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Learning to lend for off-grid solar power: policy lessons from World Bank loans to India, Indonesia, and Sri Lanka

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Abstract

The World Bank has sought to advance the diffusion of solar photovoltaic (PV) technology for off-grid applications in the developing world. As these systems are fundamentally different to centralised power stations and conventional rural electrification, the World Bank has been learning how best to lend for such technology. This study seeks to highlight the lessons learnt from the World Bank's first loans for off-grid PV to India, Indonesia, and Sri Lanka. It uses lifetime cost analysis to justify continued intervention in this sector, and it draws on theories of innovation diffusion to guide analysis and ultimately policy recommendations. Because of the special role of entrepreneurial start up companies in the rural PV sector, the paper also uses a company cash flow model to demonstrate the efficacy of various supply-side policies. Finally, the study concludes with a checklist of policy lessons and a consideration of the role of the International Finance Corporation in this sector. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Renewable energy policy; Rural electrification; Solar photovoltaic technology; Multilateral lending institutions

1. Introduction

Renewable energy technology is seen by many as a potential solution to the environmental challenges presented by the developing world's burgeoning electricity requirements.[1] Such technology has particular applicability in remote, rural areas, where it can make use of locally available resources, such as sunlight, biomass, wind, and hydro power. Often, complete electrification through grid extension has been restricted by budgetary constraints, leaving large numbers of rural households without access to electricity.

As the largest multilateral lender in the power sector, the World Bank has come under pressure to expand its lending for renewable energy. In the search for renewables that were near-commercial, the Bank has found that, in the absence of a connection to the grid, rural households were willing to pay commercial prices for solar photovoltaic home-lighting systems, and that such systems could be a cost-effective substitute for kerosene lighting and battery charging for radio and TV. Thus, with the help of the Global Environment Facility (GEF), the Bank set out to advance the diffusion of the solar home system (SHS), first in India in 1994, followed by Indonesia in 1997, and more recently, Sri Lanka in 1998.

The experience of the World Bank in the power sector has been predominantly one of lending for large centralised, fossil or hydro-based power stations, while loans for rural electrification have gone to conventional grid extension, and the development of diesel powered, micro-grid stations. As such, lending for the SHS, where power generation, transmission, and distribution is located at the level of the rural household, has necessitated policy innovations. The demand for policy innovation has, in turn, meant that the World Bank has been on a learning curve in lending for off-grid solar power.

After first considering the background to the World Bank entering the off-grid SHS market, this study goes on to use a lifetime cost analysis to provide a rationale for the World Bank and GEF's continued intervention in this sector. To further guide our analysis of the World Bank's PV loans and, ultimately, our policy

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[1] Many studies emerged in the early 1990s in response to the rising spectre of climate change, and the United Nations Conference on Environment and Development (UNCED). (see for instance Anderson, 1992; Office of Technology Assessment, 1992; Johansson *et al.*, 1993; Jhirad and Mintzer, 1993; Messenger, 1994).

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prescriptions, we then turn briefly to theories on innovation diffusion. Because of the historically significant role of the entrepreneurial start up company in this sector, and the limitations of cash-flow, our analysis also employs a company cash flow model to assess the efficacy of various supply-side policy options. Finally, we conclude with a checklist of policy recommendations and a consideration of the future of World Bank lending in this sector, with particular attention given to the emerging role of the International Finance Corporation (IFC).

2. Background to World Bank lending for the solar home system

2.1. An opening for renewable energy technology

The World Bank recognised early on that investments in rural electrification through conventional grid extension would have to be selective (World Bank, 1975). Thus, by implication, many rural households in the developing world would not receive a grid connection. The conventional alternative to grid extension is an isolated micro-grid supplied by a diesel generator. However, the remote location of these systems has made it difficult to acquire spare parts and costly to transport diesel oil, resulting in service that is generally both costly and unreliable (Lovejoy, 1992).[2] Thus, in short, the World Bank was open to alternative forms of rural electricity supply.

At the same time, as one former staff member of the Bank reflects, the environmental question was starting to "creep into the lexicon".[3] In the run up to UNCED in 1992 the World Bank's environmental record was coming under ever-increasing scrutiny. This was particularly the case in the power sector where large-scale power plants were accused of exacerbating global warming (Bosshard, 1994), while large-scale dams were seen to both damage local environments and cause social dislocation (Morse, 1992).

The World Bank and other multilateral institutions were called upon to increase their lending for renewable energy technologies (Johansson *et al.*, 1993; Office of Technology Assessment, 1992). The World Bank responded with affirmation of the increasing viability of such technologies in developing countries:

> …the clean, reliable, and increasingly cost-competitive characteristics of renewable energy technologies makes them ideal candidates for displacing other conventional energy options in a variety of developing countries in the coming years. (The World Bank 1993; p. 92)

Furthermore, organisational changes were made within the Bank to give renewable energy technology the support it would need to attract loan officers' attention. In 1993, the Asia Alternative Energy Unit was established within the World Bank to generate confidence among Bank staff (particularly loan officers) in a brand of technology that had formerly been seen as either an R & D exercise, or the sole domain of aid agency demonstration projects.[4] As one staff member said at the time, it was really a question of instigating a paradigm shift within the Bank.[5]

2.2. The solar home system gains in credibility

In the mid- to late- 1980's, entrepreneurs and other private sector companies were demonstrating that there was a market for PV technology among rural, unelectrified households for small-scale lighting and entertainment services (Hankins, 1993). The fact that rural households were willing to pay commercial prices for the SHS was seen as the strongest signal of this technology's potential. Kenya received particular attention within the Bank (Van der Plas, 1994), given that the private sector had been largely responsible for the diffusion of 20–40,000 solar home systems by 1993; an example reinforced by private sector sales in countries such as the Dominican Republic, Sri Lanka, and Zimbabwe.

The credibility of the SHS was further enhanced by reports by the Industry and Energy Department of the World Bank (Ahmed, 1994; Anderson and Ahmed, 1995), which then served as an advisory body to loan officers in the energy sector. In short, these reports found that under certain circumstances, PV technology was more cost effective than grid electrification and diesel mini-grids for rural electricity supply (Anderson, 1992).

Furthermore, with the establishment of the Global Environment Facility (GEF) in 1991, World Bank staff now had access to grants to increase the projected economic returns on loans for renewable energy technologies to the levels required by in-house guidelines.[6] Thus, with the SHS attracting both greater credibility and

[2] Indeed an internal report within the World Bank concluded that there were considerable limitations to such systems (Solar Industry Journal, 1991).

[3] Interview with former renewable energy specialist in World Bank Washington, DC, 11 December 1996.

[4] Interview with member of ASTAE, World Bank, 19 July 1994.

[5] Interview with member of Energy and Industry Division, the World Bank, 20 July 1994.

[6] In 1994, at the time of the India loan for PV technology, the minimal internal economic rate of return required to use funds from the International Development Agency in the electricity sector was 12%. Early World Bank assessments projected that a 10 million USD grant from the GEF would lift the economic return of the PV component of the India loan from 1.5 – 3.3% to 14.0 – 14.6% (World Bank, 1992a,b).

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