expansion of well-known Dutch wind mill could be registered. Those were used mainly again for grinding grain, processing of sugar cane and of course for pumping water. For Netherland wind mills have become national symbols as well as their tulips. In contrast to Germany or England, where the main energy source was coal, in Netherland the energy source number one was just wind. The estimation says that at the end of 19th century, the nominal power of all wind mills could be 1,000 MW. In Bohemia, Moravia and Silesia, the wind energy was used in the 18th and 19th century as well. This is proved by approximately 260 fully or partially mapped areas by archeologist where in the past wind mills were built.

Wind mills were built mainly in the areas where sufficiently permanent, regular and straight winds were available. Also they were built in sites where was lack of running water, where streams were quickly drying, flooding or frosting during winter months. This is the reason why many wind mills were built in the region of Northern Moravia. However, from what has been stated above, it is obvious that the usage of wind mills was focused mainly on agricultural purposes.

The very first use of a large windmill for generating electricity was a system built in USA, Ohio, in 1888 by Charles F. Brush. The postmill named after Mr. Brush was a machine with a multiple-bladed picket-fence rotor of 17 meters in diameter, equipped by a large tail hinged to turn the rotor out of the wind. It was the first windmill to incorporate a step-up gearbox in order to turn a direct current generator at its required operational speed.

Due to the fact that this was the very first electricity generating wind mill, it had of course certain limitations (Dodge, 1996). Since the forties of the 20th century, it is possible to shift the usage of term wind mills to wind power plants. In 1941 the first wind power turbine[1] was connected to electrical distribution system, hence from this date the wind energy systems have registered a very important milestone. From this time the worldwide use of wind power plants might be considered as commercialized. However, fast development of fossil fuels has pushed the concept of clean energy aside. Fortunately for renewable energy itself, due to the historical consequences made by Oil Crises in the seventies, the popularity of wind energy has reached a second chance. United States of America was to first country, which put huge amount of money into the development of wind farms and also the first country which offered tax reliefs on investments into the field of renewable energy. California was the state that has changed the meaning of wind energy and hence laid groundwork for the modern industry with wind power plants. This led to massive development in other parts of the world.

At that time the number one player among countries in the European continent which were supporting renewable energies was Denmark. Local government decided to support renewable resources by funding investment cost by up to 30%. Due to this fact, Danish wind turbines are among the best worldwide. The biggest producer of wind power plants is Danish company Vestas, which hit the 30% share in the market in 2012.

Nowadays, the wind power plants look completely different than they used to look back in the 19th century. Size and efficiency are two main variables that have moved the perceiving wind power plants to other dimensions.

3.5 Current situation in Europe

Due to the fact that the European continent is a world leader in using wind energy for producing electricity and the fact that the Czech Republic is a country that lies in heart of Europe it would not be appropriate to skip analyzing the situation among wind power plants in broader sense.

Insufficient amount of mineral fuels and dependency on importing energetic resources are two main phenomenon that threaten Europe and more precisely the European Union in general. That is the reason why European Union authorities are aware of

[1] Smith-Putnam wind turbine, the world's first megawatt-sized wind turbine

sustainable development. According to the brochure "Wind Power Plants and Their Myths", which was published by Calla[2] organization, a serious warning against European commission was made. It claims that if the current energy structure does not change, it makes the European Union dependent from 70 % on import of mineral fuels and energy. Those uncomfortable predictions have pushed the European Union to work. At the beginning of year 2007 the European commission has announced a program called "Climate change package", in which necessary steps are listed. It not only demands the EU 27 to lower the amount of greenhouse gases production by 20 % but also to encourage the share of renewable energy sources by the end of the year 2020. With regards to that package and figures in it, it is true that at present the position of renewable energy sources is not at the place where the EU wants it to be.

This might be supported by the proclamation that only 8.5 % of the whole energy consumption comes from renewable energy sources. Thus, it is necessary for fulfilling the indicative goal set in "climate change package" to have annual growth of more than 1 % in the sector of renewable energy.

The document that was mentioned above also states and defines two main goals which should be reached by individual states progressively:

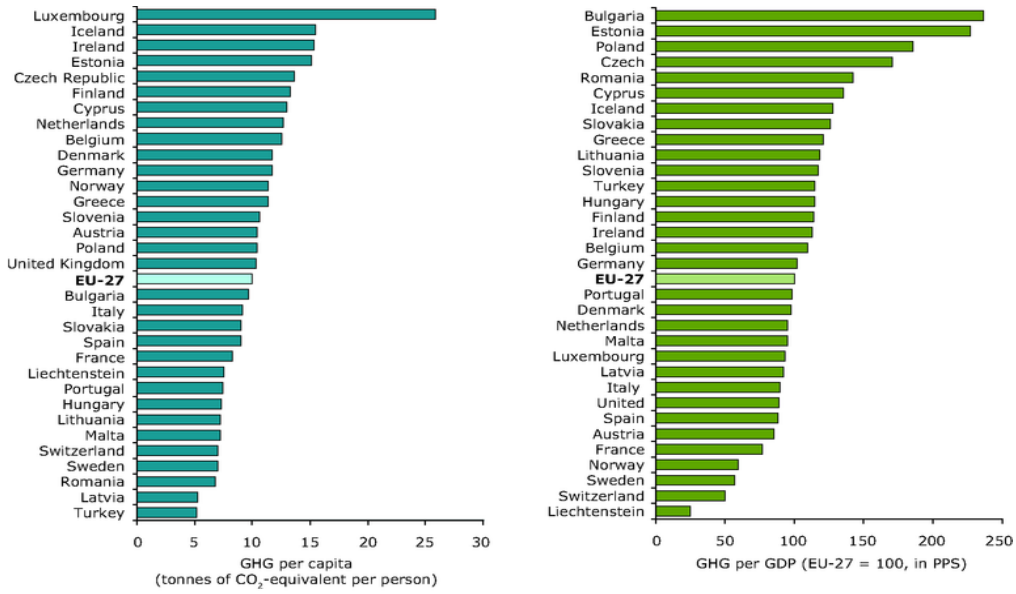
1. First goal simply describes the reduction of emission of green house gases which are outside the sector in which the market with emission tickets works (such as services, transportation, agriculture and waste)
2. Second goal deals with reaching a certain percentage share of renewable energy in the whole energy production

Based on those goals mentioned above, it is necessary to focus on them a little more. Czech Republic's duty is of course to obey them which calls for actions made by our government. From the figures below (Chart 1), it is clear that the position of the Czech Republic is not that positive. It is truth to say that in 2010 the Czech Republic was the fifth worst European state in terms of production of CO_2 per capita. The approximate number

[2] Calla - Association for Preservation of the Environment is a citizens' environmental association founded in 1991. Calla is named after a protected plant, the water-arum (Calla palustris).

was almost 15 tones. The truth is that we accomplished the decrease in production of CO_2 in comparison with year 2000 however the fact is clear.

Chart 1- Greenhouse gas emissions in 2010 per capita and per unit of GDP



Source: European Environment Agency, 2011

The Czech Republic still remains at the wrong end of this chart and with the comparison of EU-27 average it is still a way above it. It is believed that there is a chance of fixing it in near future.

All of what have been mentioned so far is not just a description of theoretical background that have no impacts on further parts of the diploma thesis. The exact opposite is truth. Czech Republic and its policies are closely related to figures and facts that are above. Unpleasant figures, personally speaking, put pressure on Czech government and more or less influence the renewable energy environment.

3.6 The nature of investment projects

Starting an economic analysis without proper definition what an investment project is, would not be a smart decision. According to businessdictionary.com the investment project is a long-term allocation of funds (with or without recourse to the project's sponsor) to carry an investment idea through to its stable-income generation stage. A viable investment project aims at achieving a profitable return that ensures (1) timely payment of interest and principal, (2) attractive return on the invested capital, and (3) positive and consistent cash flows.

I am aware of the fact that this is a general definition of all investment projects. However every single project is a unique one which means that individual definitions may vary from the one mentioned above.

3.6.1 Stages of investment project

The project development cycle comprises three phases. Those are the pre-investment, the investment and the operational phase. Each of these three major phases is divided into sub-stages. Some of those parallel activities might take place within one phase and even overlap into succeeding investment phase.

According to doc. Roušar the investment project consists of three major stages:

- Pre-investment stage
- Investment stage
- Operational stage

3.6.1.1 Pre-investment stage

At the beginning of each investment project, the seeking for opportunities that comes from analyzing the entrepreneur environment is a necessary step. After that the received impulses should be judged, particular opportunities should be clarified and so should be economic aspects coming from those opportunities. The cornerstone of this is a constant monitoring of entrepreneur environment which is closely related to firm's activity (Roušar, 2008).

In some cases it is not necessary to conduct own analysis, but it is possible to use secondary data from various state institutions such as ministers or statistical offices, trade unions, monographs or region intentions. What should not be omitted is a monitoring of technological development in the particular field, legal acts and norms. The very first assessment of possible projects should not be costly and very detailed oriented. At this stage, the result only gives us a list of possible opportunities.

3.6.1.1.1 Pre-selection

This stage might be understood as a middle stage between the pre-investment phase and its following investment phase. On the base of given opportunities it is important to evaluate whether the main idea of a project is sufficiently attractive and also realizable. Furthermore, one has to always make sure whether the consequences of project are in favor with the environmental law and standards.

Thus, the pre-selection should tell, on which opportunities should be paid more attention and compile a deep analysis with feasibility study (Kislingerová, 2010).

3.6.1.1.2 Feasibility study

According to businesdictionary.com, it is an analysis and evaluation of a proposed project to determine if it (1) is technically feasible, (2) is feasible within the estimated cost, and (3) will be profitable. Feasibility studies are almost always conducted where large sums are at stake.

From the definition above it is clear that the feasibility study should give all sources required for decision making process. All requirements and possibilities connected with moving from investment phase to operational phase should be covered in it. This counts mainly for analyzing of technical and financial requirements. The whole study obviously relies on the market situation and its prognosis.

The situation in the company and on the market is then evaluated in the context of company's micro and macro environment. Again, all of this must be supported with a precise financial-economic analysis and evaluation of particular variant of projects. The preparation itself relies in most cases on the team of experts in particular fields. Although it is possible for one person to carry out the FS, it is usually best to organize a team to investigate various ways to respond to a problem or opportunity. However the realization of final study must not be seen as a onetime deal. It is a gradual iterative process which deals with optimization regarding the goals of the company and possible feedback that might be caused due to the project realization (Diane, 1992).

What might happen is the situation when some imperfections and weaknesses are found or maybe the fact that the project is not realizable. It those cases it is immediately declined.

At last but not least it is important to add that any consequences of project should not be taken as separate. All of them might more or less be interdependent which if not considered, may lead to wrong final verdicts.

3.6.1.2 Investment phase

Once the project is clearly defined, carefully evaluated, appraised and the finance is available, the next phase of project implementation is called the investment stage. This has many steps:

- Carrying out the organizational, legal, financial measures to implement the project
- Basic, as well as detailed, engineering work
- Land acquisition
- Tendering, evaluation of bids and contracting
- Construction work and installations
- Recruitment and training of personnel
- Plant commissioning and start-up.

A well prepared technical-economic study might be together with clear timetable strong tools for making a high quality plan. That plan might then become a powerful leverage of project realization (Khatib, 2003).

On the other hand delays or gaps in implementation or management can cause increased costs or other damage to the utility, the investors or consumers. The schedule should be carefully prepared, coordinated and monitored. However that does not mean that the plan is something that cannot be changed. The exact opposite is truth. Any plan should be seen as a subject which is possible to be changed. It is crucial to monitor the plan very critically because only then any deviation from the expected run could be identified.

Thus, the continuous controlling plays a vital role in case if necessary additional funding occurs.

3.6.1.3 Operational phase

This stage of a project should not be considered only from a short term point of view but also a long term one. After the project is put into operation, a wide range of unexpected problems might occur. The problems of technological incapability or insufficiently trained stuff might be mentioned. The truth is that most of potential problems have to be eliminated in the investment phase; however it is recommended to count with them in this stage of a project.

The long-term point of view is closely related to the chosen strategy; hence revenues and expenses are derived from it as well. If the assumptions on which the project was based turn out to be wrong, then it is really hard or even impossible to counter take any remedial actions.

3.6.2 Classification of investment projects

With the usage of appropriate literature it is possible to divide projects into several different categories.

<u>Distinction according to accounting terms:</u>

- Financial: purchase of long term securities, long term deposits, long term loans etc.
- Tangible: construction of new buildings, infrastructure, land purchase, equipments, transport vehicle etc.
- Intangible: purchase of knowhow, licenses, intellectual property etc.

Distinction according to cash flow character:

- Conventional: the initial period of capital expenditure is followed by the period of capital revenue
- Non-conventional: the changes between positive and negative cash flows happen more times, for instance – necessary recultivating works after finishing extraction or necessary maintenance after certain operational period, which might cause reduction in disposable cash income

Distinction according to its purpose:

- New production facility: objective and result of this is a purchase or reproduction of tangible asset
- New product: set of activities (research, development, manufacturing) whose output is a selling of new product or service
- Organizational change: restructuring necessity in the "survival fight"
- Innovation of ICT: reaction to development in information technologies
- New firm: purchase of certain company
- New environment: reaction to changes in legislation in the field of environment protection, safety etc (Kislingerová, 2010)

Distinction according to company position:

- Developing: increasing the company capacities for producing or selling products or services
- Revealing: replacing for obsolete equipment
- Regulatory: not making any revenues but must be realized for continuing the company properly – necessity to adapt to new legally binding acts (Dayanada, 2007)

This is just a selected division of investment project according to literature review. For the purpose of this thesis it is not necessary to mention more divisions.

Due to the fact that the main aim of the diploma thesis is to evaluate the investment into wind power plant, the appropriate evaluation method should be chosen. Since the specifics of investment projects have been summarized, the evaluation techniques are the only section that is left.

3.7 Evaluation investment techniques

There is a wide range of techniques that can be used for evaluation of effectiveness on investments. Main fundamental exogenous variables are initial capital expenditure C_o, cash flow coming from individual year of investment CF_i, lifetime of the investment n and weighted average cost of capital *WACC*.

Evaluation techniques can be divided into two main groups: static and dynamic.

3.7.1 Static methods

These methods are mainly focused on checking cash flows from investment; possibly they focus on comparing that cash flow with initial capital expenditure. It is important to mention that those methods have one big disadvantage. They do not take the factor of time and risks into consideration. That is the reason why they are partially limited in use. On the other hand, they might serve as a quick tool for simple evaluation and then cancellation of unfavorable investments.

