ABSTRACT

1. Introduction

The increasing gap between demand and supply of power in India has compelled the Government to explore alternative sources of power. Renewable Energy has evolved as a potential energy source. It is fuel effective and environment friendly. Among Renewable energy sources also wind is the most feasible source. Hence, the Government has promoted this resource through suitable policy measures. The impact of Government policies on the investment scenario in wind turbine power project installations has been brought out by this research.

2. Literature Review

A detailed literature review has been done from the following:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Particulars</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Books</td>
<td>18</td>
</tr>
<tr>
<td>2.</td>
<td>Research Paper</td>
<td>56</td>
</tr>
<tr>
<td>3.</td>
<td>Reports(Government and Private)</td>
<td>50</td>
</tr>
<tr>
<td>4.</td>
<td>Government Regulations</td>
<td>14</td>
</tr>
<tr>
<td>5.</td>
<td>Websites</td>
<td>12</td>
</tr>
<tr>
<td>7.</td>
<td>Magazines</td>
<td>2</td>
</tr>
</tbody>
</table>

The details of few research papers and research reports are given below to identify the research gap.
a) Research Papers

1. Edward Kahn, (1995): In this paper Edward Kahn has compared financing cost of wind turbines with that of conventional fossil fuel plant. The paper brings out the impact of policy parameters on the profitability of wind turbine project.

2. Steven J.Harzog, (1999): This paper stresses the importance of policy and incentives in the growth of this sector. The different incentives like Accelerated Depreciation and Renewable Purchase Obligations have been discussed.

3. Amal lee Amin, (1999): The barriers faced in the development of wind industry in Gujarat have been analyzed by the author. The author feels that there is scope of development of wind power in the state as there is good potential due to adequate wind resources. The incentives and policies encourage private investment. However, there are institutional barriers that are holding wind power development in the state.

4. Santanu Guru, (2002): The paper tries to argue that Renewable Energy is not a viable source of energy in India. The author has put forth many arguments to support his proposition.

5. B. Sudhakar Reddy and J.P .Painuly (2004): The perspective of stakeholders and the barriers to diffusion of Renewable Energy Technologies have been discussed. The various stakeholders like household, industry commercial and policy experts were administered a questionnaire to understand their perspective towards employing Renewable energy technologies.

6. Akanksha Chaurey, M Kamal Gueye and N.Yuvraj Dinesh Babu, (2004): The role of financing wind installations under life cycle approach has been proposed by the authors. Financing mechanism has been identified for the four stages in the life cycle of wind turbine installations. Case study approach has been followed to study each stage of financing.

7. Peter Meisen, (2006): Peter Meisen has given an overview for four available renewable sources. They are Hydro, solar wind & biomass. He has reviewed the historic and current
situation for Renewable as well the potential for future development. The role of Government through various legislations and incentives has also been discussed.

8. Grant Hauber, (2007): This paper has explored various options of attracting European investment in Indian wind energy sector. The author has stated the opportunities and risks involve from the perspective of a foreigner. This shows what more can be done on the policy front to attract foreign investment.

9. John Cita, Bob Glass and James Sanderson, (2008): This paper tries to assess the profitability of wind power to provide power to the state of Kansas. Instead of using the traditional sensitivity model the paper has used Monte Carlo Model which is a superior model. Different variables having impact have been identified and NPV has been determined for various scenarios.

10. E. Lantz and S.Tegen, (2008): This research paper has analyzed the impact of two technologies on the economic development of a particular region. This paper has proved that wind power projects bring out a greater economic development.

11. Gudrun Benecke, (2008). The above paper throws light on the factors responsible for attracting private sector investment in the wind energy sector. CDM benefits which were supposed to give additional incentives have failed to attract investment.

12. Maria Isabel Blanco, (2008): This article is tries to find out the current generation cost of wind projects in Europe, the factors that influence these costs and the reasons behind the current increase and the possible future outcome.

13. Geoffrey Heal, (2009): This paper raises an important question relating to drawback of renewable energy that is wind and solar. Both these technologies suffer from the problem of intermittency. While estimating their potential this fact has not been taken into account.

14. Soren Krohn, Poul Erik Morthost, Shimon Awerbuch (2009): This report has covered a wide range of topics relating to wind energy. It has given details of cost, compared the cost with competitive technologies, addressed the major concerns of this sector like grid integration. It has also dealt with risks involved, method of tariff fixation.
15. Ashwini Kumar Dash, Biswajit Das (2011): This paper traces the growth of wind power industry in the world as well as in India. The paper discusses the scope of investment in the industry as well as different problems faced with reference to India. The paper has also carried out a case study of two turbine manufacturing companies that is Suzlon and Enercon.

16. Giesle Schmid, (2011): This research paper studies the impact of Government policies on nine states in India over a period 2001-2009. An empirical research has been carried out to study the effect of Electricity Act 2003 and Tariff policy 2006 and feed in tariffs and purchase quotas on the growth of grid connected wind turbine installations.

