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Investments in Wind Power - Profitability Analysis of the NBT II Windmill Park in Sindh, Pakistan

Investeringer i vindkraft - Lønnsomhetsanalyse av NBT II vindpark i Sindh, Pakistan

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Executive Summary

This paper investigates the profitability of the NBT II windmill farm in Sindh, Pakistan and the possible financial outcomes of the investment. Wind power investments are characterized by high initial capital expenditure and low operating costs. In recent years, the average construction cost of wind farms has decreased, which improves the competitiveness for wind-generated energy compared to conventional fuels.

There is a substantial shortage of electrical power in Pakistan and this attracts investors to investigate the opportunities for building more production capacity. This paper makes a thorough analysis of the investment environment in Pakistan and its current energy shortage. There are three stages of the analysis,

- Benchmark of the net present value
- Sensitivity analysis
- Monte Carlo simulation

The required real rate of return on the investment is estimated to be 9,2%, given the risk involved in the project. This provides a static NPV of approximately 100 MUSD, while the internal rate of return is 12%. The sensitivity analysis identifies the availability of wind as one of the key drivers on the NPV. Wind statistics is used as the input in the Monte Carlo simulation of income revenue. The mean of estimated wind is 723,8 GWh/annum with a standard deviation of 105,7 GWh/annum. The outcome of 1000 simulations shows an average NPV of 66,2 MUSD and a standard deviation of 19 MUSD. The assessment provides an illustration of the need for a set tariff prior to the investment decision in order to deal with the high uncertainties and risks of the investment. One of the main risks is political risk; that the Government of Pakistan discriminates foreign investors by changing regulations or contracts governing the investment. According to today's regulations and market, with high subsidies through favorable tax breaks and prices, the wind farm investment appears profitable.

Sammendrag

Denne masteroppgaven skal analysere lønnsomheten av NBT II vindmøllepark i Sindh, Pakistan, og de potensielle økonomiske utfallene av en slik investering. Vindkraftinvesteringer er preget av krav til høy startkapital og lave driftskostnader. Gjennomsnitts kostnaden for å utvikle en vindmøllepark har sunket de siste årene. Dette forbedrer konkurranseevnen for vindenergi sammenlignet med konvensjonelt drivstoff, som olje, gass og kull.
Det er betydelig mangel på elektrisitet i Pakistan og det tiltrekker seg investorer til å undersøke mulighetene for investeringer i produksjonskapasiteten. Denne oppgaven gjennomfører en grundig analyse av investeringsprofilen i Pakistan og den nåværende energimangel. Lønnsomhetsanalysen består av tre deler;

- Referanse utfallet av netto nåverdi
- Følsomhetsanalyse
- Monte Carlo simulering

Den anvendte realavkastnings kravet for investeringen er beregnet til 9,2%, gitt risikoen i prosjektet. Dette gir en statisk nåverdi på rundt 100 MUSD, og en internrenten på 12%. Sensitivitetsanalysen identifiserer årlig vind forutsetninger som en av hoved driverne av nåverdien, og på grunn av dette funnet er denne parameteren brukt i Monte Carlo simuleringen. Gjennomsnittet av estimert vind gir en kraftproduksjon på 723,8 GWh/år med et standardavvik på 105,7 GWh/år. Utfallet etter 1000 simuleringer viser en netto nåverdi på gjennomsnittlig 66,2 MUSD og et standardavvik på 19 MUSD. Vurderingene viser at for å redusere en høy risiko i prosjektet og gjøre investering i vind kraft attraktivt for en investor, er offentlige subsidier nødvendig. En av de viktigste risikoene er politisk risiko, spesielt rettet mot risikoen for at den Pakistanske staten diskriminerer utenlandske investorer og ikke møter sine kontrakts satte forpliktelser. I tillegg kommer en kommersielle risiko som særlig er basert på kapasitet i overføringsnettet. Ut i fra dagens regelverk og behovet for kraft i markedet er konklusjonen at dette ser ut til å være et lønnsomt prosjekt.

Acknowledgements

This thesis is a part of the two-year Master of Science in Economics and Business at the Norwegian University of Life Sciences. With my major in finance and minor in energy economics as a basis, I have chosen to write a thesis that includes both topics. In addition, I am keenly interested in the development of renewable energy in the world and think it is an important topic to address.

The thesis could not have been possible without help from several people. I would like to thank Ole Gjølberg at Handelshøyskolen, NMBU, as my thesis guidance counselor. Faisal Mirza and Olvar Bergland for their input on Pakistan. Kyrre Lund for providing the data needed from NBT AS in the analysis and his guidance on the paper. Einar Stenstadvold at SNPower for valuable input on wind energy projects.

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Marie Tørvold

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Introduction

This thesis presents methods and problems related to evaluations of investments in wind power. Specifically, I will assess the profitability of the Norwegian Building Technology (NBT) AS windmill project in Sindh, Pakistan. In June 2013, the Islamic Republic of Pakistan (population around 185 million, area 796 096 km^2, in 2014[1]) had an energy demand for 16 400 MW and a supply of 12 150 MW resulting in 4250 MW shortage of electricity capacity per day (Nawaz et al. 2014). This leads to load shedding and blackouts in the major cities for up to 14 hours, no electricity supply in some of the rural areas and brownouts affecting machines for manufacturing. Hence, the shortage of electrical power is a major hindrance for the development of Pakistan. Due to the issue at hand, the National Energy Power Regulatory Authority (NEPRA) has implemented a tariff system for wind power with tax as a pass-through item. The goal for the government is to increase the market share of renewable energy in the power generation (Government of Pakistan 2006). One main target group is international investors with foreign direct investments.

NBT AS develops wind farms and in their investment portfolio, they have three operating developments in China. The NBT project in Pakistan is a wind farm with an installed capacity of 500 MW. The project is divided into two subprojects since the legislation of Pakistan has a size limit of 250MW per project. The NBT II project, officially named NBT Wind Power Pakistan II (Private) Ltd, consists of two partners, NBT AS and Harbin Electric. NBT AS has Norwegian shareholding while the Chinese regional government in Harbin controls Harbin Electric. In this thesis, I will analyze the economic profitability of the NBT II project, with the use of net present valuation, sensitivity analysis and Monte Carlo Simulations. The identification of key parameters such as tariff, wind, operations and maintenance, lifetime and capital costs will help assess the profitability of the NBT II project. In addition, I will present the different types of risks influencing the key parameters and how to account for the risk involved. I will not discuss the different options for financing or the social economic aspect of the project. Neither will I cover the engineering solutions for the optimal distribution of the windmills.

[1] Based on data from the World Bank.

Initially, I will look at the risk involved in the project in Pakistan. This is in order to assess the possibilities for reaching the required rate of return of the project. Then I will address the main drivers through a sensitivity analysis. Lastly, I will determine the probability of profitability in the investment through Monte Carlo Simulations.

Structure of the thesis:
I will first introduce the energy market in Pakistan and background for the NBT II project in Sindh. This will provide a picture of the specific project and the impact of a number of risk factors. Further, I present the methodology and tools needed in a profitability analysis. This includes the net present value (NPV), sensitivity analysis, Monte Carlo simulation and the political mechanisms behind an upfront tariff. There are several other studies done on the profitability of wind farms using different techniques, and some of these are presented in the literature section. There are, in addition, articles that discuss the calculation of discount rates and the impact of choice of energy investments in Pakistan. Following this, I will discuss the validity of the data collected. Then I present the results from the mentioned methods and tools, and discuss the results and the shortcomings in the assessment. That section also describes possibilities for further analysis on the topic.
I will summarize and conclude the investment profile and probability for a financially sound project by assessing all parameters together.

The NBT II Project

In this chapter I provide background about the general investment profile of Pakistan and specific issues related to the NBT II project.

The energy market and investment environment in Pakistan and its challenges

Pakistan is a country with many challenges that so far has prohibited a high GDP growth. One major challenge is the energy supply and structure of the electric power sector. Another is the economic condition in the country considering growth and inflation, which leads to political and environmental instability.

Currently the energy sector in Pakistan cannot meet the increasing demand for electricity. Pakistan is mainly dependent on conventional fuels such as natural gas (48,22%) and oil (32,47%), the market prices for these fuel inputs have a high influence on the electricity prices (Khan & Mirza 2005). The import of petroleum products such as heating oil, light diesel oil, high speed diesel oil and motor spirits has increased over the past years (National Electric Power Regulatory Authority 2014b). The reason is probably due to the increase of privately owned and relative small local generators.

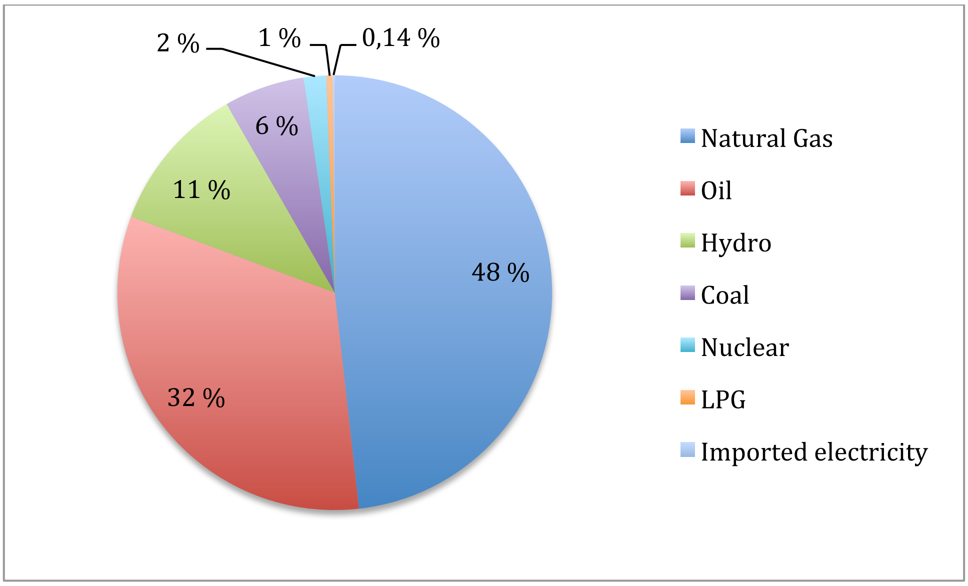

Figure 1: Primary energy supplies in the fiscal year 2012-2013 in Pakistan. Source: NEPRA, State of the Industry Report 2014

The energy shortage and load shedding hurt industrial, commercial and human needs. In addition, the energy shortage is one of the factors leading to a slow GDP growth in Pakistan. Even though textile industry has driven some growth, there has been a decline of output in 2013/2014 in the energy intensive sector due to power shortage (The World Bank Group 2014). There is a causal relationship between the energy consumption and real output in Pakistan in the manufacturing and service sectors (Tang & Shahbaz 2013). This implies that energy conserving measures such as a price increase, will reduce the long term economic growth of the country, while energy efficient policies will improve the growth (Mirza et al. 2014). Further, the impact of energy policy and a rational tariff system will help the energy sector to meet the demand from the producers (Jamil & Ahmad 2010). Another issue in the energy sector is the difficulty of collecting the payment for energy. The distribution companies (DISCOs) failed to collect 11% of all bills in 2013, which amounts to nearly 1 billion USD (The World Bank Group 2014). The issue of uncollected bills creates circular debt and illiquidity in production. In addition, this prevents the energy producers from paying for the input (fuel) in production and prohibits them from full operation of the utility (Islamabad Chamber of Commerce and Industry 2012).

The energy sector in Pakistan conducted several reforms at the beginning of the 1990s in order to address the challenge of the publicly owned utilities. The reforms included unbundling of the sector by moving from publicly owned to a mixed model with independent power producers and publicly owned companies (Parish 2006). The federal administrator is the Ministry of Water and Power. They regulate the energy sector through divisions such as Water and Power Development Authority (WAPDA), National Transmission and Despatch Company (NTDC), Private Power and Infrastructure Board (PPIB) and the Alternative Energy Development Board (AEDB). WAPDA collects the monthly electrical bills through local DISCOs such as Islamabad Electric Supply Company (IESCO). The NTDC acts as a state monopolist by purchasing electricity from the generation companies (GENCOs) and sell it to the DISCOs. The PPIB encourage investments from the private sector, and the AEDB supports research and development within renewable energy. The regulatory oversight is NEPRA. They determine the tariffs on electricity for the different consumer groups and the upfront tariff for renewable energy.

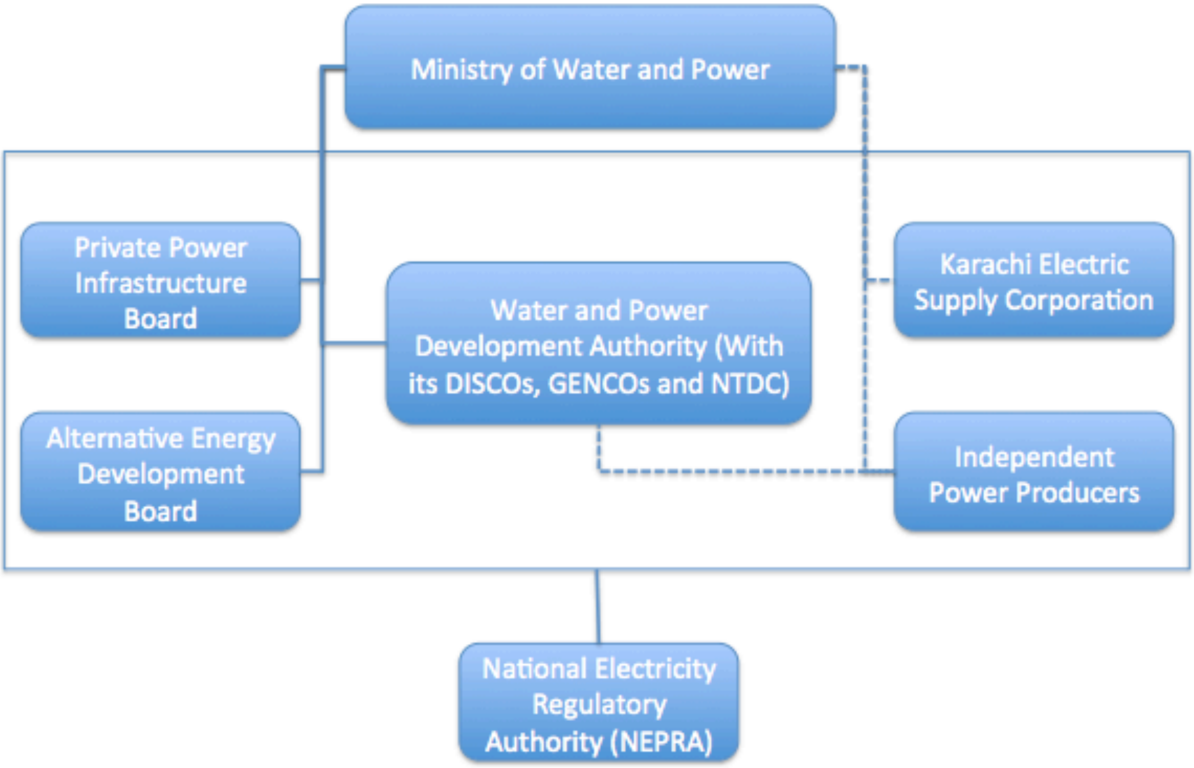

Figure 2: Overview of the energy sector in Pakistan. Source: Islamabad Chamber of Commerce and Industries

In order to reach a sustainable production of energy, the Government created AEDB in 2003. The goal is to achieve 9 700 MW energy production with small hydropower-, solar- and wind installations by 2030. Apart from the obvious environmental benefits which will not be addressed in this thesis, the main benefit of investing in wind power is the reduction of exposure to fuel price volatility (Morthorts & Awerbuch 2009). Another positive effect of implementing renewable energy sources in Pakistan is that the country has a substantial energy production based on natural gas. This type of electricity source is highly compatible to the fluctuations in renewable energy production (Lee et al. 2012). Natural gas plants have start-up rates below one hour while coal power plants range from 8-48 hours. This makes it easier to adjust the electricity production to fluctuations in the wind power, and reduce the cost of balancing supply and demand on short notice (Macmillan et al. 2013). However, a challenging aspect of wind energy is the fluctuation in wind speed resulting in highly variable production of electricity extracted from wind. This variation provides a strain on the transmission network in the country of implementation. As an illustration of changes in production, figure 3 presents the changes in Denmark's energy generation from wind throughout 1 month.

