Experimental Evidence on the Demand for Electric Cooking in Nepal *

Meera Mahadevan[†] Ryan McCord[‡] Robyn Meeks[§]
Manisha Pradhananga[¶]

December 16, 2024

Abstract

Preliminary and incomplete. Please do not cite or circulate.

To mitigate climate change and achieve CO_2 emissions reductions, many countries are promoting the electrification of end uses. In Nepal, where there have been substantial recent investments in electricity infrastructure and generation is hydropower-based and clean, a transition to cooking with electric induction stoves is a core part of government plans to ensure universal access to clean cooking. However, financial and informational barriers often impede the technology's adoption. This paper presents experimental evidence from a randomized controlled trial in Kathmandu Valley that was designed to evaluate the impact of subsidies and information treatments on the demand for electric cooking on both the extensive and intensive margins. Households receiving a subsidy were 23 percentage points more likely to adopt electric stoves and 41 percentage points more likely to purchase induction-compatible cookware. However, information treatments had little effect. Instrumenting for adoption using the randomly assigned treatments, we find that mixed evidence as to the extent to which electric stove adoption leads to shifts in fuel use (from LPG to electricity).
JEL Codes: C93, D8, O1, O13, Q56

Keywords: Electricity, energy, technology adoption, information, development

*We thank Pankaj Kumar and Udbodh Rijal. This project in covered by IRB at Duke University (2023-0241) and University of California San Diego (810846). The experiment was registered in the AEA RCT Registry (AEARCTR-0014027). This project was funded by the Asian Development Bank Technical Assistance 9940 and 6585. All errors are our own.

[†]School of Global Policy and Strategy, University of California, San Diego. Email: mmahadevan@ucsd.edu.

[‡]University Program in Environmental Policy, Duke University. Email: ryan.mccord@duke.edu

[§]Sanford School of Public Policy, Duke University. Email: robyn.meeks@duke.edu. 201 Science Drive, Box 90312, Durham, N.C. USA (corresponding author).

[¶]Economic Research and Development Impact Department, Asian Development Bank. Email: mpradhananga@adb.org.

1 Introduction

Access to clean and reliable energy is a cornerstone for economic development, health improvements, and climate change mitigation. In developing countries, where traditional fuels such as firewood and LPG are dominant in household cooking, shifting to electricity for cooking represents a crucial step toward sustainable energy transitions. Nepal offers an ideal setting to study such shifts, as it has abundant hydropower, a government actively promoting electrification, and a long history of reliance on imported LPG. Despite these favorable conditions, the adoption of electric cooking remains low. This paper explores the barriers to adoption of electric cookstoves and the impact of policy interventions aimed at overcoming these barriers.

Cooking with electricity, especially through induction stoves, can offer substantial savings on fuel costs while reducing indoor air pollution, which is associated with a range of health risks. Yet, several factors inhibit adoption, including upfront costs, misperceptions about the costs of cooking with electricity versus LPG, and ingrained cultural preferences for traditional cooking fuels. Although research has examined barriers to adoption in other contexts, such as switching from biomass to LPG or more efficient stoves (Bensch et al., 2015; Berkouwer and Dean, 2022), much less is known about the specific case of transitioning from LPG to electric cooking in urban settings like Kathmandu.

This paper presents the results of a randomized controlled trial (RCT) conducted in Kathmandu, Nepal, where we assess the effectiveness of three interventions designed to increase the adoption and use of electric cooking: (1) subsidies for electric cookstoves and induction-compatible cookware, (2) information on the recurring costs of electric cooking compared to LPG, and (3) information on the health benefits of switching to electric cooking due to reduced indoor air pollution. The context is particularly relevant following the 2015 India blockade, which caused a severe fuel shortage and highlighted Nepal's over-reliance on imported petroleum products (Giri, 2015a). The Nepalese government has since prioritized

hydropower expansion and promoted the use of domestic electricity to meet growing energy demand, especially in cooking.

We surveyed 3,521 households in Kathmandu Valley and randomly assigned them to different combinations of subsidy and information treatments. The treatments were designed to test the importance of credit constraints and informational barriers to adopting electric cookstoves. Households were randomly assigned to receive either a high subsidy (3,000 NPR), a low subsidy (1,000 NPR), or no subsidy at all. These were cross-randomized with cost and health information treatments. This design allows us to test whether reducing the upfront costs of adoption through subsidies, or addressing misperceptions about the costs and benefits of electric cooking, can significantly increase adoption.

