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Executive MBA Mergers & Acquisitions

Valuation of a Wind Energy Firm Using Real Options Analysis: Evaluation of an Acquisition of a Firm

A Master Thesis submitted for the degree of
"Master of Business Administration"

supervised by
Univ. Prof. Dr. Thomas Dangl

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Affidavit

I, **Anand Subbiah**, hereby declare

1. that I am the sole author of the present Master Thesis, "**Valuation of a Wind Energy Firm Using Real Options Analysis: Evaluation of an Acquisition of a Firm**",
   58 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

Vienna, 22 June, 2009

Date Signature

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3 Abstract

This thesis examines the application of real options valuation and discounted cash flow to valuation of a wind energy company. Various valuation approaches are reviewed, and the uncertainties and risks in valuation, especially of wind energy systems, are examined. Real options and discounted cash flow valuation methodologies are applied to evaluate the acquisition of an American wind energy company by a European utility. The analysis is used to comment on the valuation of the firm and the acquisition price paid by the purchaser.

4 Executive Summary

This thesis explores valuations techniques and applies the methodology to evaluate the acquisition in 2007 of an American company by a European utility. Specifically, this thesis addresses the issue of overly optimistic and excessive valuations which are prevalent in the mergers and acquisitions of renewable energy firms. The analysis is used to comment on the valuation of the firm and the acquisition price.

Growing concerns about energy security and climate change, have spurred governments across the globe to develop policies that promote renewable and clean energy production systems and reduce carbon dioxide and other greenhouse gas emissions. Many counties have developed targets and enabling policies for renewable energy based electricity generation. Investors have been quick to respond, and there has been a surge of mergers and acquisitions (M&A) in the renewable energy sector, with many European utilities entering the US market. Valuations of renewable energy firms have been driven high by the promise of potential future benefits. There however are significant uncertainties and risks to renewable energy investments which make them difficult to evaluate. Also many transactions are taking place in large part due to favorable policies, subsidies and incentives, which can all be reversed. According to a survey conducted by KPMG and the Economist Intelligence Unit (KPMG, 2008), “valuations have continued to rise and there have been a number of deals recently completed where enterprise value per operating MW acquired has hit the US$ 4 - 5m mark, representing a willingness by many acquirers to pay significant premiums for their targets.” Compare these acquisition prices to the power generation development cost which typically ranges from US$ 0.75 - 2.0m per MW depending on the generation technology.

Goldman Sachs sold Horizon Wind Energy LLC to Energias de Portugal, S.A. (EDP), for a reported US$ 2.15 billion (KPMG, 2008)! Clearly the acquisition was made on the premise of an expected high future growth potential. This thesis examines and reviews conventional discounted cash flow (DCF) valuation and real options valuations (ROV) techniques to examine their applicability and limitations to valuing Horizon Wind Energy.

The methodological approach for this research was to review different valuation methodologies including DCF, relative valuation and real options analysis, and examine their applicability and suitability to evaluate renewable energy systems. This thesis was developed based on publicly available data for the firms and assumptions where no data was available.

DCF and real options analysis techniques were applied to value Horizon Wind Energy. Decision tree analysis and the Black Scholes model were used for the real options analysis. The valuation analysis conducted using the DCF analysis resulted in firm value which ranged from negative to about $620 m. The decision tree analysis using a replicating portfolio that would result in the same returns as the investment asset resulted in a value of $1,906 m. The Black Scholes model resulted in a firm value of $1,414 m.

The valuation of the firm indicates that the purchase price paid for the firm was inordinately high. The rationale for EDP's acquisition and purchase price is not clear. Did EDP need to acquire Horizon to obtain a foothold in the US market? Did the potential synergies justify the price premium? This is not at all clear based on the information available for this deal. In the absence of detailed information on the specifics of this private acquisition deal, it is not possible to draw a definitive conclusion. But based on the discussion of uncertainties in wind farm development and the results of the DCF and real options analysis conducted in this thesis, it appears that EDP paid too high a premium for the acquisition of Horizon Wind Energy. It is thus critical when valuing renewable energy firms to carefully examine all available data on the transaction, reviews risks and uncertainties, and apply different valuation techniques. Different strategies for developing market penetration and market share including the option for direct entry should be carefully weighed against the option to acquire an existing wind farm.

5 Introduction

This thesis was prepared in compliance with the requirements for award of the MBA in Mergers and Acquisitions degree by the Technical University of Vienna. This thesis explores valuations techniques and applies the methodology to evaluate an acquisition of a company which develops wind farms in the US. Specifically, this thesis addresses the issue of overly optimistic and excessive valuations which are prevalent in the mergers and acquisitions of renewable energy firms. Conventional and real options valuation techniques are applied to the acquisition in 2007 of an American wind energy company by a large European utility. The analysis is used to comment on the valuation of the firm and the acquisition price.

6 Structure of the Report

The first section of this thesis describes the research hypothesis and the methodology used for analysis. The next section provides a brief overview of valuation methodologies in the context of the research hypothesis. The following two sections discuss issues, challenges and uncertainty in valuations with specific focus on uncertainty in the valuation of wind energy systems. The potential synergies from the acquisition of wind energy firms is discussed next. The following two sections describe the acquisition of the wind energy firms and the valuation analysis conducted for this thesis. The last section provides conclusions, lessons learned, and implications for acquisitions of renewable energy firms.

7 Background

Growing concerns about energy security and climate change, have spurred governments across the globe to develop policies that promote renewable and clean energy production systems that are sustainable and reduce carbon dioxide and other greenhouse gas emissions (GHG). The Kyoto Protocol[1], an international agreement linked to the United Nations Framework Convention on Climate Change, came into

[1] http://unfccc.int/kyoto_protocol/

force in 2005 and set binding targets for many industrialized countries and the European community to reduce GHG emissions. National policies have followed in support of this larger objective, and power and heat generation from fossil fuels has especially been targeted given that it contributes almost a quarter of all GHG emission (IEA, 2008). Many counties have developed targets for renewable energy based electricity generation to meet carbon emission goals towards developing a low carbon economy. Europe has been a market leader in the drive to reduce GHG emissions, and developed the EU Emissions Trading Scheme (EU ETS), which started on January 1, 2005 and capped emissions from companies in specific sectors in all EU countries. Power generation is a key sector of the economy in which emissions are capped and specific targets have been developed for renewable energy in the total energy generation mix. This has resulted in a spurt of activity over the last few years with significant investments in renewable energy generation systems and renewable energy technologies. Technologies which are well proven but were not previously commercially or financially viable have gained the attention of policy makers and investors alike. Driven by the impetus of climate change and their obligations and emission targets, countries have established a broad swathe of policies to support the development and installation of renewable energy systems. Investors have been quick to respond, and a large number of wind, solar, biomass, biofuel, small hydro, tidal wave systems, amongst others, have been installed globally. Clean energy generation from advanced clean coal technologies, waste to energy projects, hydrogen based fuel cells, etc, have also found favor.

The spate of development of the renewable energy sector has led to a large number of mergers and acquisitions in the energy sector with many large utilities, especially in Europe, acquiring renewable energy companies to rebalance their generation portfolio and reduce carbon emissions. Given the global nature of the energy industry, many acquisitions are made in countries across the globe to benefit from reductions in carbon emissions and to capitalize on attractive renewable energy policies and prospects. For instance, investments in renewable energy have been made in Asia, South America and Africa to benefit from the Clean Development Mechanism (CDM) which allows "emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one ton of CO2. These CERs can be traded and sold, and used by industrialized countries to a meet a part of their emission reduction targets under the Kyoto Protocol."[2] The US is not a signatory to the Kyoto Protocol and does not participate in the carbon trading market. However, many states in the US have established very aggressive targets for the development of renewable energy power generation projects to reduce emissions and have developed enabling policies to promote renewable generation. Utilities and firms have developed renewable energy plants, notably wind, to benefit from these policies. This has attracted many international utilities to the US market with the hope of getting in on the ground floor of what could potentially be a large and lucrative market in the future. Acquisitions of renewable energy companies are on the rise, and this has led to certain exuberance in the market and some overly optimistic valuations.

This thesis considers the acquisition of a US wind energy company by a European utility and examines the valuation and purchase price of the firm as a means of exploring the application of valuation techniques to renewable energy companies and comments on the value created for the purchaser.

8 The Research Hypothesis

The compelling demands of energy security and impacts of climate change demand action, and renewable energy systems address both issues. However, for several reasons including the relatively low load factor of typical renewable energy systems[3], the distance of renewable energy sites from load centers, the relatively higher cost of installation, the relatively low cost of energy, and the difficulty in dispatching intermittent power, generally make renewable energy systems less financially

[2] http://cdm.unfccc.int/about/index.html

[3] Renewable energy power plants are not "available" for 90+% of the time like conventional fuel power plants. Wind farms, for example, produce power when there is adequate wind and solar plants produce power only when the sun is out. A coal plant on the other hand is operational for over 90% of the time and is down only for planned or unplanned shutdowns. The load factor of the power plants is defined as the actual generation to the installed generation capacity.

attractive as an investment compared to conventional fuel power plants. Conventional pricing of fossil fuels does not impute an environmental cost on them and thus the environmental benefits of renewable energy systems is not typically valued in the pricing structure. The market for renewable energy systems is thus very much dependent on enabling policies that mitigate some of the commercial obstacles. The concerns over climate change and its social and health impacts have spurred policy shifts, provision of incentives and subsidies, and carbon emission pricing mechanisms through trading, which have all provided a welcome boost to the inclusion of a greater proportion of renewable energy systems in the overall generation mix. These market changing factors have spurred new investments in renewable energy generation, and there has been a surge of M&A activity with conventional energy firms, financial investors, private equity firms, and others acquiring renewable energy firms. There are however significant risks to renewable energy investments given that they are taking place in large part due to favorable policies, subsidies and incentives.

