ECONOMIC BENEFITS BY HARNESSING WIND ENERGY IN THENORTH-WESTERN REGION OF SRI LANKA

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Abstract

The case study is a part of the dissertation made to complete the Master of Business Administration in Project Management. Degree program in January 2009. The experimental study was performed in the north-western region of Sri Lanka, where it was identified sufficient wind potential resource is available for harnessing wind energy. Studies had been conducted in Ceylon Electricity Board (CEB) and National Renewable Energy Laboratory, USA (NREL) in 2000 and 2002 respectively to identify the feasibility of utility scale wind farms in the region. As a result of that NREL Wind Resource Assessment for Sri Lanka and Maldives completed in 2002. The Rural Electrification Unit of CEB also had conducted a site specific wind measurement study in 2000 and revealed the potential wind resource for a utility scale wind farms in the region in 2001. Also, Constraints for the Development of Wind Farms in Sri Lanka is a study conducted to simulate the grid behavior if the wind plants were connected in the north-western region. Another case study had been performed to select the suitable turbine type for the region. All these studies revealed that the utility scale wind farms are feasible in the region.

The related literature review reveals the feasibility of utility scale wind farms in the region. The NREL, CEB and other studies; direct the potential developers to the identified regions for setting up the site specific wind measurement facilities, revealed the potential feasibility of grid connected wind farms and the acceptability of wind power to the grid. Also they discuss the limitation of the wind power input to the grid

The experimental study conducted at Nirmalapura (Np) and Mullipuaram (Mp) area revealed that the wind speed in the Np is *7m/s* and the Wind Power Density (WPD) as 327 *W/m2*. In Mp the two factors are 6.8 *m/s* and the WPD 315 *W/m2*. These results verify the technical feasibility of using IEC Class III wind turbines with large rotor diameters. for larger swipe area for capturing more energy passes through the

rotor. These results have? .Jlreater chance of varying from one location to another in the same region. Hence, a site specific Wind Resource Assessment is a must to a potential wind site.

It was also observed that the wind site classifications done by NREL study do not comply as it is. The Np region classified as Good - Class 4 site with *7-7.5m/s* wind speed and 400-500 *W/m2* Wind Power Density. The experimental results show that the site is in 7-7.5 *m/s* wind speed region and WPD of 300-400 *W/m2*. The actual measured WPD seems lower compare to the NREL Classification. However, the Mp area is compatible with 6.4-7 *m/s* and WPD of 300-400 *W/m2* wind class.

Technical, social and commercial feasibilities for implementing utility scale wind farms also exist. There are capacity addition restrictions to the grid for technical reasons and it is a limitation for harnessing the potential wind resource in the region. the turbine technology must be optimized and select suitably for the wind regime. Dispite the issues due to coal power plant implementation in the region, people would welcome wind projects in to the region. This does not mean that there would not be any social resistance. Project mangers with good personal soft skills would require operating in the area. If not expert advice must be sorted. The present high cost of finance is causing projects to be more commercially riskier. However, intuitive funding methods would minimize the risks in expected returns. The project profitability is very sensitive to the currency risk in the country. Intensity of the risk is more in this industry due almost 60% of the implementation cost goes with the equipment purchase. If the capital is drawn from foreign currencies, which is obviously required for equipment purchase, the exposure to the currency devaluation is high during repayment. One another sensitive factor, transportability of equipment, is much more feasible compared to any other wind resource areas due to geographic and infrastructure conditions

Wind power is very sensitive to small variation of wind speed due to its cubic relationship to the out put power of the turbine. Hence site specific data analysis can not be ruled out to an acceptable feasibility of a project. Small variation in the wind

speed will greatly affect the energy estimations hence the revenue calculations. Use of non site specific wind data for wind project evaluation is not acceptable for any prospective developer. Technical feasibility of wind projects are undoubted in the region if a comprehensive project financing plan is available.

DECLARATION

"I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any University to the best of my knowledge and belief it does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organizations"

Signature of the Candidate

12/02/2009
Date

(W R Kaluarachchi)

To the best of my knowledge, the above particulars are correct.

UOM Verified Signature

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Lastly but not the least, I dedicate this effort to my wife and the two little kids, Nemith and Dineth who missed lot of time for their joy due to my engagements. Their patients are commendable. I convey my sincere thanks to Dr. Mrs. Jayasinghe, Professor Jayasinghe and Dr. Thilak Siyamabalapitya who poured their patients and kindness towards me to complete this study.

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Abbreviations and Acronyms

AAWS Annual Average Wind Speed

AWDR Average weighted deposit rate

AWFDR Average Weighted Fixed Deposit rate

Amb. Ambewella Site

CEB Ceylon Electricity Board

COE Cost of Energy in $/kW or Rs/kW units

GDP Gross Domestic Products

CF Capacity Factor of the wind plant operation

GW Gega Watts

IEC International Electromechanical

Ka Karathive Site

kW Kilo Watts

LIBOR London Inter-Bank Offer Rate

LKR Lankan Rupee

LNG Liquefied Natural Gas a liquid petroleum used in generating power

LOI Letter of Intent issued by CEB for private power purchase

Na Narakkalliya Site

NE North East

Np Nirmalapura Site

NREL National Renewable Energy Laboratory

Ml Mahailluppallama Site

Mp Mullipurama Site

MT Metric Tons

MW Mega Watts

PWD Predominant Wind Direction

RERED Rural Electrification and Renewable Energy Development project World Bank assisted finance scheme to develop renewable energy in Sri Lanka.

SEA Sustainable Energy Authority of Sri Lanka

SPPA Standard Power Purchase Agreement issued by CEB to the developers to purchase power from renewable energy sources.

SW South West

UK United Kingdom

USA United State of America

US $ United State Dollar currency

WAsP WAsP is the state of the art wind flow model which is the industry standard tool for the purpose. However, it should be noted that WAsP calculations have high uncertainties when calculations: extend over large spatial distances; are initiated from heights above ground significantly lower than the turbine hub height; are initiated from positions with different wind climates or markedly different exposure.

WPD Wind Power Density (W/m^2)

WRA Wind Resource Assessment technology process