



# Rethinking barriers to electrification: Does government collection failure stunt public service provision?

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## ABSTRACT

A growing body of evidence demonstrates the importance of energy access for human development. Yet, over a billion people continue to lack access, and financing electrification efforts poses a formidable challenge to resource-constrained governments. Resultingly, growing bodies of work focus on measuring consumer willingness to pay, viability of cost effective non-grid alternatives, and ways of reducing theft. We argue that these studies largely overlook a crucial policy issue – government capacity or willingness to collect revenues. We work with the public energy utility in Bihar, India, to evaluate levels of revenue collection among formally connected energy consumers. We run a randomized controlled trial to evaluate the impact of offering an incentive to local contractors to collect revenues in rural Bihar. The program made significant improvements among small, hard to reach consumers billed on minimum monthly charges. While these improvements are significant, the level of nonpayment at endline remains unsustainably high. Appropriate incentives can increase the proportion of paying consumers, but additional programs, including incentives for meter reading, are needed to further reduce insolvency. We conclude that it is crucial to examine government capacity and willingness to collect revenues when analyzing financial sustainability of energy systems in the Global South.

## 1. Introduction

Development scholars, practitioners and politicians increasingly agree on the necessity of access to electricity for human development. Yet, 1.3 billion people remain disconnected from electricity grids globally (Alstone et al., 2015). In many countries in the Global South, electricity utilities suffer from depressed cost recovery that hinders the ability to invest in higher quality services for those with access and to expand to those in need of connection. How will countries expand provision and meet increasing demands? How can resource constrained governments engender systems that are economically viable in the long run? Suggestions on energy pricing abound, from investing in cheaper alternatives to increasing tariffs on consumption. However, research has largely overlooked whether governments successfully collect the revenues they bill. We argue that, in some contexts, government capacity to collect energy bills may pose a greater challenge to financial sustainability than consumer willingness or ability to pay.

In this paper, we examine revenue collection by the state-run energy utility company in Bihar, India. This case provides an example of a context in which most citizens are not connected to the government's electricity grid, quality of power supplied is erratic, and the energy

utility is enmeshed in debt. We argue that considering government capacity to collect revenues is a crucial but overlooked policy issue that could contribute substantially to barriers to electrification.

Utilizing government administrative data, we estimate that less than half of rural consumers pay their energy bill. Working with the government, we introduced a randomized experiment offering local contractors an incentive to collect bill payments. We show that the proportion of paying consumers increases for small consumers in the experimental regions, which has important implications for the financial health of the utility. However, we note that overall, even in the treatment areas, over 60% of bills remain uncollected. These figures suggest the incentive works well for small consumers, but additional programs are necessary to expand the base of paying consumers to a sustainable level.

## 2. Revenues essential for public service provision

Financing public utilities remains a formidable challenge in the developing world. Energy utilities have accrued substantial debts in resource-poor contexts. The Indian government estimates the annual loss from the state power utilities was over \$9 billion between 2009 and

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2010; 71% of these losses were attributable to the distribution system (Government of India, 2013, pp. 136, 139).<sup>1</sup> These losses are financially unviable and can limit India's ability to invest in other public goods that are necessary for human development.

Furthermore, public economics literature theorizes that financial insolvency can lead to a low-level equilibrium of utility provision (Savedoff and Spiller, 1999; Singh et al., 1993; Strand, 2012). The low-level equilibrium is characterized by low prices for consumers, low quality services, limited capacity to expand, opportunities for corruption, and limited government incentives to challenge the status quo. In this equilibrium, low prices and low government effort and accountability endogenously feed into each other. Due to the insufficient revenues, government reduces efforts; this inertia maintains the low quality and penetration of the utility. Consequently, consumers will not be willing to pay more for this low quality service.

By illustration, several studies on optimal pricing for water argue that artificially low prices are detrimental to citizens in the long run because low prices can lead to deferred maintenance and investments in infrastructure that can expedite infrastructure depreciation (Tiger et al., 2014). Others argue that subsidies can exacerbate exclusion by benefiting only those privileged with municipal connections while precluding investment in service extension to others (see Foster, Pattanayak, and Prokopy, 2003; Furlong, 2013). "At first glance [low pricing] appears to be good for households and bad for the utility, but low revenues for the utility rebound to adversely affect households. Low revenues mean that utilities lack (1) the resources to provide high quality, reliable water services and (2) the financial incentives to extend service to unconnected households" (Whittington, 2003).

An additional issue with limited revenues concerns clean energy. Emissions from low cost energy sources are the primary driver of climate change (Alstone et al., 2015). In a low-level equilibrium of public energy provision, compromised infrastructure leads to considerable waste due to technical losses. In 2012, the Government of Bihar, India, estimated that 44% of energy was lost in transmission and distribution (Government of Bihar, 2013). During field interviews conducted in 2014, engineers in rural Bihar estimated losses to be much higher.<sup>2</sup> These losses contribute to a disturbing trend. India now has higher air-pollution levels than China, contributing to greater population health risks as a result (see Health Effects Institute, 2017). Investments are needed to improve infrastructure to promote more energy efficient provision and to invest in cleaner energy sources.