3.7.1.1 Average annual cash flow

Average annual cash flow is calculated as a sum of all cash flows connected with the investment C_o, divided by lifespan of the investment.

$$\emptyset CF = \frac{\sum_{i=1}^{n} CF_i}{n}$$

3.7.1.2 Simple payback period

By this formula it is possible to define payback of the whole investment with the condition of equal realization of cash flows as a fraction of initial capital divided by average annual cash flow.

$$t = \frac{C_o}{\emptyset CF}$$

3.7.1.3 Average rate of return

Average rate of return defines how many percents of invested capital would annually payback.

$$\emptyset r = \frac{\emptyset CF}{C_o}$$

<u>Payback period</u>

In capital budgeting for a business firm, historically, the payback period is the selection criteria that most private or physical bodies use for the capital projects selection. Even today, small businesses find the payback period selection criteria most useful. Small business owners like to look at the time it takes them to earn back their initial investment in a capital project (Business Finance, 2013).

The payback period formula is used to determine the time it will take to recoup the initial amount invested on a project or investment.

Nevertheless, everyone who works with money realizes that the main weak point of this calculation is the fact that it does not take the factor of time, which basically says that a certain amount of money today has different buying power than the same amount of money in the future.

Static methods are basically used for evaluation of less important project or for projects with shorter period of lifespan. Generally, they are not recommended for making crucial decisions such as strategic planning.

3.7.2 Dynamic methods

In comparison with static methods of evaluation, dynamic ones take the factor of time into consideration, thus the development of project in time and change of nominal value of money hold. That is the reason why they have higher information value.

On the other hand they are harder to calculate and the availability of input information is more complicated. Two main important variables are the lifespan of investment and the price of the capital that is represented by zero-risk interest rate that would be recorded when deposing the same amount of money for the lifespan of the investment.

Higher sophistication regarding the input information is a reason why those methods are not that widely used and why they are not as popular as static ones.

For the purpose of this particular project, it was decided to pick three dynamic methods that will be mention later in the section of operational phase of the project. Those particular methods are net present value (NPV), internal rate of return (IRR) and profitability index (PI).

3.7.2.1 Net Present Value (NPV)

As the flaws in the payback and ROI methods were recognized, people began to search for methods of evaluating projects that would recognize that a Czech koruna (CZK) received immediately is preferable to a Czech koruna (CZK) received at some future date.

This recognition led to the development of discounted cash flow techniques to take account of the time value of money. One of such discounted cash flow method is called the net present value.

NPV represents a cornerstone of all dynamic methods of evaluation and it is also the most used and appropriate method and it addresses directly the main goal of financial management – maximize the shareholder wealth (Brigham, Houston, 2009).

NPV is a useful method mainly for its characteristics:

- Takes time value of money into account
- Based only on prognostic cash flows
- Is cumulative

According to investopedia.com, the formula for NPV is:

$$NPV = CF_o + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_N}{(1+r)^N}$$

$$= -CF_0 + \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

Here CF_N represents the net cash flows, r is the firm's cost of capital, C_o is the initial cost of the project and t is the project's expected life.

NPV method is based on the comparison of capital outflow and capital inflow but at their present value. From what was said above is obvious that investment intended for realization must reach a positive NPV (Dayananda, 2002).

Generally speaking, the higher NPV the more economically efficient the project is. If the NPV inclines to hit a negative number, the money invested in the project would never payback.

At the beginning was mentioned why the NPV is so popular among other methods. However it also has a disadvantage. The biggest one is that this method gives us an absolute result which might distort the situation when comparing among more investment projects. That is the reason why it is recommended to support this formula by some other, which shows a relative view on investment.

Another disadvantage is the fact that the formula is dependent on the development of r which is in the turbulent environment hardly predictable.

3.7.2.2 Internal rate of return (IRR)

The internal rate of return (IRR) is defined as the interest rate that equates the present value of the expected future cash flows, or receipts, to the initial cost outlay. The equation for calculating the IRR is:

$$NPV = CF_o + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \cdots + \frac{CF_N}{(1+IRR)^N} = 0$$

$$= \sum_{t=0}^{N} \frac{CF_t}{(1+IRR)^t} = 0$$

The calculation of IRR is more complicated than the calculation of NPV (Brigham, Houston, 2009). According to prof. Kislingerová, the calculation of IRR only works if the assumption that the NPV is a declining function of discount rate holds. If this criterion is met, the calculation of IRR might be realized then.

Notice that the IRR formula is simply the NPV formula, solved for that particular value of *r* that causes NPV equal to zero.

The procedure for calculating the IRR is as follows:

1. Compute the present value of cash flow from an investment, using an arbitrary selected interest rate
2. Compare the present value so obtained with the investment’s cost
3. If the present value is higher than the cost figure, try a higher interest rate and ho through the procedure again.
4. Conversely, if the present value is lower than the cost. Lower the interest rate and repeat the process
5. Continue until the present value of the flows from the investment as approximately equal to its cost.

The interest rate that brings about this equality is defined as the internal rate of return. IRR allows investors to rank projects by their overall rates of return rather than their net present values, and the investment with the highest IRR is usually preferred. In other words, the higher IRR, the more economically effective the investment is.

Among the evaluation techniques mention in this subchapter, the one most analytics can be sure about is the net present value method. NPV leads investors toward the project that maximizes wealth in the most general circumstances.

According to Fabozzi and Peterson:

- There is an increased use of more sophisticated capital budgeting techniques
- Most financial managers use more than one technique to evaluate the same projects, with a discounted cash flow technique (NPV, IRR, PI) used as a primary method and payback period used as a secondary method
- The most commonly used is the internal rate of return method, though the net present value method is gaining acceptance
- There is evidence that firms use hurdle rates (that is, costs of capital) that are higher than most cost of capital techniques would suggest

3.7.2.3 Profitability index (PI)

Last method that needs to be examined is called the profitability index. Profitability index is an investment appraisal technique calculated by dividing the present value of future cash flows of a project by the initial investment required for the project (Accounting explained, 2011). The formula for calculating the PI is:

$$PI = \frac{\sum_{i=1}^{N} \frac{CF_i}{(1+r)^i}}{C_o}$$

Project may be accepted for realization, if the PI is higher than one which is in direct relation with the requirement of positive NPV. Economic effectiveness of a project relies on the value of PI. In other words, the higher PI, the better the project is.

Profitability index not only enables to evaluate suitable investments but it also offers a comparison between different projects. Due to this fact, the PI is usually used as a supportive decision making tool together with the NPV. It is also a an important criterion for evaluation and choosing the most effective project among more projects when an investor cannot afford to realize more than one of them.

WACC

To quantify the effect of leverage on equity and risk return, a formula know as WACC is often useful. The WACC (Investopedia, 2013) is given here:

$$WACC = \frac{E}{V} \times R_e + \frac{D}{V} \times R_d \times (1 - T_c)$$

Where, R_e = cost of equity

R_d = cost of debt

E = market value of the firm's equity

D = market value of the firm's debt

V = E + D

E/V = percentage of financing that is equity

D/V = percentage of financing that is debt

T_c = corporate tax rate

Cost of equity might be calculated on the basis of CAPM model. The CAPM formula is given here:

$$R_e = r_{RF} + \beta \times (r_M - r_{RF}) \times E$$

Where, $r_{RF} =$ risk free rate

$(r_M - r_{RF})$ x E = equity risk premium

β = beta coefficient (Brigham, Houston, 2009)

One of the nice things about WACC is that it is quite intuitive and therefore easy to understand. Since the claims on the property net cash flow consists of the debt claim and equity claim, the property value, and hence the return on property, must consist of debt share and an equity share. In the WACC formula, the return to each component is simply weighted by that component's share of the property value (Geltner, 2010). It is obvious that the WACC value will differ when the structure of funding is changed.

3.8 Specifics of investment decisions

Investment activity and the funding in general might be characterized by several important specifics:

- Decision should be considered from long-term time period
- Long-term time period causes higher possibility of risks and deflections
- Usually, it involves big capital outflows
- Requires coordination of more activities
- Relates to technology implementation
- Impacts on environment or infrastructure

Among the most important facts that should play crucial roles in decision making process, it is possible to list:

- Considering the time value of money
- Considering the risks
- Considering other factors influencing the project (Valach, 2006)

4 Analytical part

4.1 Project information

4.1.1 Investor

Investor is a private physical body who invests into different fields. The main two reasons why he is willing to invest into renewable energy project is the fact that his residence is located in relatively windy location and the diversification of his activities portfolio.

Based on the discussion with the investor, two possible funding scenarios will be analyzed. Investor is willing to use his own capital however the variant of using bank loan is also an option. It is also expected that the construction work will start in this year 2013 and so will the operational stage. This is due to the fact that the situation of supporting renewable energy sources is unstable and from the year 2014 it might be completely changed.

Because the expected construction start is planned for this year, the feed-in tariff legally bounded in the act No. 165/2012 Coll. is 2,120 CZK/MWh. This price is guaranteed by law for 20 years.

4.1.2 Location

As was mentioned above, due to the fact that the permanent residence of investor is in Olomouc region, the project location was at first oriented to this location. However, without proper analysis of chosen region regarding the wind potential, the investment would be non-sense. That is the reason why the Institute of Atmospheric Physics of Academy of Sciences of the Czech Republic was asked to process the location from the wind potential point of view.

The flow of wind in medium part of atmosphere is mainly influenced by three element factors:

- Wind streaming in medium atmosphere layer (in free atmosphere)
- Horizontal and vertical shapes of the planet Earth’s surface and its roughness and physical obstacles
- Radiation impact and its effect on Earth’s surface

- Existence of water in the atmosphere

Those factors are present simultaneously, which causes permanent pressure on selected region. In long term perspective it creates certain regime which is called a wind climate, respectively a wind conditions. For building a wind power plant, those wind conditions are a crucial decision making factors determining the economy side.

The location of Ramzová lies in the region of Olomouc, in the west part of Jeseník district. Location is situated on southwest elevation from the village. As was already analyzed above, wind conditions of selected region are determined by wind streaming in free atmosphere, its deformations due to roughness of Earth’s surface a radiation and humidity factors.

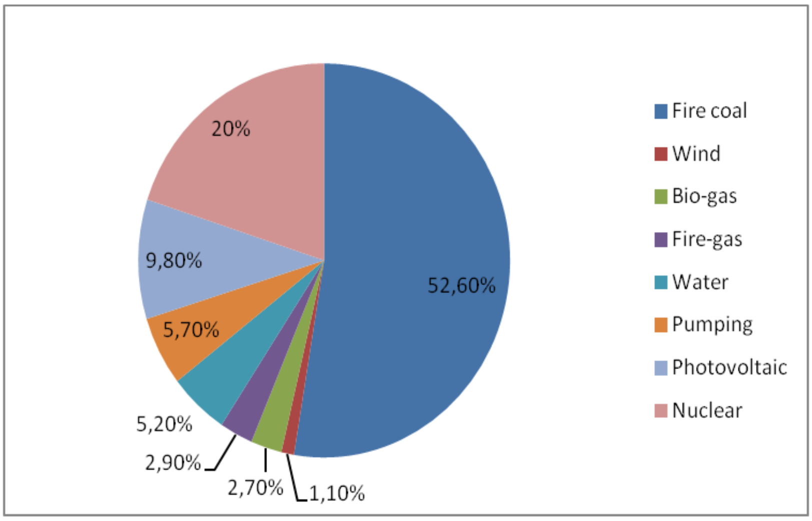
All of those factors are closely related to geographical conditions and not only the selected location itself but also its surroundings.

Selected wind power plate will be located on investor’s private land. Therefore no other costs of paying rent are needed. On the other hand, using the land for this purpose represents opportunity costs for him.

4.2 Wind energy environment in the Czech Republic

Since the year 2004 the Czech ministry of industry and trade records and then publishes all statistical data regarding the share of renewable energy in total energy production. The process of data gathering involves also other subjects such as Czech energy office, Czech statistical office, Czech hydro meteorological institute, state environmental fund of the Czech Republic etc.

Chart 2: Energy mix of the Czech Republic in 2012

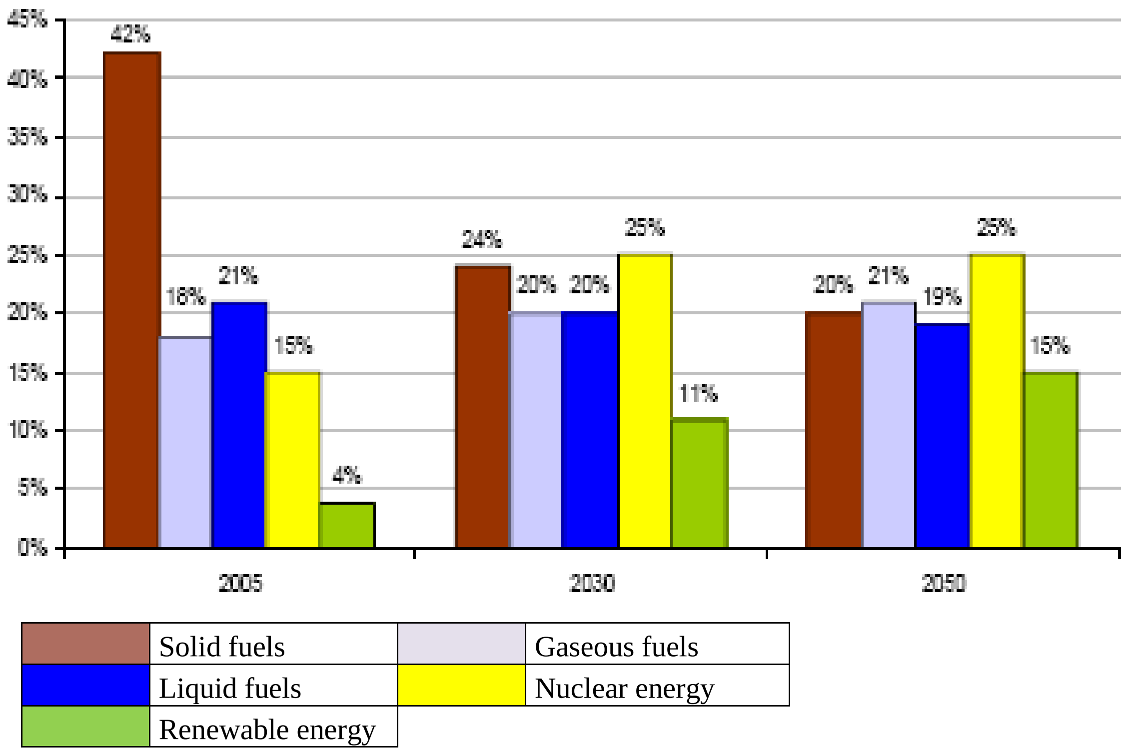


Source: Own processing of data available at csve.cz

Previous section has shown that the Czech Republic has agreed to systematically increase the share of renewable energy sources. From the pie charts below (Chart 3) I is clear that the share has increased. The indicative goal that has been set, gives the number of 15%. The truth is that not all possible renewable resources have the same chance of being hugely used in the conditions of the Czech Republic.

