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Technical Feasibility for Optimal Cost Analysis of 50 KW Mini Solar Power Plant In ajmer District of Rajasthan: A Case Study

KEYWORDS: Rural electrification policy, simulation, off grid locations

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ABSTRACT *Solar energy is not only about present but it also about future. The unlimited potential of Solar is visible in its varied applications of energy generation. One such power of solar can be seen today with homes being energized by solar panels. This energy accelerates cost saving as electricity bill is reduced to about 30% with incorporation of solar power. Energy from the sun has many features, which make it an attractive and sustainable option: global distribution, pollution free nature, and the virtually inexhaustible supply. PV technology is most widely used in the developing world. The system finds itself the best place where the problems of remote locations and fact of unreliable or non-existent electricity grids are dominant. Here, PV power supply serves as the most economic option.*

I Introduction:

India receives solar energy equivalent to over 5,000 trillion KWh per year. The daily average solar energy incident varies from 4-7 KWh per square meter depending upon the location. During 2006-07, the Government of India notified „The Rural Electrification Policy, which lay down the broad framework for rural electrification programs in the country. The Rural Electrification Policy has laid down that in "villages or habitations where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Solar stand alone is one such system. The annual average global solar radiation on horizontal surface, incident over India is about 5.5 KWh per square meter per day. There are about 300 clear sunny days in most parts of the country. Ajmer (Rajasthan) is ideally suited for exploiting the solar potential for electrification with the available technology. India is a tropical country with sunshine in plenty and long days. About 301 clear sunny days are available in a year. Theoretically, India receives solar power of about 5000 trill on kWh/ yr (600 TW approx.) on its land area. On an average, daily solar energy incident over India ranges from 4 to 7 kWh/m^2. Depending on the location sunshine hours varies from 2,300 – 3,200 hours in a year. This is far more than current total energy consumption. For instance, assuming conversion efficiency of 10% for PV modules, it will still be thousand times greater than the likely electricity demand in India by the year 2015.

II Key concept and details of project:

The government of Tilonia village Ajmer (Rajasthan) desires to implement the application of solar technology to provide rural energy solutions. Solar Technology applications to be implemented in a comprehensive manner for solutions in following areas domestic home lighting, Street lights in village panchayats limits, Shops in village, School in village, Flour mill, Clinic, Irrigation of agricultural land in the village the solar technology to be inconformity with MNRE GOI, standards and specifications. The technology provider to indicate the rate at which KWh or unit of power can be made available. The Solar technology providers to identify cluster of villages where in they can execute, while taking full responsibility of installation, maintenance and reliable functioning of the technology provided by them on sustainable basis. Depreciation to be considered is 80% of the total capital cost of the project.

III Importance of Solar Energy : Solar Energy is renewable, clean, and sustainable form of energy which helps in protecting our environment .It does not create pollution by releasing gases like nitrogen oxide, carbon dioxide, mercury and sulphur dioxide into the atmosphere as many conventional forms of energy do. Solar Energy, therefore, does not contribute to global warming, acid rain or smog. It actively contributes to the decrease of harmful green house gas emissions. Since solar energy does not use any fuel, it neither increases the cost nor does it add to the problems of the transportation and recovery of fuel or the storage and disposal of radioactive waste.

IV Cost analysis and results:

For Tilonia Village Ajmer district Rajasthan, various combinations have been obtained of solar system with solar photovolatic, Diesel, batteries and converters from the homer Optimization simulation. HOMER uses the total net present cost as its main selection tool. All the possible solar system configurations are listed in ascending order of their total net present cost. As per the optimization results an optimal combination of renewable energy technology system components are a 50KW PV, 50KW generator, 40 Trojan T-105 Batteries, 50KW Inverter and a 50KW Rectifier with a dispatch strategy of cycle charging. The total net present cost, capital cost and cost of energy for such a solar system are Rs. 863,488, Rs. 535,000 and Rs. 0.409/ KWh, respectively.

