Pre-Analysis Plan: Induction stove adoption in Kenya

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We conduct an experiment to study the adoption of an induction stove manufactured by ECOA (formerly Burn Manufacturing), shown on the right in Figure 1. Purchase of an induction stove also includes three induction pots. The induction stove has a power rating of 200W–2000W depending on the desired functionality (from low simmer to high boil).

Figure 1: Charcoal stove and induction stove

1 Experimental design

Between 12 August and 19 September 2025, study enumerators enrolled into the study 2,511 people residing in the urban and peri-urban areas around the cities of Naivasha, Gilgil, and Nakuru in Nakuru county in Kenya. Respondents were enrolled by enumerators walking around the study areas. To be eligible for study participation, participants had to spend at least half of their cooking fuel expenditures on charcoal for a standard Kenyan stove, shown on the left in Figure 1. They also had to be at least 18 years of age, have a pre-paid Kenya Power electricity meter in their homes,

Latest version available here. A prior version of the pre-analysis plan, from September 22, is here. On September 26 we were informed by our project partner that their downpayment had been lowered. This explained the low take-up rates we saw on the first two days of surveying (September 24-25) which still used the higher downpayment. We therefore lowered the downpayment, which also allowed us to increase the subsidy amounts and balance the credit treatment allocations. Starting on the third day of surveying, all study participants are randomized into the payment plans described below.

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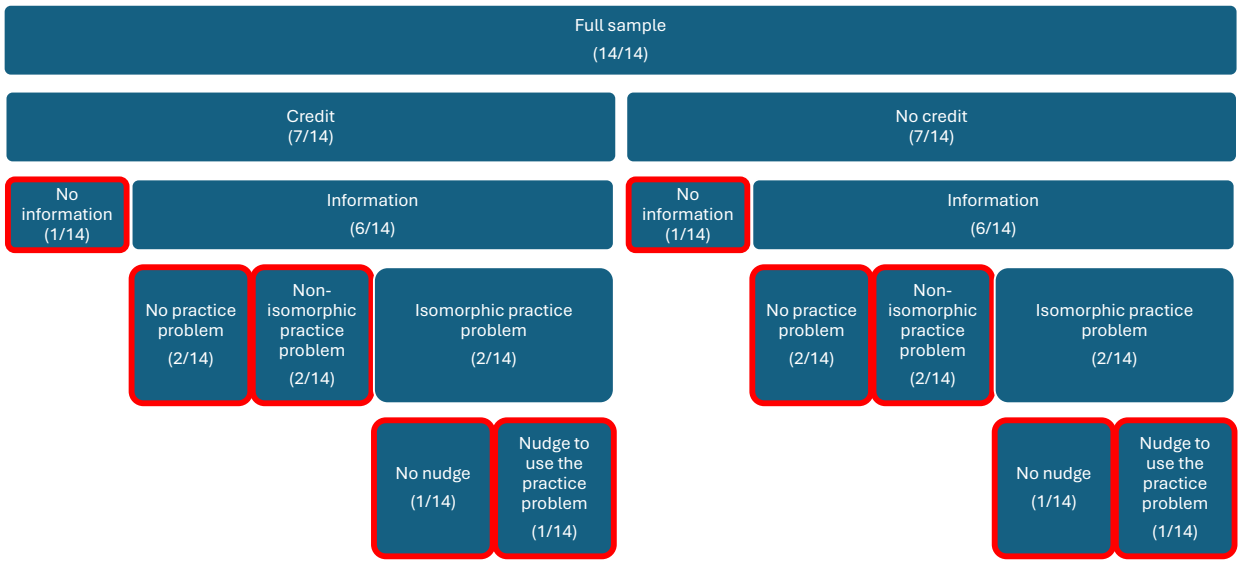
have a household size of at least 2 individuals, have basic literacy skills, spend at least US$4 per week on charcoal, and not currently own an electric or energy efficient charcoal stove. Respondents who consented to participate in the study completed a short survey consisting of demographic and socioeconomic questions. Barring financial and logistical constraints, our plan is to re-visit each household again one month after enrolment for Visit 2 and then again one month later for Visit 3.

