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Success and failure in the political economy of solar electrification: Lessons from World Bank Solar Home System (SHS) projects in Sri Lanka and Indonesia

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ABSTRACT

This study contrasts two national solar home system (SHS) programs that relied on the same World Bank approach, but reached dramatically different results. The Energy Services Delivery Project (ESDP) in Sri Lanka was an exemplary renewable energy access program, successfully installing 21,000 off-grid SHSs alongside grid-connected mini-hydro capacity and off-grid village hydroelectric systems. It reached all of its targets ahead of schedule and below cost. By contrast, the Indonesia Solar Home System Project (ISHSP), which ran from 1997 to 2003, sought to reach one million rural Indonesians through the sales and installation of 200,000 SHSs. However, by project closing in 2003, less than five percent of the original sales target, or only 8054 units, had been installed. The ESDP and ISHSP were the World Bank's first foray into a "market-based renewable energy services provision model." Based on original research interviews and field observation, the article finds that contrasting the two programs—one a success, the other a failure—offers lessons for energy and development practitioners, namely that effective programs are those that select appropriate technology, often with input from households themselves; they promote community participation and ownership; and they have robust marketing, demonstration, and promotion activities.

1. Introduction

Lack of access to electricity and dependence on traditional fuels for cooking and heating remains an enduring economic development issue for many countries, one that has catalyzed significant international momentum towards universal energy access via initiatives such as Sustainable Energy for All and the Sustainable Development Goal 7 (Ockwell and Byrne, 2017; International Energy Agency, 2017; Gollwitzer et al., 2018). The International Energy Agency (2018) estimates that worldwide about $13 billion in capital is invested at improving access to electricity or cooking devices annually.

To meet these targets, channel this investment, and capture some of the plentiful co-benefits of energy access (such as reductions in poverty, gender empowerment, improved health, and skills development, to name a few), a variety of programs and business models have blossomed over the past decades (Chaurey et al., 2012; Sovacool, 2013a; Halff et al., 2014). As merely a glimpse of the depth and complexity of actions, between 2011 and 2015, more than 106 countries have actively and formally engaged with Sustainable Energy for All and provided financial or in-kind contributions for working on tailored national strategies and investment plans (Sustainable Energy for All, 2016). One of the most significant technologies for expanding access to modern energy services within these approaches is solar electrification, especially via solar home systems, or SHSs (Ulsrud et al., 2015, 2018;

Abbreviations: $, Denotes United States dollar unless otherwise indicated; AU, Administrative Unit; BPPT, Agency for the Development and Implementation of Technology (in Indonesia); CEB, Ceylon Electricity Board; DFCC, Development Finance Corporation of Ceylon (in Sri Lanka); ESDP, Energy Services Delivery Project (in Sri Lanka); GDP, gross domestic product; GEF, Global Environment Facility; GWh, Gigawatt-hour; IBRD, International Bank for Reconstruction and Development; ISHSP, Indonesia Solar Home System Project; kW, kilowatt; LIPI, Indonesian Institute of Sciences; LOLC, Lankia Orix Leasing Company (in Sri Lanka); MEMR, Ministry of Energy and Mineral Resources (in Indonesia); MENRISTEK, Ministry of Research and Technology (in Indonesia); MW, megawatt; MWp, megawatt-peak; NGO, nongovernmental organization; NPL, non-performing loan; PB, participating bank; PCI, Participating Credit Institution; PLN, Perusahaan Listrik Negara; PV, photovoltaic; SEEDS, Sarvodaya Economic Enterprises Development Service; SHS, Solar Home System; SHSs, Solar Home Systems; SPPA, small power purchase agreements; WBG, World Bank Group; Wp, Watt-peak

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Ockwell et al., 2018; Venkateswaran et al., 2018).

Despite the abundance of actors promoting solar (and other) energy options, however, one of the most influential remains the World Bank. The World Bank Group (WBG) is a major source of financing for energy and infrastructure projects including pipelines, oil and gas fields, and power plants as well as off-grid energy systems such as SHSs and micro-hydro dams. The World Bank in particular is a multilateral institution that provides loans and credit to developing countries to stimulate social and economic development in an attempt to alleviate poverty (Clark, 1999; Sovacool, 2017).

This comparative study contrasts two World Bank funded national SHS programs—one in Sri Lanka, and one in Indonesia—that relied on the same approach but reached dramatically different results. The Energy Services Delivery Project (ESDP) in Sri Lanka cost-effectively installed 21,000 off-grid SHSs and a series of village hydroelectric systems ahead of schedule and below cost.[1] By contrast, the Indonesian Solar Home System Project (ISHSP) reached less than five percent of its target, or only 8054 units. The ESDP and ISHSP were the World Bank's first foray into what has now become known as a "market-based renewable energy services provision model." Based on original interviews and field research in both countries, this study explores the dynamics of both programs as well as implications for energy access policy more generally.