8.1 Uncertainties in valuation of renewable energy firms

Valuations in M&A transactions for renewable energy firms have been extremely high driven by a promise of potential future benefits. Investment in renewable energy systems is however fraught with risks which go beyond traditional risks for conventional power systems, and this makes valuation of renewable energy firms difficult. There are a number of uncertainties in the primary drivers of renewable energy systems which exist for both manufacturers of equipment for renewable energy systems, and to developers of renewable energy generation plants. These uncertainties make it difficult to value either kind of firm. That is not to say that the value of such firms cannot be estimated. The caution is that one needs to be aware of the underlying uncertainties so that valuations are conducted appropriately. The uncertainties in valuing renewable energy firms are discussed in greater detail later.

8.2 M&A in the renewable energy market

The risk factors significantly impact the commercial growth of renewable energy systems and its potential to capitalize on the expectation for high future growth. This also raises serious questions relating to the valuation of renewable energy systems in M&A transactions.

According to a survey conducted by KPMG, M&A activity in the renewable energy sector was up 47 percent in 2007 from 2006, with transactions amounting to US$ 55.7 billion (KPMG, 2008). While this enthusiasm for acquiring renewable energy firms is wonderful news for alleviating energy security and climate change concerns, the same KPMG survey of energy experts and firms indicated that 50 percent of all respondents, and nearly two-thirds in Europe, agreed that there is a real risk of a market bubble in the renewable energy sector.

Indeed, according to the survey conducted by KPMG and the Economist Intelligence Unit, "valuations have continued to rise and there have been a number of deals recently completed where enterprise value per operating MW acquired has hit the US$ 4 - 5m mark, representing a willingness by many acquirers to pay significant premiums for their targets." This is very significant. Compare these acquisition prices to the power generation development cost which ranges from US$ 0.75 - 2.0m per MW depending on the generation technology; Wind energy generation system costs range from 0.9 – 1.5 m per MW. It is thus clear that firm valuations in renewable energy systems are very high and acquirers are betting on an expectation of future high growth prospects and returns fueled by favorable enabling policies.

8.3 The research problem

This research topic was selected based on the author's knowledge of the energy industry. Specifically the interest in examining valuations for renewable energy systems was spurred by research conducted by the author to develop a business plan for a client to develop a new multi-billion dollar Energy and Environmental Business Unit and the proposed acquisitions. In the course of researching acquisition opportunities in the renewable energy sector, the author learned about the acquisition of an American wind energy company by a Portuguese utility. An analysis of the purchase price for this acquisition is the basis for this thesis

The investment bank, Goldman Sachs, invested an unpublished amount in 2005 in a small American wind energy developer called Zilkha Renewable Energy. The firm was renamed as Horizon Wind Energy LLC[4] and was sold in 2007 to Energias de Portugal, S.A. (EDP), for a reported US$ 2.15 billion (KPMG, 2008)!

An article in the New York Post (NY Post 2006) reported the then impending sale of Horizon Wind Energy LLC. The paper had obtained a copy of the sales memorandum for Horizon Wind and reported that Goldman Sachs was marketing the company as capable of generating US$ 800 million in EBITDA by 2011. According to the Post article, a more conservative valuation would have projected EBITDA of around $400 million. To estimate the projected EBITDA, Goldman had reportedly made optimistic assumptions regarding the additional wind generation capacity to be added in the US and Horizon's share of that total capacity. At the time of the sale, Horizon had about 924 MW of wind generation capacity under operation. In 2008 when research for this thesis was initiated, the firm had about 1,256 MW under operation (implying an estimated EBITDA of under $200 million). To derive an EBITDA of $800 million by 2011, the company would need to have about 5,000 – 6,000 MW in operation. For this new additional capacity to be operational by 2011, the firm would have to start installing these plants by 2010. Regardless, of the firm's ability to make such large capacity additions in a relatively short time period, the purchase price of US$ 2.15 billion indicates a very high multiple of EBITDA. Clearly the acquisition was made on the premise of an expected high future growth potential.

To materialize the high growth in a short time period, the firm will need to garner a huge share of the expected annual growth in wind energy in the US market. Its ability to do so is not certain given that the transmission capacity in the US is constrained and a very large number of wind projects are on hold and are awaiting investments in transmission systems, which is not forthcoming. Also, the wind energy manufacturing facilities have a 2+ year backlog on orders for wind generators and related component systems.

[4] www.horizonwind.com

This thesis examines the acquisition of Horizon Wind Energy LLC by Energias de Portugal, S.A. for US$2.15 billion as an example to explore issues related to valuation of wind energy systems (and renewable energy systems in general) in view of the risks and uncertainties of the market place and the policy environment. The thesis reviews conventional discounted cash flow (DCF) valuation and real options valuations (ROV) techniques to examine their applicability and limitations to valuing Horizon Wind Energy. Based on this analysis, broad conclusions are drawn on issues related to valuation of renewable energy systems.

8.4 Methodological approach to study

The methodological approach for this research was to review different valuation methodologies ranging from DCF to real options methodologies, and to examine the applicability and suitability of these methodologies to an industry which at present is nascent but is expected to boom in the future (much like the earlier boom in the internet-based industry, with the exception that renewable energy systems are based on actual fixed assets), apply DCF and ROV valuation methodologies to the acquisition of Horizon Wind Energy LLC by EDP, and examine if the firm was valued reasonably.

Some of the key methodological issues examined in this research include:

- Which valuation methodology is appropriate? And what are the drawbacks or advantages of different methods?
- Development of a β for CAPM analysis for an industry sector where little historical information is available
- Issues in estimating continuing/residual value where conventional growth rates are not available and the investment rate is dependent on many uncertain market factors
- Comparison of firm valuation with acquisition price
- Implications for valuing renewable energy firms

8.4.1 Data used for analysis

This thesis was developed based on publicly available data for Horizon Wind Energy LLC and EDP and for other renewable energy firms and related electric utilities. Data pertaining to firms was collected through company websites and analyst research reports were obtained through industry contacts. Required data was obtained from annual reports, financial statements, available analyst reports, academic literature on valuations, textbooks on valuations, related literature on wind and other renewable energy systems, and the course work material provided during the MBA class. No proprietary information was used in this research.

8.4.2 Summary of results

The key results of this research are:

- Narrative on investing in renewable energy systems under uncertain conditions, acquisition strategies, and risks and opportunities
- Narrative on the applicability of various methodologies and their advantages and drawbacks when applied to renewable energy systems
- Valuation of Horizon Wind Energy LLC
- Comparison of firm valuation with acquisition price
- Implications for valuing renewable energy firms

9 Approaches to Valuation of Assets

Valuation of any asset whether it be a stock or derivative in the financial and commodities market or a physical asset such as an investment project, hinges on knowledge of the sector and technology and some key assumptions which necessarily need to be made regardless of the valuation methodology used. Several valuation approaches are available and the suitability of a particular approach to a given situation depends very much of the underlying asset and its characteristics. The most common approaches to valuation are:

- Discounted cash flow valuation (DCF) – which relates the value of an asset to the present value of the expected future cash flows from the asset

- Relative valuation approach – which uses benchmark values of other known and similar assets to value an asset.

- Real options valuations – which values flexibility and thus places a premium on the valuation of an option which can be put off or even abandoned depending on market conditions.

The above three approaches are briefly discussed below. The description of these approaches draws from the materials presented in the MBA class and from the 4th edition of Valuation: measuring and managing the value of companies (McKinsey and Company, 2005). The description of these approaches is not meant to be exhaustive and serve primarily as an overview of the valuation approach. These standard evaluation approaches are described extensively in the literature.

The application of these approaches to valuing renewable energy firms and especially to the valuation of Horizon Wind Energy is discussed later.

9.1 Discounted cash flow model

The discounted cash flow (DCF) approach is a robust and tested approach that can be applied to a variety of situations. Applying the DCF approach requires the estimation of the cash flows from an asset, the discount rate, and knowledge of some of the principle value drivers of a firm – the growth rate, the return on invested capital, and the rate of investment. The relevant cash flows to be used in the analysis varies: for example, the model may use free cash flow, the capital cash flows, or adjusted present value, etc. The discount rate varies with the cash flows used in the analysis. Financial statements of a firm can be rearranged to obtain the inputs needed for the analysis. But financial statements provide actual historical data and not data for future years. It is thus necessary to forecast the relevant cash flows into the future to value the underlying asset. For stable firms with several years of available historical data, the future performance of the firm can be forecast on the basis of past performance and management plans for the future. Forecasting is possible for a few years into the future, but the same value drivers cannot always be used into the distant future to forecast long term performance. It is thus common to estimate a continuing value of the firm or asset beyond the explicit forecast period. Judicious application of the DCF approach provides reasonably good estimates of the value of the firm. The value of a firm can be estimated as:

$$V = \sum_{t=1}^{n} E(FCF_t) / (1+WACC)^t + RV / (1+WACC)^n, \text{ where}$$

E(FCF) are the expected future cash flow value of the firm over the explicit forecast period.

WACC is the weighted average cost of capital, and

RV is the residual value of the firm beyond the explicit forecasting period.

This approach while straight-forward is not easy to apply to firms that do not have adequate historical data or have complex multi-holding firm structures that makes application of the DCF complicated. Again, the literature on this subject is quite exhaustive and can be used to obtain relevant cash flows for the future.

A difficult task is to reasonably estimate the weighted average cost of capital or the WACC for the project. The WACC is defined as:

$$WACC = kd * (1-t) * D/Vl + ke * E/Vl, \text{ where}$$

kd = market cost of debt

ke = market cost of equity

D/Vl = Target level of debt to enterprise value using market based values

E/Vl = Target level of equity to enterprise value using market based values

Vl = Market Value of the firm (Levered)

t = tax rate

Application of the WACC presents its own set of difficulties given that the market cost of equity and debt is generally not known and has to be estimated. The market cost of debt for a stable and highly rated company is generally equal to the long term bond rate in the market. Similarly market values of like firms can be used to estimate the cost of equity. For below investment grade projects and assets, the market cost of equity is estimated using the Capital Asset Pricing Model (CAPM):

$ke = rf + \beta\, [E(rm) - rf]$, where

ke = cost of equity

rf = risk free rate (such as long term treasury bond rate)

$[E(rm) - rf]$ = market risk premium

β = sensitivity of the stock return to market return

The β if not known, is generally estimated from the value of similar firms. It may be necessary to estimate the levered or unlevered β and estimate the actual β based on the expected capital structure. Alternatives exist to the CAPM model, but these are not discussed here.

