

Policy Brief: Pre-paid meters and household electricity use behaviors in Addis Ababa, Ethiopia

May 2022

Does adoption of pre-paid meter reduce consumption of electricity? What is its impact on ownership of appliances, level of satisfaction, and cooking behaviour in Addis Ababa, the capital of Ethiopia? We provide answers using survey data collected from households in Addis Ababa.

Key messages and recommendations

- The Ethiopian Electric Utility (EEU) needs to continue expanding the use of pre-paid meters and educating customers about their advantages.
- Pre-paid meter customers have significantly lower electricity consumption compared to post-paid users, and greater satisfaction with utility service.
- This technology also has a positive, but modest and statistically insignificant impact on total appliance ownership.
- The impacts of pre-paid meters are heterogeneous across customers: those who are more educated, who have higher income, and who do not share meters tend to reduce electricity use more.
- The EEU needs to expand the dissemination of pre-paid meters and the replacement of existing post-paid meters.

Brief background

In Ethiopia, the location of our study, the Ethiopia Electric Utility (EEU) Company, a single and state-owned utility, has faced persistent challenges relating to billing collection, customer complaints, and calls for aggressive expansion of access to electricity. As part of the technological solution to these challenges, the utility is increasingly replacing post-paid meters with pre-paid alternatives. Despite growing deployment and adoption of this technology, relatively few studies have rigorously examined its impacts on household electricity consumption and other outcomes, however, especially in developing countries. Our research aims to fill this gap, examining the impact of the introduction of pre-paid metering in Addis Ababa, Ethiopia.

Methods

We use quasi-experimental methods and aim to address several related questions: what is the impact of pre-paid metering on households' electricity consumption? How does this system affect other related variables, such as appliance ownership and in particular cooking technology alternatives and energy-efficient devices? Is pre-paid metering related to customer satisfaction with the services provided by the utility?

Sampling and data

The sample for this study leverages the household Multi-Tier Framework (MTF) survey in Ethiopia administered

by the World Bank in 2016 as part of an international effort to better understand energy access in low- and middle-income countries. We draw on the sample from the first round to conduct a second-round survey focusing entirely on the major urban enumeration areas included in the original survey. We restricted this to data collected in Addis Ababa, which is where meter replacements have been most extensive. We surveyed a total of 1,182 households – consisting of all households in the first-round MTF survey from Addis Ababa plus an additional 400 households from a list of pre-paid meter customers in Addis Ababa.

Status of electric meter replacement in Ethiopia

The EEU is responsible for the distribution and sale of all of the country's grid electricity. The EEU operates in 11 regions and 28 districts and through nearly 560 customer service centres (CSCs). Despite its considerable problems, post-paid billing was the company's standard method of bill collection until 2007, prior to the advent of new metering technology. This traditional billing system, which remains in place in most of the country today, creates numerous challenges for the EEU. Namely:

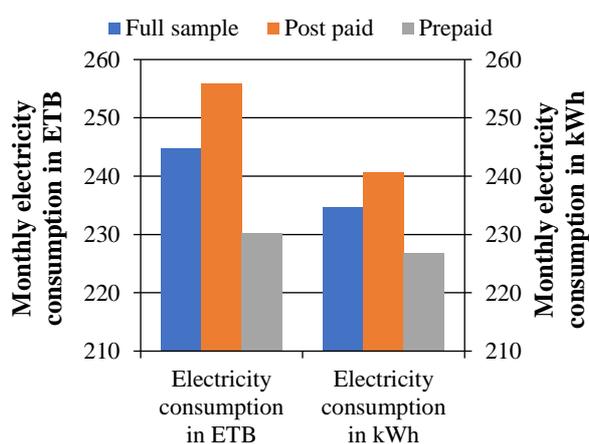
- i) It requires lengthy and inefficient revenue collection procedures as meter reading must be completed by utility personnel making the rounds of neighbourhoods and towns, followed by issuing and delivering customer bills, and finally payment collection.

- ii) Non-payment and late payment for the electricity service are common, and the company incurs a high cost for legal enforcement (i.e., collection of penalties and eventual disconnection).
- iii) This billing system is prone to a range of errors, which can lead to inappropriately high or low billing amounts. For these and other reasons, post-paid billing has long been considered problematic by the utility, and attempts to improve on billing and revenue collection remain a major challenge.

Encouraged by the success of a pilot project in the *Gerji* area of the capital city, the EEU began disseminating pre-payment meters to its customers in 2008. At present, out of a total of more than 2 million domestic customers, about half a million have pre-paid meters. The EEU believes that these meters will reduce non-technical losses, improve understanding of energy use and facilitate planning, help overcome revenue recovery and administration challenges, reduce customer debt, and facilitate improvement of customer service quality.

Pre-paid meters also include in-home displays that provide information to consumers. Customers top up their account by buying a fixed amount of electricity from a nearby payment centre. There is a disconnection when customers fail to top up their balance, but the meter has an interesting feature in that it gives a customer time to replenish their account and helps reduce the inconvenience arising from sudden disconnection.