In contrasting the ESDP with the ISHSP, the article aims to make three contributions. First, and critically, it analyzes a case of success, commonly referred to as "best practice," alongside a case of failure, or "worst practice." We took a rather simple notion of failure to mean a "successful" project met its goals or produced benefits that exceeded costs; a "failed" project did not meet its goals or had costs that outweighed benefits. In doing so, the study identifies not only the programmatic factors that often result in the success or failure of individual case studies, but also the extent that the complex agendas of international and bilateral energy and development agencies, manufacturers, research planners, politicians, and community leaders harmonize, or hinder, programmatic efforts. Both the energy policy community and perhaps the development community as a whole need to better understand the dynamics of failure alongside the better-known reasons for success.

Second, this study delves into how both Sri Lankan and Indonesian planners attempted to supply energy services in moments of crisis. Sri Lanka was undertaking the ESDP as they dismantled the functions of the welfare state, promoted privatization and restructuring, and emerged from a 26-year old civil war—providing insight for how such tensions can be managed (Caron, 2002). Indonesia was similarly dealing with the Asian Financial Crisis as its national program was unfolding (Sovacool and Drupady, 2012).

Third, the study illuminates how the World Bank designs and implements their energy projects. The WBG's annual average lending ranges $60–$70 billion in loans, grants, equity investments, and loan guarantees (World Bank, 2015), making it the largest international development bank in the world. Though it operates independently, the WBG's major shareholders are France, Germany, Japan, the United States, and the United Kingdom, and its major borrowers are Brazil, China, India, Indonesia, Mexico, and Russia. Understanding the internal dynamics, processes, and accountability mechanisms of the WBG is therefore of importance for both scholars of environmental governance and energy policy and practitioners of multilateral financial aid. Keohane (2002) describes institutions such as the WBG as "organized anarchies" created to reduce transaction costs, facilitate information, and empower agents to orchestrate complicated actions. This study therefore underscores the differing contextual factors that can stimulate or stymie WBG efforts (and perhaps those facing other, similar multilateral financial institutions).

2. Case study selection and background

This section briefly justifies Sri Lanka and Indonesia as case studies before summarizing the specific dynamics of each of their national SHS programs.

2.1. Sri Lanka's Energy Services Delivery Project (ESDP)

At the turn of the millennium, Sri Lanka faced a series of daunting energy security and development challenges. It was primarily a biomass centered energy sector, with 47.4% of demand met from fuelwood and dung, 43% petroleum, and 9.5% hydropower (Sri Lanka Sustainable Energy Authority, 2009). Seventy percent of households depended on biomass, mostly for cooking, and electricity represented only 7% of overall energy use. Moreover, 60% of household demand for electricity went to one use only, lighting (Nagendran, 2001). About half of the population earned less than $2 per day (Integrated Development Association, 2004).

To minimize the health implications of household biomass use, diversify the energy sector, and improve incomes for communities, the WBG and Global Environment Facility (GEF) initiated the $55.3 million ESDP Project in 1997. The ESDP aggressively promoted SHSs alongside various community based micro-hydro projects, a wind energy pilot, and energy efficiency investments. Its key objectives were to provide electricity to rural households, strengthen the regulatory environment in favor of energy efficiency, improve private sector performance, and reduce carbon emissions (Sovacool, 2013b).

The Credit Line Component was the largest part of the ESDP, and the one most relevant to it solar targets. It provided medium and long-term financing, targeting rural households themselves, contrasted with other ESDP components such as micro-hydro, targeted for village co-operatives, tea estate management companies, and independent power producers. One defining characteristic of the Credit Line was its phased-reduction of grants. Rather than cover costs entirely, the component gave a series of grants on a sliding scale. At the start of the program, all SHSs received a 15–20% subsidy. The GEF, a partner, also gave performance-based grants if costs declined or efficiency improved. SHS dealers received a $2.30 subsidy per Watt-peak (Wp) for offering smaller sized systems over time. However, these grants were slowly phased out so that by 2002 they covered only 8–12% of the total cost of a SHS, and by 2004 they did not exist at all. Vendors generally responded either by improving the efficiency of their operations to keep costs low, or by reducing their inventory. In 2002, the Credit Line Component was also modified to include microfinance institutions and Sarvodaya Economic Enterprises Development Services (SEEDS) agreed to manage the program. SHS penetration quickly grew, jumping to more than 3200 SHS sold in 2000 (Nagendran and Iyer, 2001) and eventual system sales of 1300 per *month* (Kapadia, 2003).

A capacity-building component supported a wide array of activities. One of the first tasks to be undertaken was an extensive feasibility study of 1048 villages to determine possible sites for SHS deployment. It was this collection of initial market surveys and pre-investment studies where planners discovered that end users were willing to pay slightly more upfront if energy services were more reliable and safer—e.g., SHSs were perceived more favorably than kerosene and diesel. The ESDP established a Technical Advisory Committee to set standards for manufacturers. It provided funds for the Ceylon Electricity Board (CEB) to prepare a National Renewable Energy Strategy and establish a Pre-Electrification Unit within the utility to provide support and training to the Credit Component discussed above. Funds were also available to participating credit institutions (PCIs) to prepare feasibility studies, business plans, and document bank loans, and grants were given to

[1] Admittedly, some of the program's successes have since been obviated by massive investments in grid electrification. As these occurred after the project's close, they are outside the scope of this study, although they are discussed in Sovacool and Drupady (2012) and Sovacool (2013b).