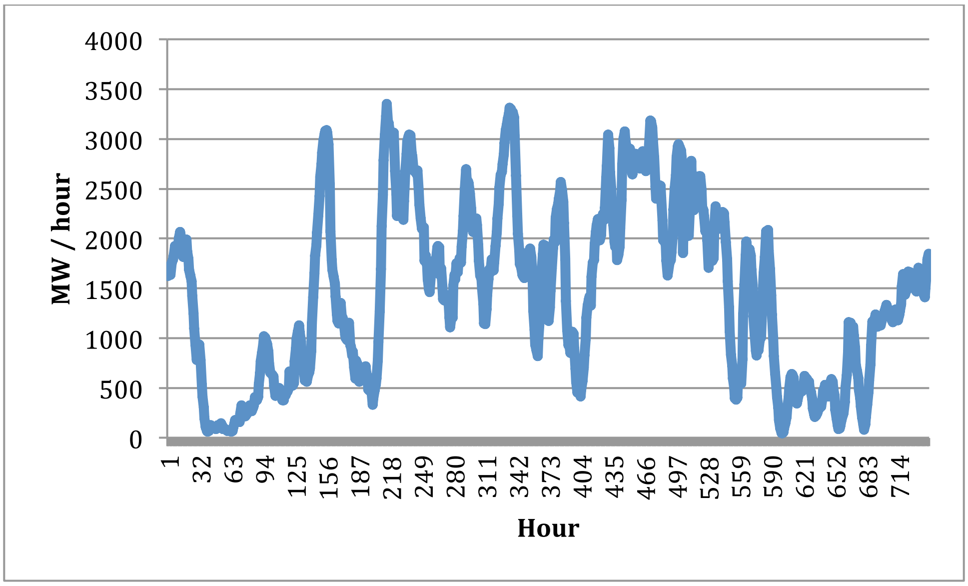

Figure 3: Changes in hourly production of electricity in DK1 area in Denmark, December 2014. Source: Nordpoolspot.com

There is focus on development and investment in other energy sources such as nuclear power, gas pipelines, hydropower and solar power in order to meet the increasing energy demand. Nuclear power is difficult to exploit due to the Nuclear Non-Proliferation Treaty (NPT), which prohibits Pakistan from importing nuclear supplies and technology. NPT member countries are unwilling to cooperate with Pakistan to further expand the sector due to their nuclear weapons (Harijan et al. 2011). However, the Karachi Nuclear Power Complex is currently being rehabilitated with Chinese investors and inspected by the International Atomic Energy Agency (IAEA). These investments are under discussion due to Chinas membership in the Nuclear Suppliers Group (World Nuclear Association 2015). There are talks of creating a gas pipeline between Iran and Pakistan, but development is delayed due to geopolitical concerns (U.S. Energy Information Administration 2014). In addition, there are ongoing discussions for construction of a gas pipeline between Russia and Pakistan. Further, there are hydropower plants in the northern region, and possibilities for expanding these. Further construction and operation is limited due to severe political instability and environmental challenges in the area. NEPRA supports development of solar power in much the same sense as wind power, and projects are under construction. Pakistan has other natural resources that they can exploit such as coal and shale gas. These resources are difficult to extract with optimum utilization due to limited financial resources, technology and location of the resource.

The national economic conditions improved during 2013/14, however it was significantly impacted by political events and natural disasters (The World Bank Group 2014). The International Monetary Fund (IMF) entered with an Extended Fund Facility (EFF) program, approved September 2013, in order to strengthen the cash reserve position. With the improvement of the confidence in business, Pakistan faced a four percent growth recovery.

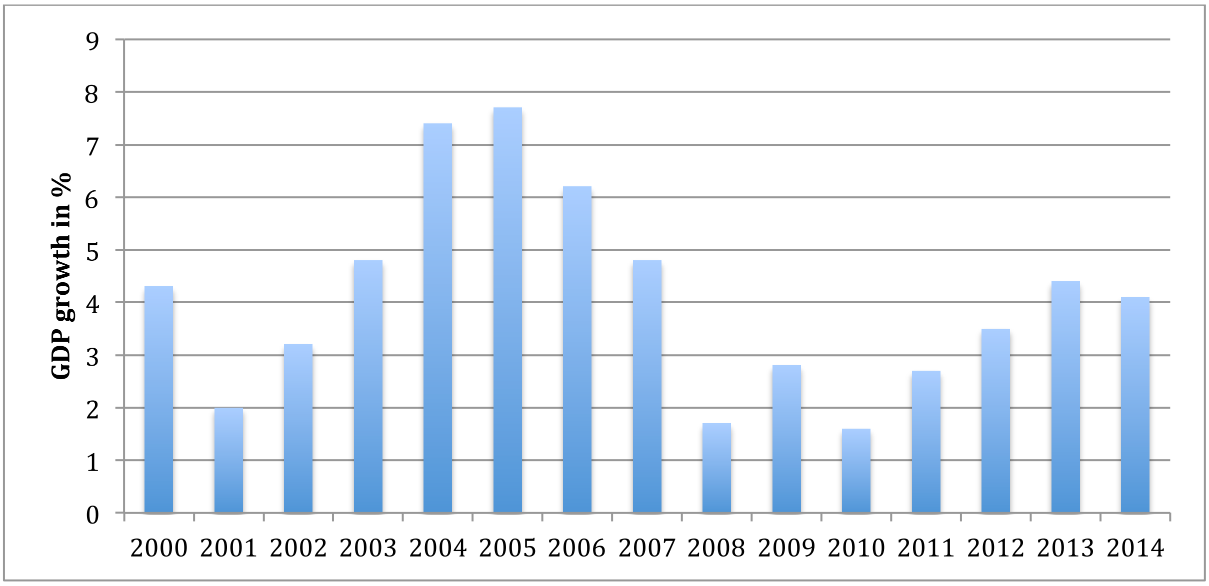

Figure 4: GDP Growth in Pakistan 2000-2014. Source: World Bank

The growth was mainly driven by higher investments in the manufacturing and service industry. The economic landscape presents large state owned enterprises (SOEs) covering around one third of the market capitalization. Several of the SOEs are burdens on the economic sector due to large financial losses: creating constraints on the private sector. The ease of doing business according to the World Bank in 2015, placed Pakistan 128th of 189 economies (World Bank 2014). If the SOE's improve productivity and efficiency this may have a positive impact on the low ranking.

The country is politically unstable and there is a severe risk for political violence that affects the investment environment negatively. The political parties are polarized and the military has a history of intervening during times with instability (BBC 2015). In mid-August, 2014 there was a 3-week long sit-down action in Islamabad lead by the third biggest political party in Pakistan. The sit-down greatly weakened the government and believed to reduce the efficiency of decision making (Malik 2015). This, together with terrorist attacks, highly influences the stability in the country and the attractiveness of foreign direct investments. Corruption is a significant risk in Pakistan, which ranks 126th of 175 countries on the Transparency International's 2014 Corruption Perception Index (Transparency International 2014). However, there are regional differences where the province of Sindh, also called the breadbasket of Pakistan, is viewed as one of the areas where improved government structures and implementations of good governance strategies are fairly well developed (The World Bank Group 2014).

Project progress and description

Established in 2004, NBT has since then built four renewable energy sites in Northern China. The projects are one wind farm in Baicheng and two in Datang. In addition, they have constructed a biomass power plant in Lishu. The windmill farm in the province of Sindh, Pakistan, is a new market for the company. Each project is individually organized with separate management, financial and legal structure. The project in Pakistan started in 2011 with initial contact with the government. Wind occurs since the sun heats differently on the surface and creates pressure differences between areas. The result of a pressure difference and the low elevation in the area makes Sindh, and the Gharo-Keti Bandar Wind Corridor, a good location to build wind farms, as seen in figure 5. The elevation varies between 60m and 100m, while 3 km west of the site there are a number of elongated ridges (Project Manager 2015).

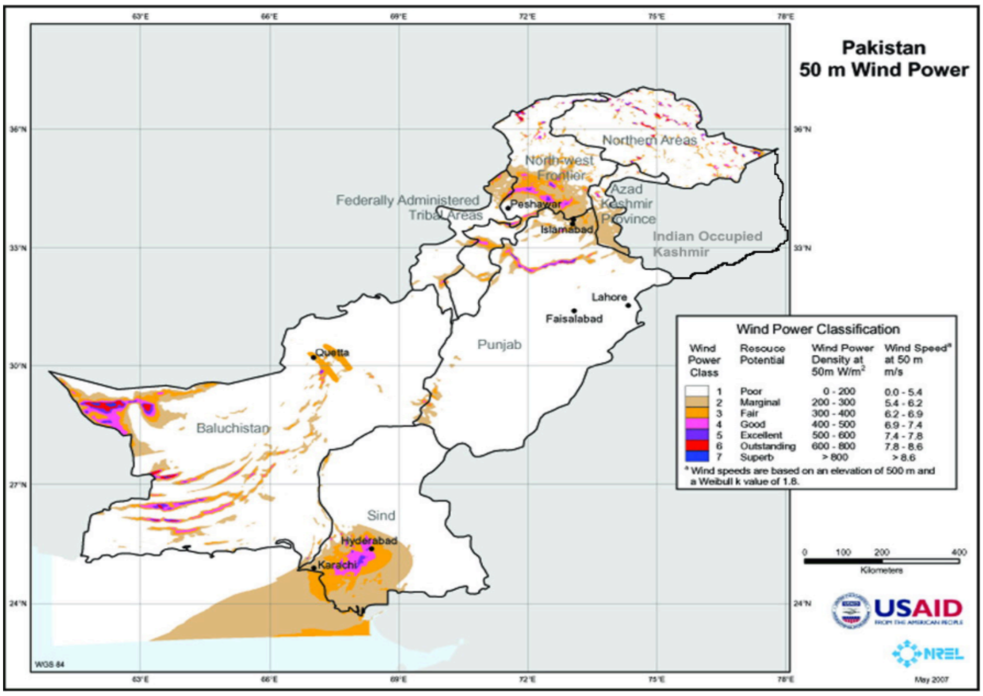

Figure 5: Map with wind estimates in Pakistan. Source: USAid

The local Sindh Province Authority granted NBT AS land approximately 110 km northeast of Karachi. The site is located close to Karachi-Hyperbad Motorway (M-9) and is 13 km away from Jamshoro 132kv, 220kv and 500kva grid. This provides NBT with lower investment costs for logistics to the wind farm and efficient connection to national power grids.

Figure 6: The location of the NBT II wind project and Jamshoro grid connection. Source: Google Maps

Initially, NBT entered a partner agreement with Malakoff, Malaysia. However, Malakoff had an early exit option and new partners were included namely Harbin Electric International (HEI) and China Energine International, both Chinese state owned enterprises.

The NBT II and NBT III projects consist of 249.6MW and 250MW, respectably[2]. NBT AS is co-owner, but has full project responsibility. HEI and NBT entered an Engineering, Procurement, Construction (EPC) contract on May 14th, 2013. The contract was entered with GE-HE Wind Energy (Shengyang) windmills. The GE1.6-82.5 turbines are well suited for high-energy capture in low-medium wind speed environments (General Electric Company 2012). The EPC entails a fixed, all-inclusive, price for the 156 windmills with finished construction and liquidity damages on the construction of the farm. Most of the upfront costs for windmill investments entails cost of turbine, foundations, electrical equipment and grid connection(Morthorts & Awerbuch 2009). Other costs are linked to jurisdiction, institutional settings and regulatory administration. These costs are needed even if the development of the wind farm is discarded. The windmills are

[2] See Appendix 1 for map over construction site and distribution of the windmills.

tax exempted for both export tax in China and import tax to Pakistan. At full production capacity the GE1.6 windmills produce 1600 kW (1,6 MW).

$$1{,}6\ MW * 156\ windmills = 249{,}6\ MW$$

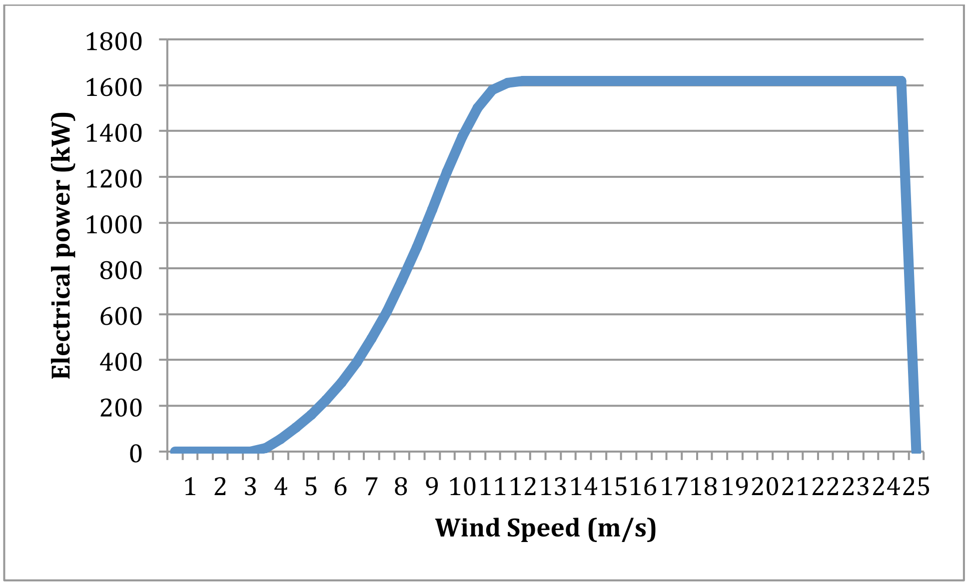

Figure 7: Power curve for GE1.6-82.5 turbines provided at site. Illustrating the kW production output according to wind speed. Source: GE Webpage

Table 1: Technological specifics on the GE1.6-82.5 wind turbines. Source: GE webpage

Rotor Diameter	**82,5 m**
Hub height	80 m
Rotor speed	9-18 rpm (rotations per minute)
Cut-out ten-minute wind speed	25 m/s
Classification	IEC II

The diameter of the rotor is large and the speed is adjusted by rotations of the blades in accordance to wind direction, this accommodates the wind estimates in the area. While the cut-out wind speed describe when the windmill will stop producing due to high winds (Morthorts & Awerbuch 2009). The standard classification is IEC II, which is meant for medium wind.