17. G.M.Pillai, (2011): This article by Mr. Pillai is on the role of states in encouraging Green Energy. According to the author there is a huge potential for green energy waiting to be tapped. The centre has created a suitable regulatory environment. However, the onus lies on the states to rise to the occasion and take advantage.

18. Felicity Jones, (2012): According to the article, favorable policy measures including tax cuts have helped the wind market to evolve. This growth has suddenly been hampered due to the decision of the Government to remove tax incentives. This growth can be increased by adopting a more sustainable policy model.

b) Reports

1. Central Electricity Authority Reports (CEA reports) from 2005-2012: These reports have helped in understanding the overall power scenario at the state level as well as at All India level.

2. Ministry of New and Renewable Energy (MNRE) Reports from 2005-12: These reports have given an insight into the growth of wind power in India, the policies adopted at state level and the future prospects.

3. South Asia energy unit of World Bank, (2010): This report by the World Bank identifies the potential for harnessing renewable energy for India’s economic development. The report gives reasons for the same as well the barriers which are being faced along with suggestions.
4. Paul Schwabe, Sander Leinsik and Maureen Hand, (2011): This report analyses the difference in the cost of generation from wind energy between seven developed nations. The metric used is LCOE which has been used from two perspectives.

5. Mercados India Pvt ltd, (2012): The report has been prepared on case study basis. It helps in understanding the problems faced in the enactment of RPO obligations by the state and the solutions for the same.

6. GWEC Report, (2013): This report traces the regulatory framework of India’s renewable energy policy from 1980-2013. This report also gives the policy environment in the states of Tamil Nadu, Gujarat and Maharashtra.

7. R.K. Gera, Dr H.M. Rai, Yunus Parvez and Himanshu Soni, (2013): This report traces the Renewable energy in India as well tries to analyze future potential. It is in descriptive format.

8. IRENA, GWEC, (2013): This report identifies and reviews significant policy and regulatory measures in different countries. These policies have contributed to the successful development of wind energy across major markets in Asia, Europe, North and South America over the last three decades. It provides an insight into the strengths and weaknesses of diverse policy design decisions across 12 of the important existing markets.

3. Research Gap

_Do the wind turbine power project installation investors still require the incentives being provided by the government or can investment become commercially viable without these also? This is the research gap._

4. Research Problem

Understanding the cost structure and profitability of wind turbine power project installations in India vis a vis Government policies is the research problem which has been identified.
5. Objectives of the study

1) To understand the role of wind power in the overall power scenario in India.

2) To study the capital and operation cost of wind turbines power project installations.

3) To study the policies of the selected state governments and their impact on financial viability of investment in wind turbine power project installations of respective states.

4) To recommend a policy to make investment in wind power project installations more lucrative.

6. Hypotheses:

**H1:** There is a gap in the propaganda made through State Government policies vis a vis tariff rates prescribed for wind turbines power project installations.

**H2:** The wind power project installations have been made to avail the benefits offered by State and Central Government.

**H3:** The cost of wind power project installations is corroborative to the hype created around such projects.

7. Scope of study

1. To study the role of wind power in the overall power scenario in the country.

2. To analyze the cost structure of wind turbine power project installations.

3. To study the state policies of selected three states under study:-
   i) Tamil Nadu
   ii) Maharashtra
   iii) Gujarat
4. The following policies have been considered for the purpose of study:

i) Tariff Policies

ii) Accelerated Depreciation benefit (AD)

iii) Generation based incentives (GBI)

iv) Renewable purchase obligation (RPO)

v) Tax concessions under Sec 80 IA

vi) Renewable Energy Credits. (REC)

vii) Clean development Mechanism (CDM) benefits.

5. The time period selected for the research is from 2005-2012.

6. The study deals with grid connected wind turbine power project installations.

7. The research is from investor’s point of view.

8. Limitations of the study

1) The researcher has studied only three selected states. The study of remaining states is out of the orbit of this study.

2) The study relates only to those policies of the Government that have impact on investment decision of the wind turbine power project installation investors.

3) The study covers only the financial parameters like capital cost, operation and maintenance costs, financing costs of wind turbines in selected states. Capital cost includes the purchase cost of turbines, cost of land, cost of grid connections, cost of installations and commissioning.

4) The study has not employed marginal costing techniques as 80% is capital cost which is fixed in nature. The operation and maintenance cost which comprises 15% of capital cost is also fixed in nature. The remaining 5% of cost is semi fixed in nature.
5) The comparison is done on the basis of published and unpublished data, information provided by wind turbine owners and developers. The study is about comparing the current policies hence period taken is from 2005-2012.

6) The study relates to grid connected wind turbine power project installations only.

9. Research Methodology

a) Type of Research

The research is both quantitative as well as qualitative in nature. It is quantitative because it analyses the cost constituents of wind power project installations like capital cost, operation cost, financial cost, etc.

