Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 79 (2015) 1054 – 1060

Energy Procedia

2015 International Conference on Alternative Energy in Developing Countries and Emerging Economies

Projected Business Risk of Regulatory Change on Wind Power Project: Case of Spain

Gyanendra Singh Sisodia[a*], Isabel Soares[b], Paula Ferreira[c], Sanjay Banerji[d], Rajiv Prasad[d]

[a]*Amrita School of Business, Amrita University, Coimbatore, India; and FEP, University of Porto, Porto, Portugal*
[b]*CEFUP & FEP, University of Porto, Porto, Potrugal*
[c]*DPS, University of Minho, Guimaraes, Portugal*
[d]*Amrita School of Business, Amrita University, Coimbatore, India*

Abstract

Regulatory uncertainties have often posed a business risk to renewable energy investors. Energy regulations in Spain were recently revised in June 2014. The objective of this study is to analyze the 50 MW wind power project under revised framework. The project is evaluated using NPV with risk and real options method through Monte Carlo simulations. As a part of this study, five scenarios were evaluated. The base scenario, "Business As Usual (BAU)" consist of recent framework that was into place, just before the new regulation was announced. The other scenarios (including newly introduced framework) were compared to the BAU. We have focused on "delay" option for the current scope. The overall results of the study suggest a negative NPV under the revised framework, with significantly higher delay value. From the results, it is advisable to delay the project. The paper presents the policy implications under scenarios selected in the papers. The article also presents the policy implication for developing countries. The study also served as the learning for developing nations from European Union states.

Peer-review under responsibility of the Organizing Committee of 2015 AEDCEE

Keywords: Regulatory uncertainty; business risk; project evaluation; renewable energy support schemes; renewable energy; wind power

* Corresponding author. Tel.: +32-46555-8968.
E-mail address: singh_gis@yahoo.co.in, ss_gyanendra@cb.amrita.edu.

Peer-review under responsibility of the Organizing Committee of 2015 AEDCEE
doi:10.1016/j.egypro.2015.11.608

1. Introduction

The tentative investment requirements for any of the projects may be mostly valid in the context of specific policy under which the investment is made. If the firm perceives the regulatory uncertainties as adversely affecting the firm's profitability, the firm may refrain from investing in such projects [1]. This study is in the context of current regulatory change that Spain has announced in June 2014 for renewable energy projects. According to the revised framework, the regulatory period for the wind power project is reduced from 20 years to 6 years. After the regulatory period is over, the project can sell wind electricity at market price. World's largest renewable energy company, EDPR[†] has estimated a loss of Euros 30 million in operating under revised framework. This study throws light on the business risk associated with medium sized, 50 MW wind power project. In Europe, feed-in tariffs, feed-in premiums, renewable certificates etc. support renewable energies. The major focus of the current study is to put forth the fluctuations in monetary profits due to changing feed-in tariff policy. The main objective of the study is to evaluate the project through traditional methods, NPV, given by Fisher (1907) [2] and through the real options approach introduced by Black and Scholes (1973) [3]. The main research question asked through this study is: Given the present policies, is it better to delay the project? To address this question, we studied following two scenarios: Scenario 1 (Base Scenario)

According to the pre-revised Spanish framework, renewable electricity generation is supported through feed-in-tariff at the rate of 73.2 Euros/MWh for the maximum of 20 years; after which, the rate is reduced to 61.2 Euros/MWh. Our assumption is that on an average 1,00,000 MW of power can be generated, and 100% is fed into the grid. However, there can be fluctuations in the wind generation, because of technical faults, or if the wind does not blow in particular months. Therefore, a power output range of 90,000-1,10,000 MWh is considered. It is also assumed that wind generator need not pay any tax on selling of electricity.

Hypothesis 1: Compared to new regulation, business risk under the pre-revised Spanish regulatory framework for wind project is less.

1.1. Scenario 2 (Spanish renewable electricity regulatory changes

Scenario 2 is based on the tentative post-revised regulations that were introduced in Spain in June 2014. The major change that took place in the new regulatory framework is the reduction of FIT (feed-in tariff) to six years. FIT includes electricity at market price, plus 50% of clean energy premium. After a regulatory period, operator can sell the electricity at the market price only. Range of minimum and maximum generation is defined, under which the projects will be eligible for FIT. We assume that for the six years the generators are eligible for FIT.

Hypothesis 2: Under the post-revised Spanish regulatory framework, business risk for wind energy project is high.