Currently the project is waiting for financial close, and the initial aim was to reach this by March 31st, 2015. If they do not reach this by then there might be a change of the tariff and the capacity level. This is a risk that needs to be accounted for in further analysis. NBT and the partners fund approximately 25% of the project, while China Development Bank (CDB), Industrial and Commercial Bank of

China and Bank of China supplies 75% to the project with syndicated loan. Investment within wind power demands high upfront costs, on average about 75%-80% of the total cost of energy (Morthorts & Awerbuch 2009). This implies that the banks cover most of the initial investment costs that accelerates the project process. The cash is available and the construction contract is set, hence the project is ready for launch when reaching the financial close.

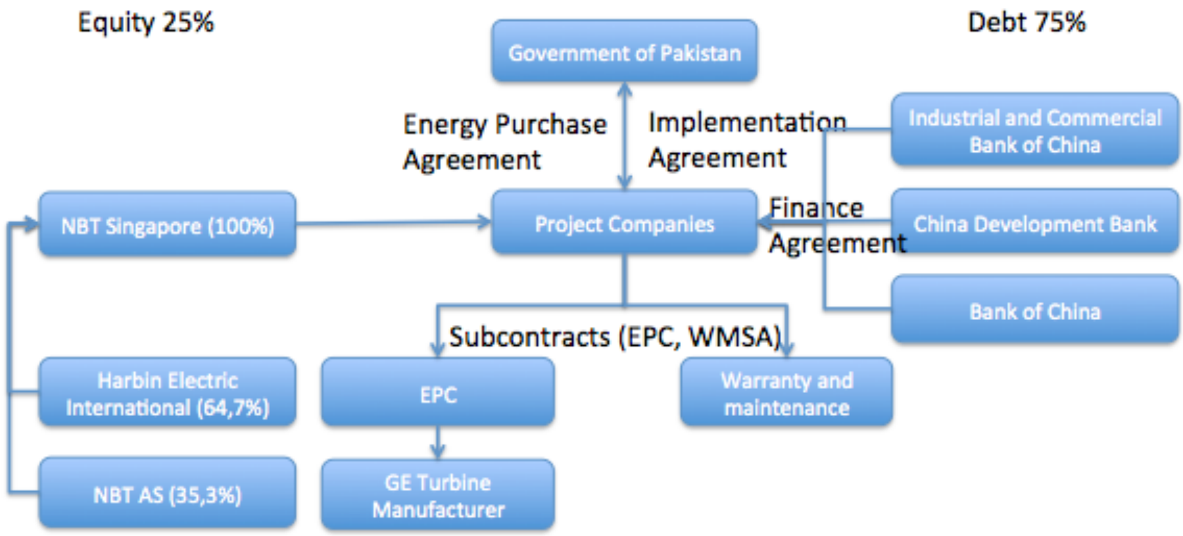

Figure 8: Project structure of NBT II. Source: NBT AS

China Export & Credit Insurance Corporation, Sinosure, provides the insurance for the project. This is to protect for financial losses caused by terrorist attacks, sovereign risk, war and expropriation. This is an insurance company that promotes China's interests for foreign trade and economic cooperation, and it is state-funded. In addition to investment insurance they provide export credit insurance. (Lee et al. 2014)

Methods for analyzing investment profitability

In this chapter I present theoretical descriptions of methods used in the model needed for the valuation of the NBT II project. First, I present the net present value method, introducing the different parts in this valuation. Second, I discuss the sensitivity and Monte Carlo simulation (MCS), what they are and how they are conducted. Third, I present the upfront tariff system and how the policy mechanism behind it operates, this is a main income driver for the analysis.

Project valuation through net present value analysis

Brealey et al. (2009) describe the NPV as "the value found by subtracting the required initial investment from the present value of the project cash flows". It is the most commonly used project valuation method prior to an investment decision. Fisher (1930) first introduced the concept in his book Theory of Interest. He emphasized that capital is the sum of estimated future income discounted into present cash value. The NPV consists of four different parts: First, it is the initial investment to set up the project before it starts generating income. Second, it is the salvage value, or sales value, at the end of the lifetime of the assets. Third, it is the budgeted expected cash flows that the project generates during its lifetime. Fourth, there is the discount rate, often called the opportunity cost of capital.

$$NPV = Investment - \sum_{t=1}^{N} \frac{Cash\ Flow^t}{(1 + Discount\ rate)^t} + \frac{Salvage\ Value}{(1 + Discount\ rate)^N} \quad (1)$$

It is important to keep in mind for the whole analysis, that the validity of the decision is only as good as the assumptions such as the cash flows and discount rate. Based on the value of the NPV, the company makes a decision of undertaking the project. With a positive NPV the project will increase the shareholders value, while a negative NPV will decrease the value (Hull 2012). In addition to the NPV investors often use the internal rate of return (IRR) as a measure. This is the rate at which the NPV is equal to zero, and a project is accepted if the estimated cost of capital is lower than the IRR. It measures the profitability in percent and not absolute numbers. Due to inconsistent factors in regards to this estimate, it is more often used in the corporate world compared to academia.

The initial cost of building the project, is a cash outflow and capital expenditure, for the company. An important factor is to recognize the capital expenditure when it occurs through the project execution, and not follow the accounting rule of depreciation. The reason being that the objective is to earn more on the investment than in the capital market. However, it is important to view the investment as all equity financed. Thus, the debt issued in order to purchase the assets should not be deducted in the cash flow nor the interest or principal payments. If not, the analysis becomes a financing decision and not an investment decision. The investment cost should account for the years that it takes to construct the plant.

Further, the investment in fixed assets should account for the salvage value at the end of the project lifespan and the tax on the profit from sales. The salvage value can be viewed as the scrap value of selling the different parts of the windmills. Or the site can be sold to other owners at a price corresponding to the estimated NPV, of maintaining the operations of the power generation. Both exit strategies are difficult to determine today, but important basis for calculating the cash flow later.

The cash flow generated during the lifetime of the project consists of several different variables. Some of the costs are fixed, costs that do not depend on level of output, while others are variable, costs that change as the level of output changes (Brealey et al. 2009). The forecast of the expected cash flow should account for the probabilities of all possible outcomes of income and costs(Harijan et al. 2009).

The total cash flow is then:

$$CF = (1 - Tax)\{(E + S) - (F + O + R)\} + Tax(D) \qquad (2)$$

(E) represents the total income from energy produced during a year and (S) is the salvage value at the end of the project lifetime. (O) is the operations and maintenance costs over a year, (R) is the replacement cost of broken parts, and (F) is the input of fuel. Further, (D) is the depreciation of the assets purchased for the project. However, variable (F) is not representable in windmill projects, since it is a renewable energy. In order to ensure consistency in the forecast economic indicators for growth in the different variables should be included.

The discount rate is a calculation of the cost of capital. Projects normally apply different sources of capital such as equity, debt and preferred stocks, and the expected return is a combination of what the investors expect and what the security holders require. The estimation requires the use of the weighted average cost of capital (WACC).

$$WACC = \left(\frac{Debt}{Total\ value}(1 - T_c)r_{debt}\right) + \left(\frac{Equity}{Total\ Value}r_{equity}\right) \qquad (3)$$

Companies have different estimates of the WACC due to different estimates of the risk profile. The returns are weighted depending on the way of financing the project, and the discount rate is the approximation of the cost of finance. In order to find the required return on equity, the model uses the capital asset pricing model (CAPM) developed by Sharpe, Lintner and Mossin. This is the theory of the relationship between risk and return on the equity in the investment project. It depends mainly on two variables; (1) The compensation for the time value of money and, one USD today is worth more than a USD tomorrow (2) a risk premium, a risky USD is worth less than a risk-free USD. The time value of money uses the risk-free rate in order to assess the return the shareholders reinvest in the company instead of a market fund. The risk-free rate has two conditions. Firstly, the cash flow has no default risk and secondly there is no risk in reinvesting the coupons. This implies that zero-coupon governmental bonds are a correct measure to use for the risk-free rate, although these rates may include an estimate for expected inflation. The duration of the bond should often be the same as the cash flow of the project (Damodaran 2008). The risk premium is the difference between the return on the market and the Treasury bill multiplies by beta. Beta is the sensitivity on the stock return based on the fluctuations in the market portfolio return.

$$\beta = \frac{Cor(r, r_m) \cdot Std(r)}{Std(r_m)} \qquad (4)$$

The standard deviation is a measure of the total risk, while the beta is a measure of the market risk, also called systematic risk. All the parameters described above are input into the CAPM, equation (5).

$$r_x = r_f + \beta(r_m - r_f) \qquad (5)$$

Determining the risk of a specific project is not an exact science, but it provides guidance. It depends on the operating leverage, determining the level of fixed costs compared to the profits. It also depends on the state, or sovereign economy. Further, combining the CAPM and the WACC provides the required rate adjusted for the financing and the market expectations. Both models are simplifications of the real world. Specifically for projects, it is common to take a sample of companies that are similar to the project accounted for and create a proxy beta (Hull 2012). Hull describes this as a problem since companies used in the proxy beta estimation can have different predictions of projects. Some risk factors such as political environment, new markets and technology are difficult to quantify, however they become strategic values.

Another method of assessing the profitability is through the payback rule. This analysis estimates how long period of time it takes the investor to recover the whole capital expenditure. The analysis has several limitations and is not appropriate for projects with a long lifespan. Hence, it is not implemented in this thesis.

Sensitivity analysis

Due to the uncertainty, a sensitivity analysis can support the assessment of the forecasted cash flow by measuring the possible outcomes of different events, such as when changes in sales, costs, investment costs and cost of capital are applied. While conducting sensitivity analysis the company is able to identify the key variables that influences the project valuation. In a way, the analysis use unknown variables to express cash flows, and then calculating the consequence of misestimating the variables (Brealey et al. 2009).

The methodology to conduct a sensitivity analysis implies first to identify the expected cash flow by establishing a base case reflecting the most probable outcome. This base case is further used to consider a pessimistic and optimistic outcome. The company will look at the movements for the NPV in case there are inaccurate forecasts. These effects are often presented in a star diagram comparing the influence of each variable on the NPV. After these estimations, it is important to assess how to reduce some of the uncertainty. The value of gaining more information means that the key drivers for a negative NPV in the pessimistic analysis should be further explored (Brealey et al. 2009).

Limitations of the outcomes of the sensitivity analysis are many and they should be kept in mind when drawing conclusions from the results. One constraint is that the analysis demands a certain level of interpretation for what is pessimistic and what is optimistic. Further, the underlying variables might be interrelated and not necessarily reflecting the market mechanism. An example is if the company wants to assess the influence of personnel costs. That change will probably affect both the variable and fixed costs. Moreover, the sensitivity analysis does not take into account the probability of the different changes in parameters, especially since the change is of equal size for all variables. However, considering the limits to the analysis, it still provides an illustration of which variables are the most important and that have to be monitored in the project assessment. (Brealey et al. 2009)

Monte-Carlo simulations

It is possible to assess the project with a particular combination of assumptions while at the same time maintaining a consistency of the variables through a scenario analysis. An addition to the traditional scenario analysis is simulation analysis, which generates several possibilities for outcomes. Monte Carlo simulations (MCS), described further below, is the most famous method (Brealey et al. 2009).

The objective of a simulation is to create a probability distribution of outcomes on the project. MCS is a procedure for sampling random outcomes for the process in order to generate alternative scenarios of the annual cash flow in a risk-neutral world (Hull 2012). These random samples can have different distributions depending on the behavior of the variable. The simulation is the result of the experiment with estimated random values, an increase in the amount of simulations increases the accuracy of the model (Spinney & Watkins 1996), similar to the law of large numbers. This is one of the main differences form the sensitivity analysis.

The calculations behind a MCS contain several steps that are based on previous estimates. First, the process demands finding the key variables to address in the assessment. This is the sensitivity analysis. Second, the analysis is based on assumptions for the mean, or expected growth rate, of the different variables together with the standard deviation from the mentioned mean. The intention is that this will assess the random change in the key variables and provide a quantified probability. The probability distribution of the parameters should be chosen based on the characteristics of the variable. Third, the simulation is run several times, producing a distribution of the different outcomes of the NPV. The distribution should follow the chosen distribution of the parameters(Khindanova 2013).

Upfront tariff, a policy mechanism

Upfront tariff, also called feed-in tariff (FIT), such as the one issued by NEPRA, is a type of policy mechanism that aims to increase the investments in renewable energy technology by creating a predictable outlook for the investor. Designed with long-term purchasing contracts to the power producer, it assesses 3 features. One is providing a purchase obligation to the government, second is the fixed price through the tariff and third a long payment duration. These features compensate the investor for the high investment costs and risk associated to the project. (Deutsche Gesellschaft Für Internationale Zusammenarbeit GmbH 2012).

The upfront tariff for wind power generators issued by NEPRA is cost based, meaning it is influenced by several different variables[3]. First, it takes into account the operations and maintenance costs and the insurance costs for managing the wind park. In addition, the tariff takes into account return on equity. This is a risk reducing measure since it implies that not only fixed costs are covered, but variable costs as well. Further, the upfront tariff covers the principal payment of debt and interest the first ten years of the project’s commercial operation. According to the tariff the price is 15,30 USDcents/kWh the first 10 years, the last 10 years the price is at 6,96 USD cents/kWh, based on exchange rate Pakistan Rupee and USD on April 14th, 2015. The different variables are indexed for different measures such as US inflation, interest rate and Pakistani Rupee depreciation. There is a cap on the tariff level up to 31% of net annual plant capacity. Production above the cap reduces the price by a certain percentage depending on the capacity factor reached.