It is qualitative in nature because it studies the impact of Government policies on wind power project installations. Thus it can be said that a Triangulation methodology has been followed.

b) Collection of Data

Primary Data:

1) Survey through Questionnaire: The primary data has been collected from wind turbine power project owners in the three specified states. An exhaustive questionnaire was framed dealing with different aspects of the given problem.

2) Unstructured Interview: The data has also been collected by conducting unstructured interviews of wind turbine power project owners and executives of wind turbine companies and financial institutions, official of state nodal agency and wind power trader. Seven wind turbine power project installation owners were interviewed to understand their views relating to profitability and expectations from Government policy. The executives of wind turbine manufacturers and developer companies were also interviewed to understand the perspective of wind power manufacturers and developers.
The executives of four commercial banks were also interviewed to understand their perspective relating to financing the sector.

**Secondary Data**

1) **Use of Library**: The secondary data has been collected by making use of the Library. The data has also been collected from published and unpublished sources like Reports of Ministry of New and Renewable Energy, Private publications and reports, Research papers, journals and Policy documents of state governments.

The data relating to overall power scenario has been collected from:

Central Electricity Authority Reports (CEA reports) from 2005-2012.

The data relating to Wind Energy has been collected from Ministry of New and Renewable Energy (MNRE) Reports from 2005-12.

2) **Use of Websites**: Important websites related to Indian wind power, state nodal agency, wind power associations have also been accessed for collecting data.

d) **Sampling Technique**

The data has been collected by making use of stratified, non-random, purposive sampling method.

1st Strata:

There are ten states in India which have encouraged wind power development. Out of these ten states, three states have been chosen for the purpose of study. This comprises 30% of population.

These states are:-

1) Tamil Nadu

2) Maharashtra
3) Gujarat

The above three states have been selected due to the following reasons

1. The state of Tamil Nadu has the highest installed capacity in India i.e. 4875 MW as on 31st March, 2010.

2. The state of Maharashtra is second to Tamil Nadu in terms of installed capacity (2071.5MW) on 31st March, 2010. It is the home state of researcher.

3. The state of Gujarat ranks third in terms of installed capacity (1864.59) as on 31st March, 2010. It is an upcoming state with tremendous potential.

2nd Strata:

Data has been collected from wind turbine power project installation owners from the selected three states.

Wind turbine power project installation owners have been defined as an individual, firm or company owning at least one wind turbine power project installation during the period 2005-12 in any one of the selected state.

d) Sampling Frame:

The sampling frame for the current study is list of wind power project installation owners for the period 2005-2012 registered with the state nodal agencies that is Gujarat Energy Development Agency (GEDA), Maharashtra Energy Development Agency (MEDA), and Tamil Nadu Energy Development Agency (TEDA).

e) Population and sample size

The population for current study comprised of wind turbine installation owners registered with respective state nodal agencies of Maharashtra, Gujarat and Tamil Nadu. The total population comprised of three thousand six hundred and twenty wind turbine installation owners.
The sample size was found out on the basis of Table given by Robert V Krejcie and Daryle W Morgan, for small sample technique. The sample size was determined to be three hundred and sixty.

10. Definition of Wind Turbine Installations for the purpose of Study

“A wind turbine installation or wind turbine power project installation for the purpose of study is a grid connected wind turbine generator. It is installed for the purpose of generating electricity to be sold to utility, third party or for captive consumption.”

11. Definition of Wind Turbine Installation Owner for the purpose of Study

“Wind turbine installation owners or wind turbine power project installation owners have been defined as an individual, firm or company owning at least one wind turbine installation during the period 2005-12 in the state of Maharashtra, Gujarat or Tamil Nadu.”
OVERVIEW OF DATA ANALYSIS

DATA ANALYSIS

Secondary Data

Financial Data

Primary Data

Analyzed by

1. Cash flow statement
2. Income statement
3. Ratio Analysis
4. Capital Budgeting

Analyzed by

1. T-test
2. Descriptive
3. Bar diagram
4. Pie chart

Analysis of Overall Power Situation

Analysis of wind power sector

Analyzed by

1. Mathematical tools like percentages.
2. Bar Diagram
12. Data Analysis:

The data has been analyzed with the help of primary as well as secondary data.

1) The secondary data has been analyzed to understand the power scenario in India and the role of wind power in the overall power scenario.

Data relating to Overall Power Scenario:

a) Total installed capacity (in MW) of power utilities in the state as well as at All India level.

b) Share of various Energy sources (in MW) at state as well as at All India level.

c) The power requirement and supply position at state as well as at All India level.

d) Consumer category wise sale of power in each state.

e) Average rates of electricity consumer wise in each state have been analyzed

Data relating to Wind Power

The following data has been analyzed to understand the role of wind power.

a) Wind power potential at state level and at all India level.

b) Wind power installed capacity at state level and at all India level.

c) Wind power generating capacity at state level and at all India level.

d) Tariff policies of selected states and Central Electricity Regulatory Commission.

e) State wise Renewable Purchase Obligations (RPO).

f) Cost components of wind turbine power project installations.
The financial analysis includes the following:

1. Cost Analysis
   a) On the basis of capital and operating cost.
   b) On the basis of variability

2. Calculation of cost of generation

3. Ratio analysis & analysis with IRR and Payback period.
   a) Taking only tariff into consideration
   b) Taking Accelerated Depreciation benefit into consideration
   c) Taking Generation base incentive into consideration
   d) Taking Renewable energy certificates benefit into consideration.