The next challenge is to reasonably estimate the residual value of firms beyond the explicit forecast period. The residual value of the firm is critical to valuation since it reflects the value the firm is expected to provide in the future beyond the explicit forecast period. The residual value is estimated as:

$RVT = NOPLATT+1 * (1 - g/RONIC)/(WACC - g)$, where

RVT = Residual value at time T

NOPLATT+1 = NOPLAT at T+1

g = expected long term growth rate

RONIC = Expected return on new invested capital

WACC = weighted average cost of capital

The critical part to estimating the Residual Value is making reasonable estimates for all the inputs required for the analysis. The growth rate and the RONIC are especially critical. The RONIC should be consistent with expected competitive conditions given the industry market conditions. The growth rate is harder to estimate, and here too it may be necessary to examine the growth rate for the industry as a whole. For instance, when valuing an energy business or asset, it is important to note that the energy industry has historically exhibited a growth rate of about 8% over a 40 year period. So, it is unlikely that in a commodities market other firms will be able to sustain higher growth rates for an extended period of time. Another important consideration is that the growth rate cannot be higher than the WACC in the long run. A growth rate higher than the WACC would result in a negative residual value. Also a company cannot grow to infinity at a rate greater than its cost of capital. So under a constant growth model, a company's growth rate cannot be higher than the WACC.

There are variations to the DCF model and these include:

- Capital cash flow valuation model
- Adjusted present value model
- Economic profit based valuation model
- Discounted dividend model

The primary difference in these approaches is the cash flows used in the analysis and the WACC used to discount the cash flow to obtain the present value.

The Adjusted present value model is especially useful since it does not require the discount rate to be changed for changes in the capital structure of a firm. The APV model is discussed again later in the context of its applicability to valuing renewable energy firms which do not grow gradually but make lumpy investments.

9.2 Relative Valuation

Relative valuation, as the name implies, uses indicative values and ratios of other similar firms to value the firm in question. It is thus crucial that the comparable firm be chosen carefully to ensure that it closely reflects the conditions of the firm under analysis. It may be necessary to control for factors that might affect ratios and multiples. Multiples such as earnings multiples, book value multiples, and revenue multiples, etc. are commonly used in such valuations.

Relative valuation is especially useful for valuing private firms for which little or no reliable data might be available publicly. It is also useful to use relative valuation to cross check values obtained through other valuation techniques.

9.3 Real Options Valuation

Every investment opportunity has options associated with it; the investor may choose to invest or not invest based on various market factors and other considerations. Many projects which may exhibit a negative present value may still be attractive for the investor from a strategic standpoint. The traditional DCF model does not explicitly account for such options analysis. For instance, if a company expects the market for communications products to grow rapidly contingent on the development of a key processor required to ramp up speed of data transfer, the company may wish to make the initial investment needed to prepare for the expansion but not actually finance the expansion till such time that it knows for certain that the processor required for the expansion will be developed as planned. In the case of renewable energy systems, investors may be reluctant to make investments till there is clarity in favorable tariff policies or carbon credits, or a host of other factors necessary to capitalize on an expected future growth. It would be very useful in such instances if the company could await the development of conditions necessary for it to rationalize the investment decision. Real options analysis provides for such informed valuation decisions to be made by investors. There is a value to the option of waiting to make a decision. Thus while the net present value (NPV) may be negative, the investor may prefer to estimate a contingent NPV which includes the option to wait to make the decision. Real options analysis is thus an invaluable tool for making decisions in many situations where the underlying factors for investment are not quite clear and rather than reject the project outright based on the negative NPV, the investor may prefer to strategically invest to obtain the option to make further investments if conditions turn out to be favorable. Of course there is also a cost of delaying the decision and potential loss of returns, and these should be subtracted from the benefits accruing from the option to delay. The longer the option period, the higher is the value of the option. Conversely short period options are less valuable since they do not provide the investors with the flexibility they seek. Similarly assets with high volatility are higher value options than those of lower volatility.

Real options analysis, as may be surmised from the name, came from valuations of financial products such as stocks and bonds and other derivatives. In all such financial instruments, it is common for investors to have a call or put option which provides them the right, but not the obligation, to purchase or sell an asset at a predefined strike price if the product value increases or decreases. Real options valuation is a subject of extensive research and volumes of literature are available on the subject. A brief description of real options analysis is provided in this section as an overview and precursor to our discussions on its applicability to value renewable energy firms. Again, this descriptions draws from the materials presented in the MBA class and from the 4th edition of “Valuation: measuring and managing the value of companies” (McKinsey and Company, 2005), and “The Dark Side of Valuation” by Ashwat Damodaran (Damodaran, 2001)

Some of the strategic decisions faced by investors when making investment decisions are; should they:

- delay the project
- abandon a project
- temporarily shut down a project
- expand a project
- change the project

The investor might wish to obtain clarity and wait till such time that conditions are favorable before making the investment.

A principal difference between the DCF model and the real options model is that the DCF model discounts the expected cash flows from a project using the risk adjusted discount rate, whereas the real options analysis discounts the certainty equivalent of future uncertain cash flows using the risk free rate.

The certainty equivalent model thus equates the certain returns from an investment with uncertain returns from the project. The other advantage is that it uses the risk free rate to discount the certainty equivalent cash flows and thus there is no need to compute the WACC as in the DCF model.

Real option pricing models use a replicating portfolio to mirror the returns from the project and thus value the project. Thus in effect, the returns from the underlying asset can be equated to the expected returns from a portfolio of financial instruments such as stocks and bonds which result in the same return. The option would by extension have the same cost as the cost of the replicating portfolio. The replicating portfolio is made up of say shares of a security and bonds which is the equivalent of saying that an investor buys a certain number of stocks by shorting bonds (borrows money) to obtain a financial return equal to the return of the option to delay the project.

The value of a project with flexibility can also be estimated using a decision tree analysis. In a decision tree the contingent NPV at a decision node is calculated by discounting the NPV at the next node. Thus the analysis moves backwards in time from the last node or transaction to the earlier nodes.

In general the decision tree analysis is simpler to implement and used for valuing assets which have diversifiable risks and the real options method is better applied to assets which where the risks are non-diversifiable.

The difficulty with the decision tree approach is to estimate the appropriate WACC to be used at each node. Also, to develop a reasonable estimate of the underlying asset value, it is necessary to first develop a DCF model. Estimating the variance of the underlying asset's cash flow is also critical to the decision tree analysis.

The three commonly used real options pricing models are:

- Binomial model
- Black-Scholes formula
- Monte Carlo simulation

The three approaches are briefly discussed below. The implications for their application to valuing renewable energy firms are discussed later.

9.3.1 The Binomial Model

As the name implies, the binomial model uses a two-step decision process to evaluate an investment. Either the value of the investment goes up after one time period, or the value goes down at the end of the time period. The increase or decrease in the price of the underlying asset is determined by the volatility of the value of the commodity. The probability of the underlying assets value to move up or down can be estimated from the factor by which the value increases (or decreases) and the risk free rate. The up and down movements in the value of the underlying asset is estimated as:

$u = e^{\sigma\sqrt{t}}$ and

$d = e^{-\sigma\sqrt{t}} = 1/u$, where

σ is the volatility of the underlying asset value.

The probability of the asset value going up is calculated as:

$p = (1+r_f-d)/(u-d)$, where

r_f is the continuously compounded risk free rate

Note: the continuously compounded risk free rate is calculated as ln(1+r)

And the probability of the asset value going down is calculated as 1-p.

If the analysis is extended to a second time period, t_2, then at t_1 the value of the asset could once again go up or go down from both the nodes of time period t_1.

If S_u is the price when the value is up, it is calculated as S_0 * u. And S_{uu}, the price at node t_2 when the value is up, is calculated as S_u * u. Once the prices at each node are estimated the value of option is calculated at each node by back calculating from the next node and weighting them by the probability of the prices going up or going down (p or 1-p).

The value of the underlying asset is estimated at time period 2 and then time period 1 and finally at time period 0 to get the option/project value.

$V_u = \max(S_u - X, 0) + (q\ V_{uu} + (1-q)\ V_{ud}))/(1+r_f)$

$V_d = \max(S_d - X, 0) + (q\ V_{ud} + (1-q)\ V_{dd}))/(1+r_f)$

$V_0 = (q\ V_u + (1-q)\ V_d)/(1+r_f)$

9.3.2 Black-Scholes formula

The Black Scholes formula was developed to value European options which can be exercised only at maturity, but is applicable to other options such as American options which can be exercised at any time up to the time of maturity. The approach can be applied to an investment project in which the decision to expand or contract or abandon, etc., can be taken at any point up to the life of the option. The Black Scholes model does not require as many inputs as the binomial model (especially as the number of nodes increase), and has been described as a "limiting case of the binomial" model (Damodaran, 2001, pp365).

The Black Scholes Model estimates the value of the project through a stochastic process where the price follows a geometric Brownian motion with constant drift and volatility. The value of an option in the Black Scholes model is estimated as:

$d_1 = (\ln(S/X) + (r_f + 0.5\ \sigma^2) * t)/\sigma \sqrt{t}$, and

$d_2 = d_1 - \sigma \sqrt{t}$

The Black Scholes model assumes a normal distribution for asset price movements, and the value of the asset is estimated as:

$V = S\,N(d_1) - X\,e^{-r_f t}\,N(d_2)]$, where

S is the value of the underlying asset, and X is the strike price or investment needed.