[3] See appendix 2 for details on the construction of the tariff

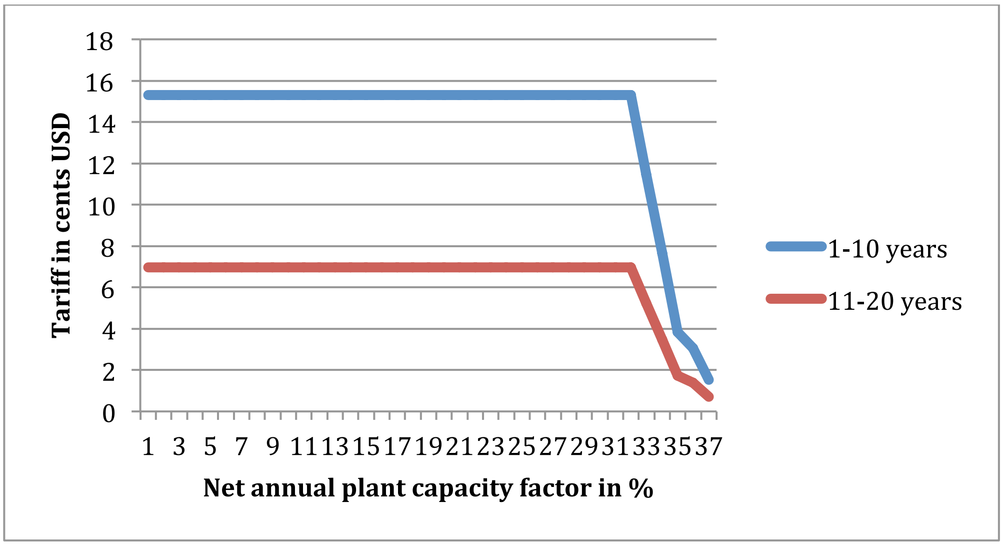

Figure 9: The changes in the current tariff in USD cents/kWh compared to production and plant capacity factor. Source: NEPRA

In addition, the power producers such as NBT are obligated to pay tax on income and duties, but the power purchaser (Government of Pakistan) reimburses the exact amount. This implies that tax behaves like a pass-through item and is not included in the valuation. To avoid that the investors take advantage of the risk reducing incentives provided by NEPRA, there is a cap on the dividend payout of 7,50% per annum. The cap is implemented as a way of keeping the return on the investment within the project and the country. The upfront tariff is issued for 20 years and expects NBT II to reach financial close by March 31st, 2015. (National Electric Power Regulatory Authority 2014a).

Even though the upfront tariff covers many of the production costs of wind, some risks have to be carried by the power producer. One flaw is that NEPRA requires the EPC signed before filing a petition, which is difficult without knowing if the application for upfront tariff will be approved. As mentioned earlier, there is an inferior market-support infrastructure, which leads to load shedding. However, any financial loss due to lack of infrastructure will be subjected to the power purchaser, according to the upfront tariff agreement with NEPRA. Dispatch notices, due to bottlenecks in the power grid, are not mentioned in the agreement, and depending on interpretation of the contract this can provide an additional risk. However, the main risk specified in the contract is the wind risk, which is carried by the producer.

Compared to tariffs on other energy sources the wind tariff ranks relatively high, second after solar PV power.

Table 2: Comparing different tariff levels for different energy sources in Pakistan. All adjusted in USD cents/kWh, based on exchange rate 08.05.15. Source: Nepra.org.pk

Valid tariff years	1-10 years	11-20 years	20-25 years	25-30 years
Small Hydro (head <20m)	9,5	3,9	-	-
Small Hydro (head >20m)	8,7	3,6	-	-
Solar PV(50-100 MW) North Regions	17,9	8,1	8,1	-
Solar PV(50-100 MW) South Regions	17,2	7,8	7,8	-
Bagasse	11,9	8,1	8,1	8,1
RLNG (60% capacity)	8,9	8,9	8,9	8,9
RLNG (92% capacity)	7,9	7,9	7,9	7,9
Coal (imported)	8,3	8,3	8,3	8,3
Wind	15,3	6,9	-	-

The price of electricity is a challenging estimate to collect in Pakistan. This is partly due to the method of calculating the electricity bills. It consists of one fixed cost depending on customer sector and level of electricity consumption, then it has a variable cost depending on the fuel market price of oil and gas, on top of this, it includes administration costs. In addition, some sectors are refusing to pay for electricity such as the military and some government departments (Masood 2015). Further, there is a high level of theft due to people connecting to the grid without paying and people bribing the inspectors who manually record the electricity meters. However, the tariff is higher than comparable tariffs in other countries, table 4.

Table 3: Comparing Pakistan tariff on wind with other countries, for similar sized projects. Source: Local government webpages

Country	Years with tariff	Tariff USD (04.14.15)[4]
Germany	1-5 years upper level Base fee following years	10,03 cents/kWh 5,58 cents/kWh
Uganda	20 years	12,04 cents/kWh
India	25 years	6,41 cents/kWh
Turkey	10 years	7,3 cents /kWh

[4] The different tariffs based on local government documents, the exchange rate is based on exchange rate 04.05.15.

Literature on Wind Mill Farm Investments

In this chapter I will present some current literature about the use of net present valuation, required rate of return and Monte Carlo Model for windmill project analysis.

Table 4: Overview of previous literature studies on topics related to the thesis

Author	**Publication year**	**Country**	**Type of valuation**	**Results**
Khanji Harijan, Mohammad A. Uqaili, Mujeebuddin Memon and Umar K. Mirza	2009	Pakistan	Net present value	Wind is a competitive source of energy compared to conventional energy in Pakistan.
Yiannis A. Katsigiannis and George Stavrakakis	2014	Australia	Net present value	Determining that a high-class wind turbine model provides a higher production of energy and a higher NPV at the high wind site
Jørgen Olsen Marianne D. Matre Mehmet A. Ünlü	2008 2010 2012	Norway, UK and Turkey	Net present value	Previous master thesis assessing the profitability of different wind energy projects presents negative NPV, but considers subsidies as an important factor.
Irina Khindanova	2013	Hypothetical case	Monte Carlo simulation	MCS assess a range of possibilities. The discount rate, investment costs, price of electricity and load factor have a significant influence on the negative NPV.
Peter J spinney and Campbell Watkins	1996	Hypothetical case	Monte Carlo simulation	Discussing the steps in the MCS and the advantages and disadvantages compared to other methods.

Ole Gjølberg and Thore Johnsen	2007	Norway and global market	Discount rate	Assessing the required rate of return needed for investments in renewable energy projects. The before tax real rate for wind power is 8,60%.
Muhammed Amer and Tugrul U. Daim	2011	Pakistan	Analytical hierarchy process	Through a multi-perspective approach biomass energy is most optimal, second is wind power and third solar power.

Harijan et al. (2009) assess the central grid connected wind power cost in Pakistan. The study is conducted for the Sindh province, the same as where the NBT II project is located. Here they first conducted an estimated wind production for 50m high mills, while NBT has 80m high towers. The higher mills means extraction of more energy from the wind in the area. According to their estimates the minimum cost of electricity generated was 4,2 USD cents/kWh in Jamshoro and maximum was 7,4 USD cents/kWh in Kadhan. EWEA indicates that using the levelised-cost approach, such as what is done in this paper, is not fitted for comparison between conventional fuels and renewables due to high uncertainty in future fuel prices. Disregarding this for purpose of illustration, the conclusion of this study is that "wind power is competitive to conventional grid connected thermal power even without considering the externalities". Their method of conducting this estimation was through first finding the estimated wind energy output. After this assessment, they complete a NPV. In the assessment, they calculate each given variable with a discount factor that uses inflation rate, real increase rate of prices or increase in cost, and a discount rate. They do not discuss the calculation for the discount rate of 10%. It seems like they have used the official discount rate set by the State Bank of Pakistan. The discount rate is an important measure for NPV calculations since it significantly affects the result. Hence, it should include the industry specific risk for wind farms. In addition, they have not completed any scenario nor sensitivity analysis of the different measures.

Katsigiannis and Stavrakakis (2014) have studied the economical aspect of high-class windmill investment and the location at three sites in Australia. They compare a possible investment using windmills from six different manufacturers, and with different classifications. Adapting the wind estimates from the areas and simulating the production of energy based on different windmills, they are able to estimate the different economical values. Through the analysis, they conclude that there is a significant difference in energy output by implementing wind turbines designed for lower wind speed. Further, the economical assessment presents a higher potential for earnings at the medium-high wind potential, however there is a possibility for a positive NPV if the right windmills are built in the low wind location. The conclusion is that high-class windmills provide the highest NPV.

There are several previous master thesis assessing the profitability of wind power investments. Olsen (2008) assesses the profitability of offshore wind turbines in the North Sea. Though a socioeconomic NPV analysis he evaluates 4 different simulations of such an investment. One of his results is that through the subsidies from Germany the NPV will be more profitable for the size of the investment compared to the other assessments where the NPV is negative. Pakistan has based their up-front tariff on the method used in Germany. Matre (2010) analyzes the development of offshore wind investments and uses a case study of Statoil investing in United Kingdom. Her estimations of this project results in a negative NPV. She identifies political, technological and market factors as key drivers for such investments. In her assessment she only uses green certificates as a source of subsidy, but comment on the possibility of higher prices for offshore wind power can provide the project with a positive NPV. However, she warns that the implementation of subsidies increases the influence of political risk in the assessment. Ünlü (2012) investigates the possibility of offshore wind power investments in Turkey. The background of the assessment presents some similar tendencies to Pakistan with the need for energy security, risks for investing and a similar cost-based upfront tariff. The results present a negative NPV for all wind classes, however he establishes that the price for production for electricity is too low and the capital costs too high. Turkey has a tariff at 7,8 USD cents/kWh and it is valid for 10 years.

Irina KhindanovaKhindanova (2013) from University of Denver assesses the valuation of an investment in wind power generation on the basis of a Monte

Carlo simulation (MCS). The methodology is first to conduct an estimation of a base case for the NPV. This is similar as the estimation done by Harijan et al. She has estimated the growth rate of costs and price of electricity to be on the same level as the inflation, 3%. The revenue is determined by the load factor, capacity, operating hours and price of electricity. Her base case NPV estimate is highly negative at -87 MUSD. After the base case is defined, she conducts a sensitivity analysis of the project to determine which inputs have the highest impact on the valuation. In that assessment, only one variable is changed while the others are maintained constant. The level of change is based on factors used by International Energy Agency and National Energy Agency, where there is a 50% change up or down. The results show that discount rate, construction costs, load factor and initial electricity price make the most significant changes on the output value. One conclusion from this assessment is that reducing the cost of capital on wind technologies increases their economic acceptance. Then she assesses the probabilities for the critical inputs used in the MCS. The end result is a normal distribution of the NPV, and a positive mean NPV for discount rates 5% and 10%.

Spinney and Watkins (1996)have discussed the use of MCS techniques for electric utilities. In the paper, they identify the key risks through sensitivity analysis, decision analysis and Monte Carlo Simulations, and how these methods can account for uncertainties and tradeoffs. The conclusion of this paper is that the MCS addresses several of the limitations in the two other mentioned methods. Further, the methodology is an advantage for large capital expenditure investment projects, such as wind power. They describe the steps as:

1) Finding the key input variables.
2) Assessing the statistical risk of each variable
3) Describing the covariance between variables
4) Multiple iteration
5) Describe the output

The simulation draws random values to model the outcomes. The accuracy of the model increases with the number of simulations completed. They describe the limitations with the MSC as related to the assumptions made in order to conduct the simulation. Especially difficulties enter with covariance, different types of risk, objective statistical tools, and dynamic relationships. Further, they discuss the issue with the discount rate that accounts for several of the risks also assessed in the parameters. The double counting of risk is handled in later analysis by using one discount rate for each simulation. In order not to double count the risk, one of the discount rates used is the riskless rate. The article discusses the advantages and disadvantages using the MCS and how to conduct a simulation through a hypothetical assessment of a power utility. This provides a different case than wind power, but the assessment has several similarities to the NBT II project. They use a normal and non-normal distribution for their assessment, comparing the two, and find that a non-normal distribution might be more appropriate.

The paper "Investments in the production of renewable energy; what discount rate should Enova SF use?" by Gjølberg and Johnsen (2007) is used as a guide to assess the NBT II discount rate. This is an assessment of a Norwegian government group, Enova SF, who invests in energy saving projects and renewable energy. However, they compare it to the world and global energy companies and this provides the necessary input in order to use the same procedure in the analysis for NBT II. The analysis combines the assessment of internal rate of return on energy companies and their capital construction in order to assess the needed risk premium for the required rate of return within the Enova investment portfolio. Through the process of creating proxy betas for investments in companies that are not listed on the stock exchange and the capital construction, they use the WACC to find the required return for Enova's projects. After that, they use the CAPM to identify the required return on equity for similar projects. Based on the WACC, the nominal return after tax for wind power is 8,10% for invested capital. While the before tax return is 11,20%, which is used for untaxed companies such as the NBT II project. Adjusted for inflation this results in 8,60% real required rate of return. In the assessment the investments are based in Norway and are using the risk-free rate (r_f) on the Treasury bills issued by the Bank of Norway. In addition, they have the assumption of a 0,40 debt share, 1,50% credit premium, and a liquidity premium between 2%-4%. The level of debt in the project has a significant impact on the required return of equity, and should be considered when conducting the analysis of NBT II due to its high gearing and relatively low equity portion.

The article by Amer and Daim (2011) discusses what type of renewable energy Pakistan should invest in based on perspective of experts. The approach identifies biomass energy and wind power as the preferred alternatives. The two options will increase the supply of energy in a demand hungry market, create local jobs and reduce the current dependency on conventional energy sources. This assessment supports the construction of the NBT II project further, and should be considered by the Pakistani government for the strategy of developing more renewable energy sources.

Data Collected for the Analysis

In this section I look closer at the quality of the wind data and estimations, the financial information, and estimations for the discount rate used further in the analysis.

Wind Data

Financing large wind farms often requires a second opinion of the due diligence of the resource assessment. This is due to the high financial risk linked to the assessment (Morthorts & Awerbuch 2009). The DNV GL's assessment of the wind conducted for NBT AS is not publicized, but I have been allowed to implement their calculations in the thesis. The measurements are from July 2012 to November 2014, measured at four different masts; A, B, C, D. In addition, NBT has received the time series data for a meteorological mast, named Lucky, located approximately 26 km south of NBT II. Lucky provides data from January 2008 to December 2012. Further they have used MERRA modeling, a NASA reanalysis product that uses geological estimates available.