4. Sensitivity Analysis

**Primary Data**

The primary data has been collected with the help of questionnaire. Out of sample size of 360 wind turbine power project owners’ data was obtained from 317 wind power owners. The data has been analyzed with the help of

1. Descriptive Statistics
2. T-test
3. Bar diagram and Pie Charts

The primary data has been obtained from 317 wind turbine power project installation owners from the states of Maharashtra, Gujarat and Tamil Nadu.
Details of Wind Turbine Power Project Installation Owners

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Particulars</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Type of Business Org</td>
<td>Sole proprietorship/individual: 38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partnership firm :92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public Ltd Co:14</td>
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<tr>
<td></td>
<td></td>
<td>Private Ltd Co:173</td>
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<tr>
<td></td>
<td></td>
<td>Trading: 95</td>
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<tr>
<td></td>
<td></td>
<td>Manufacturing &amp; Trading :3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others:2 12</td>
</tr>
<tr>
<td>3.</td>
<td>Number of WTI*</td>
<td>1-5:189</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-10:93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-15:28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 &amp;above: 7</td>
</tr>
<tr>
<td>4.</td>
<td>Capacity of WTI</td>
<td>225-500 KW:24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500-1000 KW:111</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1MW-1.5 MW:217</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;1.5MW: 17</td>
</tr>
<tr>
<td>5.</td>
<td>Year of purchase</td>
<td>2005-07:95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007-09: 143</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FY 09-11:74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After 2011:5</td>
</tr>
<tr>
<td>6.</td>
<td>Electricity generated used for</td>
<td>Sale to utility:285</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Third party sale:5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Captive consumption:2 7</td>
</tr>
<tr>
<td>7.</td>
<td>State in which WTI purchased</td>
<td>Maharashtra :133</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gujarat:95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamil Nadu:89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No:22</td>
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<td></td>
<td>IREDA:71</td>
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<tr>
<td></td>
<td></td>
<td>PFC:9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other:22</td>
</tr>
<tr>
<td>10.</td>
<td>Source of Land</td>
<td>Private:263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Government:3 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forest:23</td>
</tr>
</tbody>
</table>

*WTI: Wind Turbine Installation

Along with the above their views about working of state agencies, cost incurred on wind turbine installations and further investment in wind turbine installations has been obtained.
Proving the Hypothesis

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Proved by</th>
<th>Proved by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hypothesis 1</td>
<td>T-test</td>
<td>Ratios and IRR</td>
</tr>
<tr>
<td>2</td>
<td>Hypothesis 2</td>
<td>Descriptive statistics</td>
<td>Ratios and IRR</td>
</tr>
<tr>
<td>3</td>
<td>Hypothesis 3</td>
<td>Secondary data Analysis</td>
<td></td>
</tr>
</tbody>
</table>

13. Specific Findings

1. The cost of installation or capital cost of wind turbine power project installations includes the cost of wind turbine, grid connection cost, foundation cost and consultancy costs. The cost of wind turbines constitute of about 70-80% of total installed cost. (Table 28 and Table 29)

2. The operation and maintenance cost is generally paid to developer as a part of service contract which the developer undertakes. It is fixed at a certain rate with an escalation clause. The operation and maintenance charges as per Central Electricity Regulatory Commission are Rs nine lakh per MW. This cost is escalated by 5.72% every year. Thus operation and maintenance cost only account for around 20-30% of total cost.

3. There is no fuel cost involved as wind is a free gift of nature. The generation of wind power depends upon the capacity utilization factor. Capacity utilization factor depends on the wind resource available in a particular area and turbine capacity. The capacity utilization factor varies from 20% to 32% as per CERC.

4. Financial Cost: The financial cost is cost of financing the project. The project is financed by Equity Component and Debt component. Equity component is provided by the wind turbine power project installation owner. The debt component is provided by financing institutions like Indian Renewable Energy Development Agency (IREDA) and commercial banks.
5. The majority of cost of wind turbine power project installation is fixed in nature. Apart from cost of installation the operation and maintenance cost is also fixed in nature as it is paid at a fixed rate to the developers for operation and maintenance. Similarly, insurance, depreciation and interest on loan is also fixed in nature.