9.3.3 Monte Carlo simulation

The Monte Carlo Simulation is used for more complex option or project pricing by simulating the distribution of underlying value under a risk neutral probability by generating a large number of underlying price paths (say, for example, the volatile price of oil). The price in each period is estimated as:

$S_{it} = S_{i,t-1} R$, where

$R = e^{r_f - 0.5\,\sigma\wedge 2 + \sigma Z}$, where

Z = a normally distributed random variable.

Once these values are estimated the price in each period, the Net Cash Flow, is estimated as:

$NCF = \max(S_{it} - X, 0)$, where X is the strike price or production cost in time period t.

Using the earlier example, the oil price for each sample path is then calculated as:

$V_i = \sum e^{-r_f t} NCF_{it}$ for all time periods.

The last step is to average the project value over all the sample paths as

$V = 1/N \sum V_i$ for all time periods.

10 Issues and Uncertainty in Valuation

Valuation is perhaps as much an art as a science. While robust and tested approaches are available to value firms and specific investments, the final valuation hinges on some key assumptions in analysis. Regardless of the approach taken – DCF model, relative valuation, real option analysis – the analyst has to make critical assumptions based on historical information on the firm or investment and available market information from similar firms or financial instruments, and general good judgment based on a clear understanding of the firm being valued.

In this section, a lot of questions are posed. The objective is to reflect on the sources of uncertainty in valuations and reflect the learning when valuing firms. The questions posed and the ruminations are based on an exploration of valuation techniques by the author of this thesis. These are not idle questions. It is critical to comprehend these issues to shape the use and interpretation of data from analysis and to value firms. These considerations are critical to the valuation of the wind energy firm which is the central focus of this thesis.

10.1 Sources of uncertainty in various valuation approaches

10.1.1 DCF valuation

Consider a DCF model for valuation of a firm. Historical financial statements can provide significant information for established firms. But the data may be difficult to interpret, especially for large firms with multiple products or services. Firm operations are dynamic and interactive and thus it might not be easy to clearly identify and quantify value drivers. Even for firms with single or few products and services, past financial statements might not clearly reveal value drivers. It may be necessary to probe into specific activities of the firm and the market conditions during that period to interpret the factors and outcomes which influenced the firms operations and growth. Of course, this task is made simpler for market listed firms for which a market value is available as a reference.

Assuming that markets are rational and get the price right, a firm's market value is a clear indication of its worth. But what about periods of tumult in the financial markets, such as at the present time? Do markets get the price right under such conditions? Does the general despair in the market distort the market's ability to value a firm? Clearly that is not so. Just as some firms are overvalued during market boom times, the market values of some firms must be getting dragged down during periods of market gloom. It might thus be necessary to examine market behavior balanced with market conditions to form an informed decision on market valuations.

What about firms that are not listed in the market? Again, robust approaches are available to value such firms using relative valuation techniques or a combination of various approaches. But the fact is that assumptions have to be made in such cases; assumptions which may be reasonable but are still subjective and thus a source for uncertainty.

Other sources of uncertainty abound. What about the key value drivers of a firm? It is critical to identify and quantify these value drivers to conduct valuations. But is there certainty in quantifying these value drivers and forecasting future firm performance?

The key value drivers for a firm are growth and return on invested capital (ROIC), and hence the Investment Rate (IR) of the firm. These value drivers are the basis for forecasting firm financial performance into the future (or an explicit forecasting period), and hence to estimate the free cash flows (FCFs) available to all debt and equity investors in a firm. But these value drivers are based on past performance, to the extent that reliable past performance information is available. Moreover, the value drivers are simply a numeric indicator – they do not reveal how value was achieved and what conditions were necessary to achieve that value.

Can it be assumed that the conditions which existed in the past and enabled the performance of the firm will continue into the future? That is to say, will the value drivers still accurately estimate future performance? Generally one would expect that to be the case in stable market and economic conditions. Of course, the future operational and business plans of the firm will influence how these indicators change.

Thus by carefully analyzing past performance in the context of the firm's own business plan and the market and economic conditions prevalent at the time, one could identify and quantify key value drivers. A careful examination of future business plans and expectations of market conditions will enable the judicious use of these value indicators to forecast firm performance during an explicit forecast period of say five years.

What about the long term forecast? DCF models estimate a “continuing value” for the firm beyond the explicit forecast period. The value drivers during the long term forecast could be very different from that during the explicit forecast period.

But here we have more certainty! We know from economic theory that in open competitive markets, the long term profits are driven down to zero. Even high growth companies which may have a competitive, first-starter advantage will lose this status in the long term when one would reasonably expect market dynamics to create competitive conditions which will crowd in other investors thus driving down profits – till such time that a new idea is championed by a market leader, and the cycle starts all over again.

Thus high growth rates cannot be sustained forever. But the long term growth rate is difficult to estimate. To estimate the growth rate for the future, it is important also to examine the growth rate for like firms and for the specific industry sector as a whole. The energy industry, for example, has historically exhibited a growth rate of about 8% over a 40 year period (McKinsey, 2005). While renewable energy companies might exhibit a higher growth, the sector as a whole will return to stable growth rates in the long term. Another important consideration is that the growth rate cannot be higher than the WACC in the long run. A growth rate higher than the WACC would result in a negative residual value. Also a company cannot grow to infinity at a rate greater than its cost of capital. So under a constant growth model, a company’s growth rate cannot be higher than the WACC.

The RONIC should also be consistent with expected competitive conditions. It is unlikely that any firm, especially an electric utility, will be able to continue to sustain a high ROIC. Given that the industry is very competitive and in many cases regulated, it is unlikely that the RONIC in the long run will exceed the WACC.

The estimation of the WACC is critical for DCF model valuations. A difficult task is to reasonably estimate the weighted average cost of capital or the WACC for the project. As previously discussed, the WACC is a function of the cost of debt and equity, the capital structure of the firm, and the marginal tax rate. The tax rate is the only certain parameter in this estimation! The cost of debt and equity to be used here is not based on the book value, but on the market value of debt and equity. The process for estimating the market value of debt and equity is different for investment grade rated firms. For instance, for an investment grade rated firm (BBB- or Baa3 or higher), the long term bond rate for the firm (or for a similar firm) may be used as a proxy for the market cost of debt. The market cost of equity should reflect the risk free rate, the volatility of the stock and the expected risk premium, and is estimated using the CAPM (Capital Asset Pricing Model). The long term Treasury bond rate is a good proxy for the risk free rate, and there are generally accepted spreads for the risk premium. But the volatility of the stock, or β, has to be estimated based on observed values in the market place. The greatest source of uncertainty in the estimated of the WACC is the assumption that the capital structure of the firm will not change going forward. Even if a firm has an optimal capital structure, the use of debt and equity is dictated by financial market conditions, the availability of cheap credit, the credit rating of the firm, the ability of the firm to service new debt, etc. It is thus conceivable that the firm will not maintain the same capital structure in the future.

10.1.2 Relative valuations

A relative valuations approach is simple to apply. The difficulty lies in identifying like firms that truly reflect the characteristics of the firm being valued. Even firms that are in the same manufacturing or service sector have a multitude of inherent differences which may cause them to perform differently. Of course, the assumption is that within a single open and competitive market, like firms will drive down profits and reach equilibrium. But that is not always the case since firms take strategic decisions to distinguish themselves from their competitors. While relative valuations using multiples is very useful, especially for valuing firms that are not publicly traded, analysts should exercise caution and judgment in interpreting the results based on the use of relative valuation techniques.

10.1.3 Real options valuations

As discussed earlier, the principle behind real options analysis and valuation is to create a replicating portfolio that will deliver the same return as the expected returns from the investment project. The approach is in many ways superior to the DCF and relative valuations approach. The fundamental concept in real options analysis is that the certainty equivalent of an uncertain payoff is the certain payoff that is as valuable as the uncertain payoff. But estimating firm valuations requires estimation of the volatility, σ, of the underlying asset value in the future. The volatility decides the factor by which the value of an asset goes up or down in any time period, and the probability of the value going up or down.

In the case of decision tree analysis, the main cause for uncertainty is the need to estimate a different WACC at each node that reflects the riskiness of the investment decision at that point of time.

11 What Makes Valuations in Renewable Energy Challenging?

Some relatively new industry sectors such as the internet businesses and old businesses like pharmaceuticals have a different dynamic altogether; they thrive on innovation and the ability to deliver exclusivity in the marketplace – an exclusivity which is protected by patents and knowledge. The utility sector is not one of those dynamic, high growth industries. Utilities, especially the generation of power is a staid and relatively stable business. That is not to say that there are no uncertainties. It is just that the volatility is relatively lower in the utility sector. The renewable energy sector is a bit distinct in that there is an expectation that future high growth prospects will deliver higher returns. For instance a year ago, massive investments were made in the biofuels sector in the US and Europe with the expectation that biofuels will increasingly substitute gasoline for transportation and the sector saw significant growth. This trend was later reversed when oil prices fell and displacement of food crops became a concern. There is a lot of investment in renewable energy in Europe driven by attractive feed-in tariffs and favorable policies. In the US on the other hand, the euphoria has somewhat dampened due to the low oil price and the lack of transmission interconnectivity for evacuating wind energy from remote locations to customer load centers (AWEA, 2007).

Valuations in M&A transactions for renewable energy firms have however been extremely high driven by a promise of potential future benefits. But investment in renewable energy systems is however fraught with risks which go beyond traditional risks for conventional power systems, and this makes valuation of renewable energy firms challenging. The associated risk and uncertainties make it difficult to value renewable energy firms, especially in the case of acquisitions where the benefit is expected to accrue from future expected growth than on past performance. The caution is that one needs to be aware of the underlying uncertainties so that valuations are conducted appropriately. Some of the key uncertainties in valuing renewable energy firms include:

- Policy & regulatory risks – the valuations of renewable energy firms hinges upon government policies which could change due to their political nature. For instance the adoption of an aggressive emission target to combat climate change or an aggressive renewable energy target greatly influences investments in renewable energy

- Subsidies and incentives – can be withdrawn at any time since these are political decisions which can be reversed at will. This can seriously impact the financial viability of renewable energy firms.