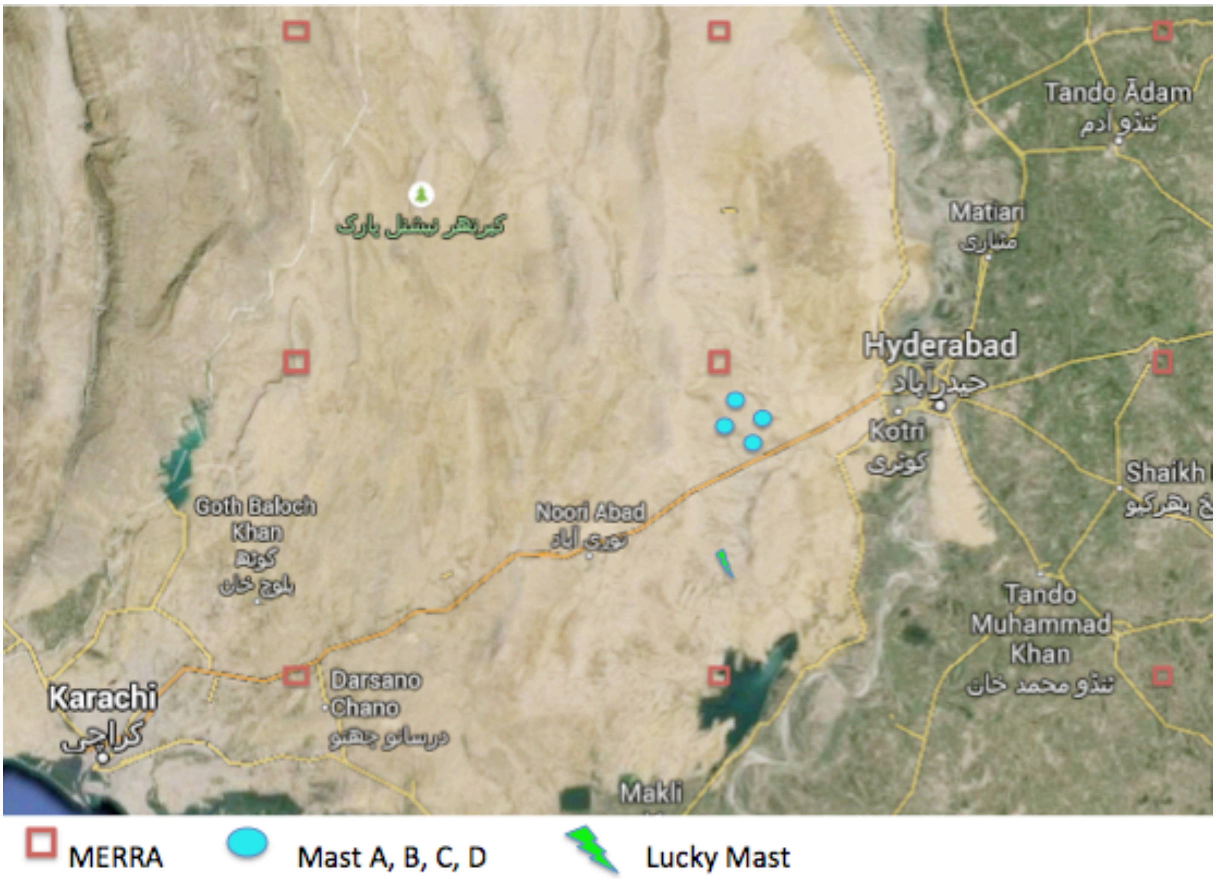

Figure 10: Map of site and surrounding are, including site masts, Lucky Mast and Merra. Source: DNV GL and Google Maps

DNV GL and meteorological institute in Pakistan collect the data provided in the analysis. In the analysis, there were several problems with Mast D, and it was found unsuited for the assessment for electricity generation from NBT II project. Due to difficulties of collecting my own data, I have accounted for the risk of second-hand data analysis. The estimations from DNV GL form the base case of the revenue stream in the cash flow analysis. A problem with the data provided, is that the estimates are of the first ten years of operation and not the full 20 years estimated lifetime. However, it should be a relative conservative estimate and it is difficult to predict how climate change might affect the wind prospects in the area.

Financial Information

The specific financial information gathered from NBT in January 2015 is recent estimations of expected costs for the project. The numbers are provided directly by NBT Singapore and will be the base case assessment of the cash flow for the net present value. A steady communication with NBT through an interview in January and e-mails following this provides updated, and relatively valid, information on the project. However, the data legitimization would be better through a proper audit.

The CAPM and WACC are used in order to provide the correct assessment of the estimated discount rate of the project. Estimation of the proxy beta for the NBT II project is based on companies that share similarities, such as wind power investments. The source for the stock prices is Bloomberg and the financial information from the audited financial reports. Both sources of information are valid and provide trustworthy information. Further, the market premium is based on the MSCI[5] world index, and is a common measure for global companies. The risk-free rate is based on the American Feds Treasury Bill 10 year rate. The long-term rate fits the lifetime of the project, while the volatile changes in a shorter termed T-bill, could provide frequent changes to the discount rate. The tariff and regulations are collected from government reports and contracts, applicable to all investments within the sector.

[5] Morgan Stanley Capital International (MSCI), a portfolio covering large- and mid-cap companies in 23 countries.

NPV Analysis

In this chapter, I present the assumptions of the wind estimates of the annual-expected wind, followed by a presentation of the calculated discount rate and cash flow and calculations of NPV benchmark. Next, I present the sensitivity analysis results, identifying the key variables that influence the NPV. Lastly, I calculate the results from the MCS with the focus on the key variables found in the sensitivity analysis.

The Wind Estimates Results

The estimates of the wind at the NBT II site show consistency over a period of time. The highest wind speeds are measured during the late summer months reaching almost 11m/s as the maximum measure compared to 4,4 m/s at the minimum in November. The average wind speed is 7,2 m/s at 80m height (DNV GL 2015).

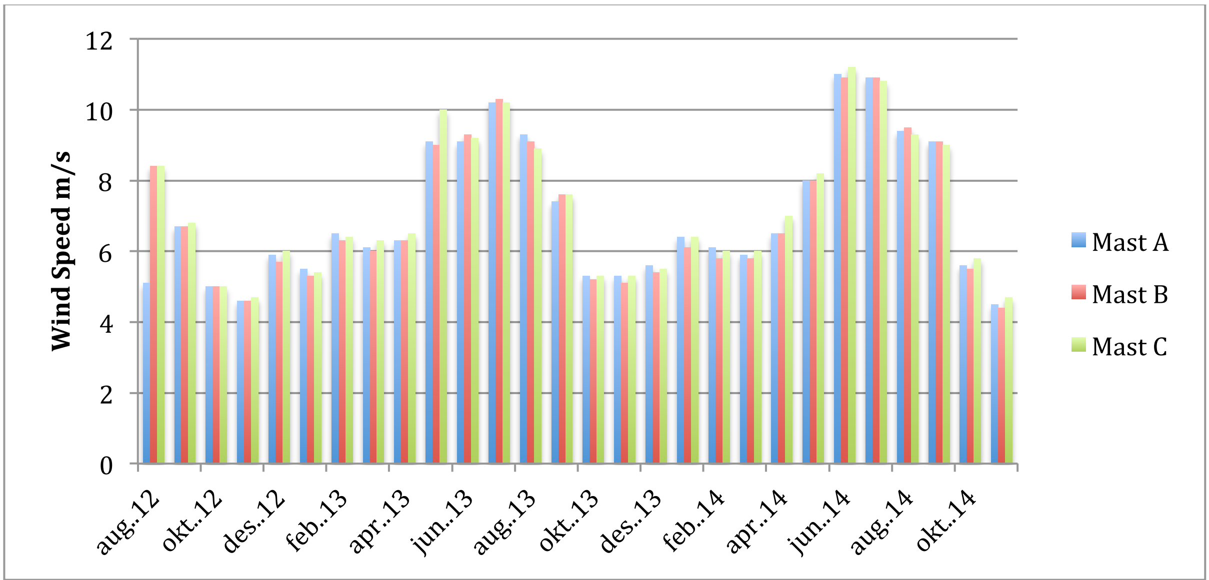

Figure 11: Wind measurements collected from Mast A, B and C. Source: DNV GL

The frequency table of the wind is usually formed with weibull distribution, which is positively skewed. However, due to the monthly observations in the dataset compared to daily, it has 2 vertexes, as seen in figure 11.

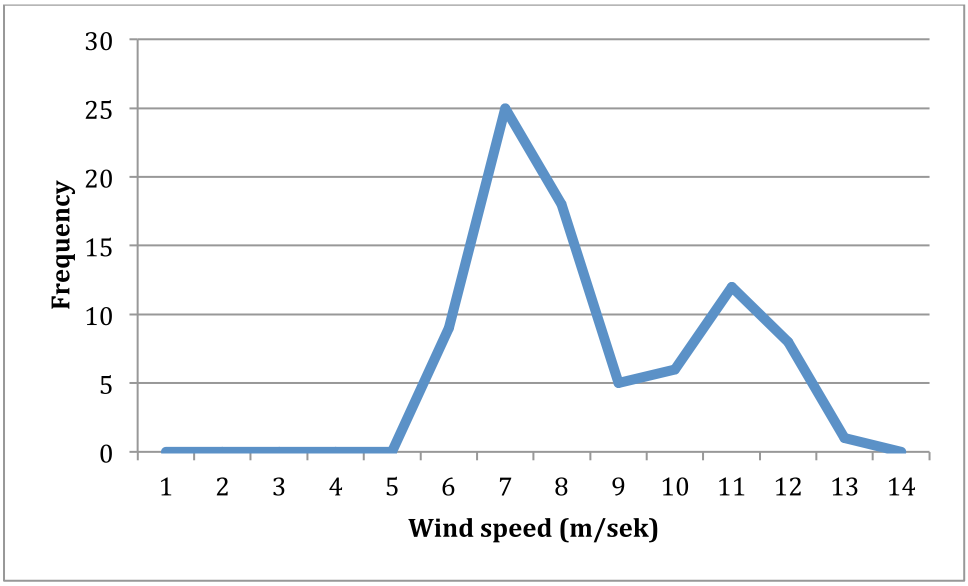

Figure 12: Frequency of different monthly wind speeds at the NBT II site. Source: DNV GL

As mentioned earlier, the wind estimation also considers the Lucky mast measurements. These measures show consistency with the measures from Mast A, B and C. The correlation makes it a reliable source, reflected in the graph for the wind measures.

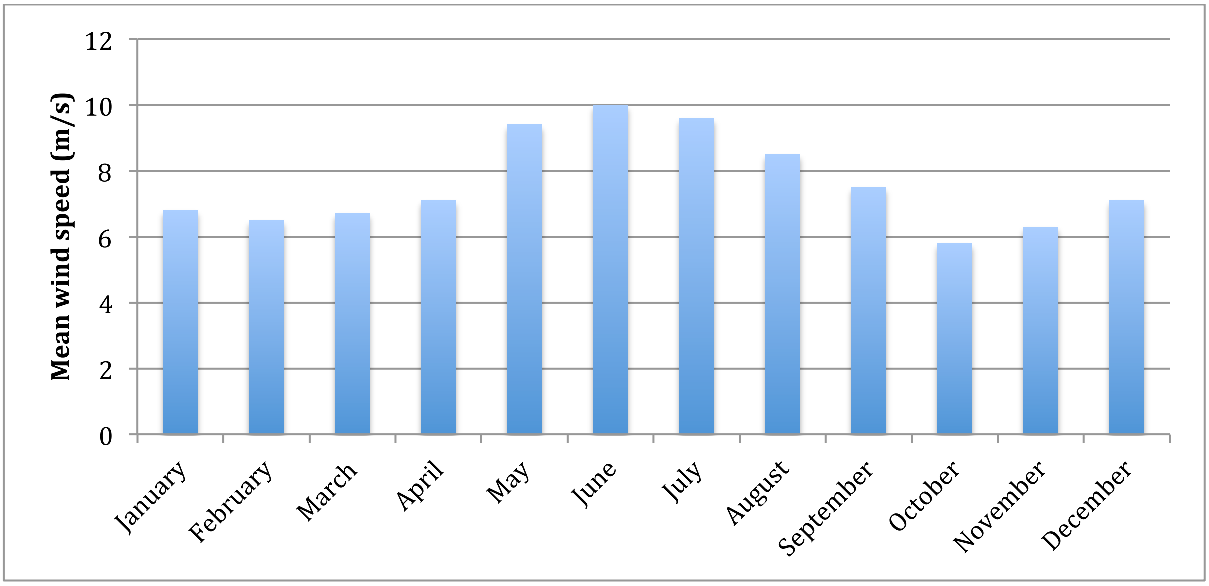

Figure 13: Mean wind speed measures collected from Lucky mast, 2008-2013. Source: DNV GL

Without accounting for the losses the gross energy output on the site would be:

$$249{,}6\ MW * 8\ 760\ hours\ \approx 2\ 190\ 000\ MWh{=}2\ 190\ GWh/annum$$

However, after considering wake effect, availability, electrical efficiency, turbine performance, environmental and production curtailment the expected net energy output estimated by DNV GL is 723,8 GWh/annum. This provides an annual capacity factor of:

723,8 GWh/annum / 2190 GWh/annum = 0,331 or 33,1%

Due to this estimated capacity factor the revenue stream will not be a straight line, since the tariff degrades above 31%. DNV GL calculated an uncertainty analysis estimated to be 105,7 GWh/annum in a one year period and 70 GWh/annum in any ten year period.
Weather is a good indicator of the validity of the wind estimates gathered. The weather in Pakistan is often characterized by extremely hot summers and cold winters. In the Karachi area, the warmest month is on average in May and the coolest in January, while December has the most rainfall and September the least. However, the weather condition during the indicated time period is similar to the historical average with no significant outliers in the area.

Base Case of the Net Present Value

The base case of the net present value reflects the most probable static outcome. Firstly, this implies an assessment of the discount factor and the results followed by an assessment of the inflow of cash, the outflow of cash and investment cost. Combining the assessments will calculate the benchmark NPV.

The discount rate is based on the method explained earlier by Ole Gjølberg and Thore Johnsen. There are four companies used to determine the proxy beta and an industry rate. The companies are international wind power investors and therefore they have been compared to the MSCI world index as the market premium.

Table 5: Overview of the companies used as benchmarks in the proxy beta estimation. Source: Bloomberg

Company	Country of origin	Ticker code	Market Cap (March 17st 2015)
Boralex	Canada	BLX:CN	457,75 M€
Vestas	Denmark	VWS:DC	8 503,67 M€
E.On	Germany	EOAN:GY	27 573,78 M€
PNE Wind	Germany	PNE3:GR	175,04 M€

The international profile of the companies makes them comparable to the NBT II project. However, the size of the companies, their currency differences and markets, could influence the final beta value of the NBT II project. As seen on the graph below the MSCI has almost continuously performed better than the wind power companies.