The analysis provides three main results. First, we find that subsidies have a significant impact on the adoption of electric cookstoves and cookware, while information treatments alone do not. Households receiving the high subsidy are 23 percentage points more likely to adopt an induction stove and 41 percentage points more likely to adopt induction-compatible cookware compared to the control group. In contrast, the information treatments had no significant effect on adoption, suggesting that credit constraints, rather than a lack of information, are the primary barrier to adoption.

Second, using the subsidy treatments as instrumental variables, we estimate the effects of cookstove adoption on fuel use. Households that adopt electric cookstoves, as induced by the subsidy treatments, significantly increase their use of electricity for cooking and reduce their use of LPG. Specifically, households in the high subsidy group reduced their LPG usage by 31 minutes of cooking time per day, which reflects a meaningful shift in fuel consumption patterns. Importantly, this shift toward electric cooking is primarily driven by the subsidies, not the information treatments, further underscoring the role of credit constraints in adoption decisions.

Third, the experiment reveals that the introduction of electric cooking also has signif-

icant implications for overall energy use. Households that received subsidies and adopted electric cooking stoves increased their electricity consumption, though not enough to offset the full reduction in LPG use. This indicates that the shift to electric cooking can be achieved without imposing significant additional strain on the electricity grid, which is a concern in countries with developing infrastructure. This result has important implications for energy policy in Nepal and other countries seeking to increase reliance on renewable electricity for domestic use.

This study contributes to the literature on energy transitions and technology adoption by providing novel evidence on the effectiveness of subsidies in promoting clean cooking technologies in urban settings. While previous studies have highlighted the role of credit and information constraints in rural areas (Bensch et al., 2015; Hanna et al., 2016), our findings suggest that in an urban context like Kathmandu, subsidies are a more effective tool for encouraging the adoption of electric cooking than information campaigns alone. Moreover, the results have broader implications for energy policy, particularly in countries with growing electricity infrastructure and a reliance on imported fuels.

2 Background

2.1 Clean cooking in the developing world

Credit constraints have often served as a significant barrier to the adoption of newer technology, particularly in the developing world. Despite large saving from switching from older, less efficient stoves, to newer, more efficient ones, household adoption rates of improved cooking stoves have frequently been found to be low (Bensch et al., 2015). Credit constraints are noted as the primary reason to low adoption rates (Berkouwer and Dean, 2022), even in the presence of clear information signals about lower cost, and health benefits. Adoption of more efficient cookstoves has been extensively studied, particularly in the context of switching out of firewood, and particularly in rural areas (Bensch and Peters, 2015; Hanna et al.,

2016). However, there is a more recent phenomenon in urban areas: a rise in political will to encourage shifts from traditional fuel-burning forms of cooking to electric cooking.

The transition from LPG to electricity is an important one because it is a transition that several growing countries are likely to make in the near future, with growing political constraints on petroleum imports, and rising concerns about the polluting potential of even cleaner fuels such as LPG. The literature has often indicated significant uncertainty about fuel prices and reliability more broadly, and this maybe exacerbated for imported fuels (Hakam et al., 2022; Jewitt et al., 2020; Puzzolo et al., 2016). Domestically produced electricity may address this uncertainty. Nepal, which produces most of its electricity from hydropower, has often been beholden to LPG imports for its needs. The transition from LPG to electricity is crucial for Nepal, especially after the 2015 India blockade, which caused a severe fuel shortage and exposed the country's over-reliance on imported petroleum products (Giri, 2015a). This event spurred efforts to diversify energy sources, with a focus on expanding hydropower, which now generates nearly 99% of Nepal's electricity with minimal carbon emissions. This shift not only supports environmental goals but also reduces geopolitical risks by decreasing reliance on foreign LPG imports.

The recent push for electric cookstoves in countries like Nepal has been met with low adoption rates once again. But the transition from LPG cookstoves to electric or induction cookstoves is not as well understood as the widely-studied transitions to more efficient cookstoves (Gould et al., 2023; Guta et al., 2022). First, as in the case of more efficient cookstoves, there may be significant barriers to the adoption of new electric or induction stoves. These barriers range from credit constraints (Berkouwer and Dean, 2022), information constraints (Mobarak et al., 2012) and cultural barriers (Hanna et al., 2016). Beyond adoption, there may be barriers to continued and consistent usage (Beltramo and Levine, 2013). For example some studies have shown that people might not have enough experience with the new fuel and might not end up using the new stove (Pattanayak et al., 2019).

