Bosphorus Solar Power Plant Project

Introduction

Turkey, despite having excellent climatic conditions does not have nearly enough solar projects to capitalize on the region’s solar potential. Hence in order to generate energy from this source along with promoting clean energy, my business plan aims to implement the “Bosphorus” project, which is an unlicensed photovoltaic plant with a capacity of 15MW, in Konya region of Turkey. With increasing demands for electricity along with a strong need to generate more energy from renewable sources; the Turkish government recently has liberalized the market inviting more players to enter this sector. Moreover, they have also agreed to buy the generated electricity according to the “feed-in tariffs” and have also offered a numerous incentives, if local equipment’s are used in the project, which are discussed in detail in our business proposal.

Location

When the total radiation map of Turkey is analysed, it can clearly be seen that the most efficient regions are the ones that are closer to the Mediterranean Sea Coast. However when this efficiency is analysed in terms of suitability to investment, it is seen that coastal regions are not feasible locations for solar investments. Finding the optimum location is one of the most important parameters of a successful solar power plant investment decision and the following criteria should be evaluated extensively for choosing the best location; geographical location of the field, climate features of the region, proximity to market, proximity to labour force and local incentives for specific investments.

For solar projects, the location that plant that will be constructed should have high solar radiation values and long sunshine durations. Furthermore, the field where the plant is to be constructed should be wide and flat with no arable or agricultural value and must have very low slope values, not more than 5 degrees. As the increase in the heat of the solar panels reduces the efficiency of the panel, a reasonable wind is desired for an optimum location. Moreover, the mountains or heights near the plant may cause shades during the day, which in turn reduces the sunshine hours, therefore it is important not to have any heights close to the plant. Additionally, the ideal location should not be in regions having a high level of seismic activity and must be close to electricity grids. Taking all these factors into account, Konya region is considered as the best location for a solar power plant.

Key Commercial Assumptions

- Purchase price per MW is $1,000,000 which is set after correspondences with major solar power plant contractors in Turkey and Europe.
- Benefiting from the Incentives for financial aid, a capital structure of 30% equity and 70% debt is aimed which is in line with the thin capitalization rules in Turkey. The debt will be provided from international financial institutions with 15 years of tenure, 12 months of grace period and 5%
annual interest rate. Similar projects in Europe are financed at EURIBOR + 3.00% margin, therefore I followed a conservative approach by choosing a relatively high interest rate, considering the fact that EURIBOR is 0.076% on 20th of November 2015.1

- Therefore the total CAPEX will be 15 Million USD. 4.5 Million USD will be equity and 10.5 Million USD will be debt as the leverage ratios suggests.
- Renewable solar power plants with an installed capacity of up to 1MW do not require a license or participate in the auction and can be lawfully built as an “Unlicensed Power Plant” under current legislation. Moreover, as long as you equip your plant with a separate metering facility each of which has 1MW capacity, you can still benefit from “Unlicensed Power Plant” advantages.
- Unlicensed projects, which are connected to the distribution system, pay a Distribution System Usage Fee which is paid on total generation (7.6$/MWh for 2015).
- An extra cost for inverter replacement will be borne every 15 years of operation, as the economic life of each inverter is limited.
- Sales Revenue is generated through the Feed-in-Tariff Agreement made with the state run market financial settlement centre (PMUM). The Feed-in-Tariff is set to $0.133/KWh for the first 10 years starting from January 2017. Following the expiration of the Feed-in-Tariff Agreement, the electricity generated will be sold to licenced retailers or to Power Exchange Market at the market price.
- The market price after Feed-in-Tariff is set to $0.133/KWh, which is the minimum feed-in-tariff paid at the moment for the electricity produced from renewable resources.
- FIT for all of the renewable technologies have been determined in USD and is paid at the end of every month. The payable USD amount is converted into TRY by USD/TRY offer rate of CBRT and is paid in TRY to the generators.
- No escalation is applied on FIT. The base FIT and local content additions are both flat in USD over the tariff period.
- Life of the project is 30 years and the power plant will be closed in December of 2046.
- Corporate tax rate is 20%.
- A capacity factor of 17% and 0.4% of annual degradation rates are employed in the calculations, which are in line with similar projects.
- 10-year-straight line depreciation is used as it is pointed in the Turkish Tax Procedure Law 333/2004.
- Weighted Average Cost of Capital (WACC) method is employed to monitor the profitability of the project more accurately.
- Discount Rate is calculated as 10%.
- Annual operational and maintenance expenses are assumed to be 1.5% of the total capital expenditure with an annual escalation rate of 5%. As the operational expenses are remarkably low in solar power plants, the widely used OPEX assumption in solar industry is 0.5% of capital expenditure but an extra cost multiplier is used in order to cover unexpected incidents, as the solar industry is relatively new in Turkey.
- After the end of the project, a 5% salvage value of total capital expenditure is employed in the cash flow calculations.
- Insurance is 0.4% of the capital expenditure as it is a widely used practice in the market.
- Decommissioning cost are $1.5 Million in total which will be accumulated with equal reserves over 30 years of project life.
- Land Cost is calculated to be $0.42 million as more than 100,000 square meters of land acquired with a unit cost of $2/square meter. It is also assumed that the value of the land appreciates at 5% per annum.