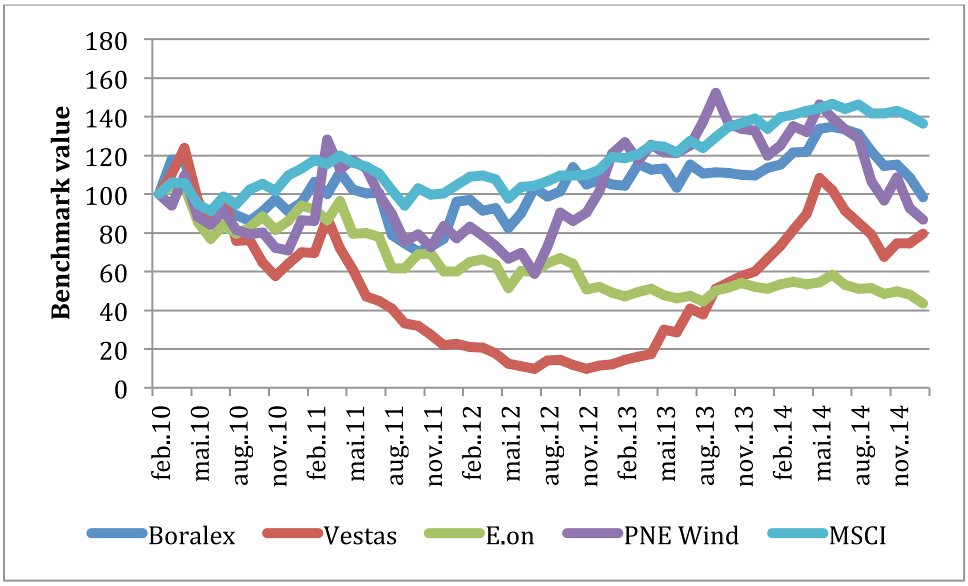

Figure 14: The benchmark comparison between the companies and MSCI between 2010-2014. Source: Bloomberg

When considering the results from the assessment it is important to consider the high standard deviations. Wind power is still a relatively new technology and the market is subjective to fast changes. The analysis first assesses the logarithmic returns, due to the empirical analysis on time-series financial information, in order to find the equity betas. Then these were adjusted to the equity level in the companies in order to find the asset beta.

Table 6: Overview of average return, standard deviation and beta estimates in wind investing companies and the MSCI for time period 2010-2014

	Boralex	Vestas	E.on	PNE Wind	Average(UW)	Average (W)[4)]
E/(E+D)[1)]	0,33	0,76	0,47	0,51	0,52	0,54
Equity beta	1,05	1,77	1,45	1,11	1,34	1,52
Asset beta[3)]	0,35	1,35	0,69	0,57	0,74	0,84
Correlation MSCI	0,52	0,44	0,71	0,40		
Annual Returns [2)]	-0,31 %	-4,69 %	-16,93 %	-2,88 %		
Std	29,36 %	58,96 %	29,58 %	39,89 %		
MSCI Return[2)]	6,31 %					
MSCI Std	14,50 %					

1) Using the average market value the past 4 years (2010-2013) and average debt level. All measured in Euro.
2) Monthly logarithmic returns for the stocks and MSCI world index, all measured in USD. Converted to annual returns
3) The equity share of enterprise value multiplied with equity beta.
4) Un-weighted (UW) average and weighted (W) is based on the market value.

The averages are 1,34 for the market beta and 0,74 for asset beta, these measures are used as beta proxies for NBT II. Further in the analysis, the cost of debt is established by the borrowing rate set by the creditors and this is expected to be approximately 8%. This estimates the credit premium to be fairly high compared to the risk free rate. Since the capital structure ratios of NBT II are E/(E+D): 0,25 and D/(E+D): 0,75. This provides a substantial gearing ratio that increases the financial risk of the investment, due to the vulnerability to changes in the economic cycles and especially recessions. This will significantly influence the required rate of return on equity. Since the tariff is indexed to USD, the implemented risk-free rate and inflation rate is based on the US Federal Reserves. Risk-free rate is a zero-coupon 10-year US T-bill average the past 5 years at 2,52%. While the average inflation rate the past 5 years in USA is at 1,96% with their target being between 1,7-2%[6]. The tax rate will not be included in the assessment, since the investment contract with NEPRA states that tax is treated as a pass-through item. Due to the nature of the investment there is a liquidity premium between 5%-7% added to the estimation. Hence, the assessment accounts for the real rate before tax as the correct discount rate estimate.

[6] Based on the Federal Reserves System in the United states

Table 7: The nominal required rate of return before tax for the NBT II project adjusted to credit premium and liquidity premium.

Nominal	Before tax		Asset beta		
Debt share	**Credit premium**	**Liquidity premium**	**0,64**	**0,74**	**0,84**
0,7	**5 %**	**1,5 %**	9,9 %	10,3 %	10,7 %
0,75	**5,5 %**	**1,5 %**	10,6 %	10,9 %	11,3 %
0,8	**6 %**	**1,4 %**	11,1 %	11,5 %	11,9 %

Table 8: The real rate of return before tax for the NBT II project, adjusted for the 5-year average US inflation of 1,96%.

Real	Before tax		Asset beta		
Debt share	**Credit premium**	**Liquidity premium**	**0,64**	**0,74**	**0,84**
0,7	**5 %**	**1,5 %**	7,8 %	8,2 %	8,6 %
0,75	**5,5 %**	**1,5 %**	8,4 %	8,8 %	9,2 %
0,8	**6 %**	**1,4 %**	9,0 %	9,4 %	9,8 %

Due to the gearing of the NBT II project it has a high levered beta, which also provides high-required returns on equity.

Table 9: Calculated levered beta for the NBT II Project.

Equity beta	Asset beta		
Debt share	**0,64**	**0,74**	**0,84**
0,7	2,1	2,5	2,8
0,75	2,6	3,0	3,4
0,8	3,2	3,7	4,2

Table 10: The nominal required return on equity before tax.

Nominal	Asset beta		
Debt share	**0,64**	**0,74**	**0,84**
0,7	10,6 %	11,9 %	13,1 %
0,75	12,2 %	13,7 %	15,3 %
0,8	14,6 %	16,5 %	18,4 %

Table 11: The real required rate of return on equity before tax adjusted for 5-year average US inflation rate of 1,96%

Real	Asset beta		
Debt share	**0,64**	**0,74**	**0,84**
0,7	8,5 %	9,7 %	11,0 %
0,75	10,1 %	11,6 %	13,0 %
0,8	12,4 %	14,3 %	16,2 %

The share of debt in the calculations makes a significant difference in the required rates for equity. It has a big impact on what the investors require in return compared to the debtors, since they carry a bigger risk. According to table 12 their expectations are almost double the return compared to the lending rate at 7%. The final discount rate is based on the 0,75 debt share and 0,84 asset beta resulting in 9,2% real rate.

Further, the analysis presents the cash flow assessment of the NBT II project. The discount rate is the real rate before tax; this implies that the cash flow should not be inflation adjusted. As discussed earlier the interest and principal payments on the debt are not cash outflows from the project. This would influence the financing decision and not the investment decision hence the cash flow of the project should be discounted by the estimated WACC. The initial investment for the wind park is 590 MUSD with a construction time estimated to 18 months. This investment cost includes interest on the capital expenditure during construction, total cost of ownership, up front fee for political risk insurance and bank fees. The EPC contract amounts to about 475 MUSD, which entails a finished site by the contractors. This investment depreciates with by linear model over 20 years and there is no tax benefit to collect through the project analysis due to tax being a pass-trough item. This accounts for the value reduction of the windmills, however at the end of the project lifetime there will be a salvage value on the equipment (Table 15). Further, the operation and maintenance cost of NBT II are estimated to 14 MUSD per year. These costs include replacement costs for broken parts, regular maintenance and administration. It is a similar estimate as the industry standard, at 3% of investment costs(Morthorts & Awerbuch 2009). However, the first 10 years of the wind farm's lifetime the EPC contract covers most of the repair and replacement costs. In addition, there is a 0,8 MUSD that covers total cost of ownership beyond operations and maintenance. The last cost element is insurance premium, which is approximately 1,9 MUSD annually. The revenue generated is depending on the wind in the region, and here the producer carries the full risk. According to the contract with NEPRA, production above 31% will have a lower price than the basic tariff. The price reduction influences the revenue stream.

Table 12: The prevalent tariff reduction compared to the plant capacity factor, given in USDcents/kWh.

Capacity factor	GWh production interval	Tariff level for interval (15,30/6,96)
Above 31% to 32%	678,9 GWh – 700,8 GWh	11,47/5,22 USD cents
Above 32% to 33%	700,8 GWh – 722,7 GWh	7,65/3,48 USD cents
Above 33% to 34%	722,7 GWh – 744,6 GWh	3,82/1,74 USD cents
Above 34% to 35%	744,6 GWh – 766,5 GWh	3,06/1,39 USD cents
Above 35%	766,5 GWh	1,53/0,69 USD cents

Table 13: The summary of the NPV without the salvage value for the 20-years investment period in the NBT II project measured in USD

Years	2016	2017-2026	2027-2037
Variables	**0**	**1-10**	**11-21**
Initial investment	-590 000 000	0	0
Production revenue level 1		103 871 700	47 251 440
Production revenue level 2		2 511 930	1 143 180
Production revenue level 3		1 675 350	762 120
Production revenue level 4		42 020	19 140
Operations and Maintenance		-14 800 000	-14 800 000
Insurance cost		-1 900 000	-1 900 000
Depreciation		-22 619 048	-22 619 048
EBIT		68 783 102	9 856 832
Sum PV Cash Flow	668 256 080		
NPV	***78 256 080***		

The estimated salvage value is highly tentative. The main uncertainty is if the tariff will be applicable for longer than the contracted 20 years. However, today this is the best estimate of the future income. The lifespan of today's windmills are unpredictable due to fast technological improvements that can further extend the duration of operation. The type of wind in the area influences the lifespan. Gusty and high velocity wind has a negative effect on the windmills, while a constant wind increase the lifetime. European Wind Energy Association (EWEA) estimates a technical lifetime of 20-25 years for onshore wind turbines. However, some turbines installed in the 1980s are still running and this illustrates the unpredictability of the lifetime of windmills(Morthorts & Awerbuch 2009). Disregarding the operational lifetime of the wind park in Sindh, there will be a scrap value of the windmills.

Table 14: Calculated salvage value of the NBT II project after the investor exits in USD. Lifespan expected to be 30 years in total.

Salvage value	1-10 years (USD)
Tariff level 1	47 251 440
Tariff level 2	1 143 180
Tariff level 3	762 120
Tariff level 4	19 140
O&M	- 14 800 000
Insurance	- 1 900 000
Value 2036	206 868 554
PV Sales value	**32,7 MUSD**

The estimated net present value benchmark is:

$$78\ 256\ 080 + 32\ 773\ 661\ \approx 111\ 000\ 000$$

For further analysis the benchmark NPV will be 100 MUSD, due to the high uncertainty in the estimated salvage value. The internal rate of return is 12%, which is higher than the estimated cost of capital at 9,2%.

Sensitivity analysis of the key variables in the model

This section of the analysis describes the level of impact input variables have on the output of net present value. The five variables analyzed are construction cost, tariff level, operations and maintenance costs, discount rate and the average annual wind. The variables are set at 50% and 25% in order to assess the level of change from the benchmark NPV. Further, all other variables are kept constant at the base value (Spinney & Watkins 1996). The sensitivity analysis helps to identify the critical input variables.

Table 15: Overview of the different case studies with the resulting NPV.

Sensitivity Analysis	-50 %	-25 %	25 %	50 %
Construction costs	395 000 000	247 500 000	-47 500 000	-195 000 000
Initial Tariff	-311 116 653	-105 558 327	305 558 326	511 116 652
O&M costs	167 072 603	133 536 301	66 463 698	32 927 396
Discount rate	314 875 916	195 155 121	23 173 953	-39 746 429
Annual average wind	-301 079 483	-90 502 572	127 237 096	148 294 787

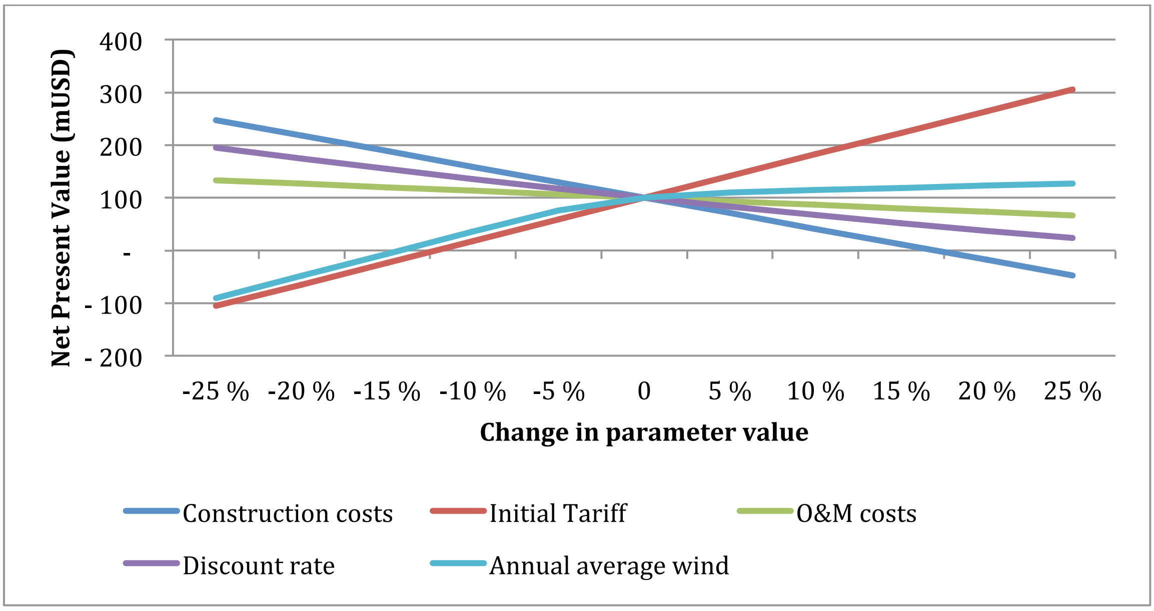

Figure 15: Star diagram for the sensitivity analysis of the NPV benchmark. The influence of a change in each parameter.

The star diagram illustrates which variables have the highest impact on the NPV. A steeper slope implies a change in parameter value (x-axis) and has a higher effect on the profitability (y-axis). In this case the steepest slope is the initial tariff, which indicates that the NPV is highly sensitive to the tariff level. Another steep slope is the annual average of wind. However, in this case it has a higher impact with low wind compared to high wind. This is due to the changing tariff level, which devalues with the capacity factor. Further, the construction cost has a high impact since the discount rate is steeper for a lower value compared to a higher one. The operations and maintenance costs have a low impact on the profitability compared to the other parameters. The sensitivity analysis is limited in scope and complexity, but it provides a good indicator to which variables that have to be closely monitored in the further analysis and risk assessment.