The look at latest number of the year 2012 regarding the installed capacity of operating wind power plants gives the number of 260 MW. Comparing to other

Chart 3 – Energy goals for 2050



Source: Own processing of data available at mpo.cz

European states the figure might seem low, on the other hand, the wind energy and its capacity factors are lower and a bit limited. One of those factors is the size of our country and the fact that Czech Republic has no direct access to sea where most of investment projects are realized as off shore. Even though that this disadvantage cannot be overlooked, the situation among wind power plants projects is slightly different. The number of installed capacities is continuously rising.

Table 2: Functioning wind power plants

Functioning wind power plants - installed capacity and production									
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Capacity (MW)	17	28	54	116	148	192	215	217	260
Output (GWh)	8.3	21.3	49.4	125	245	290	336	397	371

Source: Own processing of data available at csve.cz

Either way, the wind energy environment in the Czech Republic could be analyzed from different views and perspectives. In this chapter I would like to focus on areas that in my opinion influence the environment in general the most.

Once the boundaries of an industry have been identified, task that is left is to analyze competitive forces to identify opportunities and threats. Using the PEST analyses and Michael Porter's (Hill, Jones, 2008) well known framework, known as the five forces model helps to analyze the whole environment from the macro as well as from micro economic point of view.

The four key variables in **PEST** analysis play vital roles role every decision making process before investing into wind energy are:

A. Political/Legal
B. Economic
C. Social
D. Technological

On the other hand the **Porter's model** encompasses with other five phenomenon. Those are:

A. Threat of new competition
B. Threat of substitute products or services
C. Bargaining power of customers
D. Bargaining power of suppliers
E. Intensity of competitive rivalry

4.3 Pre-investment stage

4.3.1 PEST Analysis

4.3.1.1 Political environment – legislation of RER

As any other entrepreneurial branch, the sector of renewable energy resources is highly influenced by legal environment. Doing business with wind power plant calls for high knowledge and precise orientation in quite disorganized legislation. By legislation it is not only meant the legal acts of the Czech Republic but also as a member of European Union, thus entrepreneurs are obliged to obey some secondary sources of EU.

Among the most important ones in the Czech Republic it is possible to put:

- No. 165/2012 Coll. Act of 31 May on supported energy sources and amending certain acts
- No. 458/2000 Coll. Act of 20 November on conditions of entrepreneurship and about the power of civil service in the field of energy and amending certain acts
- Price decision of the Energy Regulatory Office No. 4/2012 of 26 November 2012 on the support for the renewable energy sources
- Notice of Ministry of industry and trade of the Czech Republic of 20 December 2012 on the reporting and recording of electricity and heat from supported sources and biomethane, number and the quality of actually used resources and on performing other regulation on supported energy act[3]

This thesis is not focused on legal examination of the entrepreneurial environment but this particular are is considered to be the area that plays very important role. The list of acts above is just a sample of many that are mentioned in supplements.

At last but not least it is important to mention a very significant legal act. It must be always taken into consideration when planning to build a wind power plant. It is No. 100/2001 Coll. Act of 1 May on assessment of environmental impact and amending certain acts.

[3] This diploma thesis deals with legislation valid before 22.1.2013.

No. 165/2012 Coll.

From all of the legal acts, this is the one that might be considered as the groundwork for area of renewable resources legislation. This act completely replaced the old act No. 180/2000 Coll. dealing with supporting renewable resources.

Regarding the § 1 of the mentioned it is clear that it deals with the support for using renewable energy sources for producing electricity, heat or biomethan.

Its main goals are defined as follows:

1) To support the use of renewable sources of energy
2) To increase the share of renewable sources in the consumption of primary energy sources
3) To contribute to economical use of natural resources and sustainable development
4) To set conditions for meeting of an indicative target of the share of electricity produced from renewable sources in the gross consumption of electricity in the Czech Republic while considering interest of costumers

This act also deals with wide terminology that is connected with this topic. It defines what a renewable energy source is, what is National Action Plan, what are the requirements put on electricity producers etc.

The crucial and the most discussed part at the same time is the section about support. At this currently valid act, there are two ways of choosing support : feed-in remuneration and green bonuses.

There was a huge change if we compare the act No. 180/2005 Coll. with currently valid act No. 165/2012 Coll. That is the reason why mentioning and examining these two types of support is non-omitable.

Feed-in tariff

One of those two types of possible support is the concept of feed-in remuneration. There is the biggest change in the comparison with the previous act. Majority of layers says that one sentence has completely changed the concept of using renewable energy.

According to valid act No. 165/2012 Coll., a feed-in tariff says that the grid operator[4] is obliged to purchase the entire amount of energy generated. However this sentence is only applicable for those electricity producers whose plants have the nominal power lower than 100 kW. In other words, if the nominal power of any renewable energy power plant is higher than 100 kW[5], it is not possible to choose this concept as a national support and the investor is hence convinced to pick green bonus.

Table 3: Feed-in tariff scheme

Advantages of feed-in tariff	Disadvantages of feed-in tariff
Higher price than green bonus	Necessity to pay for consumed energy
Fixed and regulated price	
No risks	

Source: Own processing of data availble at csve.cz

Even though that the prices are set every year by Czech Energetic Regulatory Office (ERO), its bargaining power is limited due to the act No. 165/2012 Coll., which states that the feed-in tariff cannot be lower than 95% of the one valid in the year in which the new feed-in tariff is discussed for following year.

On the other hand the feed-in tariff guaranteed by ERO for following calendar year cannot be higher than 115% of the old one that was valid at the year when the new one is discussed.

Green-bonus

Second option how to profit from guaranteed support is to take the green bonus. According to act No. 165/2012 Coll., the green bonus represents a form of support for using renewable energy sources. It is defined as a financial amount served for subjects producing electricity from renewable resources.

In other words, the green bonus is an additional premium to market price of

[4] Defined by the legal act

[5] Does not apply for water power plants projects where the limit is 10MW

electricity. In case that subject producing electricity from renewable resources chooses this kind of support and uses this produced electricity for own consumption then he/she is allowed to ask the market operator to pay green bonuses. Moreover the producer is allowed to sell the electricity surplus to any final consumer or any electricity trader.

Czech electricity and gas market operator (OTE) is a joint stock company established in 2001. OTE provides comprehensive services to individual electricity and gas market players. OTE commenced organizing trading in the day-ahead electricity market in 2002 and the intra-day and block electricity markets in later years (OTE, 2013).

Table 4: Green bonus scheme

Advantages of green bonus	Disadvantages of green bonus
More risky	No- necessity to pay for consumed energy
Higher possible profit	Necessity to find own electricity trader
No need to make new access line	

Source: Own processing of data available at csve.cz

It is up to every producer which support will be chosen. Both of them have their own advantages as well as disadvantages.

Either a certainty in the sense of fixed feed-in tariff for given time period is chosen or more risky field of green bonuses with probably higher profits is.

Finally it is necessary to mention that the possibility of choosing between green bonuses and feed-in tariffs is slightly limited. Any investor is not allowed to switch between those types of support as he or she wishes to.

The act No. 165/2012 Coll., states that this particular change might be done only once a year. In other words, it is not possible to change the support in the middle of the year just because the wind started to blow more.

Hence there is a deadline of 30th November when all application forms must be delivered to Energetic regulatory office where the support for further calendar year is precisely picked.

No. 458/2000 Coll.

This act on conditions of entrepreneurship and about the power of civil service in the field of energy and amending certain acts is sometimes called the energy act. It defines the object of entrepreneurship in the field of energy. It states what the production of electricity is, what is the distribution, what is the trade with electricity etc.

For the purpose of the thesis it is important to mention that entrepreneurship in the Czech Republic with electricity is possible only when necessary license is given by the Czech Regulatory Office.

Conditions of giving the license to any physical body are:

- Reaching the year of 18
- Full legal capacity
- Integrity
- Competence or appointment of a responsible representative

Price decision of the Energy Regulatory Office No. 4/2012

This price decision approved on 26th of November sets the support for energy coming from renewable resources. In other words, it defines the feed-in tariffs (for turbines with nominal power lees than 100kw) and green bonuses for the year 2013.

The feed-in tariff for this particular year equals to 2120 CZK/Mwh and the green bonus is set a little bit lower resulting in 1570 CZK/Mwh. From the table below it is clear that the future of supporting wind power energy is not bright. All figures have a declining trend which causes the environment less and less attractive.

These figures are considered to be valid for 20 years; however there is discussion on the ground of the Parliament of the Czech Republic that the situation could be changed in the year 2014.

Table 5: Feed-in tariffs and green bonuses price development

Feed-in tariffs and green bonuses for wind power plants				
Form of renewable energy	**Operating phase**		**Support (MGW/h)**	
	From	**To**	**Feed-in tariff**	**Green bonus**
Wind power plant	-	31.12.2003	3,703	3,153
	1.1.2004	31.12.2004	3,346	2,796
	1.1.2005	31.12.2005	3,183	2,633
	1.1.2006	31.12.2006	2,907	2,357
	1.1.2007	31.12.2007	2,856	2,306
	1.1.2008	31.12.2008	2,785	2,235
	1.1.2009	31.12.2009	2,540	1,990
	1.1.2010	31.12.2010	2,377	1,827
	1.1.2011	31.12.2011	2,326	1,776
	1.1.2012	31.12.2012	2,275	1,725
	1.1.2013	31.12.2013	2,120	1,570

Source: Own processing of data available at eru.cz

4.3.1.2 Economic environment

The economic environment is very much influenced by the political one. Due to the fact that the Czech Republic the executive power is held basically in the hand of Czech government, it offers two main choices how the economic environment in terms of renewable energy should look like.

Generally speaking, there are two concepts which are analyzed because of the current economic situation. First suggest that the government encourages the economic environment of renewable resources by giving subsidies and support. The other choice is simply letting the environment to the forces of market.

The cornerstone document affecting the energy policy in the Czech Republic is the State Energy Concept (SEC) which is a document that strategically sets goals aiming at energy sector in favor with needs of economic and social development. It includes also the environmental protection. State Energy Concept simply defines strategic priorities of the Czech energy sector for next 30 years.

Another point that should be mentioned about SEC and which influences the economic environment is the fact that it diversifies the energy mix of the Czech Republic. In other words it counts with the usage of all resources with regards to their specific conditions. It means that the use of renewable resources under the available conditions is regulated by this concept. In the 30 years horizon the primary energy sources should be:

- Nuclear fuel 30-35%
- Solid fuel 12 to 17%
- Gaseous fuel 20-25%
- Liquid fuel 14-17%
- Renewable sources 17-22%

From the figures above it is obvious that the state energy concept is mainly focused on increasing the share of nuclear power in the total energy mix and decreasing the share of solid fuels. However the strategy also suggests a decrease in supporting the renewable energy sources which highly influence the economic environment (Business Info, 2012).

At present Czech government has chosen the first scenario of supporting the economic environment of renewable energy. However the policy of supporting renewable sources that had been firstly signed in the year 2004 might be a subject to change. With the use of the latest info, it is clear that supporting energy cost a lot of money coming from state budget that with combination on current legislation increase the electricity price for customers.

Table 6: Renewable energy subsidy development

	Year	Amount
Subsidy	2010	8.5 bn.
	2011	11.7 bn.
	2012	11.7 bn.
	2013	11.7 bn.

Source: Own processing of data available at mpo.cz

As was mentioned earlier, the Czech Republic supports the energy sector of renewable resources. However as every other support it increases expenditures of Czech state budget. The table 5 shows that the amount of money has been constant for last three year however the very latest info suggest that the policy of supporting renewable resources could be changed. Current minister of industry and trade together with director of Czech Regulatory Office think about stopping the support of renewable energy in general. The quotation of Mrs. Alena Vitásková[6] is clear. She said: “I am not giving any Czech koruna for supporting renewable energy in the year 2014” (Ceny Energie, 2013).

What should be pointed out is that the final price of electricity is calculated from two parts where only one is influenced by support of renewable sources.

Those are:

- Non-regulated part (set by electricity distributor)
- Fixed electricity price
- Price of power electricity
- Regulated part (set by Czech Energy Institute)
- Distribution fee
- System services fee
- Renewable resources contribution
- Electricity operator services fee
- Taxes
- Value added tax
- Electricity tax

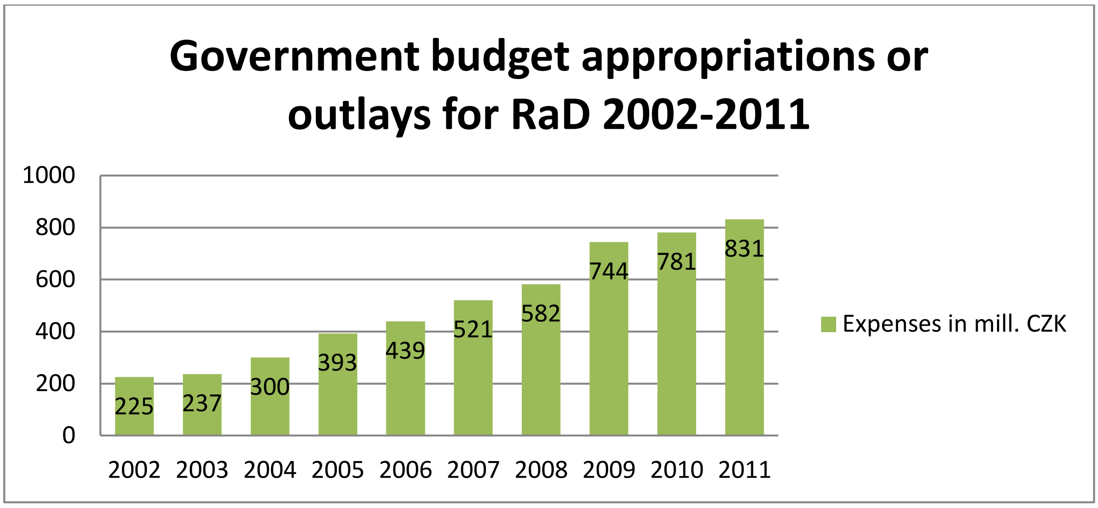
At least but not last it is crucial to mention that expenses focused on research and development aiming at production, distribution and rational use of energy has been constantly growing since 2002 (Ceny Energie, 2013).