Key Findings

Benefiting from the local incentivized feed-in-tariff of $0.133 per KWh, the project has high IRR and very short payback periods. Relatively cheap and long tenured project loan acquired through the
Renewable Energy Law Incentives also has improving effects on the project financials. As the project has rapid and high returns, the debt service is not a financial constraint. Throughout the debt, the project has an average debt service coverage ratio of 2.12. For the purpose of simpler analysis, levelized cost of electricity (LCOE) generated is calculated over the lifetime of the project and found $0.0406/KWh, which sheds more lights on the profitability of the project. According the financial analysis, the project IRR is 18%, NPV is 2.76 Million Dollars, payback period is 5 years and discounted payback period is 8 years.

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>5</th>
<th>2.76</th>
<th>18</th>
<th>0.0406</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted Payback years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payback years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV $ million</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRR %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCOE $/kwh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Scenario Analysis**

For the purpose of understanding possible outcomes of different scenarios during the FiT term and after the FiT term, various sensitivity analyses are pursued. The graph on left depicts the profitability of the project with respect to changing tariff after the 10-year Feed-In-Tariff period if the tariff is held constant (13.3$ cents/KWh) during the Feed-In-Tariff period. As can be seen from the graph, even in the lowest tariff scenario of 8$ cents/KWh, the project yields a positive NPV. However, the increasing tariff increases the NPV and IRR remarkably. The graph on the right hand side shows what the project IRR and NPV can be if the project company utilizes local photovoltaic components and benefits from the bonus for using the local components. The highest possible Feed-In-Tariff is 20$ cents/KWh if all the parts are purchased locally. Under that scenario, the project yields a 39% IRR and 8.8 Million $ NPV. Upon the researches and following correspondences with industry specialists in Turkey, I strongly believe that there are local manufacturers that can fulfill the requirements to obtain the local incentivized feed-in-tariff.

![Graphs showing the impact of Feed-In-Tariff on profitability and IRR.](image)

**Conclusion**

As a conclusion, renewable energy investments are quite profitable and bankable given the current economic and political condition of the country. National Renewable Energy Action Plan dated December 2014 states the current incentives and the intention of the government that encourages such investments. In the Appendix, you can see some part of the Income Statement and Cash Flow Statement of the financial model generated specifically for this project.
### Financial Projections (in million USD)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Year of the Project

- 1.Jan.16
- 1.Jan.17
- 1.Jan.18
- 1.Jan.19
- 1.Jan.20
- 1.Jan.21
- 1.Jan.22
- 1.Jan.23
- 1.Jan.24
- 1.Jan.25
- 1.Jan.26
- 1.Jan.27
- 1.Jan.28
- 1.Jan.29

### Payback

- 5
- 0
- 0
- 0
- 0
- 0
- 5
- 0
- 0
- 0
- 0
- 0
- 0
- 0
- 0

### NPV (in million USD)

- $2,76

### IRR (%)

- 18%