Mapping the Market Potential for Solar Photovoltaic Systems

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(Received : 31 January 2004 – Accepted : 15 March 2004)

Abstract: It has been observed that the Solar Photovoltaic (SPV) market is only partially explored. The tremendous achievements in the technological R&D are not effectively percolated to the grass-root level through a befitting object oriented marketing mechanism of the systems which would also feedback the market signals to the R&D for optimum customisation of the products. Mapping techniques have come out to be convenient, elaborative and flexible. Current practice is to map the solar energy potential and breakeven turnkey cost. But the social and environmental factors also need to be incorporated along with the economic parameters to map the market potential. The studies presented in this paper essentially propose a methodology on market potential mapping of any SPV system which would not only generate the absolute figures

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indicating the acceptance level of any system/product, but also estimate its acceptance relative to its possible competitor which may be a non-SPV system or even a less prospective SPV system.

Keywords : Solar Photovoltaic, Market Potential Mapping, Renewable Energy Systems.

Introduction

The pace at which the Solar Photovoltaic (SPV) systems have increased in number as well as types is significant but hardly up to the level of expectations made in 1970s, i.e. when, after the first oil shock, the global community realised that the renewable energy sources in general and solar energy in particular has to be utilized to the fullest, if the civilisation is to be sustainable. Since the available time to cope up with the challenges viz. energy security and environmental alterations, is limited, our all out efforts is the need of the hour. The Market Potential Mapping (MPM) for SPV systems would be an essential tool for that purpose. Economic, social and environmental factors influence the level of acceptability of any commodity, including SPV systems. The present studies focus on design and application of such a methodology to estimate the acceptance level in case of SPV systems.

Methodologies in Use

Since the most influencing parameters to the customers are economical, a significant amount of studies focused on estimation of Levelised Annual Cost (LCA), Life Cycle Cost, Pay Back Period [1,2] and such methods that do not consider the social and environmental parameters which are increasingly affecting the decision making process of the SPV systems users. The importance of social cost of energy use was probably first revealed in 1988 [3]. However, the current methodologies for mapping the potential of solar energy systems do not incorporate the findings. The dynamically generated maps of renewable energy resources, that determine which energy technologies are viable solutions are provided in [4]. Some efforts has been made [5] to map the market value as a breakeven turn-key cost (BTC) by analyzing the installed and operating costs relative to incentives, energy savings and externality values only, over the life of SPV systems, as shown in Fig.1. Similarly, [6] is a renewable energy soft-wire as well as information and relevant service provider. These services would be useful for renewable project formulation and implementation. However, to the best of knowledge of the author, the mapping facility to establish the potential of any renewable energy system – particularly solar PV system – as envisaged in this paper, is not yet available.

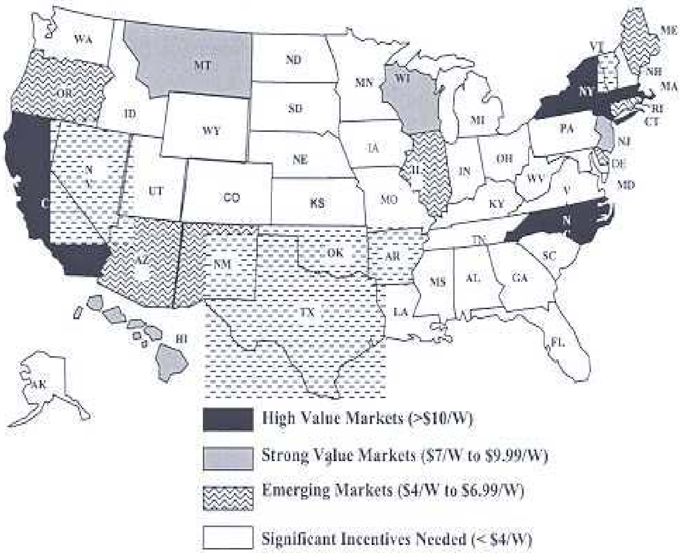

Figure 1. Breakeven Turnkey Cost (BTC) map of the United States of America.

Proposed Methodology

The proposed methodology comprises the following steps :

(a) Identification of parameters such as,

(i) Economic: Cost of product, maintenance and operating cost, prevailing subsidy, tax benefits, benefit due to absence/lesser amount (than fossil-fuel-run equivalent system) of social/scarcity/opportunity cost, resale value, etc. – all in annualised quantities;

(ii) Social: Energy habit of the customer, social custom, aesthetic value of the product, customers goodwill for reasons such as lowering of pollution by use of these "green systems", political goodwill/propaganda, population density & accessibility of the location, grid connectivity, etc. and

(iii) Environmental: Availability of solar radiation and other environmental conditions that would significantly affect the performance of the SPV system in consideration.

