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Solar power for street vendors? Problems with centralized charging stations in urban markets☆

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ABSTRACT

While energy poverty is a particularly large problem in rural areas, rapid urbanization in developing countries is also raising concerns about energy access in urban areas. How can policymakers improve energy access for the urban poor? We address this question by investigating the use of solar power for improved lighting for urban street vendors. We conduct a field study of the centralized charging station model in Patna, Bihar, India. A solar panel is installed in a marketplace and vendors can rent and charge the batteries of the lights for a daily fee. Our findings reveal potential problems with the approach. Key issues include opposition by local strongmen who operate diesel generators, the difficulty of finding local entrepreneurs to operate the system, vendor misuse of the lights, and physical barriers such as land availability. Policy recommendations include considering the sales of standalone devices and relying on the urban electricity grid for connections.

1. Introduction

Energy poverty is often considered a rural problem, yet the urban poor in developing countries also often suffer from a limited access to energy. According to the Electricity Access Database that accompanies the 2013 *World Energy Outlook* of the International Energy Agency (IEA., 2013), the household electrification rate in urban areas of developing countries is 91%. In most of these areas, the supply of electricity is intermittent and extreme voltage fluctuations damage equipment. Moreover, the household electrification rate omits access to electricity in the informal enterprise sector.

With rapid urbanization across the developing world (Montgomery, 2008), the phenomenon of urban energy poverty is increasingly significant. The number of people living in urban areas of developing countries is growing rapidly. Many of them live in slums and work in the informal economy without secure property rights or access to basic infrastructure services (Agarwala, 2013). These people demand access to electricity that can power an urban lifestyle, putting more and more pressure on the already strained power sectors of developing countries. As a result, there are no obvious solutions to the problem of urban electricity access, and energy poverty in cities more generally.

How can we tackle urban energy poverty? Distributed power generation offers one possible solution. In an urban area that suffers from limited and unreliable supply of electricity, technologies such as solar power offer a natural alternative. In an urban slum or marketplace, an off-grid solar system can provide a local source of electricity to dozens or hundreds of urban dwellers. Indeed, Parikh, Chaturvedi, and George (2012) have conducted a slum dweller survey in the city of Indore, finding that electricity access is among the most basic aspirations and priorities of the local slum population. According to Lipu, Jamal, and Miah (2013), the metropolitan area of Dhaka, the capital of Bangladesh, is suited for distributed energy solutions, such as community solar power systems. In light of these results, new technological solutions to alleviate energy poverty are of direct relevance to the greater challenge of improving energy access. Indeed, the year 2012 was declared to be the year of Sustainable Energy for All based on the premise that renewable energy can provide a sustainable and scalable solution to the problem of energy access. While much of the emphasis in the policy debates is on rural areas, the combination of rapid urbanization and remaining energy poverty warrants a fresh look at

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distributed energy solutions to urban energy poverty.

This article draws lessons from an intervention that aimed to provide street vendors in the city of Patna, Bihar, India, with solar lighting through the centralized charging station model. In the metropolitan Patna area, we estimate there to be about 30,000 street vendors based on a vendor census done by our local partner, the NGO Nidan. With a median household size of six, these street vendors support and provide livelihood to almost 200,000 people. According to Bhowmik (2012), there are about 10 million street vendors in the world. In India, rapid urbanization is increasing the number of people living in cities and creating policy challenges related to livelihoods, resilience, and sustainability (Karanth & Archer, 2014; Kumar, 2015).

Yaqoot, Diwan, and Kandpal (2014) report, based on a survey in the city of Dehradun in India, that a centralized charging station model allowing vendors to lease solar lighting equipment would probably be the most successful one. The main advantage of such a model is that vendors need not pay the high upfront cost of a standalone solar light. Moreover, a centralized charging station will result in a lower cost per vendor due to economies of scale. The primary objective of this study is to evaluate the feasibility, problems, and opportunities of the centralized charging model for solar lighting access to street vendors in urban marketplaces. The entire intervention was documented with baseline surveys, weekly reports from field researchers, and extensive discussions with both the implementation team and the study population of street vendors.

2. Methods

We begin the section by reviewing the literature on urban energy poverty and then provide a succinct but complete description of the field project.