### 2.1. Existing literature on revenues and costs

The existing literature on financial sustainability as a barrier to electrification can largely be organized into three thematic areas: whether consumer willingness to pay exceeds costs of provision, whether cheaper forms of energy can be utilized, and how theft affects revenue collection. These thematic areas overlook whether or not governments successfully collect the revenues from the amount billed to consumers.

Policymakers and scholars have expressed concerns that grid extension may be financially un-viable if costs exceed long-term revenue streams. In India, the gap between average cost of supply and average revenue realized has been increasing over time, especially in Bihar, which the government attributes to both high aggregate technical and commercial losses as well as low tariffs (Government of India, 2013). As a result of these concerns, there is a body of empirical research measuring and discussing consumer willingness to pay for electricity in developing countries (Abdullah and Jeanty, 2011; Barron and Torero,

2015; Bernard and Torero, 2013; Bose and Shukla, 2001; Dossani and Ranganathan, 2004; Lee et al., 2016c; Lee et al., 2016a). For example, research on rural Kenya concludes that grid electrification is prohibitively expensive and recommends the government focus on curtailing costs to reconcile with consumer willingness to pay (Lee et al., 2016c). Empirical work on energy pricing in Andhra Pradesh, India, shows the costs of supplying energy to farmers exceeds revenues recovered; these authors suggest increasing tariffs (Dossani and Ranganathan, 2004). Though politically unpopular, policymakers propose increasing tariffs as a potential solution (Government of India, 2013).

Another set of articles and reports focus on whether non-grid alternatives provide a more cost effective option for rural electrification. In Bihar specifically and India generally, organizations have argued that decentralized non-grid energy may be more economically viable than grid expansion (Oda and Tsujita, 2011). The International Energy Agency assumes that 70% of all rural areas in developing countries will need to be serviced by off-grid solutions (Lee et al., 2016a citing IEA). Analysis of the breadth of electrification needs in Brazil led researchers to conclude that investments into decentralized alternatives like off grid solar are necessary for universal energy access (Slough et al., 2015). Ongoing research in Bihar focuses on measuring the demand for and benefits of solar micro grids (Ryan et al., 2014); other research in Kenya compares willingness to pay for grid and non grid energy (Abdullah and Jeanty, 2011). Additional studies examine willingness to pay for non grid electricity in other contexts (Urpelainen and Yoon, 2015).

Finally, there are examples of policy work and research on electricity theft. The literature discerns four types of theft: fraud (as in meter tampering), stealing electricity by hooking a wire to the power source, billing irregularities (as in meter failure), and unpaid bills (Smith, 2004). Most discussions on non payment focus on issues with meters and with tapping directly into the grid rather than focusing on unpaid bills (see Depuru, Wang, and Devabhaktuni, 2011; Greenstone, 2014). Researchers suggest implementing smart meters, prepaid meters, and various supply schemes to remedy issues around meter reading.<sup>3</sup> Field visits with engineers in Bihar revealed an emphasis on replacing old meters with "tamper proof" meters and with ensuring 100% meter reading.<sup>4</sup> Research by political scientists finds that losses from electricity theft in Uttar Pradesh follow an electoral cycle, suggesting politicians pardon energy theft as a campaign strategy (Min and Golden, 2014). This evidence neatly follows Holland's theory of forbearance, which argues that in developing countries, allowing non-payment for public goods may be a strategy for political benefit (Holland, 2016). We argue that failure to collect revenues due to nonpayment, while comprising a fraction of the literature on financial sustainability, deserves further empirical and theoretical attention.

Evidence suggests that, in South Asia, consumers are willing to pay for energy, especially reliable energy (Aklın et al., 2016b; World Bank, 2008). Aklın et al. (2016b) find reliability is the strongest determinant of satisfaction with energy access for households across six Indian states, including Bihar. Respondents with fewer hours of energy per day are more willing to pay for increased access. Data published from this study reveal that, in Bihar, rural households without grid connections are willing to pay 373 rupees (~ \$5.74) for a connection and 140 rupees per month (~ \$2.16) for ongoing usage (Aklın et al., 2016a).<sup>5</sup> Rural households with connections report a willingness to pay 187 additional rupees per month (~ \$2.88) on average for improved supply. These numbers illustrate a willingness to pay for energy that are commensurate with the bill sizes from our sample. In Bihar, grid

<sup>3</sup> See <http://www.economist.com/news/international/21693581-new-electricity-system-emerging-bring-light-worlds-poorest-key> for a description of several ongoing projects (Accessed 17.03.2017).

<sup>4</sup> As discussed in interviews with engineers in Fatuha (2/5/14 and 2/10/14), Muzzafarpur (2/12/14), and Saharsa (2/25/12 – 2/27/14).

<sup>5</sup> The conversion uses an exchange rate of 1 dollar to 64.79 rupees, as provided by Reuters on September 24, 2017.

<sup>1</sup> The conversion uses an exchange rate of 1 dollar to 64.79 rupees, as provided by Reuters on September 24, 2017.

<sup>2</sup> Engineers estimated up to 77% and 91% losses in parts of Muzaffarpur and Saharsa districts. Interviews were conducted on 2/12/14 and between 2/25/14 and 2/27/14.

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