- Tariff risks – feed-in tariffs enforced by governments are frequently the reason that renewable energy is competitive with conventional sources of energy. While it is a wonderful incentive, a withdrawal of the favorable tariff can seriously impact revenues and returns on investment

- Oil price risks – when oil prices are high, renewable energy systems benefit (as they did when oil prices peaked at some $150 per barrel in 2008). But when oil prices drop, renewable energy systems are less attractive as an investment option and need subsidies and/or incentives to make them financially viable

- Technology risk – most renewable energy systems are based on robust and proven technology. But there could be severe technology related risks which could be unrelated to the operation of the system, and can impact the market for renewable energy systems. For example, the biofuels industry in the US and in Europe saw enormous investments from private equity firms and other investors. But an increase in food crop prices and the uncertainties related to the cost effectiveness of food-crop based biofuel (apart from sugarcane based biofuel production), brought the industry crashing

- Conventional utility risks – renewable energy systems are subject to many of the conventional risks faced by fossil-fueled plants. These include environmental clearances and permitting risks and construction delays, etc. In addition, renewable energy systems face uncertainty in power generation since they are dependent on a natural resource for fuel which is not always available (for instance, wind generators cannot produce power without adequate wind speeds, and any unforeseen change in wind speed can significantly impact the financial viability of the plant

- Paucity in transmission system – much of the transmission capacity in the US and Europe is at full capacity and unable to transmit additional renewable energy. Also many renewable energy plants are in locations far from customer load centers and there is no transmission capacity available to transmit this intermittent power. The lack of transmission capacity and the large investment needed in new transmission systems to evacuate renewable energy is proving to be a major constraint to development of grid-connected renewable energy systems.

- International treaty risks – the Kyoto protocol will terminate in 2012 and it is expected that it will be replaced by an equally strong or stronger treaty which will continue to impose carbon emission limits on more nations. The Kyoto Protocol gave rise to the emission trading market, the CDM and the Joint Implementation (JI) mechanisms as a means of monetizing the benefits of carbon emission reductions. The financial viability of several renewable energy projects hinges on the additional cash flow stream from carbon emission reductions. The lack of consensus on a new and enabling protocol emerging at the end of 2009 in Copenhagen could seriously limit these additional carbon fueled revenue streams

- Carbon prices – the price per ton of carbon on the EU ETS has seen vast swings as the price of oil changed, and the financial market crashed. The price of carbon on these trading platforms greatly impacts the development of renewable energy systems in developing countries where many projects are being installed to offset emission caps of EU countries. Even in the US market, the imputed price of Renewable Energy Certificates (RECs) can influence the economics of renewable energy plants

- US policy for climate change – the US is not a signatory to the Kyoto Protocol and is not a participant in the carbon markets. A climate change bill is currently being discussed in the US political arena. The passage or failure of this bill and the mechanisms it employs to monetize carbon emission reduction benefits, will have a huge impact on renewable energy investments and valuations in the US market

It is critical to be aware of the above discussed risks and uncertainties when valuing renewable energy firms, and to account for them in the valuation analysis.

11.1 Uncertainties specific to wind energy systems

Wind energy systems share with other renewable energy systems all the risks and uncertainties discussed above. Some uncertainties specific to wind energy systems include:

- Production Tax Credit – The US government provides a Production Tax Credit (PTC) to renewable energy power generators including wind energy generators. The credit amounting to 2.1 cents per kilowatt-hour has been essential to wind energy generation. This however is a political policy and is not written into law, and can thus be withdrawn at will. The policy is extended periodically for one to two years at a time. The policy was not extended and allowed to lapse in three different years. It has been empirically shown that wind energy generation in the

Western States of the US nose-dived each time the "Production Tax Credit" was not extended (Figure 1)

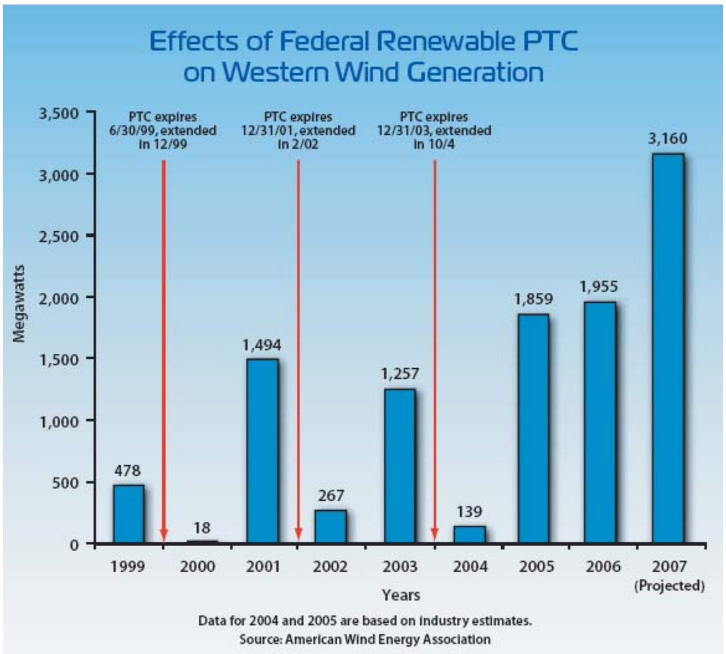

Figure 1: Effects of Federal Renewable Production Tax Credit on Western Wind Generation in the US. Source: American Wind Energy Association

- Land permitting and siting – individual wind energy generation towers do not require much land. However, large wind farms installations require a fair amount of land, which is not easy to lease in the US

- Societal objections – there is strong objection to installation of wind energy farms in the US. People just do not wish them in their backyards, and wind farm installations frequently find it difficult to lease the land required. Objections range from wind power structures spoiling the landscape, to destroying the view and impacting tourism, to killing birds. This is a serious risk for developing large wind farms in the US

- Distance from load centers & transmission constraints – wind sites with good generation potential generally are in remote or less populated locations and the power from these wind farms needs to be transmitted long distances to load centers. The transmission linkage required for this is weak or absent. It is estimated that almost 300,000 MW of wind projects in the US are currently awaiting grid connections (AWEA, 2009). The investment required for this transmission linkage is enormous. Further, getting rights of way to build transmission lines is in itself a problem! Thus, transmission capacity shortages are especially acute for wind energy farms.

- Manufacturing capacity shortages for wind energy systems – there are currently huge order backlogs for wind energy systems which may impede the expected growth of the sector. The large and reliable wind turbine and system component manufacturing facilities have order backlogs stretching up to 2 years or more. It is thus difficult to capitalize on market demand and install new plants at a rapid rate.

Valuation of wind energy generation systems should consider the above risks and uncertainties and factor these in estimating the volatility when evaluating future benefits.

12 What are the Synergies for M&A in Wind Energy?

The rationale for acquisition of a firm or an asset is that the investor hopes to obtain value from the deal and thus obtain a return on the investment which is equal or better than the return the same investment made in some other transaction would bring. Investors make acquisitions for various reasons and hence the returns they seek could be quite different depending on the investor’s perspective. While some may seek only short-term financial returns others may seek higher returns over a longer period of time, some may seek to enter into a market in which they do not have a presence, or believe that they can better manage the acquisition than the seller and thus obtain greater returns whether tangible or intangible. The reasons are many. But the basic objective in an acquisition or merger is to create and obtain value for both parties in the transaction, where the definition of the value is subjective and is defined by the interested parties.

The question in this thesis is; given that the purpose of an M&A transaction is to create value for parties involved in the transaction, why would an investor acquire a wind energy developer? Again, there could be many reasons. But one could expect that the principle reason to make the acquisition is to obtain value from the potential synergies (tangible and intangible) and to obtain a financial return on the investment. By acquiring an operational wind farm, the acquirer obtains:

- Additional revenue stream from the sales of electricity, and additional profits. The stability of this revenue stream would depend on whether the wind farm has a long-term power purchase agreement (PPA), which would ensure stable revenues, or sells power in the spot electricity market, in which case the revenues could be higher albeit with the risk of not being able to sell all available generation. The utility acquirer also could exploit synergies to bring down operational costs and increase profits

- Entry in to the renewable energy and wind energy market. The acquirer obtains the ability to develop and grow a new market and resource, and capitalize on any upside potential that may exist including entry in to a new country and serve as a launch pad for further acquisitions in wind and other renewable energy

- Risk diversification. The acquirer, especially another electric utility, can hedge its risks if it is overexposed to power generation from conventional fossil fuels. Oncoming regulation related to GHG emissions, or expected future increases in price and/or reduced availability of fossil fuels are causes for uncertainty which can be mitigated by making acquisitions in renewable energy plants.

- Social and corporate responsibility. Investing in renewable energy businesses could be a strategic corporate objective which also brings social benefits

The expectation of higher profits and prospects for future growth in renewable energy has created an appealing market for renewable energy firms and M&A in the business has been steadily going up. According to the KMPG survey (KPMG, 2008), there was a bubble in the acquisition price for renewable energy firms. But this was not unique to the renewable energy business. Up until early 2008, the exuberance in the global financial markets had pushed up valuations of many firms, and the steep increase in oil prices (up at $150+ per barrel) had especially boosted valuations for renewable energy firms. The availability of relatively cheap financing in the debt market further fueled the trend.

