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Transition towards off-grid photovoltaic systems: Is price the final answer?

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Abstract

There are 1.3 billion people living without electricity, a large portion of which is in the bottom of the economic pyramid. Rural electrification via photovoltaic systems is one possible solution to alleviate their poverty. The aim of this article is to qualitatively investigate the potential for the transition towards off-grid photovoltaic systems. Two interrelated aspects are specifically investigated: photovoltaic system price and relative advantages for rural adopters. It has been shown that apart from the price, there are other advantages that can motivate rural inhabitants to adopt photovoltaic systems.

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1. Introduction

Energy access has a profound impact on development and poverty alleviation. As a result, it should be placed as a priority in a global level [1]. In particular, providing access to electricity can improve living quality in terms of health, education, income and environment [2]. Global demand for electricity grows rapidly – almost double that of the total energy consumption. This rising demand together with the anticipated cut back in nuclear power generation, arose after the incident of the Fukushima Daiichi plant in Japan in 2011, emphasize the strive for alternative electricity source. According to the World Energy Outlook 2012, there are 1.3 billion people living without electricity [3]. Another 1 billion have sporadic access [4]. A large portion of those populations is in the bottom of the economic pyramid. Their poverty can be alleviated by electrification. However, today's electrification process is encountering the challenge of environmental concerns. In addition it has been acknowledged that several developed countries have

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been locked-in in the traditional source of fossil fuels. Therefore, electrification process should be leapfrogged directly towards renewable energies [5]. Among all the renewable alternatives, solar energy has the highest growth in contributing to electricity generation at 42% during 2000-2010 and is expected to increase 26-fold during 2010-2035 [3]. Rural electrification via photovoltaic (PV) systems is one possible solution. Although PV systems have been used for rural electrification since 1960s [6], there are still a large number of people who have not benefited from the diffusion of this technology. One reason may be due to the perceived high cost of PV systems by policy makers.

Academically speaking, economics is an inevitable component in the analysis of diffusion of energy technologies, and of course, not least for PV systems [7]. According to a UNDP report [8], financial mechanisms to support rural electrification via PV systems can be elaborated under three actors: customers, companies and financial organizations. Different actors exercise their own distinct financial mechanisms. This article investigates the financial mechanism features associated with customers or adopters.

Despite the need for sustainable form of energy, researches on the diffusion and adoption of energy technology still lack theoretical and generalization advancement [9]. Thus, this article aims to bridge this gap by investigating the potential for the transition towards off-grid PV systems for rural electrification in the general context without using any specific case. One of the most important indicators that lead to the adoption of the new technology is relative advantages which are the perceived advantages from the adopters' point of view in comparison to the existing alternatives. They usually shed positive effect on the customer acceptance and, as a result, adoption of the new technology takes place [10-12]. In addition to the benefit for society at large, the relative advantages must have personal relevance for the adopters [9]. Although these advantages are almost always associated with economic gain or loss, there are also other advantages. Thus this study explores the potential advantages directly affecting individual adopters. Two interrelated aspects are specifically investigated: PV system price and relative advantages for rural adopters. Connected to these two aspects, there are two sub-research questions: what are the main factors that have major impact on the price of PV systems? and what are the relative advantages for adopting PV systems among rural users? The discussion on price and advantages is relevant to the diffusion of energy technologies as they are the driving force for the adoption especially for the adopters in the bottom of the pyramid (BOP) market. These adopters have very limited income and require different strategies compared to other groups of adopters [13].

Methodologically, this study qualitatively investigates the transition when rural inhabitants switch from traditional energy sources to off-grid PV systems. Those traditional energy sources are, however, often not in the form of electricity but come in other forms of energy that can be replaced by electricity access. Attempts have been made to identify the potential factors that exhibit strong impact on the transition in rural context. The article also strives to provide a finding that can be generalized to bridge the research gap mentioned above. Consequently, the analysis is on the general context of off-grid PV systems for BOP adopters without specifying community or country cases. However, some specific examples are given to render readers a better understanding of the context. The information employed in the analysis is based on previous studies and also author's empirical research in Thailand and Bangladesh. The adopters that are the focal attention of this article are individual adopters in the BOP market.

The next section discusses the factors that affect PV system price. Section 3 elaborates on the relative advantages that the rural inhabitants may gain from adopting PV systems. The article ends with finishing remarks regarding conclusion, limitation, policy implications and potential for future research.

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