Investigation of Technical and Financial Viability of Wind Power in Sri Lanka

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ABSTRACT

Key objective of this project is to investigate the technical and financial viability of wind power development in Sri Lanka. The project consists of following activities directed towards achieving this objective.

1. Examine the NREL-USAID wind resource map to identify 3 potential sites of the categories off shore, coastal and inland for wind power development.
2. Carry out site-specific wind resource assessments.
3. Identify site-specific design aspects and their economic impacts.
4. Cost estimation of the 3 projects.
5. Analyse different financing methods for the identified projects.
6. Analyse different revenue realization options
7. Arrive at conclusions considering the value addition of each project.

2 INTRODUCTION

Electricity demand in Sri Lanka has been growing continuously during past few decades. With the expansion of the economy, actual generation has shown a growth rate of 6.8% during the last ten years. According to Long Term Generation Expansion Plan of Ceylon Electricity Board, the demand for electricity is expected to increase as depicted in Figure1.

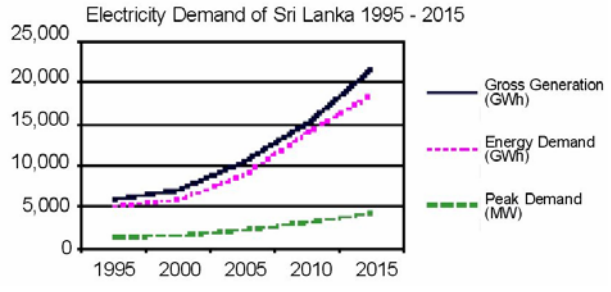

Figure 1

In order to account for the growing demand for Electricity, CEB's plan is to increase the system installed capacity up to 2,190 MW by 2013. But 90% of the proposed generating facilities are based on thermal power. Only a few of them are meeting the planned schedules and the rest will come up with a certain time delay. Therefore the system is likely to face a shortage of both energy and generation capacity in the future.

Alternative power generation options such as small-hydro, wind and bio mass are some of the options which CEB may consider to meet the expected power shortage.

According to rough estimates, the total available hydro power potential in Sri Lanka is around 2,000 MW and more than 50% of this potential has already been utilized. Most of the unexploited sites are not commercially attractive for hydro power development. By and large it is anticipated that the hydro power utilization will saturate within the next 10 years. Wind is an energy source in abundance and has the potential to take the place of hydro within the next decade.

Our intension is to ascertain the threshold values for critical parameters pertinent to wind power development and to create awareness among stakeholders on this subject.

3 METHODOLOGY

3.1 Site Selection

Under site selection, our primary objective was to filter the three sites having the highest wind potential, taking one site from each category; coastal, off-shore and hill country. Site selection was based on the Sri Lanka wind resource map developed by NREL-USAID, which was published recently.

Following sites were selected for further analysis.

- Ambewela - Hill country
- Mannar - Coastal
- Little Basses - Off-shore

Wind data was analyzed for the above three sites and plant factors were calculated based on the Wind Turbine Generators (WTGs) selected for each site.

3.2 WTG Selection

WTG selection is very important in a wind power project as it plays an important part in the overall project viability. Horizontal axis upwind three blade wind turbines have become the market standard, among WTG manufactures. There are two basic options available in the market, which are very widely used.

Option 1 - Danish concept

- Constant rotor speed
- Stall regulated power control
- Induction generator
- Direct grid connection 3

Option 2 - German concept

- Variable rotor speed
- Pitch regulated power control
- Synchronous generator
- AC-DC-AC conversion for the grid connection

When selecting a machine several factors have to be considered. These are; energy yield, availability in the market, maintenance, transportation, installation and other sitespecific parameters.

3.3 Project Financing

1. Most intricate part of any project is the financing. Even if a project is economically attractive, it cannot be implemented without proper project financing. Conducive financing is significant for the success of any project and it is more relevant to wind power because of the marginal viability. Source of funding are of the form of debts and equity investments. The composition can vary between the two extremes of 100% equity to 100% loan. But modern projects are financed by a mix of both sources where the typical debt to equity ratio is around 70-30. This composition range ensures adequate risk sharing and sufficient funding availability for large investments.

3.4 Project Costs

1. Project Investment According to the conceptual designs of the wind farms, investment requirements are estimated based on current market prices (both local and international). Summarized cost components are shown below.
   1. WTGs (Wind Turbine Generators)
   2. Civil Works (foundation + site infrastructure)
   3. Electrical Equipments
   4. Project Development Cost
   5. Engineering/Management
   6. Transmission line & substation
   7. Consultancy fees
   8. Contingencies

2. Operation and Maintenance Cost O&M costs mainly cover the following.
   - WTG maintenance
   - Operational expenses
   - Insurance
   - Land lease
   - Site management fees
   - Electricity usage
   - Other utility costs

Financial analysis is based on above cost components and some basic assumptions. Scenario based sensitivity analysis of project IRR is carried out for the following parameter variations.

1. Variation of construction cost (cost overruns)
2. Reduction of energy output
3. Annual escalation of revenue

4 PPA OPTIONS

For any product, its selling price is the most significant parameter for survival. It is no exception for electricity production as well. In the case of wind power development, the amount of revenue collectable for each year is very important. And this figure depends on the agreement the project developer has with its buyer or the consumer.

At present there are several Power Purchase Agreements (PPA) applicable for wind power development. But all these options are not readily available for execution. However, the analysis is done on the assumption that the particular PPA option considered can be negotiated with the Power Purchaser without any additional constraints. Following are the options under which wind power could be developed on commercial basis.

- Small Power Purchase Agreement
- Submission of Proposals over a Request for Proposal (RFP) announced by CEB
- Unsolicited proposal
- Self generation for individual institutes

5 CONCLUSION

Findings of our exercise can be presented as a step towards realizing the goal of developing wind power in Sri Lanka. According to our findings, it can be concluded that it's just a matter of time before the first commercial wind power plant generates its first kilowatt hour. It is factual that the prevailing conditions (technical as well as financial) are not conducive enough for true commercial operation of wind power plants. But the trend is certainly in the right direction.

Here we have identified the threshold values for each critical parameter and as soon as these are achieved, wind power will be considered as a commercially feasible power generating option.

We have also identified Great Basses, Mannar and Ambatale as the most attractive sites on the three categories we analyzed. The conclusions with regard to all three sites are that they are realizable only if the threshold values identified by the study are achieved by the project developer.

6 ACKNOWLEDGEMENT

As university undergraduates, knowledge and experience gained through the activities related to this project are very important and at the same time it is a great pleasure to give an initiative to look at the wind power industry in Sri Lanka in a different angle.

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