This growth was not kept only in the years 2003 and 2006 when the share of state expenditures going to research and development was stagnating. Between 2002 and 2011

[6] Chairwoman of Czech Energy Regulatory Office

the average annual reached 15.6 %.

Graph 1: Government budget appropriations or outlays for RaD 2002-2011



Source: Own processing of data available at vlada.cz

4.3.1.3 Social environment

The development of wind energy, respectively, construction of wind power plants represents unique phenomenon, which in most countries divides not only experts but also public and political representatives at all levels (national, regional, local).

As was mentioned in other sections of the diploma thesis, for project realization the determining physical-geographical and technological conditions of selected territory (this means sufficient wind potential, the absence of limiting factors in terms of a regulator construction and protection of nature and landscape and capacity of the local electric transmission network) are not the only variables that should be analyzed.

Usually the success of large wind power plants relies on social and political acceptance made by local resident's sites and municipal authorities. The decision-making process is highly influenced by their subjective opinions, experiences and preferences. In most cases, the pressure is made by more or less strong interest groups.

All of this means that the realization of wind power plant project is a confrontation of investors' interest and the interest of local community. It depends on both sides how effective the process of negotiation is. The biggest problem in the Czech Republic is mostly connected with wrong attitude of both sides coming from reluctance and intransigence.

Due to those clashes between inventors and local representatives, several new terms have been developed. Those are:

- NIMBY
- LULU
- NIABY
- BANANA (Stephens, 2005)

All of them are shortcuts for designation of different attitude. NIMBY means Not-In-My-Backyard and represents the situation when local public does not want to approve certain project even if they might somehow profit from that project (Stephens, 2005).

The other abbreviation is connected to the land use. LULU means locally-Unwanted-Land-Use. The third terms is a shortcut for Not-In-Anyone's-Backyard which means an opposition to that kind of projects that should not be realized basically anywhere.

The last shortcut BANANA means build-absolutely-nothing-anywhere-near-anything. This attitude might be found among those groups of local people who simply fights against any activist lobby groups or against any investment projects in general. This group of people represents a strong threat for investment where the final verdict relies on locals.

According to Wolsink the local opposition might form four possible scenarios that can occur separately or together with others. Those are

A. The situation when a positive attitude towards building wind power plant is in the combination of rejection its realization near backyards. This a real NIMBY attitude which can be easily characterized by following sentence. Using the wind energy is a great idea but I do not want it here.

B. The second attitude called NIABY simply describes the situation when local people are against the realization of using wind energy in general. It could be characterized by following statement. I am against any possible usage of wind power and therefore I do not want it here or anywhere else.

C. Third scenario that might happen is a slight differentiation of the NIABY form. It is called a dynamic NIABY. It outlines the situation when firstly accepted concept of wind energy is favorable to local people however due to the confrontation with concrete investment, discussions and negotiations the first publicly positive opinion is changed to negative one.

   As previous scenarios this could be quoted as following. I thought that the wind energy is a good way and I agreed to be build in our backyard but then I figured out that it is a bad thing.

D. The last scenario is represented by the fact that local people reject the concrete wind power project. The reasons are of different cores (wrong placement, extent of the project, advantages for municipality etc.).

   It does not say that the wind energy investment project is wrong but for reasons mentioned above it is not approved. In other words it says that this particular project is bad but if certain conditions are changed, it could be approved.

If the chosen community of local people is not able to be convinced about the investment project, usually certain leverages are chosen. The most usual are:

- Municipality budget benefit: meaning that certain amount of wind power plant revenues goes to local budget
- City awareness: increasing the city awareness due to support of clean energy
- Tourism: meaning that city can profit from building cycle routes or touristic routes, building info centre etc.

All that was mentioned above was done because of the fact that most of large wind power plant projects are wrecked due to strong public voice. With the usage of well-known Latin quotation “vox populi, vox dei” it is obvious to say that social environment might play a decisive role.

The local community’s opinion gets even stronger if the investment project needs to be placed on land owned by municipalities or on land that is not administratively proper for building in general. This is exactly the situation where the lobby of investors is highly expected.

Fortunately the diploma thesis deals with medium wind power plant that is located on private property. This gives the investor two strong advantages. He does not have to ask for local community permission in terms of buying necessary property and also due to the height of the wind power plant many of myths cannot be defended.

On the other hand, occasional and emotional protests made by local people might call for any kind of vandalism that surely influences the operational phase of the power plant. This is analyzed in the section of risks.

4.3.1.4 Technological equipment

As was already mentioned in the section regarding the legislative environment, the situation among supporting wind power plants has been changed. The fact that choosing the appropriate support is no longer in the hands of owner (investor) pushed me to choose between lower amounts of wind turbines.

Before the examination of the selected wind turbine starts, it is necessary to mention that wind turbines could be divided into many categories. Generally, they are divided into categories based on their rated capacity, axis rotation or connection to the grid.

1) According to rated capacity

Table 7: Wind Turbines Division

<table>
<tr><th colspan="9">Wind turbines</th></tr>
<tr><th colspan="3">Small turbines</th><th colspan="3">Medium turbines</th><th colspan="3">Large turbines</th></tr>
<tr><th colspan="2">Turbine</th><th rowspan="2">Power (kW)</th><th colspan="2">Turbine</th><th rowspan="2">Power (kW)</th><th colspan="2">Turbine</th><th rowspan="2">Power (kW)</th></tr>
<tr><th>Diameter [m^2]</th><th>Area [m]</th><th>Diameter [m^2]</th><th>Area [m]</th><th>Diameter [m^2]</th><th>Area [m]</th></tr>
<tr><td>≤ 8</td><td>≤ 50</td><td>10</td><td>16.1-22</td><td>200.1-400</td><td>130</td><td>45.1-64</td><td>1600.1-3200</td><td>1500</td></tr>
</table>

8.1 - 11	50.1-100	25	22.1-32	400.1-800	310	64.1-90	3200.1-6400	3100
11.1-16	100.1-200	60	32.1-45	800.1-1600	750	90.1-128	6400.1-12800	6400

Source: Own processing of data avaible at cez.cz

According to data from the table above it is possible to state that there are three groups of wind turbines. The group of small turbines itself could be divided into two sub categories. The first one, with the limit of 2.5 kW is primarily used for charging batteries. This kind of accumulated energy could be used for powering telecommunication equipment, radios, refrigerators, lightning and other electric appliances.

The second subcategory has a limit of nominal power of 100 kW. These turbines are usually offered and used for tempering or in some cases for heating water or even houses. All these two categories are usually not connected to the grid; they are not suitable for selling the produced electricity.

The two following categories are represented by medium and large wind turbines. The medium category has a diameter limit of 45m and the nominal power should not exceed 750kw. Due to the strong technological development the last category of large wind turbines has basically no limit. At present we can see huge wind turbines located near the cost (off-shore) with the nominal power of 3 MW and height of 140m.

Horizontal axis turbine

Today’s huge wind power plants are from the point of basic elements very similar. In most cases we can see a three blades turbine with a horizontal axis of rotation and its rotor facing towards the air flow. Basic construction elements of this kind of plant are mast, rotor and engine room. In the case of small wind power plants, the use of rotor and horizontal axis of rotation is the most used principle.

Unlike huge wind power plants their construction is a way simpler and the range of possible design solutions is wider. One of those modifications could be the number of rotor blades. Theoretically speaking the quotation “the less is better” holds, because the power plant with lower number of blades could theoretically reach higher efficiency. However this was just a theoretical proclamation, in practice the situation is little bit different. Due to the fact that lower number of blades needs higher speed of rotation, it causes bigger noise and strains the whole system more.

Besides that one of disadvantages of lower-number rotor blades is their relatively high start-up speed[7] necessity which brings a lot of significance. This plays a vital role if we consider that for small wind power plants the speed of wind at lower level above the Earth's surface is not that fast (Hanslian, 2012).

That is the reason why in the case of small wind power plants the three blades rotor is considered to be a standard version. On the other hand it is possible to find some wind turbines with higher number of blades where the heaviness and lower efficiency is counterbalanced by relatively bigger productivity with lower speed of wind. The rotor itself might be a subject to other simple modifications regarding the shape of blades or the angle of turbine towards the wind. In some cases an aerodynamic tunnel could be used as a part of wind turbine to increase the speed of wind coming into the rotor.

Vertical axis turbine

Completely different chapter of wind power plates are represented by those which have the vertical axis turbine. Their main advantage is the fact that the rotation of the rotor is not necessary. In most cases those kinds of wind power plates are lighter and constructively simpler.

The lower efficiency can be put among their disadvantages. Generally speaking, this type of conception based on vertical axis construction is not suitable for huge wind power plants. On the other hand in case of small wind power plants, this construction represents a possible and vital alternative which is used often.

The construction of vertical axis wind power plant is based on the rotary principle of Darrieus turbine which uses a more sophisticated aerodynamic principle of gaining energy. Its construction is based on the vertically oriented blades (usually two) which rotate among its vertical axis.

Theoretical efficiency of Darrieus turbine should be equivalent with "classical" wind turbines. In practice, the reality is quite different. Due to the set of technical reason their efficiency is a little bit lower. Power plant straining is eliminated by systematic

[7] This is the windspeed at which the rotor starts turning

curvature of particular blades in the way that their top and bottom edge is fixed to central pillar.

Besides that typical visual form we can find several modifications using the same aerodynamic principle. One of those possible modifications is a simple use of blades oriented in the “H” shape. In this case, the robust construction of blades and the plant in general is crucial.

Based on the market research and mainly on consultations with experts in the field of wind power plants the choice was eliminated to two possible turbines:

1) <u>CZ 100 : 100 kW</u>

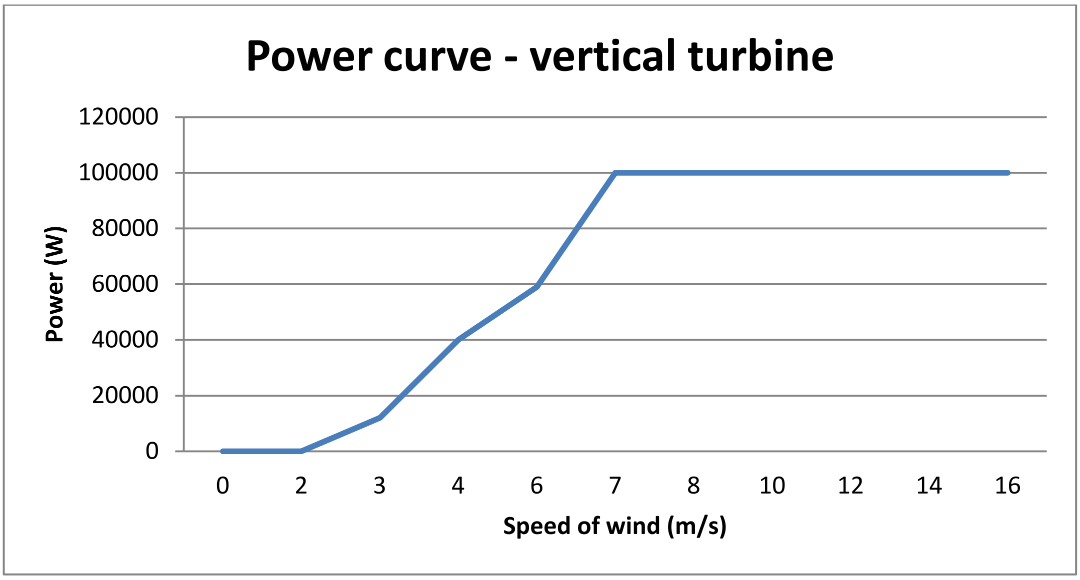
Picture 2 – Vertical Wind Turbine

Source: Own processing of picture available at wind-solar.cz

<u>Specification of the wind turbine:</u>

- Nominal power: 100 kW
- Type of turbine: vertical
- Start up wind speed: 1.8 m/s
- End up wind speed: 25 m/s
- Nominal wind power: 7m/s
- Blade quantity: 3
- Rotor diameter: 24m
- Tower height: 18m

Graph 2: Vertical Turbine Power Curve



Source: Own processing of data available at cez.cz

2) <u>100000.H1 : 100 kW</u>

Picture 3 - Horizontal Wind Turbine

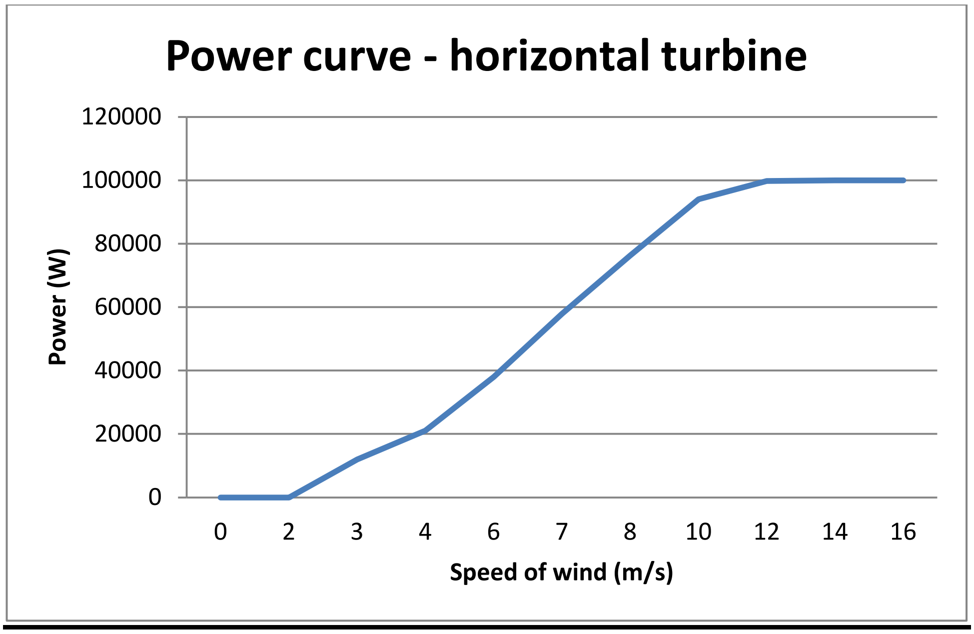
Source: Own processing of picture available at csve.cz

<u>Specification of the wind turbine:</u>

- Nominal power: 100 kW
- Type of turbine: horizontal
- Start up wind speed: 2.5 m/s
- End up wind speed: 25 m/s
- Nominal wind power: 13 m/s
- Blade quantity: 3

- Rotor diameter: 15.6 m
- Tower high: 36 m

Graph 3: Horizontal Turbine Power Curve



Source: Own procesing of data available at windenergyresources.com

Even thought that there are many complicated calculations and equations involved in understanding and constructing wind turbine generators, two main facts that play the key roles are:

1) The power output of a wind generator is proportional to the area swept by the rotor

2) The power output of a wind generator is proportional to the cube of the wind speed

Wind is made up of moving air molecules which have mass - though not a lot. Any moving object with mass carries kinetic energy in an amount which is given by the equation:

Kinetic Energy = 0.5 x Mass x Velocity2,

where the mass is measured in kg, the velocity in m/s, and the energy is given in joules.