6. The cost of generation calculated is 5.33 kwh. This is compared to tariff rates prevailing rates in three states under study shows that cost of generation is greater than applicable tariff rate.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Particulars</th>
<th>Rate in Rs kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cost of generation</td>
<td>5.33</td>
</tr>
<tr>
<td>2.</td>
<td>Tariff rate in Gujarat</td>
<td>3.56</td>
</tr>
<tr>
<td>3.</td>
<td>Tariff rate in Maharashtra</td>
<td>5.07(without AD), 4.29(with AD) at 20%CUF</td>
</tr>
<tr>
<td>4.</td>
<td>Tariff rate in Tamil Nadu</td>
<td>3.39</td>
</tr>
</tbody>
</table>

7. The reason for feed in tariff is less than cost of generation in all three states because the capital cost assumptions for tariff calculations in three states are less than market price of wind turbine power project installations.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Particulars</th>
<th>Amount in Rs/MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Market price</td>
<td>60 million</td>
</tr>
<tr>
<td>2.</td>
<td>Gujarat</td>
<td>50 million</td>
</tr>
<tr>
<td>3.</td>
<td>Maharashtra</td>
<td>51.69 million</td>
</tr>
<tr>
<td>4.</td>
<td>Tamil Nadu</td>
<td>53.5 million</td>
</tr>
</tbody>
</table>

8. The method of tariff calculation adopted by the three states is cost plus method. The parameters which are same in all three states as well market norm are as follows:
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Particulars</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Debt Equity Ratio</td>
<td>70:30</td>
</tr>
<tr>
<td>2.</td>
<td>Loan repayment period</td>
<td>10 yrs</td>
</tr>
</tbody>
</table>

9. The parameters which differ in all three states are as follows:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Capital cost</td>
</tr>
<tr>
<td>2.</td>
<td>Operation Cost</td>
</tr>
<tr>
<td>3.</td>
<td>Interest rate on debt</td>
</tr>
<tr>
<td>4.</td>
<td>Rate of depreciation</td>
</tr>
<tr>
<td>5.</td>
<td>Capacity utilization factor</td>
</tr>
<tr>
<td>6.</td>
<td>Return on Equity</td>
</tr>
</tbody>
</table>

10. Only the state of Maharashtra has adopted the guidelines laid down by CERC and has determined tariff rates according to wind power zones. It has also laid down separate rates for those availing Accelerated Depreciation benefit and those who are not availing the accelerated depreciation benefit.

11. The states have laid down a certain expected return on equity for calculating tariff rates. The comparison between actual returns from cash flows calculated and expected return on equity for calculating tariff rates is given in the table below:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>State</th>
<th>Return on Equity as per SERC</th>
<th>Return on Equity calculated from cash flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gujarat</td>
<td>14%</td>
<td>6.95%</td>
</tr>
<tr>
<td>2.</td>
<td>Maharashtra</td>
<td>Average 21.55</td>
<td>16.52%</td>
</tr>
<tr>
<td>3.</td>
<td>Tamil Nadu</td>
<td>19.85%</td>
<td>11.70%</td>
</tr>
</tbody>
</table>
12. Comparison of Return on Equity based on only tariff compared with Return on Equity under incentives.

(In Percentage)

<table>
<thead>
<tr>
<th>Sr</th>
<th>States</th>
<th>ROE under Tariff</th>
<th>ROI under Tariff</th>
<th>ROE under AD benefit</th>
<th>ROI under AD benefit</th>
<th>ROE under GBI benefit</th>
<th>ROI under GBI benefit</th>
<th>ROE under REC benefit</th>
<th>ROI under REC benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gujarat</td>
<td>4.33</td>
<td>3.70</td>
<td>4.33</td>
<td>3.70</td>
<td>5.94</td>
<td>4.18</td>
<td>22.08</td>
<td>9.02</td>
</tr>
<tr>
<td>2.</td>
<td>Maharashtra</td>
<td>11.68</td>
<td>5.90</td>
<td>5.87</td>
<td>4.16</td>
<td>13.07</td>
<td>6.32</td>
<td>12.07</td>
<td>5.47</td>
</tr>
<tr>
<td>3.</td>
<td>Tamil Nadu</td>
<td>8.03</td>
<td>4.81</td>
<td>8.03</td>
<td>4.81</td>
<td>9.53</td>
<td>5.26</td>
<td>31.03</td>
<td>11.49</td>
</tr>
</tbody>
</table>

a) The Return on investment and return on equity based on tariff is greatest in Maharashtra as the tariff rate is the highest. The returns are second highest in Tamil Nadu as it has a good resource but the tariff rate is the lowest as compared to other states.

b) The returns based on only tariff are less than returns based on different incentive schemes. The returns based on tariff and under Accelerated Depreciation scheme are same because Accelerated Depreciation leads to tax saving hence improve the project returns and not accounting returns. Only in the state of Maharashtra the returns are different because the tariff rate is lower for those availing the accelerated depreciation benefit.

c) The greatest returns can be obtained from the APPC –REC route. However, the market for REC is yet to develop.
13. Comparison of Project and Equity IRR under various incentives schemes.