Figure 1. Household electricity consumption



Currently, all domestic customers in Ethiopia are eligible for meter replacement, but actual replacement has been implemented gradually over time. New customers or existing post-paid users who apply for a new meter today are automatically assigned to the pre-payment system.

Some households apply for meter replacement because they want to switch to pre-paid meters. In other cases, households may request meter replacement due to technical problems with the old post-paid meter. The third group of pre-paid meter users is composed of those moving into new residences, including condominium areas and newly built houses.

Descriptive statistics

The data shows that 89% of the sampled households have a meter on the premises, while the remaining 11% are unmetered (i.e. they get electricity from their neighbours). Among the metered households considered in our analysis (N = 1,030), 56% are post-paid meter users, and the remainder are pre-paid subscribers. Meter sharing is commonplace in Addis Ababa: of the total sample households used in this empirical study, more than 26% share meters with their neighbours.

Results

We find strong and consistent evidence that the pre-payment system significantly reduces household electricity consumption. Pre-paid meter users have at least 13% lower monthly average electricity expenditure and 19% lower monthly average electricity consumption. Turning to the other outcome variables of interest, our first observation is that pre-paid metering has a positive, but modest and statistically imprecise influence on total appliance ownership. Further analysis by appliance type does not reveal statistically significant impacts on specific categories of appliances, i.e. entertainment, domestic labour-saving, or lighting devices. Thus, the overall effect may be slightly positive on ownership across all categories, but with clearly positive and significant impact only on the use of energy-efficient light bulbs. This is encouraging, as the promotion of such energy-saving devices is also a goal of the EEU. Pre-paid meters do not appear to have any meaningful impact on household cooking behaviour, as reflected by the number of cooking and baking episodes per week, or on the use of electric stoves.

Table 1. Differential impacts across income groups, education and meter sharing

		(1)	(2)	(1)	(2)
		Lower Income		Higher Income	
Income	Estimate	NS	NS	(0.24-0.28)	(0.18-0.25)
	S.e			(0.08-0.12)	(0.08-0.13)
	N	531	530	494	494
		Lower Education		Higher Education	
Education	Estimate	NS	NS	(0.23-0.27)	(0.18-0.21)
	S.e			(0.08-0.11)	(0.08-0.11)
	N	475	473	550	551
		Do not share meter		Share meter	
Meter Sharing	Estimate	NS	NS	(0.22-0.25)	(0.13-0.19)
	S.e.			(0.07-0.12)	(0.06-0.10)
	N	244	244	781	780

Note: Column (1) refers to electricity consumption in ETB; Column (2) refers to electricity consumption in kWh; NS refers to non-significant; S.e. refers to the standard errors

The impacts of pre-paid meters differ across different household types. For example, household electricity consumption behaviours, as well as their capacity to process information provided by prepaid meter (which is a function of education level), are variable, creating the possibility that pre-paid metering may also have differential impacts. We find that electricity consumption decreases for both low-income and high-income groups with pre-paid meters, but that the effect is greater for higher-income households.

Pre-paid metering reduces electricity consumption, especially among households with relatively more educated heads, which is consistent with the idea that pre-paid metering may have a higher impact on households that are more aware of their electricity consumption. Finally, pre-paid metering significantly reduces electricity consumption among households that do not share meters.

Conclusion and policy implications

Our study shows that scaling up of pre-paid metering has the potential to reduce household electricity consumption substantially. Importantly, we find that pre-paid metering does not have a disproportionately negative effect on consumption by lower-income households, which might be a particular concern given that such households already consume relatively little electricity. This finding is vital for countries like Ethiopia, where increasing demand for electricity is a strain on existing generation capacity. Increased dissemination of pre-paid meters and the replacement of existing post-paid meters could save electricity and further enable efforts to expand electricity

access, while incentivising energy conservation among higher income and consumption households. It should also be noted that pre-paid metering may be even more effective when combined with efforts to improve energy literacy. That means education, as major predictor of energy literacy, may enhance the capacity of customers to monitor and make rational decisions based on the information provided by pre-paid meters. This requires the efforts of the utility company to continue to enhance customers awareness about the multiple advantages of pre-paid metering. It also implies that government education policy yields important benefits for the energy sector.

These findings are timely and relevant for the policy environment in Ethiopia. The EEU is currently investing in expansion of pre-paid metering technology. Our study shows the need to sustain this investment and expand or increase the dissemination of pre-paid meters alongside replacement of existing post-paid meters. This is, because the former could save electricity and further enable efforts to expand electricity access, while incentivising energy conservation among higher status and consumption households.

Acknowledgement:

This research was funded with UK Aid from the UK government under the Applied Research Programme on Energy and Economic Growth (EEG), managed by Oxford Policy Management. The views expressed in this policy brief do not necessarily reflect the UK government's official policies.

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