Knowing the density of wind, the hitting power to the wind turbines is calculated from the combination of kinetic energy together with the air density and swept area. This results in the following equation:

Power = 0.5 x Swept Area x Air Density x Velocity3,

where Power is given in Watts (i.e. joules/second), the Swept area in square meters, the Air density in kilograms per cubic meters, and the Velocity in meters per second (Andres, 2013).

<u>For the selected location the power of wind will be calculated as following:</u>

$$\textbf{Power} = 0.5 \times 3.14 \times (24/2)^2 \times 1.2452 \times 7^3$$
$$= 0.5 \times 3.14 \times 452.16 \times 1.2452 \times 343$$
$$= 303197.0871 \text{ W}$$

The number of wind power is larger than rated power of our wind turbine. This is mainly due to Betz limit[8] and inefficiencies in the system.

For calculating the electricity output for our wind power plate, following factors are important. Those are average wind speed in our location, power curve of our wind power plant, type of our wind power plant, guarantee given by suppliers and local conditions.

Now it is time to mention that for completely precise numbers of wind conditions, at least two years measuring of the wind would be needed. For the purpose of my thesis the data generated from mathematical models were used. Those give valuable viewpoint but not hundred percent precise.

For calculating the energy output following variables were used:

- Capacity factor (c)– it is a decimal number that states what amount of energy was produced compared to what energy could have been produced

[8] Albert Betz was a German physicist who in 1919 concluded that no wind turbine can convert more than 16/27 (59.3%) of the kinetic energy of the wind into mechanical energy turning a rotor

- Nominal power (P)– nominal power of selected wind power plant

Based on statistical evaluations done by Technical University of Ostrava and measurements of wind in selected location it is possible to use following data for capacity factor:

Table 8: Coefficient of wind speed

Speed of wind (m/s)	4	5	6	7	8
Coefficient	0.08	0.14	0.18	0.25	0.31

Source: Own processing of data available at spvez.cz

The formula for calculating the potential energy (SPVZ, 2012) output in the chosen location is then:

E = P x number of hours x c

= 100 x (24 x 365) x 0.2

= 175 200 kW/year

This is a number that is used in further calculations as a potential year production of electricity. To be more precise, this number was used for calculations only during the lifespan of the selected wind power plant which is CZ-100 vertical turbine.

4.3.2 Porter's five forces

4.3.2.1 Threat of new competition

The only type of competition that might occur in this particular field is at the beginning of the project realization. Due to the fact that there is a limited capacity of grid framework available for connecting new devices producing electricity from renewable resources (wind turbines, photovoltaic plants…) in each location, other potential investors are seen to be competitors. They might (if they succeed) take the reserved power for themselves.

On the other hand, at the time when a contract for connecting the power plant to the grid is signed, there is no longer the threat of new competitors.

4.3.2.2 Threat of substitute products or services

Generally speaking, it is not easy to find a substitute of electricity. In the narrow sense we can see substitutes in electricity coming from other renewable resources. It could be small water power plants, solar plants, geothermal plants etc.

Everything that enables people to decrease their dependency of electrical power might be seen a substitute in the broader point of view. At present there is a wide range of new products that are considered to be saving. That might be a way how to decrease the consumption of electrical energy as well.

4.3.2.3 Bargaining power of customers

First of all it is important to repeat that the market of renewable energy is a very specific environment. Due to the legislation the completion almost does not exist. In some points of view it is not the typical competitive environment where the fight for customer is on daily basis.

According to act No. 165/2012 Coll., this states that any distributional company of electricity is obliged to buy all electricity for strict and by state guaranteed prices. This applies only for feed-in remuneration subsidy.

In the region of Olomouc, which is the planned location for the wind power plate turbine is only one customer. It is a CEZ Distribuce, Due to facts that were mentioned above, CEZ Distribuce, is obliged to buy all energy coming from renewable resources if the produces chooses a feed-in remuneration as his subsidy[9].

Thus, the negotiation power of CEZ corp. is quite limited because the law of the Czech Republic must be respected.

4.3.2.4 Bargaining power of suppliers

[9] Assuming that green bonus is not taken into consideration

There are basically two views on the power of suppliers. The first one says that there are two main leaders on the wind turbines market which are Vestas and Enercon. The truth is that both of them focus on large wind power plants that in this particular thesis do not play an important role.

The second one suggests that for medium wind turbines the situation is the worst. Even thought that the technology of wind turbines is not a unique one in this time, the bargaining power is strongly limited.

However this is an entrepreneurial sector, the position of suppliers is slightly different. The only suppliers that occurs here is the one who sells the whole equipment at the beginning of an investment project. Another fact that makes this investment project specific is that during the lifespan of wind turbines basically no other suppliers are needed. In other words, no other suppliers are involved in the process after the initial purchase is made.

4.3.2.5 Intensity of competitive rivalry

With regard to what has been mentioned above, it is not true that the classic rivalry exists among entrepreneur subjects. Again, it is important to remind that once an agreement between the producer and the distributor is signed, there is no longer a threat of competition in the classic sense. What is known is that competition puts any businesses under constant pressure to offer the best possible range of goods at the best possible prices, because if not, consumers have the choice to buy elsewhere (European Commission, 2012).

The only thing that matters is the situation when the capacity for certain region of the Czech Republic (in this case the region of Olomouc) is about to be exceeded, then the broader sense of competitiveness might be used.

4.4 Investment stage

The investment stage together with the operational stage represents the most important parts of the diploma thesis. This is done just for simpler orientation in the thesis and because of the fact that wind power plant generates revenues only from produced electricity.

Based on the PEST analysis and date given by Physical Instituted of the Czech

Republic and their recommendations, the selected wind power plant for investment is FAN HONG 100kW. This type of wind power plant was chosen becasuse of the fact that selected location does not acquire high energy potential based on gathered data. Vertical power plants enables to use more wind capacity than horizontal one in the location where wind changes its blowing direction.

The whole wind power plant project is a turnkey investment which will done by Czech supplier. Of course only if pre-calcualtions will be positive enough.

Before ana calculations starts, it is crucial to repeat that the projects deals with two different scenarios. After the discussion with banking home, its offer regarding interest rate and annuitty paymets could have been used. Those scenarios are:

1. <u>Financing by equity : all initial investments will be covered from own capital</u>

2. <u>Financing by debt and equity: the ratio will be 50-50, meaning that 50% of investemnt will be funded from bank loan and 50% from own equity</u>

4.4.1 Types of financial support

Feed-in tariff and green bonuses are not only support that investors who invest money in renewable energy might choose. There are few national and European programs that are possible to be used.

This of course means that any subject investing in clean energy is offered some kind of benefit. It could be a donation or low interest rate loan. Either way it represents viable option that could change the investor’s cash flow.

4.4.1.1 Effect 2013

The EFFECT Program (Efekt in Czech language) is a program of Ministry of Industry and Trade of the Czech Republic that supports energy savings projects and use of renewable energy resources in the Czech Republic. It also completes energy programs of structural funds of the European Union. Because it is a national program it is a part of

Czech legal system as an Act No. 406/2000 Coll. Donations are given to activities of public enlightenment, consulting, energy management and small investment projects.

Grants of this program might be offered to entrepreneur subjects (physical and legal bodies (non-governmental organizations, universities (according to act No. 111/1998 Coll.), cities, municipalities, regions a its organizations, socially and health facilities, interest groups, statutory organizations, associations of legal bodies.

Unfortunately this program is strongly ceiled. The budget of this program is only 30 mil. CZK only which makes the possibility of getting it hard. For that reason the calculations mentioned at the end of my thesis do not include it.

4.4.1.2 The Operational Programme Environment

Based on the amount of financial resources, the Operational Programme Environment (OPE) is the second largest Czech Operational Programme. Between 2007 and 2013, this Programme will offer almost EUR 5 billion from the Cohesion Fund and the European Regional Development Fund, and an additional EUR 300 million from the National Environmental Fund of the Czech Republic and the state budget. The Operational Programme's main goal is to protect and improve environmental quality throughout the Czech Republic (OPZP, 2007).

The whole Programme is divided into seven axis with different purposes. For the investment projects focusing on building wind power plants, the axis number three represents a viable option.

This priority axis focuses on:

- The construction of new facilities and the modernization of the existing facilities with the aim to increase the use of renewable energy sources for heat generation, electric energy generation and for combined heat and electric energy generation
- Realization of energy savings and the use of waste heat

This implies that only certain investment projects could be found suitable. Those regarding electric energy generation have several conditions:

- The installation of photovoltaic systems for electric energy generation

- The construction and modernization of wind and small water power plants
- The construction of geothermal power plants and biomass burning plants (solid, gaseous or liquid biomass)
- Grants may account for 20% of the total eligible expenses, however, there is a maximum limit of CZK 50 million

Unfortunately, there are two reasons why this Programme is not suitable for our particular wind power plant. The first one is the condition that all projects asking for grants from this Programme have to be co-funded by certain public authority (municipality, government organization etc.) This condition is not fulfilled.

Second reason is of administrative character. Any grant application can be submitted only during calls announced for a specific area of intervention. Right now there is no call for the priority axis number three. After the conversation with OPE Information Centre, it was said that if the budget of OPE does not run short, there probably will be some additional calls.

For better orientation in the diploma thesis the table below shows necessary figures that play crucial roles in operation stage. Hence some of them are exogenous variables for dynamic methods of evaluation. They are supported by explanations of the most important calculations.

Table 9: Summary information about the project

Project information		
Vertical wind turbine CZ-100	5,420,000	CZK
Tower	780,000	CZK
Electrical components, cables	620,000	CZK
Ground preparation	80,000	CZK
Fencing	40,000	CZK
Administration fees	60,000	CZK
Total initial investment	7,000,000	CZK
Bank loan (Scenario 2)	3,500,000	CZK
Performing degradation	2	%
Lifespan	20	years

Indexation	2	%
Discount rate (WACC)	8.99	%
Income tax	15	%
Yearly output during lifespan	113,880	kW
Feed-in tariff	2.12	CZK
Depreciation	133,300/319,300	CZK

Generated Output

From the equation above (**P x number of hours x c)** it is possible to predict potential energy output for selected vertical wind power plant. This energy output is recalculated in profit in loss account due to performance degradation announced by producer. The performance degradation was stated at 2 % level for every year.

Revenues

Due to the fact that the wind power plant is a medium one, there are not many choices of other income that from selling the electricity. Large wind power plants are sometimes used as billboards and might gain additional revenues from being posted by advertisements. In this case it is not even possible. In 2013 there is no taxation revenue that used to be valid for photovoltaic panel until 2011.

Costs

The chosen wind power plant has one strong advantage. The operational stage does not involve huge investments or other costs that exist in cases of large wind power plants. However, there are still some factors that cannot be overlooked.

The wind power plant will be placed on land owned by the investor which eliminates some costs (rent, levy) and possible problems in the future. The only costs that must be covered are the insurance and maintenance services. According to data from unnamed banking institution, the all risks insurance program costs 17,700 CZK/year. This cover all catastrophe that might occur during the operational stage of the project except those of wanted caused action.

Every machine needs some kind of maintenance services. Due to the 5 year warranty given by producer, there are no costs, however after those years, a yearly payment of 14,000 CZK (1% annual growth) must be taken into profit and loss account. This covers changing oil, belts, tower bolts, filters as well as inspecting for, crack, broken pads, testing shafts, hydraulic components etc.

There is only one little catch. The lifespan of gear box is expected to be between 15-20 years. For the purpose of my thesis, a pessimistic variant of changing it after 15 years was chosen. That is the reason why gear box replacement reserve was created. The cost of new one is expected to be 427,500 CZK.

The scenario 2 supposes a funding from bank loan. For the purpose and due to limitations in bank institution, the debt/equity ratio is 1, meaning that 3,500,000 CZK was borrowed. The whole Debt B-o-Y / D-o-Y ratio is calculated in the supplements.

Depreciation

According to Czech legal system, the depreciation group for this kind of investment is number four. The first year the depreciation rate is 2.15 % and all following years have 5.5 % rate. The value of wind power plant itself is 6,200,000 CZK.

Income tax

Again, according to legal act No. 586/1992 Coll., the income tax is 15%. Due to the fact that this particular rate is very unpredictable, the constant value of 15% was covered for the whole lifespan of the power plant.

Salvage value

Even though that the lifespan of selected wind power plant is 20 years, it does not mean that after that the wind power plant does not operate at all. The producer of wind power plant states that after approximately 20 years, it might be necessary to change low and high speed shafts, yaw drive or yaw motor, controller, brakes or pitches. It all depends of how much the wind power plant would be strained. Due to the fact that salvage value influences the dynamic methods of evaluation it should be covered in calculations. Nevertheless the value prediction is hard to be done. Based on consultations with experts in the field of wind energy it might be said that the average value of selected wind power plant is approximately 1,500,000 CZK. This amount is included in the last year in profit and loss account.

WACC

As was mentioned above the WACC formula consists of several variables that influence the decision making process a lot.

Regarding the **risk free rate**, the statistics of the Ministry of finance of the Czech Republic and its 15 years bonds rate were used.

Table 10: Risk Free Rate

Name of the issue	ISIN	Risk free rate	Maturity (years)
Bond of the Czech Republic 2009-2024	CZ0001002547	5,70%	15

Source: own processing of data available at mfcr.cz

From the table above the figure 5.7 % will be used as a **risk free rate** for computing WACC.

According to statistics done by Damodaran, the **ERP** for the Czech Republic is 7.08%.

Last variable that has to mentioned is the **beta coefficient**. When computing beta coefficient it is recommended to use already calculated figures for chosen sector. The problem of this procedure is the fact that they have to be re-calculated to certain company's level. This is done by using the financial leverage which formula is:

$$\beta_{leveraged} = \beta_{unleveraged}(1 + (1 - t) \times \frac{D}{E}$$

According to secondary data from Damodaran the $\beta_{unleveraged}$ for alternative energy sector in Europe is 0.4657. The $\beta_{leveraged}$ is calculated in supplements.

4.5 Operational stage

One of the biggest advantages of this project is the fact that selected wind power plant needs almost no maintenance during its lifespan. It means that no personnel are needed for producing the electricity. The wind power plant itself does not require any additional natural sources. All operational costs are mentioned in the calculations.