(In percentage)

<table>
<thead>
<tr>
<th>Sr.</th>
<th>States</th>
<th>Project IRR under Tariff</th>
<th>Equity IRR under Tariff</th>
<th>Project IRR under AD benefit</th>
<th>Equity IRR under AD benefit</th>
<th>Project IRR under GBI benefit</th>
<th>Equity IRR under GBI benefit</th>
<th>Project IRR under REC benefit</th>
<th>Equity IRR under REC benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gujarat</td>
<td>7.01</td>
<td>3.96</td>
<td>12.18</td>
<td>13.08</td>
<td>8.10</td>
<td>5.44</td>
<td>14.43</td>
<td>17.26</td>
</tr>
</tbody>
</table>

a) When project and equity IRR are compared based on only tariff the highest returns are generated in the state of Maharashtra followed by Tamil Nadu. This is because Maharashtra has the highest tariff rates among the three states.

b) The Equity IRR is less than project IRR signifying that cost of debt is greater than project IRR.

c) When Accelerated Depreciation benefit is taken into consideration the project IRR and Equity IRR is greatest in the state of Tamil Nadu followed by Maharashtra. This is because Maharashtra has a separate rate of tariff for accelerated depreciation benefit which is lower than tariff rate for those not availing the benefit.

d) The Equity IRR is greater than project IRR under Accelerated Depreciation benefit.

e) The project and Equity IRR are highest in Maharashtra based on Generation based incentive followed by Tamil Nadu. This is because though Tamil Nadu has the highest generation it has the lowest tariff rate among the three states.

f) In case of GBI, the Equity IRR is greater than Project IRR only in the state of Maharashtra.

g) In case of APPC-REC benefit, the highest returns are generated by Tamil Nadu followed by Gujarat. This is because Tamil Nadu has the highest Average power
purchase price compared to the three states. There is not much difference between the APPC of Gujarat and Maharashtra but the capacity utilization factor has been taken to be higher for Gujarat for the purpose of this study. As a result there is difference in project returns.

h) The Equity IRR is greater than Project IRR for Tamil Nadu and Gujarat.

i) The highest returns are generated by the REC scheme followed by Accelerated Depreciation and then Generation based incentive.

14. The debt service coverage ratio which shows the ability of the project to pay off its debt obligations is greater than 1 only in case of APPC-REC route. In all other cases it is less than 1 signifying that the operating income is not sufficient to pay off its debt obligations.

15. The equity payback period is least in case of Accelerated depreciation benefit. The cumulative cash flows are highest in case of APPC-REC benefit.

16. The sensitivity analysis conducted for capacity utilization factor shows that one percent change in capacity utilization factor brings about a change of .61% in Project IRR and .93% change in Equity IRR. Hence, it can be concluded that equity IRR is more sensitive to change in capacity utilization factor.

### Sensitivity Analysis for Capacity Utilization Factor

<table>
<thead>
<tr>
<th>CUF</th>
<th>Base 23%</th>
<th>Base 24%</th>
<th>Base 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project IRR</td>
<td>7.01%</td>
<td>7.62%</td>
<td>8.22%</td>
</tr>
<tr>
<td>Equity IRR</td>
<td>3.96%</td>
<td>4.88%</td>
<td>5.81%</td>
</tr>
</tbody>
</table>

17. The sensitivity analysis conducted for capital cost shows that Equity IRR is more sensitive to change in capital cost. Project and Equity IRR are more sensitive to decrease in cost than increase in cost.
Sensitivity Analysis for Capital cost

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>90</th>
<th>97.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital cost</td>
<td>82.5</td>
<td>90</td>
<td>97.5</td>
</tr>
<tr>
<td>Project IRR</td>
<td>8.00%</td>
<td>6.81%</td>
<td>5.77%</td>
</tr>
<tr>
<td>Equity IRR</td>
<td>5.47%</td>
<td>3.66%</td>
<td>2.14%</td>
</tr>
</tbody>
</table>

14. Findings from Primary Data

1. Out of a 317 wind turbine installation owners 173 were private limited companies and 92 were partnership firms carrying out trading or other activities. The highest number which is 189 of wind turbine owners own one to five wind turbines. This indicates that investment in wind turbines power project installation was made only as an investment avenue to avail the benefit of accelerated depreciation.

2. During the year 2007-09, 143 wind turbine owners had purchased wind turbines. Ninety one percent of wind turbine owners had purchased wind turbines for the purpose of availing tax benefits and Accelerated Depreciation benefit and only 9% had purchased for generation.

3. 78 wind turbine installation owners had chosen a particular state due to availability of wind resource and policy of the state Government as the reason for investing in a particular state. 77 wind turbine owners had chosen a particular state as they were the residents of that particular state.

4. Ninety three percent of wind turbine installation owners had availed financial assistance in the form of loan. Commercial banks were preferred for taking loan by 215 wind turbine installation owners over Indian Renewable Energy Development Agency (IREDA). Only 71 wind turbine installation owners had availed loan from IREDA. The loan rates varied from 11% to 12.5% and the general tenure of loan varied from 7 to 10 years.

5. The land for installing wind turbine power project installations had been purchased by 263 wind turbine installation owners from private source, while government land was
purchased by 31 wind turbine installation owners and forest land was purchased by 23 wind turbine installation owners. The land for installing the wind turbines were purchased by the developers’ hence individual wind turbine owners did not face any problems in land purchase.

