

Title: Electric Cooking Demand in Rural Minigrid

Stakeholder: Winch Energy, MEMD

Theory of Change: For minigrid operators facing under-utilized solar-battery systems, encouraging customers to use cooking appliances during the daytime could significantly increase system utilization at almost zero marginal cost. Understanding customers' willingness to adopt electric cooking can reveal potential increases in electricity consumption, while insights into usage behavior can inform policies/strategies for clean cooking transition. The findings from this experiment could also apply to customers connected to the national grid under lifeline tariffs, who access electricity at \$0.066/kWh. For instance, using an electric kettle once a day to boil 1.7 liters of water could increase electricity consumption by about 5 kWh per month, costing \$0.33—an attractive option compared to other energy sources like charcoal. This could also offer utilities a path to grow electricity consumption.

Electric cooking not only fosters cleaner cooking practices but also could increase electricity demand. This study started a pilot project to study the adoption of e-cooking appliances and demand changes in mini-grids developed by Winch Energy in the Lamwo district of Uganda. This project selected 189 customers and distribute electric kettles in February 2024.

We obtained 15-minute resolution load records of each customer, treating any consumption of 0.05 kWh or more during 15-minute interval as an event likely indicating water boiling. This assumption is based on two facts: 1. Most customers do not have appliances that consume more than 0.05 kWh in 15 minutes. 2. Boiling a full 1.7-liter kettle consumes about 0.17 kWh, with less water requiring less energy. Consequently, additional events observed after distributing kettles are used as proxies for boiling water. The load records of the 189 customers, revealed that 34 customers never recorded events, suggesting they may not have used their kettles. 18 customers showed a high number of events before receiving their kettles, suggesting they likely possess other high-power appliances, making it difficult to determine if the events are from water boiling. The remaining 137 customers, who are the primary focus, demonstrate findings below.

The fig. 1 shows that among the 137 customers, there is an increase of 52 events per day, suggesting potential kettle usage. Each customer uses their kettle an average of 11 times per month, leading to an additional 107 kWh per month on top of their previous monthly consumption of 1281 kWh. However, usage varies significantly among 137 households: six customers use their kettles more than twice daily, and another 12 use them more than once a day, and less frequent use by others.

Based on preliminary results, two additional findings were observed: First, while customers use their kettles throughout the day, notable peaks in usage occur before noon (7-11 AM) and after dinner (7-10 PM), as shown in fig. 2. Second, an observation of the maximum load in mini-grids with more than 10 kettles distributed shows that the peak load has not increased and remains within the safe operating limits of the current systems. (These minigrid systems have either 40 kW or 80 kW solar with 144 kWh battery systems.)

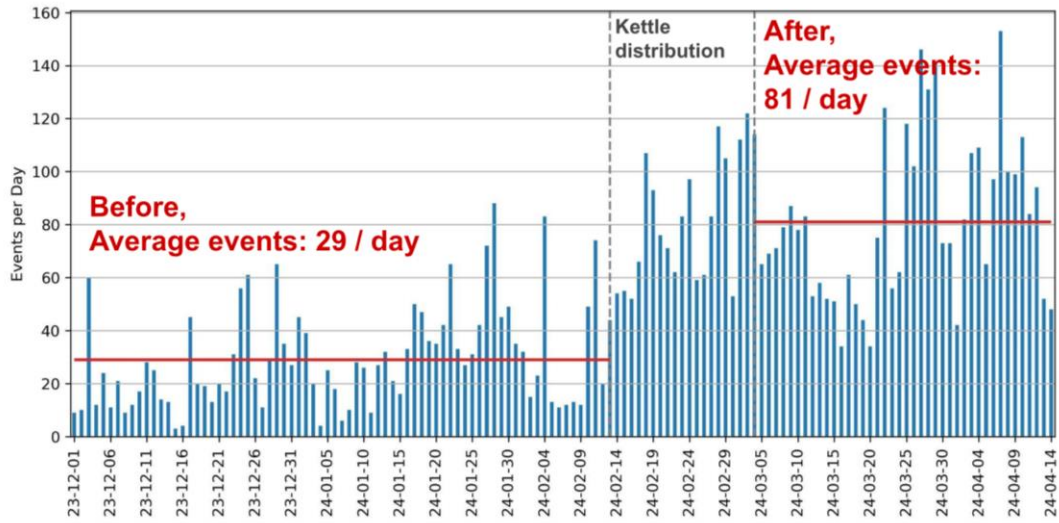


Fig. 1 - This figure shows an increase of 52 events per day among a group of 137 customers after receiving electric kettles, suggesting a rise in water boiling activities. An event, serving as a proxy for estimating water boiling, is defined as the use of 0.05 kWh or more within a 15-minute period as recorded by customer meters. The x-axis represents daily data from December 1, 2023, to April 14, 2024.

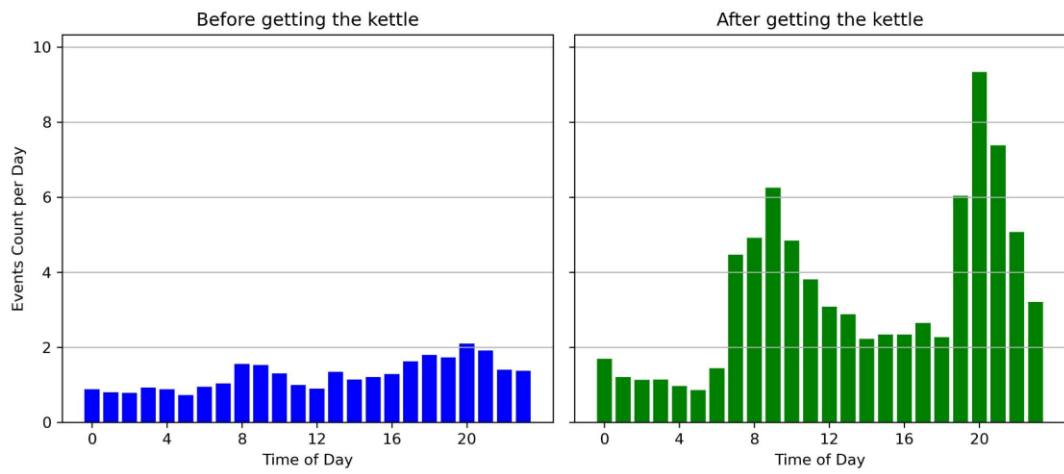


Fig. 2 – Time of events, before and after among a group of 137 customers.

These preliminary results are based on only two months of data after the distribution of kettles. Continuing data collection over a longer period will help solidify the findings. One investigation is to determine whether existing electricity consumption features can indicate potential electric kettle usage after getting the kettle. Moreover, two additional initiatives will be implemented: 1. For customers who received kettles, Winch Energy has set up a time-of-use tariff that offers a 50% discount during off-peak hours (9 AM-3 PM) to encourage increased usage, with the current rate set at 0.28 USD/kWh. 2. The potential for other appliances, such as induction cookers, is being explored; and efforts are underway to replicate the study in areas connected to the national grid where the lifeline tariff is significantly lower at 0.066 USD/kWh.