The only things that should be mentioned in this stage are the risks that might occur. Those are examined in the subchapter risks of the project.

4.5.1 Scenario – 50 % debt, 50 % equity

First scenario supposes using a bank loan at the given interest rate. After checking client's solvency several choices were offered from which the most suitable one was chosen. The tables shown below are just samples for quick orientation. The whole calculations might be found in supplements.

Hence, the bank loan for this scenario is 3,500,000 CZK, with 15 of maturity and interest 5.3 %. Investor is obliged to pay yearly payment of 344,761 CZK. The whole calculations are to be found in supplements number 7.

4.5.1.1 Profit and loss

Total revenues are defined as a product of feed-in tariff (indexation of 2% covered) and expected output (degradation of 2% covered). Total expenses are represented by maintenance services (the supplier covers all expenses during first five years due to warranty agreement), gearbox replacement reserve and insurance.

Table 11: Profit and Loss Account – 50% equity, 50% debt

Year	2013	2014	2015
EBITDA	139,300	324,652	324,503
Depreciation	(133,300)	(319,300)	(319,300)
EBIT	6,000	5,352	5,203
Interest	186,550	178,117	169,235
Pre-tax profit	(180,550)	(172,766)	(164,032)
Tax rate	15%	15%	15%
Taxes	0	0	0
Net profit	(180,550)	(172,766)	(164,032)

4.5.1.2 Cash flow

Calculation of cash flow represents a necessary step for further parts of the diploma thesis. Dynamic methods are based on cash flows and so are variables such as initial investments, lifetimes of project and WACC.

Table 12: Cash flow statement - 50% equity, 50% debt

Year	2013	2014	2015
EBITDA	6,000	5,352	5,203
Taxes	0	0	0
Interest	186,550	178,117	169,235
Operating cash flow	(233,800)	(31,583)	(13,967)

4.5.1.3 WACC

The first scenario deals with equity as well as debt. It means that the project is funded from 50% equity and 50% from debt represented by bank loan. Here, the WACC increases during the lifespan due to the yearly repayment of the debt. The whole WACC calculations are listed in supplements.

Table 13: WACC - 50% equity, 50% debt

Year	2013	2014	2015
WACC	0.0675	0.0686	0.0697
1+WACC	1.0675	1.0686	1.0697
$(1+WACC)^n$	1.0675	1.1419	1.2239
Cash flow	(233,800)	(31,583)	(13,967)
$CF/(1+WACC)^n$	(219,022)	(27,658)	(11,412)

4.5.2 Scenario – 100% equity

As was mentioned above the second scenario suggests a situation when investor is ready to cover all initial investment by his own capital. This is mainly due to the fact that yearly payments do not have to be paid.

4.5.2.1 Profit and loss

The amount of total revenues and total expenses are the same as in the first scenario. Total expenses are computed and based on facts (insurance, maintenance services…) that cannot be changed so easily. The only difference is that no interest from bank loan is charged.

Table 14: Profit and Loss Account – 100% equity

Year	2013	2014	2015
EBITDA	139,300	324,652	324,503
Depreciation	(133,300)	(319,300)	(319,300)
EBIT	6,000	5,352	5,203
Interest	0	0	0
Pre-tax profit	6,000	5,352	5,203
Tax rate	15%	15%	15%
Taxes	900	803	780
Net profit	5,100	4,549	4,423

4.5.2.2 Cash flow

Here the cash flow is computed differently. It was already mentioned that the WACC differs if the cost of equity or cost of debt are changed. Due to the fact that in this scenario, the cost of debt does not equal to zero, the WACC and thus cash flow is different.

Table 15: Cash Flow Statement – 100% equity

Year	2013	2014	2015
EBITDA	139,300	324,652	324,503
Taxes	900	803	780
Interest	0	0	0
Operating cash flow	138,400	323,849	323,723

4.5.2.3 WACC

The second scenario deals only with equity. It means that the project is funded from 100% own capital. The WACC is the same during the lifespan because of the fact that there is no cost of debt.

Table 16: WACC – 100% equity

Year	**2013**	**2014**	**2015**
Cash flows	138,400	323,849	323,723
WACC	0.0899	0.0899	0.0899
1+WACC	1.0899	1.0899	1.0899
$(1+WACC)^n$	1.0899	1.1878	1.2947
$CF/(1+WACC)^n$	126,984	272,646	250,037

4.6 Environmental analysis

It is a well known fact that coal-fired power plants strongly burden our environment. It includes a wide range of negative effects from moving villages to other places, through the opencast mining itself, storing firm waste to water contamination. What cannot be forgotten, is mentioning the problem of landscape restoration and its financial expenses. Also there are well known problems of storing used nuclear waste.

At past, one of the most discussed issues was the production of very aggressive sulfur dioxide (SO_2) which harmed most forest covers not only in the Czech Republic but in many other places on planet Earth.

After the process of desulphurization, the production of SO_2 was lowered by huge amounts, however as a side effect of the process, the production of CO_2 was on the other hand increased. CO2 is a green house gas that is monitored worldwide; however it is not produced during the operational phase of wind power plant. If the project is realized, it is supposed to produce 141,046 kWh on average per year and thus significantly helps to protect the environment and climate in general.

During its lifespan of 20 years it is supposed to save approximately following amounts of:

SO_2…………… 28 t

NO_x…………… 21 t

Fly ash…………245 t

CO_2…………… 4,375 t

For removing this amount of NO_2 from nature, a forest of 0,3 km^2 would be needed. In case of comparison the amount of electricity produced by selected wind power plant with classic coal-fired power plant, then 3,500 tons of coal would be needed for producing the same amount of electricity. The coal would create a train long of 1 km. Also on behalf of the project, 97 tons of limestones do not have to be extracted in order to to disuphuralize the combustion products that coal-fired plants produce.

Generated electricity is able to satisfy electricity wants of 120 people which might be represented by one very small village. Because of this clean energy, one village of 120 people can use this electricity for 7 days.

4.7 Risks of the project

Risks and uncertainties represent inseparable parts of investment projects and significant variable of investment decisions at the same time. Even thought that risk analysis is a relatively young part of project evaluation, it is clear that risks must not be ignored even when dealing with investment project of small extent.

Thus it is one of the most important parts of the project because it enables to analyze the investment project from wider point of view. It also recommends what precautionary measures should be implemented in order to eliminate possible risks.

Neglecting the risk analysis together with preparing precautionary measures could lead to serious complications during any phase of the project. The truth is that risk can occur during any stage of the project which in results put the investor under bigger pressure.

As was mentioned in previous parts of the diploma thesis, the investment project is divided into three main stages. Different risks might hit different stages. Here is the list of some of them regarding each stage.

4.7.1 Pre-investment stage

The pre-investment stage might be, figuratively speaking, seen as clearly administrative. It is mainly about receiving tons permissions, warrants or notices. Although the paper work represents the major part of this stage, there are still areas that have to be taken into consideration. Those might be:

- Statement the regional office
- Statement of the Czech Environmental Inspectorate
- Statement of the Department of the Environment and Agriculture of Olomouc region
- Statement of the Regional Hygiene Station
- Statement of the Civil and Military Aviation Office
- Positive environmental impact analysis
- Building permit
- Positive approval process
- Physical wind measurements done by the Institute of Physics
- Source of funding

This is just a necessary but probably not complete list of steps that if are not fulfilled might cause risks and postpone the start of operational phase. As was said before, the operational stage is mostly administrative and several permissions might occur due to changes in legislation as the process is going.

4.7.2 Investment and operational stage

Due to the character of risks that might occur during investment as well as operational stage it was decided to merge these two stages of investment project into one. Previous stage could be characterized as purely administrative so the risks are mostly also administrative. However investment and operational stage are of different core and so are their risks.

It is possible to divide those risks into several categories:

- Acts of God

According to legal information institute it means an extraordinary and unexpected natural event, such as a hurricane, tornado, earthquake, tsunami, or even the sudden death of a person. An act of God may be a defense against liability for injuries or damages; insurance policies often exempt coverage for damage caused by acts of God. Under the law of contracts, an act of God often serves as a valid excuse if one of the parties to the contract is unable to fulfill his or her duties -- for instance, completing a construction project on time (Cornell University Law School, 2010).

That implies that the increase in cost is probably possible not only during the first stage of the project but also in further stages. It is hard to predict extraordinary events as were mentioned above (earthquake, lighting hit etc.) that could not only damage the wind power plant but also to destroy it completely.

Either way it represents a possible threat of increasing costs reaching up to millions. Finally it is necessary to mention that acts of God are usually something that has to happen in order to cause damages. In other words, if the wind does not blow or it blows fewer than was expected, it is not the case. In this case the cash flow predictions are to be modified.

- Legislation

These risks are provoked usually by economic and legislative politics of Czech government (changes in taxation law, environmental law, antimonopoly law, changes in investment policy etc.)

- Human factor

Those are risks that are coming from certain level of knowledge and competences of all subjects involved in the project. Because of the fact that the selected wind power plant is a turnkey investment, most of the risks rely on suppliers. Usually, the problem of vandalism is put in this risk category. The situation that someone deliberately destroys the wind power plant might have serious impacts on its operational stage

- Technology

As a result of chosen technology, several risks might occur. Those are mostly of mechanical failure when wind power plant due to often and strong wind deviations or certain construction errors stops functioning.

All risks that have been mentioned above are the most important for this particular wind power plant. Some of them are easier to prevent, some are not. Either way the purpose was to point out that not counting with risks is in highly turbulent environment strongly irresponsible.

5 Evaluation of results and recommendation

Two variants of funding were analyzed. The first one supposed the funding based on 50% from bank loan and 50 % from equity.

Several evaluations methods were conducted and analyzed but the most valuable method NPV that tells how much money would be gained beyond the initial investment was the most important. The net present value of (5,910,570) CZK together with insufficient results of PI and IRR meant evident rejection of investment. It meant that money invested in wind power plant under selected conditions would not generate gains during the lifespan.

Because of this reason the second scenario based on funding from 100% equity was analyzed. The biggest advantage was the fact that the investor would not have to pay yearly payments. Moreover the value of WACC was decreased due to lower cost of debt. However the results were very similar to those of first scenario. Net present value equaled to (3,964,680) which meant the same final verdict. The other methods have offered again very insufficient results.

Table 17: Dynamic Methods Comparison

	Scenario : 100% equity	Scenario : 50% equity / 50% debt
NPV	(3,964,680)	(5,910,570)
PI	0.43	0.16
DPP	47	129
IRR	(8%)	(10%)

Based on all calculations and analysis of the whole renewable energy conditions valid in 2013 it is not recommended to invest into selected renewable energy project of wind power plant.

At last but not least, it is important to mention that even this type of medium wind power plant is able to save unquestionable amount of fly ash, CO_2, NO_x and SO_2 and thus protect the environment over all.

6 Conclusion

The field of renewable energy in the Czech Republic is a topic that is discussed by wide public a lot at present. The reason is the changing guaranteed support and price policy announced by Czech government and Czech Regulatory Office. Due to the fact that Czech Republic has signed several international and European binding agreements, its internal energy policy is slightly influenced and hence dependant on external conditions.

The aim of this diploma thesis was the examination of wind energy environment in the Czech Republic followed by the economic analysis of investment into concrete wind power plant project. The use and development of wind energy in the Czech Republic is a phenomenon that is hard to be predicable. On one hand, there is the supportive policy stated by Czech government, on the other hand there is the length of bureaucratic processes, regulatory compliance and attitude of public institutions needed for realization of any wind power plant. The real development will be hence strongly determined by political environment. Based on the pre-investment analysis, mainly due to technological and legal factors, the vertical axis wind turbine of 100kW nominal power was selected for the purpose of the investment project. The truth is that this choice makes the realization process itself easier because the Environmental Impact Analysis does not have to be conducted. Based on its results, most of huge wind power plants projects are cancelled. On the other hand, their energy output is enormously higher and thus a way out of selected 100kW power plant. The wind power plant of 100kW nominal power was planned to be built in the year 2013. It would mean that feed-in tariffs guaranteed by Czech Regulatory Office for the year 2013 might be used. Hence the calculations were done with the usage of feed-in tariffs equal to 2.12 CZK/Kwh. The initial investment was 7,000,000 CZK.

The economic analysis was divided into two scenarios of funding. The first variant supposed funding 50% from equity and 50 % from debt. Regarding the economic evaluation, several methods were used however the most appropriate was the Net Present Value one. The negative result of Net Present Value supported by other unsatisfactory results of other dynamic methods meant clear rejection of funding by 50% equity and 50% debt.

Because of the fact that selected wind power plant is considered to be categorized in medium wind turbine groups where the initial investment costs are not in tens of millions, the other variant based on funding 100% form equity was analyzed. The same evaluation methods were calculated, however the results were not favorable again. Even thought that they were better than the first scenario, still the project rejection was the only option.

At last but not least it is necessary to mention that Czech Republic still stays at the wrong end on production of green house gas emissions per capita. The only thing that there is no doubt about is the fact that wind power plants produce no green house gases or fly ash which makes them truly clean source of energy. Unfortunately for the majority of investors in the Czech Republic this positive fact does not represent a decisive criterion.

Finally, what must be pointed out is the fact that the whole economic analysis was based on using the feed-in tariff as a chosen support. It would be interesting to conduct an analysis based on green bonuses for small or medium enterprises that use higher amounts of electricity. The possibility of using generated electricity together with the chance of selling the surplus is a way for possible overhead cost reductions. This might be the future of wider wind energy use.

7 Bibliography

Monographs

BRIGHAM, Eugene and Joel HOUSTON. *Fundamentals of finacial management*. Litten Publishing. 12th edition, c2009. ISBN 978-0-324-59771-4.

BURTON, Tony et al. *Wind energy handbook.* John Wiley and Sons Publishing. 2nd edition, c2001, ISBN 978-0-471-48997-9.

DAYANANDA, Don et al. *Capital Budgeting: Financial Appraisal of Investment Projects*. The University of Cambirdge Press. 1st edition, c2002, ISBN 0-521-81782-X.

DIANE, Claire. *How To Conduct A Feasibility Study For Information Technologies*. Diane Publishing. c1992. ISBN 978-1-122-14465-0.

FABOZZI, Frank and Pamela PETERSON. *Finacial Management and Analysis*. John Wiley and Sons Publishing. 2nd edition, c2003. ISBN 0-471-23484-2.

GELTNER, David. *Commercial Real Estate Analysis & Investments.* West Group Eagan Press. 2nd edition, c2010. ISBN 978-0-324-38214-3.

HILL, Charles and Gareth JONES. *Strategic management*. Houghton Mifflin Publishing. 8th edition, c2008. ISBN 978-0-547-00497-6.