2. Data and Methodology

2.1. Data and assumptions

A 50 MW (39 units of 1.3 MW) wind power project was studied in the current context. Wind towers were considered to be installed at optimal elevation where it can receive optimal wind speed for electricity generation. Factors such as steel cost, site, and labor cost etc. can affect installation cost. Per

---

[†]Please refer edpr.com

megawatt installation cost considered in the study ranged from 1.2 and 1.8 million Euros/MWh‡ with the average of 1.5 million Euros. The assumed cost consists of labor cost and other costs, including official/regulatory formalities. The project is considered to be irreversible in nature (with a life of 25 years), that requires at least 4 years setup period before it can generate electricity, with no salvage value at the maturity of the project.

Cost associated with the leasing of land was estimated to be Euros 1,00,000 per year with an annual increment of 10% after every fifth year. Operations and maintenance cost is estimated to be 13.91 Euros/MWh with fluctuation of 12.51 to 17 Euros per MWh. Staffing and insurance are assumed to be 3,05,932 Euros per year with the increment of 10% after every fifth year. Present value (PV) factor ranging from 2-5% are considered; in the most likely case PV factor of 2.5% is taken. Assumptions that we have considered were similar to the assumptions that were made by Monjas-Barroso & Balibrea-Iniesta (2013) for evaluating wind power projects in Denmark, Finland and Portugal [4]. The average market prices of electricity in Spain were obtained from MIBEL§

Table 1: Table showing the major inputs to the project

Variables	Value
Total investment estimation without subsidy (E)	(75000000)
Installation cost Euros per MWh	1500000
Capacity in MW	50
PV factor	2.50%
Project life time(t) in years	25
O & M per MWh	13.91
Volatility(σ)	20%
Risk free rate(r)	5%
Dividend rate(δ)	4%
leasing per year in Euros per year @10%increment after every 5th year	100000
Staffing and insurance per year @10%increment after every 5th year	305932
Energy produced MWh per year	100000
Electricity selling price Euros per MWh with standard deviation of 16.71 Euros per MWh	46.16
Selling price with subsidy Euros per MWh	Market price +50% premium over market price

2.2. Methodology

With the above-mentioned data and assumptions, the project under two scenarios was evaluated through this study. We evaluated the project through NPV (with risk factors) and through a real options approach (with “delay” and “expand” option). The methodology for the study is mentioned in a methodology flow chart (fig. 1).

‡ The prices range considered were influence from IRENA.Org report downloaded from http://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-WIND_POWER.pdf

§ Average electricity price two years (2012 and 2013) were obtained from Mibel data available at http://www.mercado.ren.pt/

We used existing models used in other studies (Black and Scholes, 1973; Santos et al., 2014; Michalidis, 2009; Boomsa et. al., 2012) to address our study [3][5][6][7]. Input values with varying risk parameters (under assumptions) were considered for modelling the business risk. For, the modelling purpose, a trial version of @Risk software developed by Palisade (2000) was used [7].

