Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 90 (2016) 455 – 462

Energy Procedia

5th International Conference on Advances in Energy Research, ICAER 2015, 15-17 December 2015, Mumbai, India

Models for Deployment of Solar PV Lighting Applications in Rural India

Saumya Anand[a], Anand B. Rao[b,*]

[a] *Centre for Technology Alternatives for Rural Areas, Indian Institute of Technology Bombay, Powai, Mumbai, INDIA*
[b] *Centre for Technology Alternatives for Rural Areas, Indian Institute of Technology Bombay, Powai, Mumbai, INDIA*
[*] *Corresponding Author. Tel: (+91) 22 25767877, Fax: (+91) 22 25767874, E-mail: a.b.rao@iitb.ac.in*

Abstract

Promotion of solar energy is one of the major steps taken by the Government of India in its pursuit of sustainable development in recent years. In spite of the growth in electricity generation capacity reaching to 272.5GW, 75.02 million households, mainly in rural areas, are not yet electrified. Out of these, 72.4 million rural households use kerosene as primary lighting source whereas, only 0.92 million rural households use solar energy as primary lighting source (Census, 2011). Although solar PV lighting applications are better alternative in terms of quality of illumination, durability and versatility of use, there has been limited success with the deployment of this technology. This study has analysed various business models for deployment of solar PV lighting applications to identify the determinants of success and failure in rural India. The study is based on case studies, survey and interaction with various stakeholders. A variety of socio-economic, technical and market barriers have been identified. Those included are individual ownership models (Kattiwada in Madhya Pradesh, Hadi in Sindhudurg, Chavani in Raigad and Selco) and fee for service models (Amle in Palghar and Darewadi in Pune). The study shows that the major factors affecting the deployment of solar PV applications in rural areas are: the presence of local market for solar PV based products to create linkage between energy service providers and beneficiaries/end-user(s), availability of innovative financing mechanism to make product/ service affordable to the customers, awareness among people w.r.t. solar PV or other renewable energy technology, the reputation of vendor (or NGO) in the respective region which drives the acceptance of the product/ service, and willingness to pay for the product and its maintenance. Although an initial capital subsidy helps in acceptance of solar PV product/ service, the sustained use of product/ service is observed only when the users contributed fully or substantially towards the same. The lessons from the study can be extended to similar situations for other applications of solar PV technology (e.g. water pumping) or other renewable energy technologies.

Keywords: Solar PV Deployment; Individual Ownership Model; Fee for Service Model; Primary Lighting Source

doi:10.1016/j.egypro.2016.11.212

1. Introduction

India ranks fourth in energy consumption in the world. Since 1950s starting from installed electricity generation capacity of 1,713MW, India is now standing with capacity of 272.5GW as on May 31, 2015 [1]. However inspite of such huge capacity, the nation is still facing the challenge of providing a reliable energy access to its people. Because of increasing population and hence increasing energy demand, there has been over-dependency on fossil fuels for power generation. This has in turn made the future of fossils such as coal, lignite, petroleum etc. very uncertain. In India, 61% of total installed power generation is from coal/lignite whereas renewable energy sources hold a contribution of only 13% [1].

With respect to these issues of energy security and excessive burden on fossil fuels and simultaneously, considering India's high solar insolation which is 4-5kWh per square meter with an average of 300 sunny days in a year, solar power generation (both on-grid and off-grid) is being looked upon as one of the possible solutions. Also, in 12th five year plan, the potential for renewable energy in the country has been estimated to be over 100GW [2]. It is to be noted here that, 43% of rural India still depends on kerosene as a primary source of lighting [3].

2. Cases Studied For Solar PV Lighting Applications

So far in India, solar PV technology is mostly encouraged via three different modes: Individual Ownership Model (beneficiary owns the whole system which is provided to him at full/ subsidized cost), Rental or Fee-for-Service Model (a third party is involved who is responsible for operation and maintenance of solar lanterns whereas cost of services is paid by end user) and Micro-grid Model.

The case studies discussed in this paper are based on field experience involving interactions and discussions with beneficiaries, local NGOs, vendors and other stakeholders. It should be noted here that the discussion for deployment models is being carried w.r.t. focus on lighting application of solar PV in this paper.

2.1. Case Studies on Individual Ownership Model

2.1.1. Hadi Village, Sindhudurg (Maharashtra)

Hadi village is situated in Sindhudurg district in Maharashtra, India. It has 330 households with a population of 1144 [3]. Though village is electrified, few households do not have electricity connections because of their hilly terrain. The main occupation of these people is farming and labor. The villagers have been using biogas for cooking purpose (mainly) for last 8 years which was installed by local NGO named Bhagirath Pratishthan. Therefore, the villagers already have the prior knowledge about renewable energy sources and their benefits.

In January 2013, 101 households in the village purchased SPV technology based products. Out of 101 households, 81 households purchased solar lantern whereas rest of the 15 households purchased solar home systems on which they can run AC appliances also. In order to understand the scenario, 10 households have been surveyed, 7 of them are those who have purchased solar PV technology based products whereas rest 3 households didn't, however they are aware of the technology. The type of deployment process followed in Hadi is very unique, unlike other parts of India. It is to be noted here that a common platform for direct interaction between end-user(s) and product/ service provider(s), was established in this case. Such a platform provided, a freedom of choice for selection of product(s) as per the needs, to the villagers, and also enabled the scope for establishing market linkages for post-sale services for these products, thus benefitting end-users as well as the vendors. This in turn helped is creating a self-sustaining market scenario for Solar PV based products in Hadi village. The deployment process for Solar PV based products has been explained in figure 1.