6. The wind turbine power project installation owners were not very satisfied with the policies of the state governments or Central Government. The major reasons of dissatisfaction were:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Policy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Incentives</td>
<td>Removal of incentives like Accelerated Depreciation and Generation based incentive.</td>
</tr>
<tr>
<td>2.</td>
<td>Tariff Rates</td>
<td>Low rate of tariffs provided by state Governments.</td>
</tr>
<tr>
<td>3.</td>
<td>Grid infrastructure</td>
<td>Poor grid facilities for power evacuation.</td>
</tr>
<tr>
<td>4.</td>
<td>Evacuation Infrastructure</td>
<td>Total cost of evacuation infrastructure not covered under capital cost for tariff calculation.</td>
</tr>
<tr>
<td>5.</td>
<td>Timely payment by DISCOMS</td>
<td>The distribution companies not making timely payments as in case of Tamil Nadu.</td>
</tr>
<tr>
<td>6.</td>
<td>RPO and its compliance</td>
<td>The RPO limit set was not being strictly followed affecting the marketability of wind power.</td>
</tr>
<tr>
<td>7.</td>
<td>Land issues</td>
<td>Land Issues are major problem in Maharashtra due to poor local support.</td>
</tr>
<tr>
<td>8.</td>
<td>Finance issues</td>
<td>The rate of interest for wind installations is very high.</td>
</tr>
<tr>
<td>9.</td>
<td>Change in policies</td>
<td>Frequently changing policies by</td>
</tr>
</tbody>
</table>
8. The wind turbine installations were purchased by the wind turbine power project owners from the manufacturers and developers. The wind turbine owners only made investment in such projects hence they did not face any problems relating to obtaining permissions and clearances, land purchase and development of infrastructure.

9. Ninety eight percent of wind turbine power project installation owners were not interested in making further investment in wind turbine power project installations.

10. The wind turbine power project owners invested in wind turbine power project installations to avail the benefits of Accelerated Depreciation and Income tax benefits u/s 80IA. However, with the removal of benefits they were no longer interested in further investment.

15. Conclusions

<table>
<thead>
<tr>
<th>Sr</th>
<th>Conclusions from overall power scenario.</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1. Demand for power is greater than supply of power.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Increase in private sector participation in power generation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Fossil fuel is a major source of power.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Conclusions from wind power.</td>
<td>1. Steady but lopsided growth of wind power in India.</td>
</tr>
<tr>
<td></td>
<td>2. Lack of uniformity in implementation of tariff policy.</td>
<td></td>
</tr>
</tbody>
</table>
3. Tariff is calculated on cost plus basis but the cost parameters vary in each state.
4. CERC rates are not being implemented by states except Maharashtra.
5. Policies have not been implemented on long term basis.
6. No uniformity in Renewable purchase obligations.

   1. High cost of installation
   2. The cost of generation is greater than tariff rate applicable in all the states.
   3. Tariff rates are too low to attract investments.
   4. The greatest benefit to investors as per cash flows is from REC-APPC route but due to underdeveloped REC market has failed to attract investment.
   5. Accelerated Depreciation Benefit is the biggest driver for wind power investment.

4. Conclusions from primary data.
   1. The wind turbine owners were not very satisfied with the policies of the State or Central Government.
   2. Investment made to avail tax benefits.
   3. The wind turbine power project owners borrowed mostly from commercial banks.
   4. The cost was hyped to increase profitability of wind turbine
16. FINAL CONCLUSION

The present study has assessed the overall power situation in India and the role of wind energy in the overall power situation and derived conclusions based on it as above. It was observed that there has been an increase in wind turbine installations in the three states under study as well as at all India level. The wind power installations are capital intensive. As a result incentives are required for early recovery of the capital cost.

The Government has encouraged wind power by providing incentives. The Accelerated Depreciation benefit and Income tax benefit under sec 80 IA have been the main drivers for investment in the wind turbine installations as observed from this study. However, the reason for investment by wind turbine installation owners was to avail tax benefits and not generation as has been proved by the study.

*The reason for the same, on the basis of this study can be enlisted as follows:*

1) **The Tariff rates provided by state governments are not enough to attract investment.**

2) **The Tariff rates are not uniform throughout India and vary from state to state.**

3) **The states do not strictly adhere to the guidelines laid down by Central Electricity Regulatory Commission (CERC) for Tariff determination.**

   As a result, incentives have to be provided to attract investments in wind turbine installations.

This fact has been proved by the primary data in the study that 98% of wind turbine installation owners were not interested in reinvestment in wind turbine installations due to withdrawal of Accelerated Depreciation benefit and Generation based Incentive. *Hence, it can be said that wind turbine installations*
still require the incentive provided by the Government as they cannot become commercially viable without these incentives.