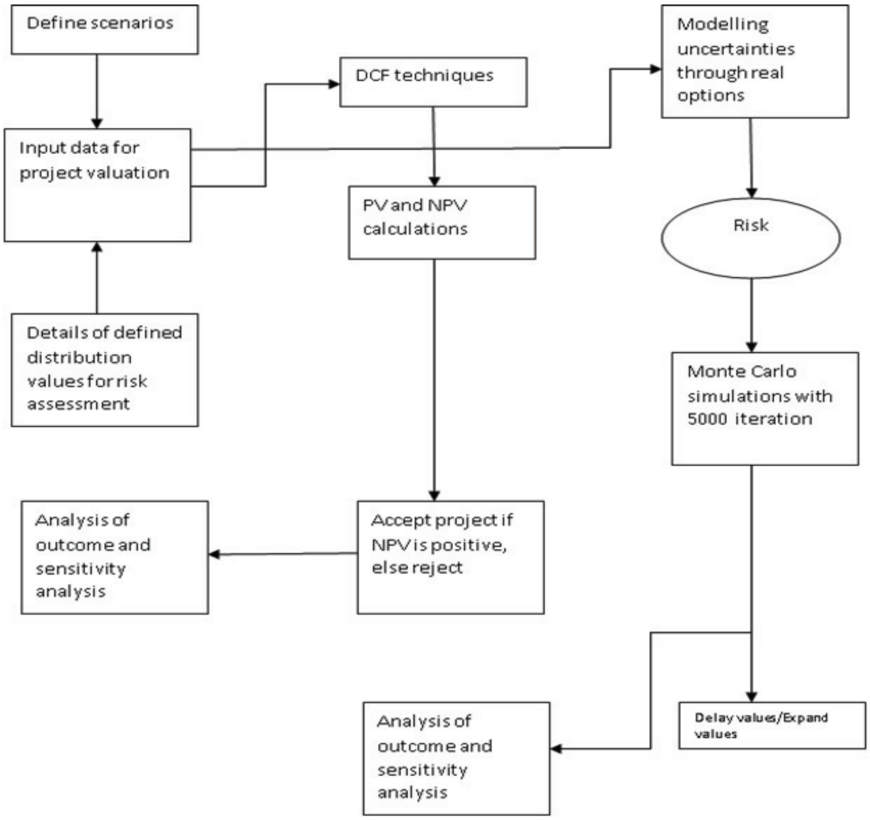

Fig.1. The methodology flow chart

For calculating the NPV, following model (Irving Fisher, 1907) was used:

$$NPV\{t = 0, N\} = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t} \quad (1)$$

Where, t represents time, Rt represents cash flow at time t, N means project life in years, and i represents discounted rate of interest. Further, for delay value calculations, following Black and Scholes model was used:

Delay Value=[(e^$^{(-\delta * t)}$)*S*N(d1)-E*(e^$^{(-r*t)}$)*N(d2)] (2)

Whereas,

$$d1 = \frac{[ln\frac{S}{E}+(r-\delta+\left(\frac{v}{2}\right)*t]}{\sqrt{v}*\sqrt{t}}; \quad (3)$$

and d2=d1-[√ v * √ t]; (4)

S denotes a present value of stock, E denotes the initial investment cost for taking up the project, v represents variance=$\sigma 2$, N(d) represents the cumulative normal distribution

Further, the value to expand a project is calculated though following model

$$\text{Expand Value}=[(e^{\wedge(-w*t)})*S*N(d1)-E*(e^{\wedge(-r*t)})*N(d2)] \quad (5)$$

Where,

$$d1 = \frac{[ln\frac{S}{E}+(r-w+\left(\frac{v}{2}\right)*t]}{\sqrt{v}*\sqrt{t}} \quad (6)$$

In addition, w represents the cost associated with waiting an extra year to expand, and d2 is same as equation 4.

NPV with risk values were calculated for each scenario through Monte Carlo simulations. Thus, different ranges of output for varying levels of inputs were observed and analyzed.

Under the real options method, we decided to study the delay and expand option. Both options were appropriate as the regulatory changes (along with our assumptions) are in a transition stage. Varying range of values for, risk free rate, volatility and deviation in cash flow were considered. Finally, the delay and expansion values obtained as the outcome were analyzed.

3. Results

This section presents the results of the study described by NPV and real options method. In the base scenario (fig 2&3), the NPV in the deterministic case is 20.8m Euros. However, with the fluctuations in input values, the NPV could range from 1.5 to 23.7 m Euros. The variables that significantly affect the NPV are PV, installation cost (Inst. cost), energy output (o/p), and O&M cost. Nonetheless, NPV in this scenario is positive, so according to the NPV rule, the project should be taken up.

In the scenario 2, since the regulatory period is significantly reduced, the profits of projects are largely dependent upon the market price of electricity (fig. 4&5). The higher market prices could lead to higher profits. The NPV could vary from -74.6 to 40.8m Euros. Nonetheless, through NPV method, reported average NPV is -12.50. Therefore, according to the NPV rule, the project should not be taken.

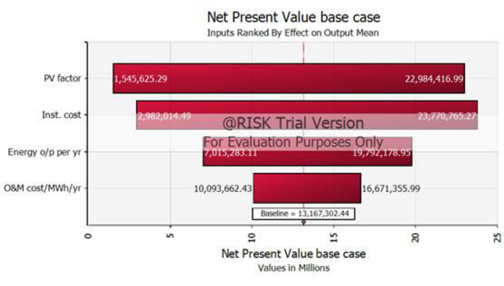

Fig. 2. NPV risk fluctuation (in Euros) for scenario 1.