KHATIB, Hisham. *Economic Evaluation of Projects in the Electricity Supply Industry.* The Institution of Engineering and Technology Publishing. 2nd edition, c2003. ISBN 978-0-86341-304-9.

KISLINGEROVÁ, Eva. *Manažerské finance.* C.H. Beck Press. 3rd edition, c2010. ISBN 978-80-7400-194-9.

MACZULAK, Anne. *Renewable energy: sources and methods*. Infobase Publishing. 1st edition, c2010. ISBN 08-160-7203-5.

ROUŠAR, Ivo. *Projektové řízení technologických staveb*. Grada Publishing. 1st edition, c2008. ISBN 978-80-247-2602-1.

SEQUENS, Ethan and Pavel HOLUB. V*ětrné elektrárny: mýty a fakta*. Calla Publishing. 2nd edition, c2006. ISBN 80–86834–09–3.

VALACH, Josef. *Investiční rozhodování a dlouhodobé financování*. Ekopress Publishing. 2nd edition, c2006. ISBN 80-86929-01-9.

Internet sources

ACCOUNTING EXPLAINED. *Profitability index* [online]. c2011 [cited on 20.12.2012]. Available at WWW: http://accountingexplained.com/managerial/capital-budgeting/profitability-index

ANDRES, Ramirez. *The power of wind* [online]. c2013 [cited on 25.2.2013]. Available at WWW: http://www.reuk.co.uk/Calculation-of-Wind-Power.htm

BUSINESS DICTIONARY. *Investment project* [online]. c2013 [cited on 10.2.2013]. Available at WWW: http://www.businessdictionary.com/definition/investment-project.html

BUSINESS FINANCE, *Payback Period in Capital Budgeting* [online]. c2013 [cited on 4.1.2013]. Available at WWW: http://bizfinance.about.com/od/Capital-Budgeting/a/payback-period.htm

BUSINESSINFO. *Vláda schválila energetickou koncepci* [online]. c2012 [cited on 14.1.2013]. Available at WWW: http://www.businessinfo.cz/cs/clanky/vlada-projednala-statni-energetickou-koncepci-25043.html

CENY ENERGIE. *Cena elektřiny: z čeho je složena* [online]. c2013 [cited on 4.3.2013]. Available at WWW: http://www.cenyenergie.cz/elektrina/clanky/cena-elektriny-z-ceho-je-slozena.aspx

CORNELL UNIVERSITY LAW SCHOOL. *Act of Go*, [online]. c2010 [cited on 2.3.2013]. Available at WWW: http://www.law.cornell.edu/wex/act_of_god

DAMODARAN, Aswath. *Updated data* [online]. c2013 [cited on 1.3.2013], Available at WWW: http://pages.stern.nyu.edu/~adamodar/

DODGE, Darrell. *Wind Power's Beginnings*, In: Telosnet [online]. c1996 [cited on 2.3.2013]. Available at WWW: http://www.telosnet.com/wind/early.html

ENERGY REGULATORY OFFICE. *Legislation* [online]. c2013 [cited on 10.3.2013]. Available at WWW: http://eru.cz/dias-browse_articles.php?parentId=134

ENVIRON BUSINESS. *Intorduction to the Kyoto Protocol* [online]. c2006 [cited on 1.3.2013]. Available at WWW: http://www.environbusiness.com/cchange/kyoto.html

EUROPEAN COMMISSION. *What is competition policy* [online]. c2012 [cited on 24.2.2012]. Available at WWW: http://ec.europa.eu/competition/consumers/what_en.html

EUROPEAN ENVIRONMENT AGENCY. *Greenhouse gas emissions per capita and per unit of GDP in purchasing power standards* [online]. c2011 [cited on 13.1.2013], Available at WWW: http://www.eea.europa.eu/data-and-maps/figures/greenhouse-gas-emissions-per-capita-1

HANSLIAN, David. *Malé větrné elektrárny pro lokální aplikace* [online]. c2012 [cited on 7.1.2013], Available at WWW: http://www.energie21.cz/archiv-novinek/Male-vetrne-elektrarny-pro-lokalni-aplikace__s303x58608.html

CHESTNEY, Nina. *Climate negotiating positions of big greenhouse emitters* [online]. c2012 [cited on 1.3.2013]. Available at WWW: http://www.reuters.com/article/2012/11/22/us-climate-talks-emitters-idUSBRE8AL0PO20121122

INVESTOPEDIA. *Weighted Average Cost Of Capital* [online]. c2013 [cited on 8.3.2013]. Available at WWW: http://www.investopedia.com/terms/w/wacc.asp#axzz2MYsaUlRa

KELLY, L., G. HERRMANN and M. HERRMANN. The Journal of Economic Education , Vol. 33, No. 3, [online]. c2002 [cited on 10.1.2013]. Available at WWW: http://www.jstor.org/stable/1183439

MOTLÍK, Jan. et al. *Obnovitelné zdroje a možnosti jejich uplatnění v ČR* [online]. c2007 [cited on 15.2.2013], Available at WWW: http://www.cez.cz/edee/content/file/energie-a-zivotni-prostredi/oze-cr-all-17-01-obalka-in.pdf

MPO. *Státní energetická koncepce* [online]. c2013 [cited on 2.2.2013]. Available at WWW: http://www.mpo.cz/dokument119078.html

OTE. *Main reading* [online]. c2013 [cited on 17.2.2013]. Available at WWW: https://www.ote-cr.cz/about-ote/main-reading

PARLIAMENT OF AUSTRALIA. *United Nations Framework Convention on Climate Change* [online]. c2010 [cited on 3.2.2013]. Available at WWW: http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/Browse_by_Topic/ClimateChange/Governance/International/unfcc

PEAVLER, Rosemary. *Payback Period in Capital Budgeting* [online]. c2013 [cited on 2.2.2013]. Available at WWW: http://bizfinance.about.com/od/Capital-Budgeting/a/payback-period.htm

STEPHENS, Ric. *From NIMBYs To DUDEs*: The Wacky World Of Plannerese [online]. c2005 [cited on 14.2.2013]. Available at WWW: http://www.planetizen.com/node/152

SVAZ PODNIKATELŮ PRO VYUŽITÍ ENERGETICKÝCH ZDROJŮ. *Výpočet výroby elektřiny*, [online]. c2012 [cited on 30.12.2012]. Available at WWW: http://www.spvez.cz/pages/vitr.htm

UNITED NATIONS. *Framework convention on climate change* [online]. c1992 [cited on 12.1.2013], Available at WWW: http://unfccc.int/essential_background/convention/background/items/1349.php

WOLSINK, Maarten. *Wind power implementation: The nature of public attitudes: Equity and fairness instead of 'backyard motives* [online]. c2005 [cited on 15.2.2013]. Available at WWW: http://cvi.se/uploads/pdf/Kunskapsdatabas%20samhalle/tillstandsprovning/opinion%20och%20acceptans/forskningsresultat/The%20nature%20of%20public%20attitudes.pdf

Legal acts

No. 100/2001 Coll. Act of 1 May on assessment of environmental impacts and amending certain acts

No. 165/2012 Coll. Act of 31 May on supported energy sources and amending certain acts

No. 458/2000 Coll. Act of 20 November on conditions of entrepreneurship and about the power of civil service in the field of energy and amending certain acts

Price decision of the Energy Regulatory Office No. 4/2012 of 26th November 2012 on the support for the renewable energy sources

Notice of Ministry of industry and trade of the Czech Republic of 20th December on the reporting and recording of electricity and heat from supported sources and biomethane, number and the quality of actually used resources and on performing other regulation on supported energy act

8 Supplements

Number 1: Installed wind power in Europe

Number 2: EU power mix 2010 and 2012

Number 3: Wind atlas of the Czech Republic

Number 4: Profit and loss account 100% equity

Number 5: Cash flow statement 100% equity

Number 6: WACC 100% equity

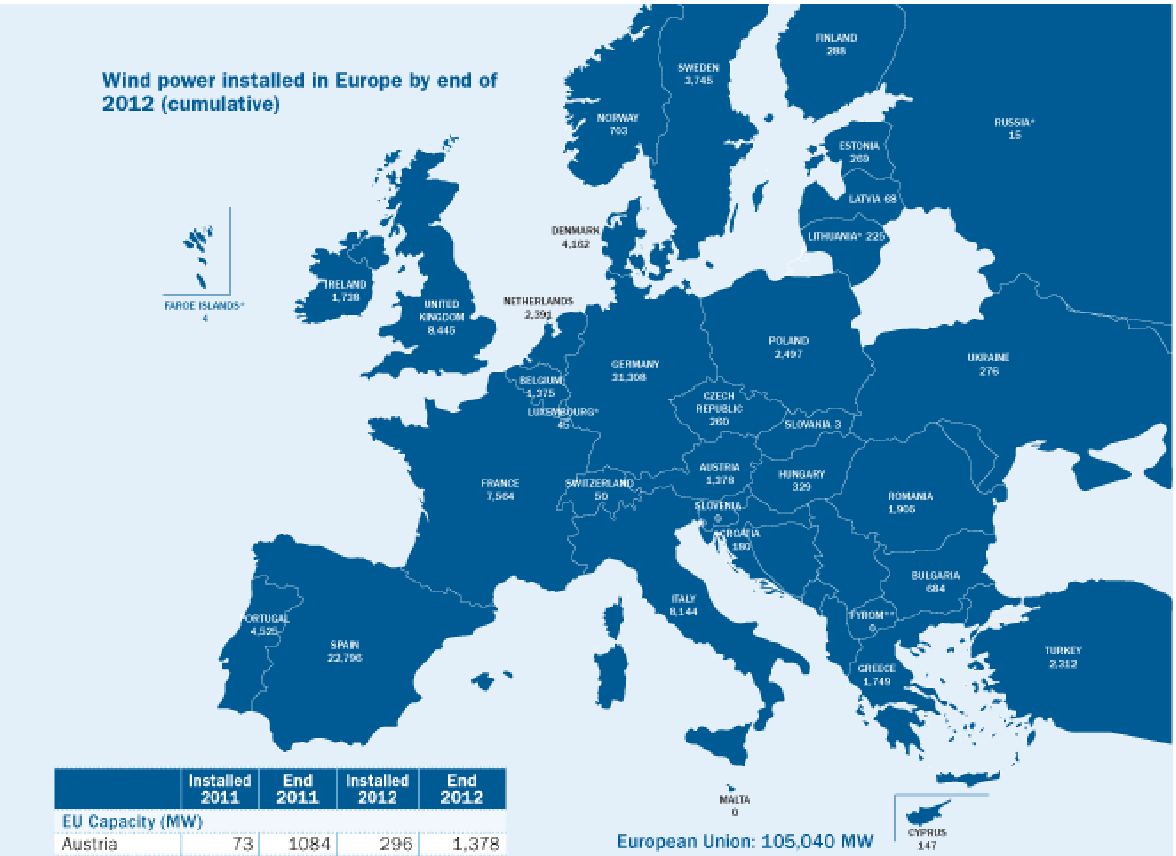
Number 7: Profit and loss account 50% equity, 50% debt

Number 8: Cash flow statement 50% equity, 50% debt

Number 9: WACC 50% equity, 50% debt

Number 10: Bank Loan Payments

Supplement 1: Installed wind power in Europe



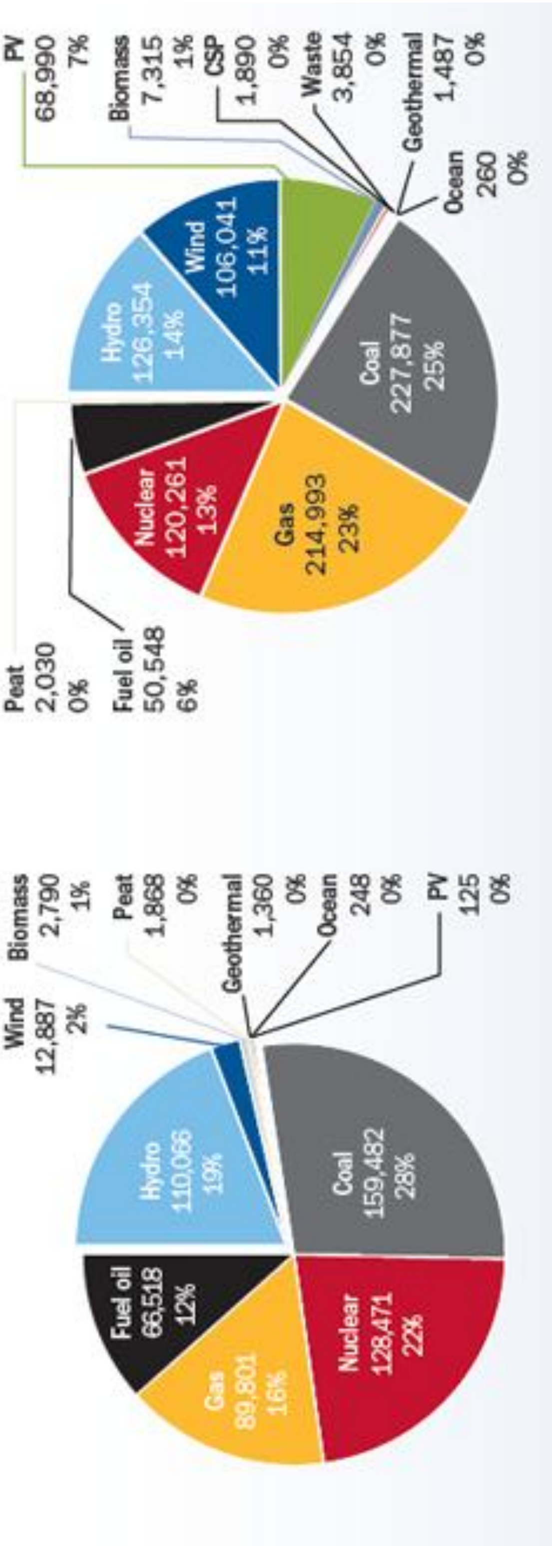
European Union: 105,040 MW
Candidate Countries: 2,492 MW
EFTA: 753 MW
Total Europe: 109,581 MW