2.1. Literature review

Energy access is easier to achieve in urban than in rural areas because of high population densities and the anchor load demand provided by industrial and commercial users. Since this article focuses on solar lighting, we discuss energy access in terms of basic electricity for services such as lighting, mobile charging, and air circulation. According to the International Energy Agency's 2013 Electricity Access Database (IEA, 2013), for example, 91% of urban households in developing countries had an electricity connection while the corresponding number was only 65% in rural areas. In a typical urban area, industry and commerce create demand for power and high population densities enable distribution companies to reach households more easily than in remote rural communities. Therefore, it is not surprising that most of the literature on solar lighting has focused on rural areas (Chakrabarti & Chakrabarti, 2002; Kirubi, Jacobson, Kammen, & Mills, 2009; Palit, 2013; Smith & Urpelainen, 2014; Urpelainen, 2014; Wong, 2012). Several field studies both within India and in other countries suggest that off-grid solar power is a viable option for providing basic electricity access, such as lighting and mobile charging, to remote rural communities where the cost of grid extension is too high. For example, Chakrabarti and Chakrabarti (2002) document the use of decentralized renewable energy in the Sagar Dweep island in West Bengal, India, already in the 1990s. Palit (2013) reviews various solar energy programs for rural electrification in South Asia, noting that the potential for cost-effective decentralized solar energy generation is considerable, provided issues related to financing, business models, and technical standardization can be overcome.

For our purposes, experience with centralized charging stations is particularly important. Chaurey and Kandpal (2009) evaluate the viability of centralized charging stations for solar lanterns in rural India. They find that the model "has the potential to build and strengthen many institutions at the local level and at national level. Setting up of central charging stations would require identifying, selecting and training entrepreneurs to operate and manage a charging station, while at the same time, undertaking servicing of solar lanterns in terms of minor repairs and replacements of parts" (Chaurey & Kandpal, 2009, 4916–4917). They note, however, that financial viability requires that households be willing to pay a daily rental that is higher than the implicit daily cost of owning a solar lantern. In other words, the centralized charging station depends on factors such as a lack of disposal income or imperfect access to credit at affordable interest rates. This observation is also key to understanding the economics of the centralized charging station in the urban areas, as we shall shortly see.

Despite the general focus on rural energy poverty, many urban areas are also afflicted by this malaise. In India, where electrification rates are generally much higher than in Sub-Saharan Africa, some states nonetheless suffer from limited electricity access. The 2011 Census of India shows, for example, that Bihar's urban electrification rate was only 67% and that of Uttar Pradesh only 84%. Based on these numbers alone, there are more than 50 million urban dwellers in these two large states without access to electricity. Most of these people live in slums and participate in the urban informal economy as street vendors, domestic workers, servants, and other similar occupations. With rapid urbanization throughout the developing world, the number of people without electricity access in urban areas may remain stagnant or even increase.

This article focuses on lighting for street vendors, a topic that has not been studied in great depth in previous research. Although slums and the informal economy have been studied (Agarwala, 2013; Hayami, Dikshit, and Mishra, 2006; Jha, Rao, and Woolcock, 2007; Medina, 2007), including several important studies that describe and explain variation in electricity use (Baruah, 2010; Mimmi, 2014; Parikh, Chaturvedi, and George, 2012), few of these studies emphasize lighting access for street vendors in urban markets in particular. This is unfortunate, given that reliable and bright lighting is essential for drawing customers and selling goods such as fruit, sweets, juice, and meals. Without lighting, customers cannot inspect product quality and may also worry about the safety of the street vendor's stall.

The most important recent study on the topic of solar lighting for street vendors is Yaqoot, Diwan, and Kandpal (2014). They conduct a survey of 150 urban street vendors in India to evaluate the feasibility of solar lighting models. Their main finding is that rentals of solar lights based on the centralized charging station model is ideal for street vendors. Not only does the model relieve vendors of the need to make high upfront payments, but it also provides them with access to maintenance and product service. However, it is important to remember that Yaqoot, Diwan, and Kandpal (2014) base their analysis on a survey. Our contribution is to actually test the centralized charging station model in a real setting. The only example we could find of a centralized model being implemented in a marketplace was carried out by a women's Self-Help Group (SHG) in the Chittur District of Andhra Pradesh in 2011. With help from SELCO-India, a single system was set up to charge and distribute thirty batteries to local vendors that were members of the SHG. Unfortunately we were unable to find any evidence of the impact the centralized model had on the entrepreneurs' livelihood or the long-term sustainability of the project.[1]

[1] Acharya, Keya. 'INDIA: 'Women Make Good Business Sense?' Inter Press Service News Agency, September, 15 2011. Available at http://www.ipsnews.net/2011/09/india-women-make-good-business-sense/(accessed January 27, 2015).