One of the largest reasons for reluctance to adopt electric cookstoves may be concerns about electricity availability and reliability (Batchelor et al., 2018; Giri, 2015b; Jewitt et al., 2020; Puzzolo et al., 2016; Spotlight Nepal, 2023). In this context, however, Nepal has made well-known improvements in increasing their electricity supply and improving power reliability (Acharya et al., 2024; IFC News, 2019; Open Data Nepal, 2022; Timilsina and Steinbuks, 2021). Reports suggest that electricity power outages have slowed down over the last decade in Nepal, making it much more viable as a reliable fuel, especially for essential tasks such as cooking (Kathmandu Post, 2023). The majority of generation is hydro-based and therefore clean (Bhandari and Subedi, 2023; IFC News, 2019; U.S. Agency for International Development, 2017). Additionally, the Nepal Electricity Authority (NEA) and recent IPP contracts have increased supply, contributing to more reliable electricity in Kathmandu, where reliability has improved in recent years (kpi, 2022; Ghising, 2022; Kathmandu Post, 2023; Open Data Nepal, 2022).

In addition to concerns regarding fuel availability, the transition to electric cooking involves significant upfront costs. These include the purchase of electric stoves, as well as electric-compatible cookware, particularly for induction cooktops, which require specialized materials. Despite these clear financial barriers, there is limited empirical evidence on the extent to which credit constraints affect households' ability to adopt electric cooking technologies. This gap in the literature suggests a need for more focused research on the financial accessibility of electric stoves and the role of credit facilities in facilitating this energy transition.

Finally, there remain large potential informational barriers to electric cooking adoption: both in terms of health and cost. Recent research has unequivocally found negative pollution and health impacts from LPG cooking, previously considered a relatively clean cooking fuel (Daouda et al., 2024; Lebel et al., 2022). Due to years of experience with LPG and its associated costs, there may also be misconceptions that LPG is much cheaper than switching

to electric cooking (Hakam et al., 2022; Saha et al., 2021). There may also exist cultural barriers: flame-based cooking in Nepal is deeply ingrained in cultural traditions, particularly in rural areas where firewood and open flames are central to communal gatherings and the preparation of traditional dishes. This cultural attachment, combined with perceptions of better taste and the practical challenges of using electric stoves for certain foods, has led to reluctance in shifting to electric cooking despite its health and environmental benefits.

3 Conceptual Framework

The conceptual framework for the Randomized Control Trial (RCT) builds on established economic models of technology adoption and the role of financial and informational constraints. By randomizing households into high and low subsidy groups, and cross-randomizing them with cost and health information treatments, this design allows us to disentangle the effects of credit constraints and information provision on the adoption of electric cooking technologies, fuel use, and cooking behavior. The treatment arms are expected to alleviate specific constraints—credit, information, and preferences (Bensch et al., 2015; Hanna et al., 2016; Mobarak et al., 2012).

For the high subsidy group, we expect a significant treatment effect on electric stove adoption. The economic theory of credit constraints implies that liquidity issues often prevent households from adopting cost-saving technologies despite future benefits (Berkouwer and Dean, 2022). By reducing the effective price of stoves and cookware, the high subsidy mitigates this constraint, leading to higher adoption rates and a greater shift away from LPG. In contrast, the low subsidy group may still face binding financial constraints, resulting in lower adoption rates and less pronounced shifts in fuel consumption, in line with previous studies on improved cookstove adoption (Bensch et al., 2015).

The cost information treatment is designed to address misperceptions about the relative cost of LPG versus electricity. By explicitly informing households about the cost advan-

tages of electric cooking, we expect increased adoption, particularly among price-sensitive households who may have initially underestimated the savings from switching (Allcott and Taubinsky, 2015). This mechanism is consistent with findings in the energy literature that demonstrate the power of correcting informational barriers to facilitate technology adoption (Bensch and Peters, 2015).

The health information treatment, which emphasizes the risks of indoor air pollution from LPG, targets non-monetary motivations for switching to electric cooking. Households may underestimate the health costs associated with LPG due to information asymmetries or delayed health impacts (Daouda et al., 2024; **?**). By making these risks more salient, we expect the health information treatment to shift preferences towards electric stoves. However, given that health benefits may not provide immediate economic returns, we anticipate that this treatment could generate a weaker effect relative to cost information, as financial constraints often dominate household decision-making in these contexts (Dupas, 2011).