	Installed 2011	End 2011	Installed 2012	End 2012
EU Capacity (MW)				
Austria	73	1084	296	1,378
Belgium	191	1,078	297	1,375
Bulgaria	28	516	168	684
Cyprus	52	134	13	147
Czech Republic	2	217	44	260
Denmark	211	3,956	217	4,162
Estonia	35	184	86	269
Finland	2	199	89	288
France	830	6,807	757	7,564
Germany	2,100	29,071	2,415	31,308
Greece	316	1,634	117	1,749
Hungary	34	329	0	329
Ireland	208	1,614	125	1,738
Italy	1,090	6,878	1,273	8,144
Latvia	17	48	21	68
Lithuania*	16	179	46	225
Luxembourg*	1	45	0	45
Malta	0	0	0	0
Netherlands	59	2,272	119	2,391
Poland	436	1,616	880	2,497
Portugal	341	4,379	145	4,525
Romania	520	982	923	1,905
Slovakia	0	3	0	3
Slovenia	0	0	0	0
Spain	1,050	21,674	1,122	22,796
Sweden	754	2,899	846	3,745
United Kingdom	1,298	6,556	1,897	8,445
Total EU-27	**9,664**	**94,352**	**11,895**	**106,040**
Total EU-15	**8,524**	**90,145**	**9,714**	**99,652**
Total EU-12	**1,140**	**4,207**	**2,181**	**6,388**

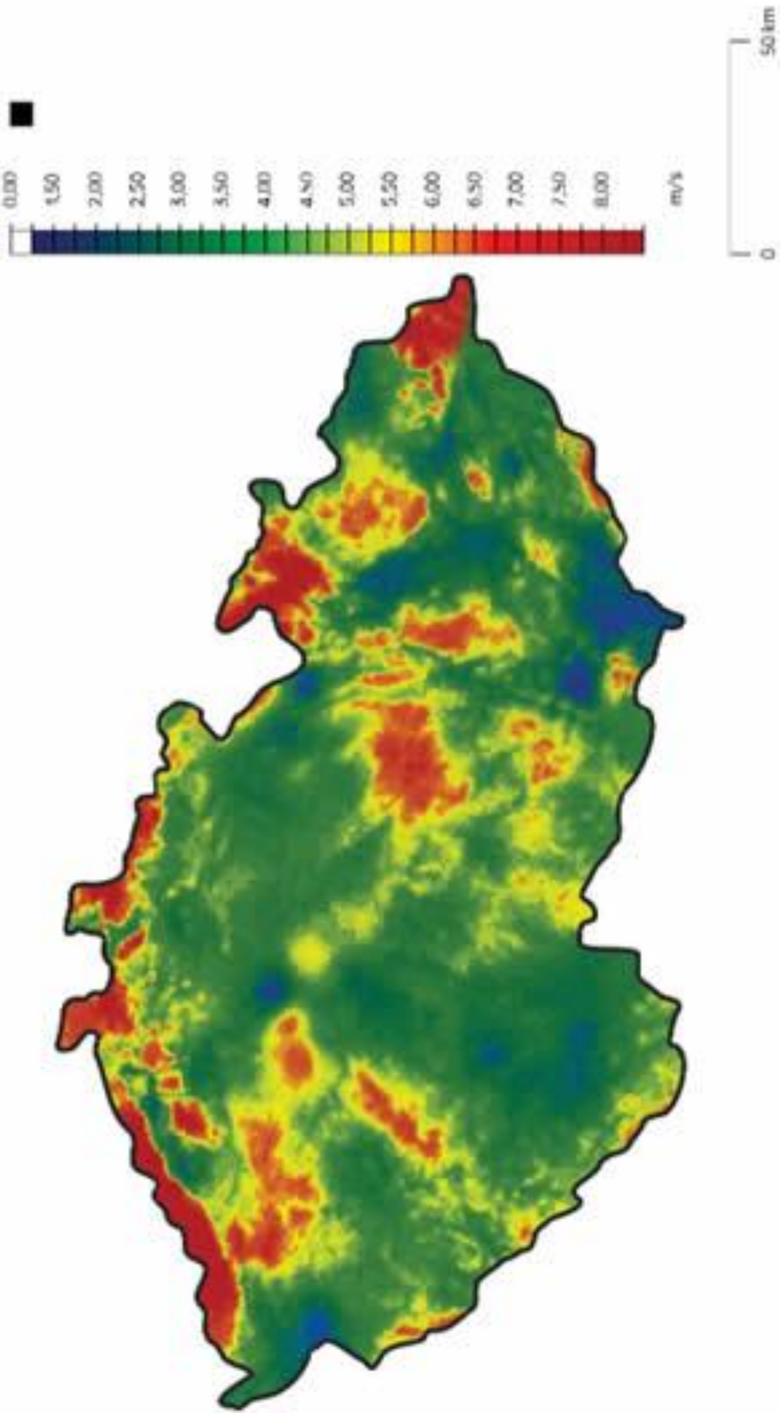
	Installed 2011	End 2011	Installed 2012	End 2012
Candidate Countries (MW)				
Croatia	52	131	48	180
FYROM**	0	0	0	0
Serbia	0	0	0	0
Turkey	477	1,806	506	2,312
Total	**529**	**1,937**	**554**	**2,492**
EFTA (MW)				
Iceland	0	0	0	0
Liechtenstein	0	0	0	0
Norway	99	537	166	703
Switzerland	3	46	4	50
Total	**88**	**583**	**170**	**753**
Other (MW)				
Faroe Islands*	0	4	0	4
Ukraine	66	151	125	276
Russia*	0	15	0	15
Total	**66**	**171**	**125**	**296**
Total Europe	**10,361**	**97,043**	**12,744**	**109,581**

* Provisional data or estimate.
** Former Yugoslav Republic of Macedonia
Note: due to previous year adjustments, 207 MW of project de-commissioning, re-powering and rounding of figures, the total 2012 end-of-year cumulative capacity is not exactly equivalent to the sum of the 2011 end-of-year total plus the 2012 additions.

Supplement 2: EU power mix 2010 and 2012



Supplement 3: Wind atlas of the Czech Republic



Supplement 4: Profit and Loss Account: 100% equity

Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Feed-in-tariff (CZK/kWh)	2.12	2.16	2.21	2.25	2.29	2.34	2.39	2.44	2.48	2.53	2.58	2.64	2.69	2.74	2.80	2.85	2.91	2.97	3.03	3.09
Indexation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Performance degradation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Theoretical annual production (kW)	87,500	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000
Recalculated annual production	87,500	171,500	168,070	164,709	161,414	158,186	155,022	151,922	148,884	145,906	142,988	140,128	137,325	134,579	131,887	129,250	126,665	124,131	121,649	119,216
Revenues	185,500	370,852	370,703	370,555	370,407	370,259	370,110	369,962	369,814	369,667	369,519	369,371	369,223	369,075	368,928	368,780	368,633	368,485	368,338	1,868,191
Revenue taxation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Land levy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gear box replacement reserve	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	427,500	0	0	0	0
Maintenance	0	0	0	0	0	(14000)	(14140)	(14281)	(14424)	(14568)	(14714)	(14861)	(15010)	(15160)	(15312)	(15465)	(15619)	(15776)	(15933)	(16093)
Other operating costs	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700
EBITDA	139,300	324,652	324,503	324,355	324,207	324,059	323,910	323,762	323,614	323,467	323,319	323,171	323,023	322,875	322,728	351,080	350,933	350,785	350,638	1,850,491
Depreciation	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)
EBIT	6,000	5,352	5,203	5,055	4,907	4,759	4,610	4,462	4,314	4,167	4,019	3,871	3,723	3,575	3,428	31,780	31,633	31,485	31,338	1,531,191
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-tax profit	6,000	5,352	5,203	5,055	4,907	4,759	4,610	4,462	4,314	4,167	4,019	3,871	3,723	3,575	3,428	31,780	31,633	31,485	31,338	1531191
Tax rate	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Taxes	900	803	780	758	736	714	692	669	647	625	603	581	558	536	514	4,767	4,745	4,723	4,701	229,679
Net profit	5,100	4,549	4,423	4,297	4,171	4,045	3,919	3,793	3,667	3,542	3,416	3,290	3,165	3,039	2,914	27,013	26,888	26,762	26,637	1,301,512

Supplement 5: Cash Flow Statement: 100% equity

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
EBITDA	139,300	324,652	324,503	324,355	324,207	324,059	323,910	323,762	323,614	323,467	323,319	323,171	323,023	322,875	322,728	351,080	350,933	350,785	350,638	1,850,491
Taxes	900	803	780	758	736	714	692	669	647	625	603	581	558	536	514	4,767	4,745	4,723	4,701	229,679
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating cash flow	138,400	323,849	323,723	323,597	323,471	323,345	323,219	323,093	322,967	322,842	322,716	322,590	322,465	322,339	322,214	346,313	346,188	346,062	345,937	1,620,812

Supplement 6: WACC 100% equity

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Cash flows	138,400	323,849	323,723	323,597	323,471	323,345	323,219	323,093	322,967	322,842	322,716	322,590	322,465	322,339	322,214	346,313	346,188	346,062	345,937	1,620,812
WACC	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899
1+WACC	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899	1.0899
$(1+WACC)^n$	1.0899	1.1878	1.2947	1.4111	1.5379	1.6762	1.8269	1,9911	2.1701	2.3652	2.5779	2.8096	3.0622	3.3374	3.6375	3.9645	4.3201	4.7093	5.1327	5.5941
$CF/(1+WACC)^n$	126,984	272,646	250,037	229,322	210,333	192,903	176,922	162,269	148,826	136,497	125,186	114,817	105,305	96,584	88,581	87,354	80,134	73,485	67,399	289,736

Supplement 7: Profit and loss account: 50% equity, 50% debt

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Feed-in-tariff (CZK/kWh)	2.12	2.16	2.21	2.25	2.29	2.34	2.39	2.44	2.48	2.53	2.58	2.64	2.69	2.74	2.80	2.85	2.91	2.97	3.03	3.09
Indexation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Performance degradation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Theoretical annual production kW	87,500	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000
Recalculated annual production	87,500	171,500	168,070	164,709	161,414	158,186	155,022	151,922	148,884	145,906	142,988	140,128	137,325	134,579	131,887	129,250	126,665	124,131	121,649	119,216
Revenues	185,500	37,0852	370,703	370,555	370,407	370,259	370,110	369,962	369,814	369,667	369,519	369,371	369,223	369,075	368,928	368,780	368,633	368,485	368,338	1,868,191
Revenue taxation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Land levy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gear box replacement reserve	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	42,7500	0	0	0	0
Maintenance (ths)	0	0	0	0	0	(14,000)	(14,140)	(14,281)	(14,424)	(14,568)	(14,714)	(14,861)	(15,010)	(15,160)	(15,312)	(15,465)	(15,619)	(15,776)	(15,933)	(16,093)
Other operating costs	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700	17,700
EBITDA	139,300	324,652	324,503	324,355	324,207	324,059	323,910	323,762	323,614	323,467	323,319	323,171	323,023	322,875	322,728	351,080	350,933	350,785	350,638	1,850,491
Depreciation	(133,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)	(319,300)
EBIT	6,000	5,352	5,203	5,055	4,907	4,759	4,610	4,462	4,314	4,167	4,019	3,871	3,723	3,575	3,428	31,780	31,633	31,485	31,338	1,531,191
Interest	186,550	178,117	169,235	159,880	150,026	139,646	128,713	117,198	105,069	92,293	78,837	64,663	49,734	34,009	17,446	0	0	0	0	0
Pre-tax profit	(180,550)	(172,766)	(164,032)	(154,825)	(145,119)	(134,888)	(124,103)	(112,736)	(100,755)	(88,127)	(74,818)	(60,792)	(46,011)	(30,434)	(14,018)	31,780	31,633	31,485	31,338	1,531,191
Tax rate	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Taxes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,767	4,745	4,723	4,701	2,296,79
Net profit	(180,550)	(172,766)	(164,032)	(154,825)	(145,119)	(134,888)	(124,103)	(112,736)	(100,755)	(88,127)	(74,818)	(60,792)	(46,011)	(30,434)	(14,018)	36,547	36,378	36,208	36,039	1,760,870

Supplement 8: Cash Flow Statement: 50% equity, 50% debt

Cash flow statement	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
EBITDA	6,000	5,352	5,203	5,055	4,907	4,759	4,610	4,462	4,314	4,167	4,019	3,871	3,723	3,575	3,428	31,780	31,633	31,485	31,338	1,531,191
Taxes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,767	47,45	4,723	4,701	229,679
Interest	186,550	178,117	169,235	159,880	150,026	139,646	128,713	117,198	105,069	92,293	78,837	64,663	49,734	34,009	17,446	0	0	0	0	0
Operating cash flow	(233,800)	(31,583)	(13,967)	4,595	24,155	44,766	66,484	89,366	113,476	138,880	165,645	193,845	223,555	254,857	287,836	355,847	355,678	3555,08	355,339	2,080,170

Supplement 9: WACC 50% equity, 50% debt

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
WACC	0.0675	0.0686	0.0697	0.0708	0.0720	0.0732	0.0746	0.0760	0.0774	0.0790	0.0806	0.0823	0.0841	0.0860	0.0880	0.0899	0.0899	0.0899	0.0899	0.0899
1+WACC	1.0675	1.0686	1.0697	1.0708	1.0720	1.0732	1.0746	1.0760	1.0774	1.0790	1.0806	1.0823	1.0841	1.0860	1.0880	1.0899	1.0899	1.0899	1.0899	1.0899
$(1+WACC)^n$	1.0675	1.1419	1.2239	1.3147	1.4157	1.5283	1.6544	1.7963	1.9565	2.1384	2.3458	2.5836	2.8574	3.1746	3.5443	3.9124	4.2606	4.6398	5.0528	5.5025
Cash flow	(233,800)	(31,583)	(13,967)	4,595	24,155	44,766	66,484	89,366	113,476	138,880	165,645	193,845	223,555	254,857	287,836	355,847	355,678	355,508	355,339	2,080,170
$CF/(1+WACC)^n$	(219,022)	(27,658)	(11,412)	3,495	17,063	29,292	40,186	49,751	57,999	64,945	70,612	75,031	78,237	80,279	81,212	90,953	83,480	76,621	70,325	378,041

Supplement 10: Bank Loan Payments

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Debt B-o-Y	3,500,000	3,341,789	3,175,145	2,999,619	2,814,738	2,620,002	2,414,887	2,198,839	1,971,277	1,731,584	1,479,117	1,213,193	933,095	638,067	327,315
Interest	186,550	178,117	169,235	159,880	150,026	139,646	128,713	117,198	105,069	92,293	78,837	64,663	49,734	34,009	17,446
Yearly payment	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761	344,761
Yearly repayment	158,211	166,644	175,526	184,881	194,736	205,115	216,048	227,563	239,692	252,468	265,924	280,098	295,027	310,752	327,315
Debt E-o-Y	3,341,789	3,175,145	2,999,619	2,814,738	2,620,002	2,414,887	2,198,839	1,971,277	1,731,584	1,479,117	1,213,193	933,095	638,067	327,315	0

9 List of tables/graphs/charts

<u>Tables</u>

<u>Graphs</u>

<u>Charts</u>