Monte Carlo Simulations of the Possible Outcomes of the Net Present Value

The Monte Carlo Simulation is based on 1000 random outcomes of the base case. The predictability of most of the costs, the tariff and capital expenditure are good since binding contracts sets them. However, the producer carries the risk of changes in annual wind and electricity production. Due to this fact, the simulation is based on the annual average of electrical production (723,8 GWh/annum) and the standard deviation (105,4 GWh/annum). In this analysis, the distribution of the wind is a normal distribution. This distribution is used in employed by Khindanova (2013), as well as by Spinney and Watkins (1996). As shown in the sensitivity analysis, the discount rate has a high impact on the final NPV calculations. The simulation is combined with a scenario analysis with different levels of the discount rate at 7% and the estimated IRR of 12%, in addition to the 9,2% in the base case.

In the first simulation the base case of 9,2% discount rate is applied. Due to the different levels of tariff depending on the production capacity factor an IF-function in excel is used in the simulation. The IF- function eliminates the different tariff levels if the electricity production is below this, while it calculates the amount within the set capacity.

Table 16: Presentation of descriptive statistics of the 1000 simulations based on annual wind estimated, with a 9,2% discount rate

Number of samples	**1 000**
NPV mean	66,2 MUSD
NPV Median	67,6 MUSD
NPV StD	19 MUSD
Min	-3,4 MUSD
Max	110 MUSD
Skewness	-0,41
Kurtosis	-0,12

This shows that the mean is below the base case of the NPV. The median is higher than the mean, which implies more observations on the upside and more extreme values at the downside. Further, a negative skewness illustrates a fat left tail, which suggests the standard deviation underestimates the risk. Kurtosis above zero indicates extreme values, which increase the probability of black swans. All of the results above are visible in the normal distribution and frequency graph.

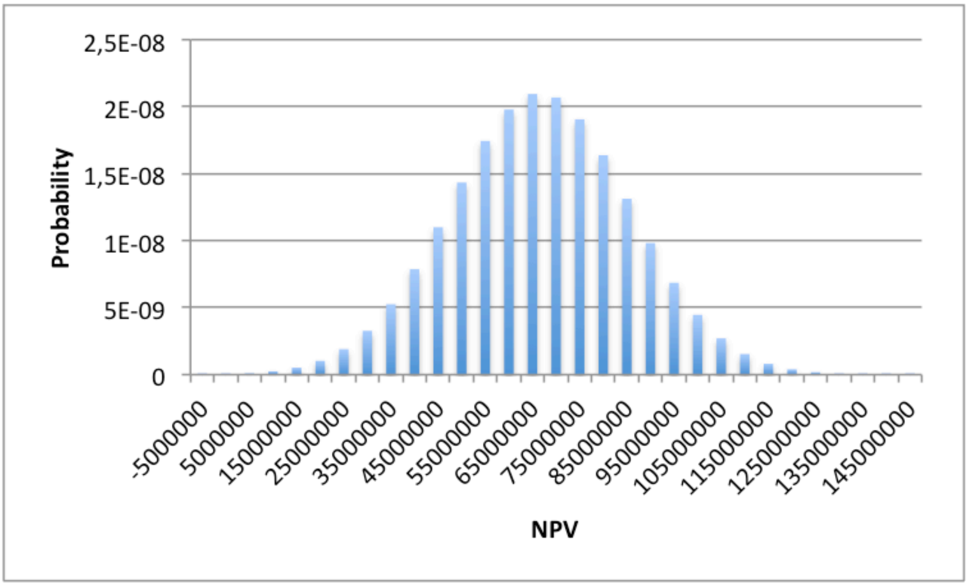

Figure 16: Normal distribution of the NPV for 1000 simulations with the 9,2% discount rate

The frequency table of each NPV approximately follows a normal distribution, but illustrates the negative skew.

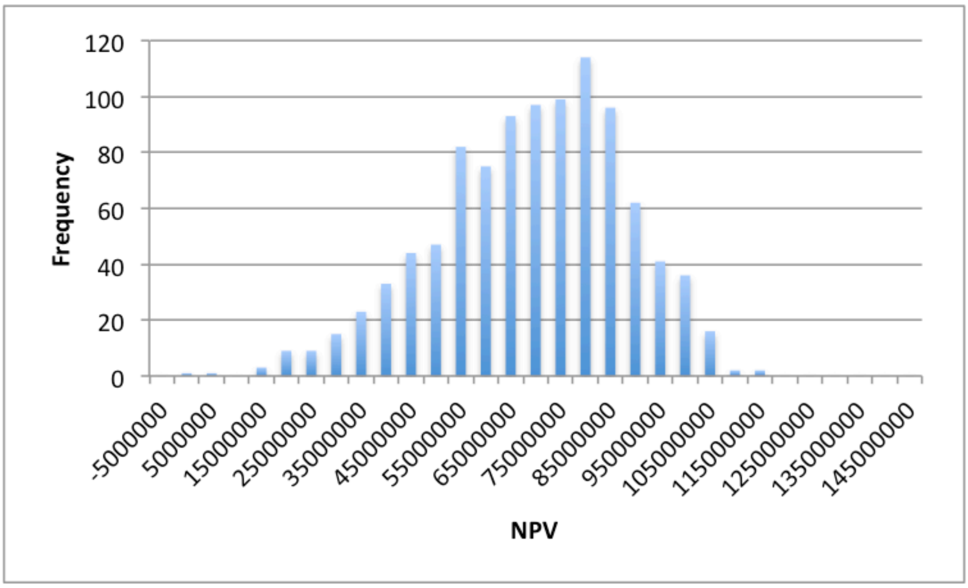

Figure 17: Frequency table of outputs NPV for the 1000 simulations with 9,2% discount rate

Next, the simulation assumed a discount rate of 7% with the same implementation as described above.

Table 17: Presentation descriptive statistics of the 1000 simulations based on annual wind estimated, with a 7% discount rate

Number of samples	1 000
NPV mean	151,6 MUSD
NPV Median	153,4 MUSD
NPV StD	20,9 MUSD
Min	72,5 MUSD
Max	200,9 MUSD
Skewness	-0,47
Kurtosis	0,14

This shows that the mean above the earlier estimates of the NPV at approximately 151 MUSD. Some of the same results as in the MCS above are found here. The median is higher than the mean, and the skewness is negative while the kurtosis is even higher in this sample. All of the results above are visible in the normal distribution and frequency graph.

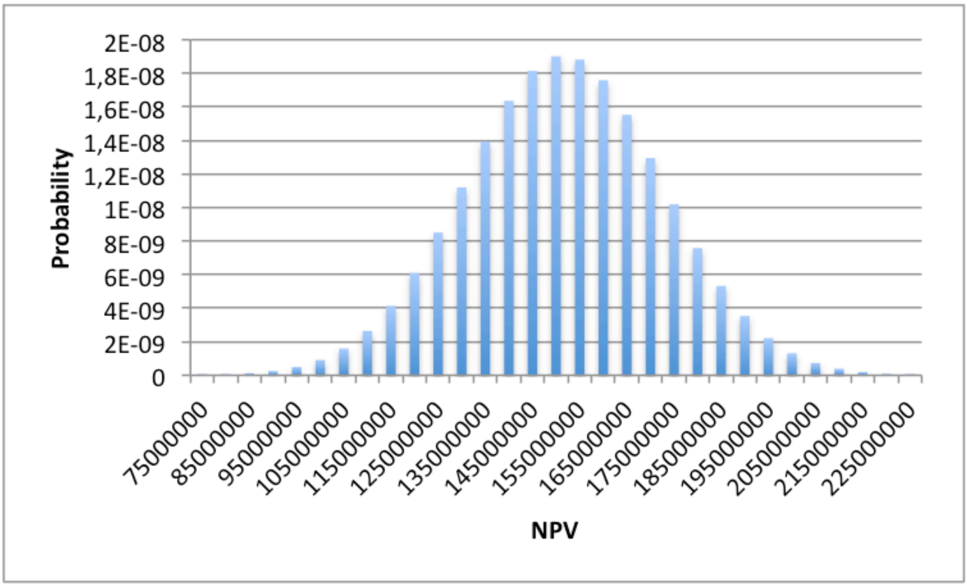

Figure 18: Normal distribution of the NPV for 1000 simulations with the 7% discount rate

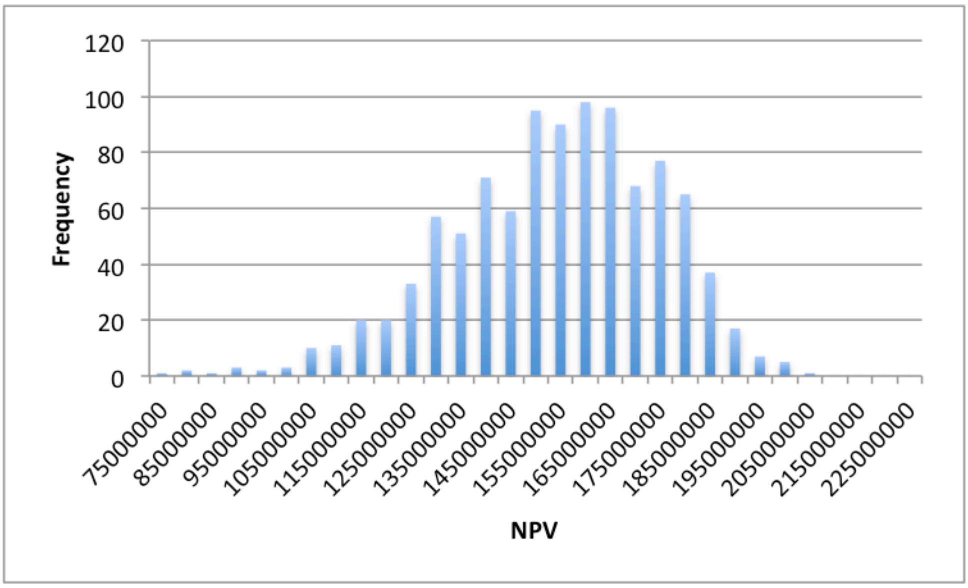

Figure 19: Frequency graph of outputs NPV for the 1000 simulations with 7% discount rate

The last simulation was made with a 12% discount rate, and this impacts the NPV negatively. The same procedure as described above is applied.

Table 18: Presentation of descriptive statistics of the 1000 simulations based on annual wind estimated, with a 12% discount rate.

Number of samples	1 000
NPV mean	-21,2 MUSD
NPV Median	-19,9 MUSD
NPV StD	16,6 MUSD
Min	-80,3 MUSD
Max	16,8 MUSD
Skewness	-0,50
Kurtosis	0,10

The mean in this simulation becomes negative, at approximately (-21 MUSD), and the financial loss can be significant. However, standard deviation is the lowest of the 3 simulations. This shows some of the same findings from the sensitivity analysis; that a decrease in the discount rate lead to a bigger change compared to an increase in the rate. Some of the same results as in the simulations above are found here. The median is higher than the mean and the skewness is negative. Further, the kurtosis is still above zero, but lower than the two previous cases. All of the results above are visible in the normal distribution and frequency graph.

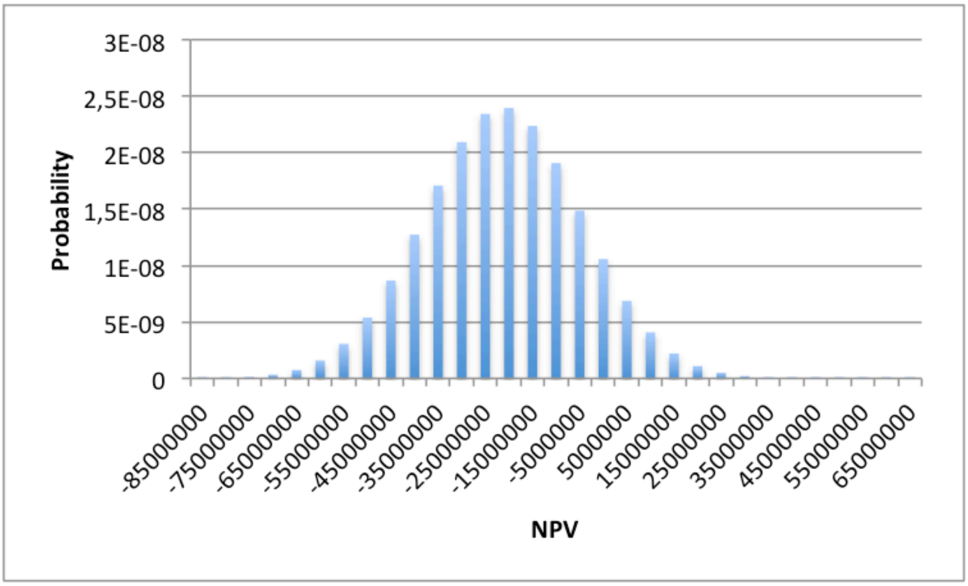

Figure 20: Normal distribution of the NPV for 1000 simulations with the 12% discount rate

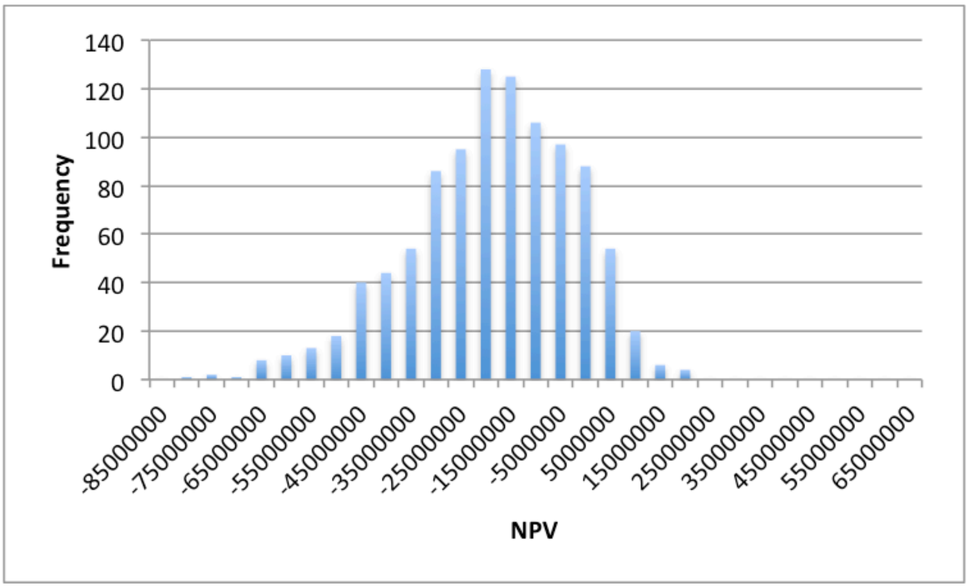

Figure 21: Frequency graph of outputs NPV for the 1000 simulations with 12% discount rate

Discussion

In this chapter I will link the theory applied and results, by addressing difficulties and shortcomings in the analysis. First I will discuss the costs and different options for hedging the risks in the estimates. Then I address the tariff and how it is implemented. Furthermore, I discuss the influence of production of electricity based on the annual wind. Further, the result from the MCS is addressed. Then, I recommend some strategies for improving the energy market in Pakistan, which can improve the country's attractiveness for investors. After that, I discuss findings by other researchers and how the results for NBT compare with these. Lastly, I present some possibilities for further studies such as real options, clean development mechanism and other investment options.