4 Randomized Experiment on Electric Cookstoves

We conduct a randomized experiment in the Kathmandu Valley, which is located within the Bagmati Province of Nepal. The experiment randomly varies interventions designed to alleviate constraints to the adoption of electric stoves. In the sub-sections that follow we describe the sampling procedures employed, the experimental design, and the intervention details.

4.1 Study Area Selection and Sampling Process

In June and July 2023, the research team surveyed 3,521 households in the Kathmandu Valley. Our selection procedure to attain this sample was comprised of two steps, as described in the paragraphs below.

First, we start with 2,190 households that were previously surveyed by our research team

in 2021. These households are situated along the Bisnumati River, which runs north-south along the western side of Kathmandu, and were part of an earlier study on the effects of smart meters. All of those households were within 1 km of the river, with approximately half located to the western side of the river and the other half to the eastern side. These households are located in a relatively consolidated area, and serve by approximately 60 transformers (half on the east and half on the western part of the river). We can match households with smart meters (on the eastern side) to the transformers through which electricity is distributed.

Second, to systematically extend the sampled area to include additional households that would be less densely concentrated, but still similar to those selected in the first step, we used NEA data on transformer locations within a 2 km distance to the east of the Bisnumati River. We select transformers on the eastern side of the river, and went north of the sample selected in the first step, as these are the neighborhoods in which households had smart meters installed during the same intervention mentioned above. We extend the study area up to the Tokha Municipality, as this is within Kathmandu District, urban/peri-urban like the areas included in the first step, and also proximate to Bhat Bhateni store locations.

Limiting to this area, there are 172 transformers. The locations of these transformers selected in the second step – and their proximity to transformers in the first step – are mapped in Figure A1.[1]

From the utility records of all households served by these 172 transformers, we randomly sampled 7 to 8 households per transformer. This results in 1,331 additional households selected within the second step. From the two steps, the 3,521 household sample results. When surveyed in summer 2023, these households were asked if they consented to participate in a future study on electric cooking. Of the households surveyed, 2,894 consented to participate in the study going forward.

[1]The map does not show transformers on the western side of the river from the first step, as the distribution system on the western side is not connected to smart meters and therefore we do not have GPS location data.

4.2 Experimental Design

Using this sample, households are randomly assigned by computer through a cross-randomization design. Households are randomly assigned to receive one of three electric cooking subsidy treatments – a higher subsidy of 3,000 NPR, a lower subsidy of 1,000 NPR, or no subsidy – that can be used to purchase electric cookstoves (or the pots/pans specific to electric induction stoves). Based on the project budget, approximately 600 households were intended to be assigned to the high and low subsidy groups, and 1800 households assigned to no subsidy group.[2] The locations of households randomly assigned to the subsidy treatments are mapped in Figure 2.

We cross-randomize the subsidy assignments with three information treatments, with information provided on the operating costs of electric stoves, the health benefits from electric cooking, or no information. Households were intended to be assigned in approximately equal numbers (1000 households per treatment) to each of the information treatment groups. The locations of households assigned to the subsidy treatments are mapped in Figure 3.

This cross-randomization led to 9 different groups to which households could potentially be assigned.[3] The 9 groups and actual numbers of households assigned to each are depicted in Table 1. Randomization was done on a computer, forcing balance on seven baseline characteristics that were collected via the 2023 household survey.[4] Due to this approach, there are slightly different numbers of households assigned to the treatment groups.

[2]Numbers were a bit lower across all three groups, as we are randomized across 2,894 households rather than the 3,000 households we estimated prior to the study.

[3]The 8 different treatment combinations include high subsidy-cost info, low subsidy-cost info, no subsidy-cost info, high subsidy-health info, low subsidy-health info, no subsidy-health info, high subsidy-no info, low subsidy-no info. The pure control group is assigned to no subsidy-no info. For ease of viewing, we do not display all 9 groups in one map.

[4]The baseline variables on which balance was forced in randomization are: household size, household head education (both if they have less than 1 year of schooling and if they bachelor's degree or more), if the house is connected via a smart meter, if the household already owns an induction cookstove, and an income proxy based on appliances (increasing in the number of appliances owned including microwave, AC and washing machine).