(b) Quantification of each parameter should also take care of three levels of awareness of the target population, such as,

(i) Totally un-aware;
(ii) Aware but not yet totally realised; and
(iii) Totally aware and realised.

(c) A reasonable time frame based on

(i) Estimated product-life;
(ii) The life of the technology; and
(iii) Other factors, such as, the dynamic nature of the above-mentioned parameters, the replacement frequency that depends on general habit of the users.

The use of Geographical Information Systems (GIS) and continuous monitoring as well as updating of the data (identified parameter) would be essential. Dedicated software would process the raw data, based on the above-mentioned steps, and generate Acceptance Index (AI) of the SPV system and MPMs with colour coding facility, as indicated in Fig.2. The software should also be capable to generate data for another system (already in the market), which is thought to be replaced. The corresponding data may be compared by finding their ratios, which would be the relative Acceptance Index (RAI). Thus, even in a PC, such exercise may be conducted within practical time and convenient way.

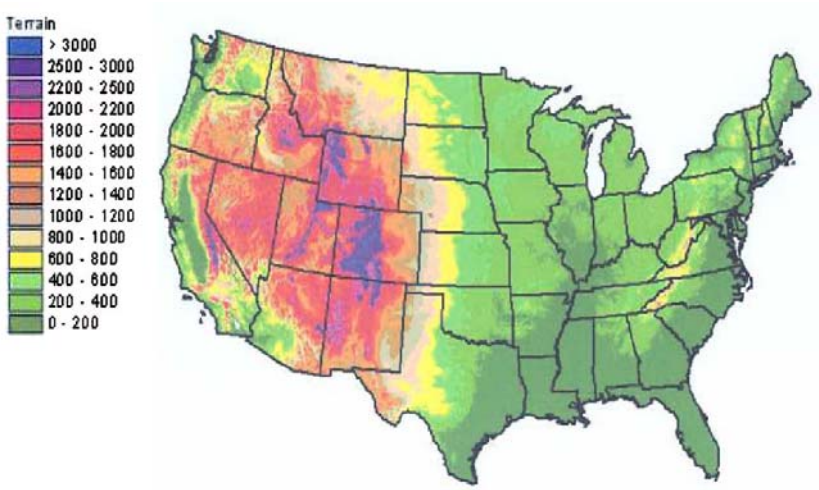

Figure 2. Market potential map as envisaged in this paper.

Sample Results

In the absence of extensive data and also the software, only very simple calculation has been made to find the relative Acceptance Index (AI) of irrigation pumps powered by SPV systems with compared to the diesel operated systems. To calculated the relative AI of the SPV power system, the following relations have been used:

Relative AI = [Levelized Annual Cost (LAC) of diesel system]/[Levelized Annual Cost (LAC) of SPV system]

LAC of diesel system = Initial investment x capital recovery factor + cost of diesel x number of operating hours/year + annual maintenance cost

LAC of SPV system = Initial investment x capital recovery factor + annual maintenance cost (including the battery replacement cost)

Initial investment = Cost of SPV system for 2000 hours of operation per year*capacity factor + cost of pumping system

Capacity factor = Number of hours of operation per year / 2000

The relative AI obtained under certain assumptions are shown in Table 1.

Table 1. Relative Acceptance Index of SPV Operated Pumps for Irrigation Purpose.

Cost of Diesel($/Lt)	0.3	0.4	0.5	0.6
No. of hours of operation per year				
1000	1.55	1.83	2.11	2.39
2000	1.65	2.04	2.42	2.80
3000	1.70	2.14	2.58	3.02
4000	1.73	2.21	2.68	3.16

Assumptions:

Input variable parameters	Unit	Value
Cost of Diesel Pump Set (5 HP/3.7 kW)	US$	2000
Cost of Pump Set with SPV System (5 HP/3.7 kW) for 2000 hours of operation/year	US$	4000
Bank discount rate (%/100)	number	0.05
Life of the systems (same for both)	Years	20
Annual maintenance cost (assumed % of cost of system)	%	5

Conclusions

Because of the inherent flexibility, the facility would be applicable to both existing systems as well as the systems yet in the concept or in the process of development. In fact, the specifications of such systems under development may be optimised to maximise their Acceptance Index (AI). The dynamic and varied nature of the input factors could be fully tackled and utilised with the help of already developed networking technologies for the procurement of data and even personal computers for its processing. The approach seems to be useful to the policy makers, the manufacturers, as well as the researchers in the SPV field.

Acknowledgements

The author wishes to acknowledge the moral support given by the authorities of the Indian Institute of Social Welfare and Business Management (IISWBM), India as well as the Energy Resources Section (ERS) of the Environment and Sustainable Development Division (ESDD) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the Organizing Committee of the Photovoltaic Science and Engineering Conference (PVSEC-14), Chulalongkorn University, Bangkok, Thailand, to carry out the work and writing this manuscript.

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