The costs are either estimated or contracted, and this opens for hedging and reduces the possible negative impact on the profitability. Based on the sensitivity analysis changes in the capital expenditure give the highest impact on the NPV. However, this is mostly a fixed price due to the EPC contract with GE Shengyang, which removes the risk of changes in this cost. Some of the additional costs such as bank fees and insurance are also contracted. Thus, the possibility of large changes in these variables is small. Further, operations and maintenance costs have a low influence on the NPV, meaning that a wrong estimation in this parameter does not have a high impact on the final decision. However, the CF does not account for a possible growth rate in this estimate. The tariff accounts for approximately 1,8 USD cents/kWh to cover the operations and maintenance costs and they are indexed to the PKR/USD exchange rate and the US CPI. Hence, they can change yearly or quarterly when the tariff is estimated. The last cost influencing the required rate of return on the estimation is the discount rate. The challenge when using theoretical models such as CAPM and WACC is that they simplify a complex financial world. In the process of simplification and adding practicality, the investors will establish their own best estimate of set of assumptions about the financial environment. The beta estimate is sensitive to outliers and individual stocks present unsystematic risk that can result in bias in the CAPM context. However, the beta estimate used in this assessment is approximately the same as the beta estimate found in Gjølberg and Johnsen (2007). Their real WACC, for wind power before tax, was estimated to 8,6% with a debt share of 0,4. Thus, they used implied a risk-free rate of 5%, which is higher that the value today. The investors will normally calculate a risk premium for their investments and consequently require assumptions based on a higher discount rate. This is especially crucial for the banks and financial institutions that may increase the interest rate on the loan to cover for the risk. However, through insurance policies provided by Sinosure and the incentives for the large investment banks this risk is reduced. Further, the debt level or gearing of the project influences the discount rate. In this case, the gearing is high and for further analysis the financial construction of the investment should be taken into account. A further assessment of the debt share in NBT might reduce the long-term share of debt. Lastly, due to the treatment of tax in the analysis there is no tax shield in the WACC. This might influence the base case NPV, however due to additional analyses of the profitability the difference has been be accounted for.

The tariff, as explained earlier, is built up by several different elements and is indexed. The tariff levels are, however, maintained constant in the analysis in order to simplify the estimations and the model. This simplification can provide imperfection to the NPV and could be partly the reason for the high static NPV. Further, if NBT AS does not reach financial close on the project by March 31st, 2015 there is a high probability that the contract with NEPRA will be changed. Depending on the level of "good faith", according to the agreement with NEPRA and what the government considers NBT to provide, there might be an extension of the deadline. With a new agreement in place, some of the conditions might change and the tariff will most probably be less favorable to the investor. Currently there is only speculation about the design of the new tariff. The degree of reduction in the tariff is something NBT has to consider as significant risk to the profitability. For the Government of Pakistan it is important to proceed with the wind farm project due to the power shortage in the country and their credibility of attracting foreign direct investment to the country. Because of the political aspect the deadline of financial close might be extended, but there is no guarantee this will happen. One of the risks of investments in developing countries is the high exposure to regulatory changes. This is a difficult risk to hedge especially since the government can void contracts and insurance companies are resistant to cover such regulatory changes (Henisz & Zelner 2010). However, it is a risk carried by all investors since the contract with NEPRA is a legislation and it serves as a standard for all wind power producers.

The wind estimates are uncertain due to relatively unpredictable weather conditions. The choice of windmills is based on the medium wind in the area. According to the article by Katsigiannis and Starakakis, mentioned in the literature review, the IEC II is a high standard for windmills. Their results showed a positive NPV for the areas with the same mean wind as NBT II and with the given classification. The production of electricity at the NBT II wind farm can meet the estimation level, but due to lack of capacity and congestion in the national and regional power grid, the distribution may be another limitation. In order to prevent a collapse of the transmission network the NTDC can issue dispatch notices leading to load shedding. Reducing the risk by dispatch notices is challenging. There is an amendment in the agreement with NEPRA specifying that NTDC should carry this risk and not the NBT II project, since the project cannot decide on the capacity expansion of the grid. As discussed earlier, the power purchaser does not have an impeccable reputation of paying its electricity generators on time, due to limited cash flow. A possibility for NBT to reduce that risk is by entering power purchase agreements specifically to high power consuming customers such as manufacturers and factories.

The MCS provide the investor with an improved picture of how the investment profile will change relative to annual wind. The distribution used for the wind estimates is normal distribution, for further analysis a Weibull or non-normal distribution could probably be more appropriate. The descriptive statistics for the base case in the MCS provides an assumption that the downside of the investment is higher than the upside relative to annual wind in the area. The reason for this finding is due to the tariff or price per kW being reduced when the capacity factor is higher than 31%. Based on these results the base case NPV of 100 MUSD might be too optimistic. As mentioned in the literature chapter, Spinney and Watkins discussed the problem of double counting the risk. Due to this the MCS is done based on three different discount rates. The real required rate of return (9,2%), the IRR (12%) and 7%. These estimates have similar results to the base case in respect to the larger economic downside compared to the upside of the investment.

The strategy for improving the electricity market in Pakistan contains several aspects, such as a wider base of energy sources, improvements on the transmission network and energy conserving initiatives. As mentioned earlier, there are several investment initiatives in different energy production facilities. Some focus on renewable energy while other use conventional fuels. A long-term perspective will have a positive weighting towards renewable energy, due to the reduction of CO_2 emissions, as reflected in the article by Amer and Daim(2011). The investments are all contributing to meeting an increasing gap between energy demand and supply in the market. One of the main investors in these developments is China. They have an interest in restructuring the transmission infrastructure in Pakistan due to the local cotton production. Further, they are one of the few investors with excess risk-willing capital. Another aspect to improve the energy sector is the possibility of incorporating smart grid technology into the transmission system, especially for the industry sector. A smart grid will make it easier for producers to analyze and forecast demand (Aslam et al. 2015). Further, it helps to implement renewable energy into the transmission grid. The recent launch of powerful lithium batteries created by Tesla can improve the use of renewable energy further. By storing excess energy when there is wind, and use it when there is low wind. Another positive effect of wind power is that it can decrease the burden of fuel price volatility. Followed by portfolio theory, renewable energy can be viewed as a possibility to expand the technology in the electricity portfolio. Other energy conserving measures may be to modernize and improve the distribution system by upgrading outdated transformers, cables etc. However, as Mirza et al. (2014) concluded, an increase in the energy prices will not be an effective method due to the negative influence on the GDP growth, they should rather focus on energy efficiency. The focus on improving the energy sector in Pakistan might attract additional investors, and can influence the NBT AS investment.

There have been several previous assessments of the profitability of windmill farms, and what impacts the investments. As mentioned in the literature chapter, previous master theses find a negative NPV in these investments. There are three main differences from the findings in this project compared to those. The first difference is the high tariff in Pakistan. They all comment on the possibility of a positive NPV if prices or subsidies were higher at the different investment locations. The second difference is that these analyses were done for offshore windmill projects, this is a newer technology and the capital expenditure is higher compared to onshore investments. The third difference is the discount rate. However, the discussion concerning estimated discount rate is presented above.

Another possibility to assess profitability of a project is through the implementation of real option theory. The analysis provides flexibility to the assessment of the net present value that other models fail to assess. However, the method is complex and even though it is popular in academic assessments, it is not often used in the corporate world. With the application of the real options model investors can value the project and its evolution over time. The method provides a value to waiting and gaining more information. The result from a real option valuation can give the go ahead on a negative NPV project (Hull, 2012). If the NPV show extreme values, either positive or negative, the addition of real options is probably not necessary. On the other hand, if there is a relatively small negative NPV the implementation of real options can provide a go ahead with the project. This assessment is not done in this paper. However, for the 12% discount rate assessment of the MCS with a relatively small negative mean NPV, it could be implemented and provided a positive value.

Clean Development Mechanism (CDM) issue a financial instrument called Certified Emission Reduction (CER) implementer under the Kyoto protocol. This allows developing countries to build sustainable energy projects by pricing the CO_2 emission they reduce. This market has taken a hard hit after the financial recession due to many credits on the market and low economic activity in Europe. Pakistan became eligible to issue such credits after signing the protocol in 2005 (Climate Change Division 2013). CER trading can be a significant source of income for many renewable energy projects and investments. It can be considered as an additional subsidy for the project. EWEA assumes an average reduction of 690g CO_2/kWh with wind energy compared to conventional fuels. For the NBT II project the estimated CO_2 reduction in a year is estimated below.

$$723{,}8\ GWh * 690\ g\ CO_2 kWh = 500\ 000\ tonnes\ CO_2$$

According to the Policy For Development Of Renewable Energy For Power Generations 2006(Government of Pakistan 2006), the income from CER's is shared between the Government of Pakistan and the NBT II project. It has not been taken into account in the assessment, since the evaluation of future market prices is a complex estimation due to changes in the market. As seen in the graph below, recent years have had a decrease in the price of the CERs.

Figure 22: Prices of carbon emission quotas measured in Euros. Source: investing.com

Another aspect that can be assessed further is the tariff level in Pakistan for different energy sources and for wind power investments in other developing countries. An economic evaluation of the different energy resources in Pakistan can provide an aspect of which energy source that can generate the highest NPV. For an investor, this has the value of estimating the best investment prospect and where they will get the highest return is obviously crucial. In addition, a comparison between wind investments depending country of contract, generates a decision tool where the investor has a wider understanding of the investment options. A common method of comparing investments in energy is through the levelized cost of electricity (LCOE). However, this tool should be used with discretion due to several assumptions in the calculation done by the assessment maker, such as expected future fuel prices, different use of real and nominal terms and differences accounting for subsidies and tax.

Conclusions

Based on the results from the net present value, sensitivity analysis and Monte Carlo simulation the investment appears profitable. The estimated real discount rate applied is 9,2%, providing a benchmark NPV of approximately 100 MUSD, while the Monte Carlo simulation average the NPV to 66,2 MUSD and standard deviation of 19 MUSD. This implies that the expected NPV should be closer to the Monte Carlo simulation estimate compared to the benchmark. The use of the three academic models makes the results applicable in real life. However, it is important to maintain a rational view of the risks involved, especially considering the sovereign uncertainty. Thus, this risk is in the discount factor with a high credit premium and liquidity premium. For further investigation the investor should assess the possibility of dispatch notices in case of bottleneck on the transmission system, the generation of income through Clean Development Mechanism and comparison between investment profiles. There are three main reasons to maintain the high tariff for wind power in Pakistan; more generation of electricity from a diversified portfolio of resources, focus on renewable energy due to pollution and the international investment focus on renewables.

As an external analyst the estimates and assessments has primarily external information as the main source of information. The analysis is based on a number of assumptions and expectations that can leave room for misinterpretations; hence the thesis provides an illustration of the investment situation. Thus, the results are reliable based on today's expectations and available information, and it appears profitable.

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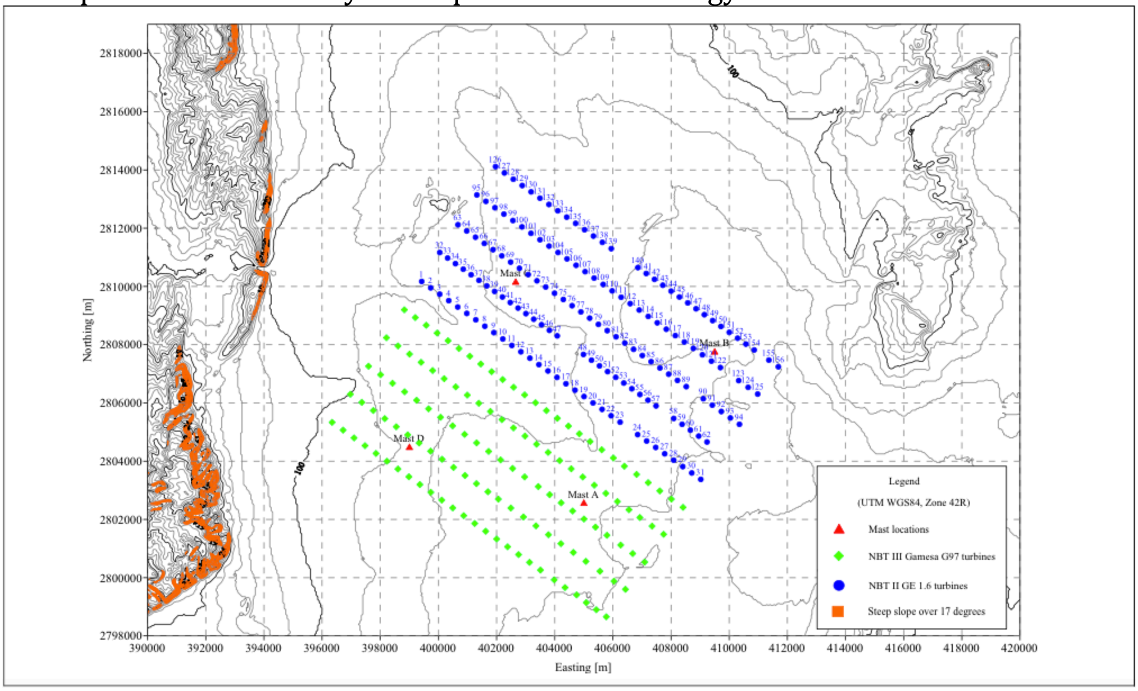
Appendix

1) Below is a map showing the 30,000 acres site terrain for NBT II (green) and NBT III (blue). The windmills are evenly distributed across the site and are located close to each other. The distribution of the windmills across the wind farm is a highly technical engineering solution. It is an important aspect in the efficiency of the production of energy.



2) Contract between NEPRA and NBT Wind Power Pakistan II (Private) Ltd. Opting for Upfront Tariff for Wind Power Projects. (Case No. NEPRA/TRF-290/NBT-II-2014) explaining the reference tariff per kWh. They index the operations and maintenance (O&M), return on equity, principal payment and interest on a quarterly basis. While the insurance is annually.

Years	O&M	Insurance	Return on Equity	Principal Payment of Debt	Interest	Total tariff (PKR)
1	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
2	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
3	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
4	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
5	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
6	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
7	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
8	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
9	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
10	1,6040	0,7833	4,6902	5,2331	3,2496	15,5602
11 to 20	1,6040	0,7833	4,6902	-	-	7,0775
Indexation	PKR/USD US CPI	PKR/USD	PKR/USD	PKR/USD	PKR/USD LIBOR	

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