4.3 Intervention

The intervention occurred in January and February 2024 and was comprised of delivering the combinations of information and subsidy coupons to households based on the randomized assignment. The timeline depicting the intervention relative to the survey implementation is shown in Figure 1.

The intervention proceeded as follows. All 2,894 households were visited by project staff during these two month period. They were thanked for consenting to participate in the study and received a small mobile phone re-charge credit in thanks for their continued participation in the study.[5] The full script for this interaction is in Appendix B1. For the pure control households, the interaction ended there. The households assigned to other combinations of treatments received additional documentation, per their random assignment.[6]

Households randomly assigned to receive either of the information treatments received a paper on which their respective messages – cost or pollution – were printed. Images of these information texts, printed in Nepali, are in the appendix (Figure B1). The full English translations of the information on the cost of electric cooking and the pollution reduction from electric cooking, are in Appendices B2 and B3, respectively.

Households randomly assigned to receive either the high or low subsidy treatments received a paper explaining that they had been randomly selected to receive a voucher for a subsidy of NPR 3000 or NPR 1000 that could be used on either an induction stove or cookware compatible with an induction stove. This printed information detailed the logistics of using the subsidy vouchers. Full information on these message – both the pamphlets printed in Nepali (Figure B3 and the English translations of the messages – are in Appendix B4.)

[5]The credit was for 100 Nepali Rupees, which was approximately 0.75 USD at the time.

[6]there were 57 households for which the intervention was unable to be delivered, either because they had moved isnce the 2023 survey or they were not home to receive the treatment during the multiple attempts made by the research team. We show the breakdown of the undeliverable treatments by assignment in Appendix Table B1.

These households also received a physical voucher card marked as "Subsidy to buy induction appliance". The card stated the amount of subsidy, a household unique id assigned by project staff, and the logo of Bhat Bhateni super store, which is the largest chain store in Nepal with 27 store locations throughout the country.[7] The mega store is well known in the country and sells most household goods, from food to appliances, cookware, and furniture, as well as clothes.

To use the subsidy, a household member had to bring the voucher to the customer service desk in the Bhat Bhateni store. Households had to be a Bhat Bhateni Club Card member or register to become one if they were not already. It costs nothing to become a member and is essentially a system through which shoppers earn points and rewards based on their prior purchases, like one would find in many major retailers in the United States.[8] The households were then directed towards the induction stoves and induction-related cookware within the store. The subsidy coupons were eligible to be redeemed from the date that the households received them through April 30, 2024.

The subsidy vouchers could be used in Bhat Bhateni locations throughout Kathmandu Valley. There are 9 super store locations throughout Kathmandu Valley (mapped in Figure B4). Prior to the intervention Bhat Bhateni had provided the research team with a list of all induction stoves and related cookware sold in their stores. The voucher card could only be used towards these designated induction related cooking items.

5 Data

We use two main sets of data for this study: data from a household survey conducted by our research team and data collected by Nepal Electricity Authority. We describe both in the sections below, as well as test for baseline balance following the randomization.

[7] Pictures of the subsidy voucher are shown in the Appendix (Figure B2).

[8] Given the coverage of the super store many people in the study were already Club Card members. Because of their own club card system and their store's system of giving annual "rewards" to their customers, Bhat Bhateni already had a voucher system set up with employees trained to receive vouchers.

5.1 Survey Data

We have two rounds of households survey data. The baseline survey conducted in June and July 2023. The follow-up survey was conducted June and July 2024.

The timing of the follow-up survey was selected as it one year after the baseline survey was implemented and approximately 6 months after the onset of the intervention. Of the 2,894 households randomly assigned to treatment, we were able to re-survey 95% (2,740 households) at the follow-up mid-2024. As a check, the survey data are matched with the information on voucher use from Bhat Bhateni.

Responses to the 2023 baseline survey provide help us better understand the study sample (Appendix Table D1). We see that approximately one-third of households pay for their electricity bills by cash/cheque, where the other two-thirds pay by credit. Respondent report, on average, that their prior month electricity bill was 2,090 Nepali rupees. Although almost all household respondents report knowing their most recent electricity expenses (97%), only 54% report know what their monthly electricity consumption (in kWh) was. More than two-third of households have a smart meter installed, which is indicative of the study's sampling strategy. In "normal months", respondents report just over 1 electricity outage per week on average; this increases to 5.5 outages per week in the "bad" months when electricity reliability substantially worsens.