With the growing demand for power, there is an urgent need to encourage wind energy by increasing and bringing uniformity in tariff rate. Besides, suitable incentives like reinstating Accelerated Depreciation benefit, Tax exemption, linking tax to generation, and increase in Generation based incentive. Besides this the REC market should also develop by increasing the RPO limit and strict enforceability of RPO by states. It should become mandatory for common consumers to source some part of their power requirement through a renewable energy source, either by installing a source or by purchase of REC.

Thus wind power can be a solution to India’s growing power requirement and should be encouraged through suitable policy measures.

17. Recommendations

General

1. Availability of affordable and un-interrupted power to the citizens should be the goal of the Government.

2. This can only be possible if different resources of producing electricity are tapped.

3. To increase the popularity and usage of wind energy, stand alone wind turbines can be installed to meet the need of a group of houses, or a housing society. This method can also be adopted for solving the problem of rural electrification. A small cluster of wind turbines can be installed and with the help of local grid can also meet the requirements of residential as well as industrial area.

4. The power to produce power through various technologies like small wind turbine, bio gas etc should lie with the people. The Government has taken suitable steps but these technologies have not become popular due to lack of technology, awareness and availability. There is need to increase the awareness as well as
availability for the same. The need to produce power in every home is an urgent need because as per finding demand from domestic sector is growing very fast.

Specific

1. Tariff:
   a) A uniform rate of tariff should be adopted by the State Electricity Regulatory Commission (SERC) on the basis of guidelines from Central Electricity Regulatory Commission (CERC).
   b) To calculate the tariff rate the capital cost of wind turbine installation is calculated by indexation formula. The two factors which are “increase in energy prices and foreign exchange” should also be factored in the formula for calculating the capital cost.

2. Tax Benefits:
   a) Tax benefit under sec 80IA should be extended for 20 years.
   b) Withdrawal of Minimum Alternate Tax (MAT) applicable to wind turbine installations.
   c) Accelerated Depreciation Benefit should be reinstated till the time REC markets become profitable for wind turbine installation owners.
   d) Production Tax Credit: In USA, tax credit is given on the basis of production known as Production tax credit. A tax credit on similar lines should be adopted in India. This will help in providing incentive on the basis of generation.

3. Generation Based Incentive (GBI):

In order to attract greater investment it is necessary to increase the rate and limit of this benefit. The GBI should be fixed at Rs 1.00 per unit and maximum limit should be 124 lakh per MW. This benefit should give greater profitability than Accelerated Depreciation
benefit so that even those who are eligible for Accelerated Depreciation should opt for this benefit. As this benefit is based on generation it is better option for the growth of wind turbine installations.

4. Renewable Purchase Obligations (RPO):

a) It is necessary to enforce the same rate of RPO in all states. The RPO Obligations should also be strictly enforced.

b) RPO limit should be increased.

5. Renewable Energy Credits:

a) Increase the scope for RPO obligations: The RPO obligations should be made mandatory for not only power utilities but also for consumers of electricity. The consumers should be divided into two categories.

```
Consumers of Electricity

<table>
<thead>
<tr>
<th>Wholesale consumers</th>
<th>Retail Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Large scale industries</td>
<td>1. Small scale industries</td>
</tr>
<tr>
<td>2. Medium scale industries</td>
<td>2. Domestic consumers</td>
</tr>
<tr>
<td>3. Railways</td>
<td>3. Commercial consumers</td>
</tr>
</tbody>
</table>
```

A certain portion of electricity consumption by the above category of consumers should come from renewable energy sources. The can be done in two ways;
a. Wholesale consumers:

Either obtain electricity directly through a renewable energy source for example by installing wind turbines for captive consumption or purchasing electricity from renewable energy source for wholesale consumers. These consumers should get the advantage of Accelerated Depreciation benefit.

Or

Purchase a certain portion of their electricity requirement from power utilities a higher rate than prescribed rate.

Purchase REC from the power exchanges. The second two categories should get a tax benefit at a certain percentage. The REC should have a minimum duration of two years.

b. Retail consumers:

The retail consumers should also either install a renewable energy source like a small wind turbine for fulfilling their requirements for which either they should get a subsidy or a tax benefit.

Or

Purchase REC from power exchanges. The REC for retail consumers should be of a smaller Denomination and fixed value. The REC should expire within a year.

6. Financial Requirements:

Priority sector lending: The Government should declare renewable energy as a priority sector. A certain percentage of banks loan should be provided for renewable energy installations. The banks should have a fixed target for financing this sector.
7. Land:

Government should create a land bank and transferring the land to wind turbine power project owners on lease. Only the land for foot print area for erecting the tower and unit substation and approach road is required. Hence, the remaining area can be utilized for some other purpose including agriculture.

18. Areas for further research

1. It has been observed from the current research that there is shortage of power as against the increasing demand. There is a need to divert the efforts by the next generation researcher to find viable solution to the problem by inventing smallest wind turbine at cheapest cost to provide electricity to households. Hence, the financial viability of small wind turbines can be taken up for further study.

2. The off –shore wind turbines have a great potential as India has a large coast line. The financial viability of off shore wind turbines can also be the source of further study.