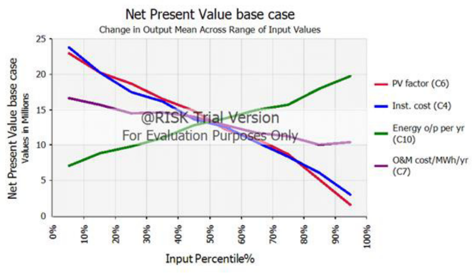

Fig. 3. NPV risk fluctuation(in Euros)

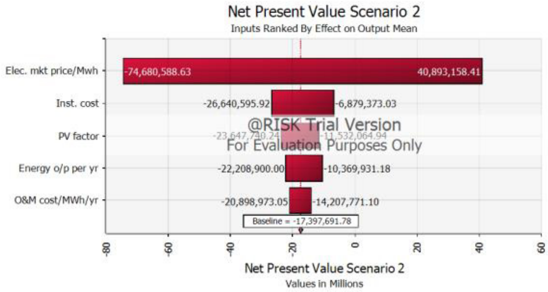

Fig. 4. NPV risk fluctuation (in Euros)for scenario 2

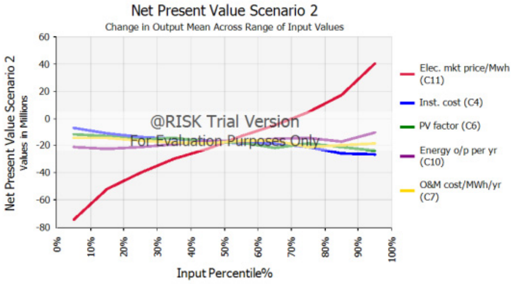

Fig.5. NPV risk fluctuation for scenario 2

The value of an option to delay in scenario 1 is lower than NPV for the base scenario, and value to expand is higher (Table 2). Therefore, if the base scenario had continued, the project would have been profitable. However, for scenario 2, the value of delay is considerably higher than the value to expand. Therefore, according to the real options valuation method, it is better to delay a project until the suitable information arrives.

Table 2: Results of NPV, delay and expand options

Values in million Euros	NPV	Value of an option to delay	Value of an option to expand
Scenario 1 (Base case)	20.80	19.04	8.22
Scenario 2 (Revised regulation)	-12.58	9.37	3.61

4. Conclusion

Business risk for medium sized wind power projects was evaluated through this study. The electricity data from Mibel was used. NPV risk was calculated and compared for two projects. Black and Scholes real options model was used to calculate the option to delay and option to expand the project. Under the revised framework, the investment seems risky, and it is better to delay the project. This study leads to further study that leads to framing new policies under which the investors' return on investments could be safeguarded.

However, the wind power may still be not competitive with other mainstream sources of power like thermal, nuclear etc. and hence needs greater regulatory support. The reduction in the price protection from 20 years to 6 years in Spain has shown that the new projects post-regulatory change are unviable according to our study. So, developing nations in Europe as well as elsewhere including India who want to promote wind power should learn from Spain's mistake and provide price protection to new wind power plants for the entire project life of 20 - 25 years.

References

[1] Fabrizio KR. The Effect of Regulatory Uncertainty on Investment: Evidence from Renewable Energy Generation. *Journal of Law, Economics, and Organization* 2012; 29, 765–798.

[2] Fisher I. The Rate of Interest: Its Nature, Determination and Relation to Economic Phenomena, New York: Macmillan Co.; 1907.

[3] Black F, Scholes M. The pricing of options and corporate liabilities, *Journal of Political Economy 1973;*,81, 637–659.

[4] Monjas-Barroso M, Balibrea-Iniesta J. Valuation of projects for power generation with renewable energy: A comparative study based on real regulatory options, *Energy Policy 2013;* 55, 335–352.

[5] Santos L, Soares I, Mendes C, Ferreira P. Real Options versus Traditional Methods to assess Renewable Energy Projects, *Renewable Energy 2014; 68*, 588–594.

[6] Michailidis A, Mattas K, Tzouramani I, Karamouzis D. A Socioeconomic Valuation of an Irrigation System Project Based on Real Option Analysis Approach, *Water Resources Management 2008;* 23, 1989–2001.

[7] Boomsma TK, Meade N, Fleten SE. Renewable energy investments under different support schemes: A real options approach, European Journal of Operational Research 2012; 220, 225–237.

[8] Palisade Corporation, RISK risk analysis and simulation add-in for microsoft excel: a software package. Version 6, Newfield, NY, 2000.