1.1 Randomized treatments

Between visits 1 and 2, each respondent is assigned to one of the ten treatment groups highlighted in red in the graphic below, per the fractions stated in parentheses:

Figure 2: Randomized treatments



- **Credit:** Participants must pay a downpayment of Ksh 1,500 (≈US$12 at the time of the study) during Visit 2 and can then pay for the remainder of the stove in instalments. Participants in the credit control group must pay the full price during Visit 2.
- **Information:** Participants receive information about the cost of the electricity used to cook various meals on an induction stove, as well as the cost of the charcoal used to cook those same meals on a charcoal stove.
- **Isomorphic practice problem:** Participants receive a problem about grocery costs that can be represented identically to the problem to estimate the aggregate energy savings from adopting an induction stove.
- **Non-isomorphic practice problem:** Participants receive a problem about grocery costs that is similarly difficult in terms of the algebra required, but that cannot be represented like the problem to estimate the aggregate energy savings from adopting an induction stove.
- **Nudge to use the practice problem:** Participants are encouraged to consider that the helpful practice problem could be used to inform how they may go about setting up the savings estimation problem.

Within each of these six cells, each respondent is assigned to one of 9 cells according to the two additional treatments described below. Thus, all treatments are fully cross-randomized and

stratified on each other. All treatment assignments are furthermore stratified by baseline LPG ownership, baseline electricity expenditure, and baseline charcoal expenditure.

- **Fixed cost subsidies:** The price of the stove when paying upfront is US$82. Each respondent is randomly assigned a subsidized price. With 49% probability each they are assigned either a 10% discount or a 75% discount (a price of US$73.80 or US$20.50, respectively). To maintain incentive compatibility, the remaining 2% of the sample is assigned a random subsidy drawn between 10% and 85%. The realized draw is a 69% discount (a price of US$44.63).
- **Marginal cost subsidies:** We randomly assign one-third of study participants into the control group, one-third to receive a 25% subsidy on the cost of electricity used for the electric stove, and one-third to receive a 75% equivalent subsidy. During Visit 2, prior to the beliefs elicitation, respondents in the treatment groups are told that they would receive this subsidy. Respondents are informed that only electricity used by the electric stove is subsidized; they do not receive any subsidies on electricity used for other purposes.

1.2 Data collection

During Visit 2, we measure beliefs and willingness-to-pay. After Visit 2, we measure charcoal stove usage, induction stove usage, and collect payment data. Throughout the study period we measure power outages and voltage quality.

1.2.1 Beliefs

To measure beliefs about the aggregate change in energy expenditures, we conduct two incentivized beliefs elicitations. The first elicits respondents' modal belief, while the second elicits a confidence interval centered on the respondent's answer of the mode. Specifically, for the first elicitation respondents are told that they will be paid if their answer is within Ksh 40 of our prediction of their change. For the second, we conduct a binary search over different ranges of potential uncertainty beginning with a range of Ksh ±640 and increasing or decreasing based on respondents' answers. For this elicitation respondents are told that the more accurate they are the more likely they are to receive an incentive.

To study the effect of effort on responses we randomize respondents between two levels of incentives. Half of respondents are incentivized with Ksh 500 and Ksh 500 for the two elicitations, while the other half are offered Ksh 50 and Ksh 50.

1.2.2 Willingness-to-pay

To measure willingness-to-pay (WTP), we implement the mechanism defined in Becker, Degroot, and Marschak (1964), building on the implementations developed in Berry, Fischer, and Guiteras (2020), Dean (2024), and Berkouwer and Dean (2022).

Neither the respondent nor the enumerator know the respondent's randomly assigned price. The enumerator conducts a binary search over the range of Ksh 1,500 to Ksh 18,000 (US$12 to US$139), first asking *"If the price of the ECOA is Ksh 9,792 [US$76] would you want to buy it?"*, then proceeding to a higher or lower price based on the respondent's answer, and repeating this process until arriving to the nearest Ksh 10 (US$0.08). After arriving at a final WTP, the price is revealed and the respondent buys the stove if and only if their WTP is at least as high as the price.

Prior to the BDM each respondent completes two practice exercises, one for a jar of skin balm and one for a bar of soap. Each respondent is allocated a random price for the lotion and a random

price for the soap. Respondents are randomly assigned whether they would be offered the lotion using take-it-or-leave-it ('TIOLI') and the bar of soap using BDM, or vice versa.