Regardless of the synergies and benefits to acquiring an operational renewable energy business, is acquisition the best option for entry, growth and value creation? To create real value, a firm should be able to increase the combined firm's cash flow after the acquisition and create long term value – the synergies have to come from increased revenues, or lower cost of capital, or higher margins, or more efficient capital utilization, or market power, etc. Could the same or greater value be created through independent development of a renewable energy portfolio? Does acquiring an operational company provide a strategic market advantage? Does the acquired firm have fully approved plans, land leases and permits to develop more plants? Does it have approved plant sites that have existing transmission capacity to evacuate power? Does the acquired firm have firm arrangements with equipment manufacturers for supply of equipment? Do the potential synergies from the acquisition justify the premium for making the acquisition? These are important issues to be addressed in making a decision to acquire a wind farm operator.

13 Acquisition of Horizon Wind Energy LLC

This thesis examines the acquisition of Horizon Wind Energy LLC by Energias de Portugal, S.A. for US$2.15 billion as an example to explore issues related to valuation of wind energy systems (and renewable energy systems in general) in view of the risks and uncertainties of the market place and the policy environment. This section describes the acquisition of Horizon Wind Energy LLC by EDP, provides background information on the firms involved in the transaction, describes the analysis conducted in this thesis, and presents the results of the analysis. Based on this analysis, broad conclusions are drawn on issues related to valuation of renewable energy systems.

13.1 Description of the parties involved in the M&A deal

13.1.1 Description of Horizon Wind Energy

According to the firm's website (www.horizonwind.com), Horizon Wind Energy develops, constructs, owns and operates wind farms throughout North America. The firm is based in the city of Houston in Texas, United States. Horizon presently operates some 2,000 MW of wind farms in the US.

Horizon has transitioned through several stages. The Company began in 1998 as a "build-transfer" developer known as Zilkha Renewable Energy. In 2005, the firm was sold to the investment bank Goldman Sachs, and the firm was renamed as Horizon Wind Energy LLC and operated as a "developer-owner-operator". EDP acquired Horizon on July 2, 2007. In December 2007, Horizon's ownership was transferred from EDP to EDP Renováveis S.A. ("EDPR"), a renewable energy developer and operator headquartered in Madrid, Spain.

Horizon hopes to capitalize on the favorable market for renewable energy systems in the US and continue to grow. The firm hopes that with the lowering of costs of wind energy systems, it will be in a position to grow faster.

13.1.2 Description of EDPR

EDPR is headquartered in Madrid, Spain. The firm designs, develops, manages and operates several renewable energy plants in Europe. According to the firm's website[5], the firm has first class assets and a sound development pipeline which have helped it grow rapidly. EDPR hopes to capitalize on the favorable market for renewable energy systems in Europe, the US, and elsewhere in the world to grow its business. The firm hopes to benefit from the improvements in renewable energy technology and lowering of technology costs.

EDPR is a subsidiary of Energias de Portugal, S.A. ("EDP"), the Lisbon, Portugal, headquartered vertically-integrated utility company. EDP is currently ranked third in

[5] www.edprenovaveis.com.

the United States in wind energy by net installed capacity. Through its various subsidiaries, EDP holds significant electricity and gas operations in Europe, Brazil, and the United States. In June 2008, EDP listed 22.5% shares of EDP Renováveis in an initial public offering on the Euronext Lisbon Stock Exchange, where it is the fifth-largest company by market capitalization.

13.1.3 Description of Goldman Sachs

The Goldman Sachs Group, Inc. is a leading global financial services firm. According to its website[6], the firm provides investment banking, securities and investment management services to clients that include corporations, financial institutions, governments and high-net-worth individuals.

Goldman Sachs purchased Zilkha Renewable Energy in 2005, and renamed it as Horizon Wind Energy LLC. In July 2007, Goldman Sachs sold Horizon to EDP.

13.2 The M&A deal

Goldman Sachs sold Horizon Wind Energy LLC in 2007 to EDP for a reported US$ 2.15 billion (KPMG, 2008)! Given that it was a private sale of a company that was not listed in the market, no information is publicly available about the sale transaction.

An article in the New York Post (NY Post 2006) reported the then impending sale of Horizon Wind Energy LLC. The paper had reportedly obtained a copy of the sales memorandum for Horizon Wind and it reported that Goldman Sachs was marketing the company as capable of generating US$ 800 million in EBITDA by 2011. According to the Post article, a more conservative valuation would have projected EBITDA of around $400 million by 2011. To estimate the projected EBITDA, Goldman had reportedly made optimistic assumptions regarding the additional wind generation capacity to be added in the US and Horizon's share of that total capacity.

[6] www2.goldmansachs.com

In 2007, Horizon Wind Energy[7], had about 924 MW of wind generation capacity under operation.

The sale price of $2.15 billion was a very high multiple of EBITDA. Clearly, there was very high expectation for the firm's potential to rapidly grow in the wind energy market in the US.

14 The Valuation of Horizon Wind Energy

Horizon was acquired from Goldman Sachs by EDP for US$2.15 billion in 2007. At the end of 2007, the firm had 924 MW of wind farms under operation in the US. In 2008 at the time the research for this thesis was initiated, the firm had 1,256 MW under operation (implying an estimated EBITDA of under $200 million based on typical tariffs for wind energy and EBITDA margins). To derive an EBITDA of $800 million by 2011, the company would need to have about 5,000 – 6,000 MW in operation. For this new additional capacity to be operational by 2011, the firm should have started installing these plants by 2008. Regardless, of the firm's ability to make such large capacity additions in a relatively short time period, the purchase price of US$ 2.15 billion indicates a very high multiple of EBITDA.

According to the American Wind Energy Association[8], the US added 8,500 MW of wind energy capacity in 2008, which was a record for any year. Capacity additions in 2009 are expected to be lower at about 5,000 MW. For Horizon to materialize the expected high growth in a short time period, the firm will need to garner a huge share of the expected annual growth in wind energy in the US market. Its ability to do so is not certain given that the transmission capacity in the US is constrained and a very large number of wind projects are on hold and are awaiting investments in transmission systems, which is not forthcoming. Also, the wind energy manufacturing facilities have a 2+ year backlog on orders for wind generators and related component systems.

[7] www.horizonwind.com

[8] AWEA website http://www.awea.org/pubs/factsheets/Market_Update_4Q08.pdf

The Horizon sale deal was transacted in mid 2007, before the crash in the global financial markets when market exuberance was still high. Oil prices were going up rapidly and even then energy analysts were predicting prices above $100 per barrel. There was high euphoria over the development of biofuels to replace gasoline use in transport. The year 2007 had seen wind energy capacity additions of some 3,500 MW, and there was investor interest to develop more. All these factors combined to give renewable energy including wind energy a big thrust in the US.

The focus of this thesis is on the valuation of Horizon Wind Energy, and to examine if EDP paid too high a price for Horizon.

14.1 Thesis Methodology

The methodological approach for this thesis research was to review different valuation methodologies ranging from DCF to real options methodologies, and to examine the applicability and suitability of these methodologies to a wind energy firm. The next step was to apply DCF and ROV valuation methodologies to the acquisition of Horizon Wind Energy by EDP, and examine if the firm was valued reasonably.

Several assumptions were made during the course of the analysis and these have been documented. In fact, given the difficulty extracting required data from Horizon financial statements published by EDPR, a simple cash flow analysis was developed for Horizon. Some of the methodological issues examined in this research include:

- Which valuation methodology is appropriate? And what are the drawbacks or advantages of different methods?
- Issues in estimating continuing/residual value where conventional growth rates are not available and the investment rate is dependent on many uncertain market factors.
- Adapting ROV techniques to valuing Horizon Wind Energy

14.2 Data for Analysis

At the time of its sale, Horizon Wind Energy was a private firm held by Goldman Sachs, and no information was available publicly on the sale transaction. Obtaining the sales memorandum for this transaction would have been invaluable in understanding the rationale for the expected growth prospects for the firm. This thesis was developed based purely on publicly available data for Horizon Wind Energy LLC and EDP and for other renewable energy firms and related electric utilities. Data was collected from company websites, and some analyst research reports were obtained through industry contacts. The data used in this analysis is from published annual reports, financial statements, available analyst reports, academic literature on valuations, textbooks on valuations, related literature on wind and other renewable energy systems, and the course work material provided during the MBA class. No proprietary information was used in this research.

14.3 Valuation approach and issues in valuation

The standard valuation approaches such as DCF models, relative valuation, and ROV have been described in earlier sections of this thesis. The suitability of a particular approach to a given situation depends very much of the underlying asset and its characteristics, data available for the firm or investment, and the analysts knowledge of the industry and ability to make reasonable assumptions.

This thesis applied the DCF and ROV approaches to valuate Horizon Wind Energy at the time of its sale in 2007 since the objective was to examine the reasonableness of the sale price. The description of how DCF and ROV were applied to value Horizon Wind Energy and the assumptions made in the analysis are discussed below.