Reports on appliances and other electricity-related and cooking practices provide important insights for this study. Approximately one-third of respondents report heating their houses in the winter, whereas almost no households (3%) report cooling with air conditioners. Households have a substantial number of electric appliances, with most respondents having a refrigerator (89%), fan (84%), and a kettle (64%). On average, approximately 2 hours per day are spent on cooking (13.5 hours in the last week).

5.2 Utility Data

From NEA, we have monthly data for the 3500 consumers in the 2023 survey starting in April 2018 and going through September 2024. These data can be matched to the utility billing data via the consumer id and serial number.

These data include information on the type of bill, the units consumed (kWh), amount due on bill (NPR), amount payable, and date the bill was due. Additionally, there are data on the date the bill was actually paid, the monetary amount that was paid at that time, and the method through which the payment was made.

5.3 Randomization Balance

Using data from the baseline survey, we check for balance on key variables that might affect either adoption and use of electric cookstoves: household size, the education of the household head (both if they have no formal education and if they have higher education), if the house has a smart meter installed, the number of electric cooking appliances owned, and whether the household owns and induction stove. Table 2 presents results from these balance tests and shows that none of the 8 treatment groups are statistically significantly different from the control group (column 9).

6 Empirical Strategy

In this section, we describe how we capitalize on the experimental variation in treatment assigned to estimate the effects of the intervention.

6.1 Intent to Treat

First, we estimate the effect of being randomly assigned to a particular treatment (or combination of treatments). Given the baseline balance shown in the prior section, we estimate

the impact of the intervention's treatment arms using a simple specification, first combining the two information treatments together as follows:

$$\begin{aligned} \mathrm{Y}_i = \alpha + \beta_1 \mathrm{HighSubsidy}_i + \beta_2 \mathrm{LowSubsidy}_i + \beta_3 \mathrm{Info}_i \\ + \beta_4(\mathrm{HighSubsidy}_i \times \mathrm{Info}_i) + \beta_5(\mathrm{LowSubsidy}_i \times \mathrm{Info}_i) + \epsilon_i \end{aligned} \tag{1}$$

The variable Y_i represents outcome variables of interest for household i, either at the extensive or intensive margins. Regarding the former, the variable may denote adoption of induction cookstoves or compatible cookware. On the intensive margin, it refers to usage of fuels – such as LPG or electricity, the proportion of meals cooked using each fuel, and other metrics related to fuel usage. $\mathrm{HighSubsidy}_i$ is an indicator variable equal to 1 if household i is randomly assigned to the high subsidy treatment group and 0 otherwise. Similarly, $\mathrm{LowSubsidy}_i$ is an indicator equal to 1 if household i is assigned to the low subsidy group and 0 otherwise. Info_i is an indicator variable equal to 1 if household i received any information treatment (either cost or health) and 0 otherwise. With these variables in the specification, the omitted group is comprised of the pure control households – those who were assigned to neither subsidies nor information treatments. The constant term is denoted by α, while β_1, β_2, and β_3 capture the effects of the high subsidy, low subsidy, and the combined information treatments, respectively.

The equation also includes two interaction terms to estimate the combined effect of treatments that overlap due to the cross randomization. The term $\mathrm{HighSubsidy}_i \times \mathrm{Info}_i$ represents the interaction of being in the high subsidy group and receiving any information treatment, while $\mathrm{LowSubsidy}_i \times \mathrm{Info}_i$ represents the interaction of being in both the low subsidy group and receiving any information treatment. As a result, β_4 and β_5 capture the combined effects of high and low subsidies when interacted with the information treatment, respectively. Lastly, ϵ_i represents the error term for household i.