1.2.3 Stove usage

We measure charcoal stove usage through two data sources:

- We install temperature sensors (produced by Climate Solutions) to monitor usage of households' charcoal stoves. The installation occurs during Visit 1 such that we are able to estimate a within-individual treatment effect. For households who owned two or more charcoal stoves at baseline, we installed monitoring devices on up to two stoves that were no more than three years old (older stoves than this often caused the device to malfunction). Figure 1 shows a picture of a charcoal stove instrumented with a temperature sensor.
- We ask about charcoal expenditures during the endline survey (Visit 3)

We measure induction stove usage through two data sources:

- We collect high-frequency usage data for both electric stoves and charcoal stoves. The electric stoves collect power usage (in watts) on a minute-by-minute basis. Since the devices have a continuous wireless connection with servers (to enable disconnection in case of non-payment), these data are transmitted to a dashboard in real-time.
- We ask about electricity expenditures during the endline survey (Visit 3)

We measure LPG usage by asking about LPG expenditures during the endline survey (Visit 3).

1.2.4 Payment data

For respondents who purchase the stove by paying in instalments, we will observe daily payment data as well as data on which days the respondent is 'locked out' of their stove.

1.2.5 Power quality and voltage

We deployed PowerWatch devices with 29 respondents during Visit 1. To ensure geographic coverage, we deployed 6 devices in Gilgil, 11 in Naivasha, and 12 in Nakuru.

2 Primary hypotheses for the behavioral economics of induction stove adoption

We study through layered treatments how individuals form beliefs about energy expenditures should they adopt the stove. To do so, we compare the accuracy of the elicited beliefs of respondents across the treatments using ordinary least squares regression. To improve power, we may pool groups that are not statistically different from each other. We are interested in the following contrasts:

1. The impact of pure information - we will compare respondents who receive information with respondents who do not.
2. The impact of a non-isomorphic calculation - we will compare respondents who do the non-isomorphic practice problem with respondents who do not.
3. The impact of an isomorphic calculation - we will compare respondents who do the isomorphic practice problem with respondents who do not.
4. The impact of a similarity nudge - we will compare respondents who receive a nudge with respondents who do not.

As a secondary outcome we will also investigate the impact of these treatments on willingness to pay. We are unsure whether we will have sufficient power to detect effects on willingness to pay because theory suggests that the impact of changing beliefs on willingness to pay hinges on a number of unknown factors including prior beliefs about savings and risk aversion.

3 Primary hypotheses for the environmental economics of induction stove adoption

To estimate the causal effects of stove purchasing on stove usage and CO_2e emissions, we employ an instrumental variables approach using the randomly assigned price and the credit treatment as instruments for adoption. Our preliminary outcomes are the impact of induction stove adoption on:

- Number of minutes spent cooking with charcoal per day
- Electricity expenditures and corresponding CO_2e emissions
- Charcoal expenditures and corresponding CO_2e emissions
- LPG expenditures and corresponding CO_2e emissions
- Aggregate energy expenditures and corresponding CO_2e emissions

Our primary outcomes are the cost per ton of CO_2e abated separately for:

- The electricity subsidies, among people in the credit treatment group
- The electricity subsidies, among people in the credit control group
- The fixed cost subsidies, among people in the credit treatment group
- The fixed cost subsidies, among people in the credit control group

We explore the determinants of aggregate subsidy efficiency by the same four groups, as follows:

- The number of marginal adopters incentivized by each $1 of subsidy (including when factoring in payments to inframarginal adopters).
- The externality avoided by each marginal adopter, as proxied for by charcoal stove usage, induction stove usage, charcoal emissions, and electricity emissions.

Since we announced the electricity subsidy prior to eliciting WTP, the impact of the usage subsidy on CO_2e consists of both a selection channel and an impact channel. From a policy perspective, this is immaterial: the policy goal is to lower aggregate emissions and whether this is through a selection channel or a treatment channel is immaterial. Since we are informing all participants of the usage subsidy prior to WTP elicitation, we cannot use the experimental variation to disentangle these. Still, we will explore disentangling this through an appropriate econometric tool.

We will additionally report the following secondary outcomes of interest: time savings, self-reported health, whether WTP and induction stove usage vary by underlying power quality.

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