14.3.1 DCF Valuation of Horizon Wind Energy

DCF analysis is a standard approach to valuing firms and can be applied to firms operating under a variety of conditions. The first step in the analysis is to estimate the cash flows from the firm. This analysis estimated free cash flows for Horizon to conduct the valuation, since these cash flows are available to both debt and equity holders of the firm. The general procedure is to take the financial statements of the firm and rearrange them to develop the free cash flow from asset operations. Financial statements for Horizon were obtained from the EDPR annual report (EDPR, 2007). The Profit and Loss Statement, the Balance Sheet and the Cash Flow Statement for Horizon were analyzed. Since the company was in private ownership prior to the sale, no financial statements could be obtained for earlier periods. The financial statements for the firm were rearranged in an attempt to obtain the free cash flow for the firm. Since the data was for only one period and no detailed notes were provided with the financial statements, it became impractical to use the data to develop reliable and meaningful free cash flows for the firm. Attempts to obtain other corroborating data for the firms were unsuccessful. It was thus decided to develop cash flow statements independently for the firm. This is not such a far fetched or difficult exercise for a stand-alone wind farm company. The operational revenues for a wind farm are easily predicted based on the installed capacity, assumed load factor, and tariff. Based on the installed capacity of 924 MW in 2007, the annual operational revenues for the base year were estimated using a load factor of 40%, which is typical for wind farms. The tariff was assumed to be $40/MWh, which was higher than typical for wind generation in 2007. In fact, the financial statements from Horizon/EDPR indicated that the tariff was much lower. Choosing a higher tariff for this analysis is thus conservative since it will only overstate, and not understate, the revenues and free cash flow. The EBITDA was assumed to be 85% which is not atypical for stable wind farms given that they have very little operational costs apart from maintenance costs which too are low. The EBITDA percentage chosen is in fact the target EBITDA for EDPR. Again, the selection of a higher EBITDA will only overestimate the free cash flow, which is a conservative approach to the analysis. Straight-line depreciation was assumed for the analysis. The tax rate was based on the standard marginal tax rate in the US and EU. Based on this exercise, revised free cash flow was developed for the firm. The reinvestment rates for wind farms is very predictable – reinvestments are only made to augment capacity, and these are predictable given that wind farms are added in "modules" of standard capacity, and no reinvestments are made in years with no capacity addition. If it were assumed that no capacity additions are made after the acquisition, the wind farm will be a stand-alone investment generating generally predictable revenues, especially since much of Horizon's generation is sold through long-term PPAs and not sold in the volatile electricity spot market.

It should be noted that to overstate revenues and cash flows is to be conservative in this analysis since that will only lead to a higher firm valuation. And since the comparison of the firm's valuation is being made with the sale price, overstating results a conservative approach to the analysis.

Next the free cash flows were forecast for an explicit forecast period of 5 years. The general procedure in a DCF analysis is to project historical cash flows to future years using the key value drivers as the benchmark for growth. The value drivers used in this analysis are the Return on invested capital, ROIC, the investment rate, IR, and the growth rate (which is the product of ROIC and IR). In the case of Horizon Wind, historical financial data was not available and thus it was not possible to make reasonable estimates of historical ROIC, IR and growth rate, and to forecast future free cash flows for the explicit forecast period. For instance, based on 2 years financial statements for 2006 and 2007 (reported by EDPR for Horizon), the estimated ROIC is either negative or just above zero and the IR ranges from 360% to over 84,000%. This is not unreasonable given that in the initial years, the firm may choose to make large investments in new capacity without having generated enough free cash flows and taking on additional debt. But the investments required for capacity expansion are huge and the revenues generated from increased power generation are not very large. But the large net investments made on an annual basis with very low increases in revenues, results in very large negative free cash flows during the explicit forecast period.

The continuing value or residual value of the firm is estimated using an assumed ROIC and growth rate. For this analysis, the ROIC is set equal to the WACC since no firm is expected to provide returns greater than the WACC in the long run, and the growth rate is set lower than the WACC, since a growth rate higher than the WACC would entail a negative value.

The WACC for Horizon was estimated as described earlier using the market value for debt and equity. Before the sale of Horizon, it was part of Goldman Sachs, which is AAA rated. After the sale, the firm was part of EDPR, which had above investment grade credit rating. The cost of debt for the firm can thus be estimated to equal the long term bond rate for the parent firm, which was 5%. The cost of equity was estimated using the CAPM model, where the stock volatility, β, was equated to the beta for electric utilities which is about 0.5. Based on a risk spread of 5%, the cost of equity was estimated to be 7.5%. An equity research report on EDPR prepared by the firm NOVA Equity Research estimated the WACC to be 7.16% (NOVA, 2008), which compares well with the estimated WACC.

Based on the estimated WACC, the free cash flows of the firm during the explicit forecast period and the estimated continuing value was discounted to obtain the expected present value of future benefits from the firm.

The large negative free cash flows during the explicit forecast period are not offset by the residual or continuing value of the firm, leading to negative net valuation of the firm. Therefore the purchase price of $2.15 billion is not justified. If it were assumed that the company does not undertake any investment for capacity addition and grows free cash flows grow moderately on an annual basis (say at 10%) due to tariff increases and/or other cost savings, the firm valuation is about US$620 million, which is far lower than the purchase price.

Considerations in DCF Analysis

There are several approaches to developing DCF models and these were tested during the research for this thesis. Also, there are certain features about wind energy systems that need to be considered when valuing it using DCF. These issues are discussed below.

Investments in a wind project are lumpy and it depends on when conditions are favorable and finances are available. A period of no growth may be followed by huge investments if the firm gets all approvals and clearances for a new wind farm. Thus the growth rate is more a step function than a linear function. Thus revenues and NOPLAT are stable till such time that an investment is made resulting in increased revenues, apart from any increases due to an increase in the tariff or improved load factor and hence generation. EDPR/Horizon sold 87% of all generation through long term PPAs making the revenues quite stable and not subject to the variances in the electricity spot market.

Instead of using the historical growth rate, the actual rate of growth of installed capacity can be used as a proxy to the growth rate since the revenues from unit installed capacity are quite predictable. The PPE can also be used as a forecast driver for firms which make lumpy investments.

Instead of ROIC, the Cash Flow Return on Investment (CFROI) could be used as the basis for making the financial projections. The CFROI is especially applicable for industries with long lived fixed assets (>15 years) and large fixed assets to working capital (McKinsey, 2006, pp 212-213) – conditions which are true for wind energy. In the CFROI approach, the IRR for the cash flow stream has three components – the initial investment, the annual cash flow and the residual value, where initial investment is gross invested capital in the prior period, the annual cash flow is NOPLAT plus depreciation, and the residual value is equal to the NOPLAT plus depreciation plus return of the original working capital. This approach was considered and applied as a variation to the standard DCF analysis. But it did not improve the valuation of the firm.

Another option is to use the Adjusted Present Value (APV) for the lumpy investment model. The APV methodology separates the value of operations into two streams: the value of the company if it were all equity financed, and the value of the tax shields due to debt. Rather than use a WACC, the APV explicitly measures the value of cash flow effects of financing separately.

14.3.2 ROV Valuation of Horizon Wind Energy

A real options valuation of Horizon Wind Energy was also conducted. The analysis was conducted using two approaches:

- Decision Tree Analysis
- Black Scholes Formula

As described in an earlier section, the principal difference between the DCF model and the real options model is that the DCF model discounts the expected future cash flows from a project using the risk adjusted discount rate, whereas the real options analysis discounts the certainty equivalent of future uncertain cash flows using the risk free rate. A principal advantage of real options analysis is that it allows investment decisions to be made on a contingent basis ensuring that investments are made only if certain conditions are satisfied. Thus applying real options analysis to the purchase of Horizon Wind Energy, the buyer could model the growth and value of the firm on a contingent basis assuming that investments for future capacity addition would be made only if conditions for investment were favorable. If for example, the tariff were to decrease or if the installation cost increase over a specified time period and the return on investment is low, new investment would not be made. If on the other hand conditions were favorable for investment in wind farms, the firm would decide to make investments to add capacity. This approach provides investors with flexibility to make better informed investment decisions.

In the case of Horizon Wind Energy, EDP, the buyer, would first evaluate the value of the firm based on the existing wind farm capacity and its potential to generate cash flow. The next step would be to value the firm with the option of making investments for capacity additions. EDP would make these investments in capacity addition only if conditions for developing wind farms were favorable in the future. To obtain this flexibility in investment decisions and benefit from increased future cash flows, EDP may have been willing to pay a premium on the seller. But is the purchase price with the implicit premium justified?

To answer this question, an analysis was conducted using the decision tree analysis and Black Scholes model. Horizon at the time of its sale was expected to grow rapidly and capture a large share of the new wind farm installations in the US. Acquiring an experienced wind farm operator such as Horizon Wind Energy would provide EDP an entry into the potentially lucrative US wind energy market. But it was also likely that the investment environment for wind farms in the US could change for the worse, and the firm could perform poorly. The real options analysis would allow the buyer to examine if the premium demanded for the purchase of the firm was justified based on probable increased future cash flows, which would require additional investments to be made. The real options analysis was used to value the firm with the flexibility of making conditional future investments. If the expected firm value with option to expand results in a positive net present value, the purchase would be justified. If the value of the firm with the expansion option does not justify the purchase premium, the purchaser would be paying a high price.

Decision Tree Analysis

The procedure for developing a decision tree is straight forward. The first step is to estimate the present value of the project without flexibility in making future investment or strategic decisions. The present value of Horizon Wind Energy is the discounted future cash flows expected from the investment. This first step assumes that EDP purchases Horizon with an installed capacity of 924 MW and makes no additional investments to augment capacity till such time that conditions are favorable and the returns are attractive. The NPV of this investment is quite simply the discounted cash flows from the 924 MW under operation. This first step draws from the DCF valuation without additional investments.