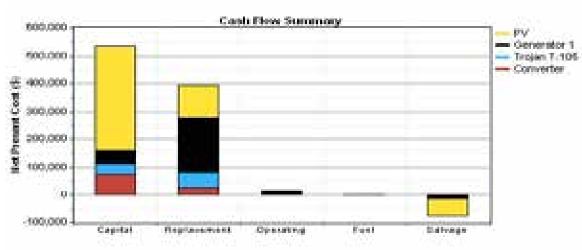

Figure 1.1 (a): Cash Flow Summary based on the Selected Components

Figure 1.1(a) shows the cash flow summary based on the components selected in the system. The batteries have a low impact on the capital and O&M costs. PV and converter share the maximum portion of the capital investment.

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The replacement cost for generator and PV cell is higher.

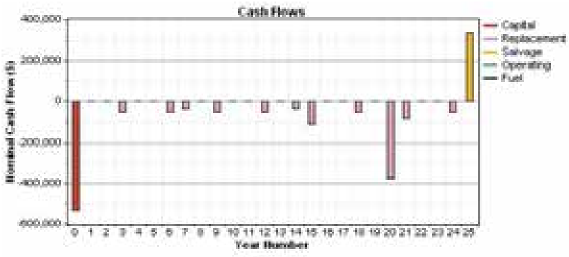

Figure 1.1 (b): Yearly Cash Flow of the System in its Lifetime

The yearly cash flow throughout the system's lifespan is shown in Figure 1.1 (b) Replacements occur majorly in the 15th and 20th year of the system, mostly for changing batteries and replacing PV Panels. Other replacements and repair of electronics items is required time to time. All these cash flow calculations do not consider any discounts, government funding or subsidies.

V Conclusion and summary:

Applying homer software this study presents an analysis for choosing the best individual renewable energy technology system and then compares it with conventional grid extension. Firstly, the load demand pattern of location over different seasons is studied yearly and suitably modelled. With the help of simulations, the optimized sizing of Mini-Hydro power, wind turbine generator, solar photovoltaic's and diesel Generator systems is obtained. As per the optimization results an optimal combination of renewable energy technology system components are a 50KW PV, 50KW generator, 40 Trojan T-105 Batteries, 50KW Inverter and a 50KW Rectifier with a dispatch strategy of cycle charging. The total net present cost, Capital cost and cost of energy for such a solar system are Rs.863, 488, Rs.535, 000 and Rs.0.409/KWh, respectively. The electrification of a location with Renewable Energy Technologies and a diesel backup is both the most cost-efficient and the most environmentally friendly option.

REFERENCE

[1] Nema, P., Nema, R.K., Rangnekar, S. (2010) 'PV-solar / wind hybrid energy system for GSM/CDMA type mobile telephony base station', International Journal of Energy and Environment 1(2), pp.359-366 (available from: | [2]. Iniyan, S., Sumathy, K. (2000) 'An optimal renewable energy model for various end uses', Energy 25, pp. 563–75. | [3]. Chakrabarti, S., Chakrabarti, S. (2002) 'Rural electrification programme with solar energy in remote region—a case study in an island', Energy Policy 30(1), pp. 33–42. | [4]. Muneer, T., Muhammad, A., Saima M. (2005) 'Sustainable production of solar electricity with particular reference to the Indian economy', Renewable and Sustainable Energy Reviews 9(5), pp. 444 - 473. | [5]. Kaushika, N., Gautam, N.K., Kaushik, K. (2005) 'Simulation model for sizing of standalone solar PV system with interconnected array', Solar Energy Materials and Solar Cells 85(4), pp. 499–519. | [6]. Schmitt, A., Huard, G., Kwiatkowsk, G. (2006) 'PV-hybrid microplants and mini-grids for Decentralised Rural Electrification in Developing Countries', EDF Research and development, France. | [7]. Kaldellis, J.K., Zafirakis, D., Kaldelli, E.L., Kavadias, K. (2009) 'Cost benefit analysis of a photovoltaic-energy storage electrification solution for remote islands', Renewable Energy 34, pp. 1299–311. | [8] Bates, J., Wilshaw, A. (1999) Stand-alone PV systems in developing countries, Technical report, The International Energy Agency (IEA), Photovoltaic Power Systems (PVPS) programme. |