The next step is to model the uncertainty and the resultant cash flow in an event tree which has no decision nodes. Based on an estimated volatility, the cash flows in each time period are estimated using a probabilistic approach that dictates that at each node the cash flows can increase or decrease as a function of the volatility. The probability of the asset value increasing or decreasing is a function of the volatility and the risk free rate. Using the formulas described earlier, the factors by which value goes "up" and "down" at any given node were estimated based on a volatility of 25%. The volatility captures a whole host of possibilities – change in tariffs and installation costs, PTC offered or withdrawn, carbon credits available or not, etc. To be conservation in the analysis, a relatively high volatility of 25% was assumed (volatility in the utility sector, especially electricity generation, is generally low). The risk free rate was assumed to be 5%. The probability of an "up" or "down" movement at each node was calculated using the formulas described earlier. The event tree was constructed over a period of four time periods, T_0 to T_3. (Figure 2)

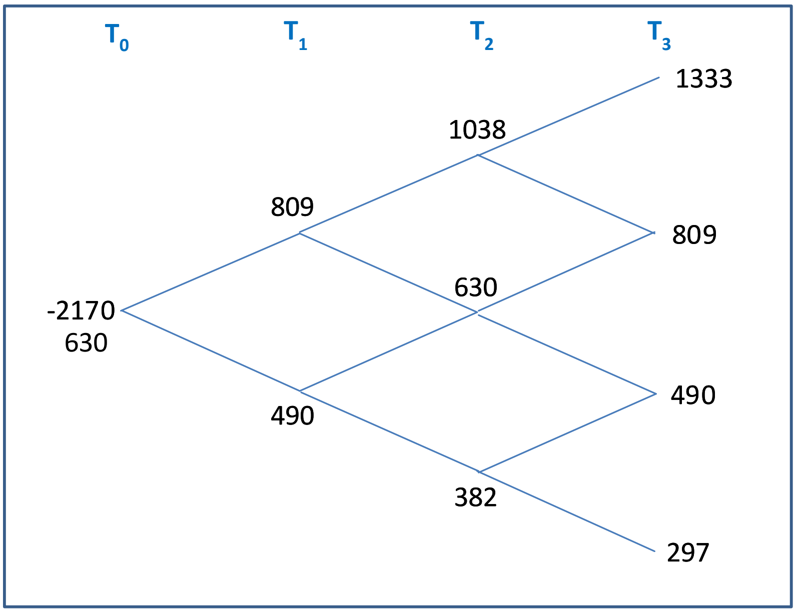

Figure 2: Decision Tree Analysis – Firm Value without Flexibility

To value to firm with the flexibility of making additional investments in capacity addition and increase cash flow, it is assumed that at each node a decision for additional investment is made to add wind farm capacity if conditions are favorable for investment. To create a favorable investment environment, it was assumed that increases in tariff PTC and/or carbon credit would increase the effective tariff by 50% and the installation costs would reduce by 20%. This optimistic view to create a favorable investment environment is a conservative assumption. The increased cash flows and the PV at the last node, T_3 is recalculated as shown in Figure 3.

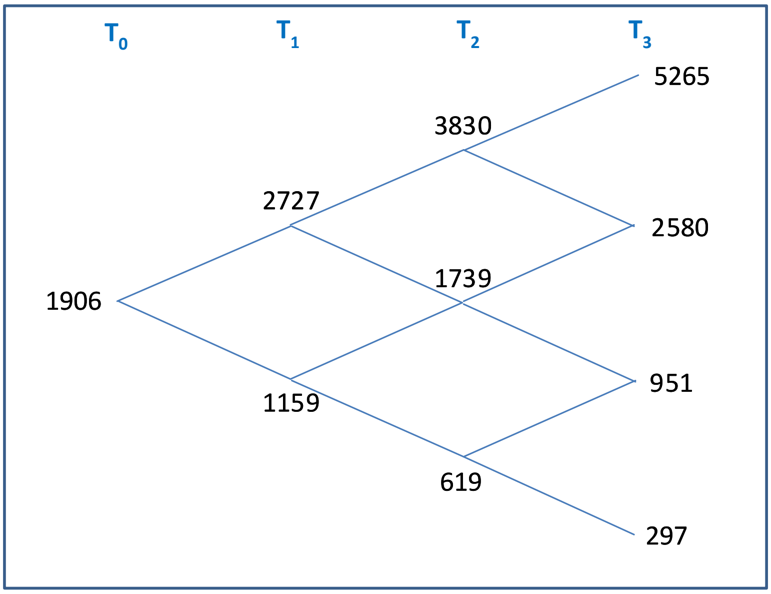

Figure 3: Decision Tree Analysis – Firm Value with Flexibility

The next step is to move backwards from right to left recalculating the value at each node based on the value of the "up" and "down" movements in the subsequent node. This calculation as described earlier could be considered as a parallel to buying a replicating portfolio of N shares and selling B bonds in an investment which mirrors the return from the underlying asset.

For example, since the PV at T_3 at the uppermost two nodes is 5,265 and 2,580, the PV at the previous node is calculated as:

1333 N + 1.05 B = 5265, and

809 N + 1.05 B = 2580

Solving for B & N, we get

B = -1491

N = 5.12

That is to say the return is equivalent of borrowing 1491 bonds of $1 each to purchase 5.12 stocks of the underlying asset. Thus the PV at the previous node is estimated as:

PV = 1038 N + 1 B

PV = 3,830

Working backwards the PV is recalculated at each node. It is important to note that new investments are made at each node only if the PV with the flexibility is higher than the PV without the flexibility. Thus for example, at the bottom node at T_3, no new investment would be made since the PV with the investment is lower than the PV without the investment.

The PV of the firm at T_0 is recalculated to be equal to 1,906 as opposed to 630 from the DCF analysis. Thus the value of the flexibility to expand is 1,276 (the actual value of flexibility is higher still since the DCF PV with investments in capacity expansion is negative). But despite this improved NPV which reflects additional wind farm capacity added at each node when conditions are favorable, the NPV of $1,906 m is lower than the purchase price of $2,150 m and thus does not justify the purchase premium.

A different approach to the calculation would be to use the WACC to discount the PV from one node to the previous node. But the difficulty with that option is that the WACC would have to be re-estimated at each node to reflect the riskiness of the decision at that point of time.

Black Scholes Formula

The Black Scholes formula as described earlier can be applied not just to value call and put options but also to value investment projects in which the decision to expand or contract or delay or abandon, etc., can be taken at any point up to the life of the option. The Black Scholes model is applied to value Horizon Wind Energy with the option to make future investment decisions if conditions are favorable.

Assuming a favorable investment climate (which is a conservative estimate), it is assumed that Horizon is able to add 5,000 MW over 3 years after acquisition (at the time of the transaction it was assumed that Horizon would add substantial new capacity each year and ramp up to 6,000 MW from its pre-sale 924 MW capacity). It is important to note here that while option value increases as the time horizon to exercise the option increases, it is unlikely that Horizon will have a long term advantage in developing the wind farm market in the US.

Applying the formulas for the Black Scholes model described earlier, the PV of the firm is based on the cash flow generated from the additional capacity installations and the strike price is equivalent to the installation cost for additional capacity. Volatility is assumed to be 25%, consistent with the volatility chosen for the DTA analysis. The annual risk free rate is assume to be 5% and the life of the option is considered to be 3 years.

The Black Scholes valuation of the firm with the option to expand is estimated at $1,414 m, which is much lower than the purchase price of $2,150 m and thus does not justify the purchase price premium demanded by the seller.

14.4 Results of analysis

Horizon Wind Energy LLC was valued using the DCF and real options methodology. The real options analysis was conducted using a decision tree approach and the Black Scholes model. All the valuations were below the purchase price of $2.15 billion indicating that the purchase price paid by EDP was too high.

The rationale for EDP's acquisition and purchase price is not clear. Did EDP need to acquire Horizon to obtain a foothold in the US market? Did the potential synergies justify the price premium? This is not at all clear based on the information available for this deal. Horizon was operating wind farms with installed capacity of 924 MW at the time of the purchase, and it was expected that it would rapidly expand its presence in the US wind energy market to gain a large market share. But as discussed earlier in this thesis, there was no clear advantage that EDP would have acquired from the purchase. Given the volatility in the wind energy market and the constraints and uncertainties in developing the market, EDP could perhaps have developed wind farms in the US without acquiring Horizon. Even considering that the acquisition gave EDP an advantageous market entry in the US wind market, why should the firm pay a large premium for the purchase? The expected additional capacity additions will require large investments to be made, and there were no guarantees that Horizon would be able to capitalize on its market presence to gain a huge market share in the future. The analysis shows that even if Horizon were to capture a large market share and grow as forecast by the seller, the firm valuation and purchase premium was not justified. EDP should have valued Horizon based on its installed capacity and expected cash flow and paid a much smaller premium for gaining a foothold in the US market through an experienced wind farm operator.

In the absence of detailed information on the specifics of this private acquisition deal, it is not possible to draw a definitive conclusion. But based on the discussion of uncertainties in wind farm development and the results of the DCF and real options analysis conducted in this thesis, it appears that EDP paid too high a premium for the acquisition of Horizon Wind Energy.

Some important lessons learned from this analysis include:

- It is critical that valuations be conducted carefully and thoroughly regardless of the valuation approach used
- The uncertainties in renewable energy systems should be identified and explicitly accounted for in the valuation
- Think carefully about the potential synergies of an acquisition and examine if these will actually materialize. And if they do materialize, will the firm be in a position to exploit and act on the synergies?
- Electricity generation is a staid business, and irrational expectations for the growth prospects of firms should be carefully weighed against market and economic conditions and risks
- It is important to make assumptions that are reasonable and conservative
- There are advantages and disadvantages to the use of each valuation technique, and not all approaches are suitable for all types of investments or projects
- It is important that more than one valuation method be employed for an investment or project. Within a valuation approach there frequently are options to conduct the analysis in different ways – for instance, there are different types of DCF analysis and different cash flows that can be used in the analysis

- The option of market entry through direct entry should be considered if there are no market barriers to penetration

15 Conclusion

Horizon Wind Energy was acquired by EDP for $2.15 billion in 2007. At the time of its acquisition, Horizon had some 924 MW of wind generation capacity. The hypothesis for this thesis was to examine if the purchase price was reasonable.

Several valuation techniques were reviewed including DCF and Real Options Theory, and their applicability to a wind energy system was examined. The uncertainties in valuation were examined in the context of renewable energy systems in general, and wind energy systems in particular. Financial statements for the firm were obtained through company websites. Analyst reports and other pertinent data were obtained through web searches and industry contacts.

Various valuation techniques were applied to the transaction making reasonable assumptions where required. The valuation of the firm indicated that the purchase price paid for the firm was inordinately high. Even gaining the potential synergies from the acquisition does not justify the premium paid.

It is thus critical when valuing renewable energy firms to carefully examine all available data on the transaction, reviews risks and uncertainties, and apply different valuation techniques. Different strategies for developing market penetration and market share including the option for direct entry should be carefully weighed against the option to acquire an existing wind farm.

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