Additionally, we estimate an alternate specification in which the different information

treatments – cost and health information – are estimated separated as follows:

$$\begin{aligned} \mathrm{Y}_i = \alpha &+ \beta_1 \mathrm{HighSubsidy}_i + \beta_2 \mathrm{LowSubsidy}_i + \beta_3 \mathrm{CostInfo}_i + \beta_4 \mathrm{HealthInfo}_i \\ &+ \beta_5(\mathrm{HighSubsidy}_i \times \mathrm{CostInfo}_i) + \beta_6(\mathrm{HighSubsidy}_i \times \mathrm{HealthInfo}_i) \\ &+ \beta_7(\mathrm{LowSubsidy}_i \times \mathrm{CostInfo}_i) + \beta_8(\mathrm{LowSubsidy}_i \times \mathrm{HealthInfo}_i) + \epsilon_i \end{aligned} \tag{2}$$

$\mathrm{HighSubsidy}_i$, $\mathrm{LowSubsidy}_i$, $\mathrm{CostInfo}_i$, and $\mathrm{HealthInfo}_i$ are indicator variables that take the value 1 if households were randomly assigned to those respective treatments, and 0 otherwise. The interaction terms, $\mathrm{HighSubsidy}_i \times \mathrm{CostInfo}_i$, $\mathrm{HighSubsidy}_i \times \mathrm{HealthInfo}_i$, $\mathrm{LowSubsidy}_i \times \mathrm{CostInfo}_i$, and $\mathrm{LowSubsidy}_i \times \mathrm{HealthInfo}_i$, depict households who received a combination of both a subsidy (high or low) and an information treatment (cost or health). The error term is denoted by ϵ_i.

6.2 Treatment on the Treated

Second, we estimate the effect of the intervention on those that received treatment using 2SLS. We examine the effect on appliance and fuel usage by instrumenting for the adoption of induction cookware or stoves using the subsidy and information treatment assignments as instruments. The second-stage regression, where adoption of induction cookware and induction stoves is instrumented using the treatment assignments, is specified as:

$$\mathrm{Y}_i = \alpha + \lambda \hat{\mathrm{Adoption}}_i + \gamma X_i + \epsilon_i \tag{3}$$

We create multiple instruments for the Adoption variable. First, we instrument for adoption using only the assignment of households to either of the subsidy arms. Additionally, we instrument for adoption using all of the treatments (subsidy treatments and information treatments).

Finally, in these specifications, $\mathrm{Outcomes}_i$ refers to appliance or fuel usage (e.g., elec-

tricity usage, LPG usage, cooking time). The variable $\hat{\text{Adoption}}_i$ is a dummy for whether a household adopted either an induction stove or induction-compatible cookware, instrumented by the treatment assignment. ϵ_i is the error term.

The first-stage regression for the adoption of induction cookware or induction stoves, instrumenting using the subsidy treatment arms is given by:

$$\text{Adoption}_i = \alpha + \beta_1 \text{HighSubsidy}_i + \beta_2 \text{LowSubsidy}_i + \epsilon_i \tag{4}$$

The first-stage regression for the adoption of induction cookware or induction stoves, instrumenting using all treatment arms is given by:

$$\text{Adoption}_i = \alpha + \beta_1 \text{HighSubsidy}_i + \beta_2 \text{LowSubsidy}_i + \beta_3 \text{CostInfo}_i + \beta_4 \text{HealthInfo}_i + \epsilon_i \tag{5}$$

In this first-stage regression, Adoption_i is an indicator variable that is equal to 1 if the household adopted either an induction stove or induction-compatible cookware. HighSubsidy_i and LowSubsidy_i are indicator variables indicating whether a household received the high or low subsidy treatment, respectively. Lastly, CostInfo_i and HealthInfo_i are indicator variables for whether the household received the cost or health information treatment. ϵ_i is the error term.

7 Analyses and Results

7.1 Survey-based outcomes

In Table 3, the results show that subsidies have a significant effect on the adoption of induction stoves and compatible cookware. Households in the high subsidy group (3000 NPR) were significantly more likely to purchase both induction stoves, as well as induction-compatible

cookware, compared to those in the low subsidy and no subsidy groups. The magnitude of these effects is substantial; for instance, households receiving the high subsidy were 23 percentage points more likely to adopt induction stoves compared to the control group. The high subsidy households were further 41 percentage points more likely than control households to adopt induction cookware. Low subsidy groups (1000 NPR) were expectedly not significantly more likley to adopt the more expensive induction stoves than the control group but had high levels of adoption of the more affordable induction-compatible cookware. In contrast, the information treatments had no statistically significant impact on adoption. This could imply either that the information treatments did not deliver new information that households were not already familiar with, or that the information treatments were not sufficient enough to induce adoption. The adoption rates observed line up with the prior that credit constraints appear to be the crucial barrier to adopting new technology such as induction stoves, particularly given that households do not feel compelled to switch out of LPG cookstoves.

While adoption may be credit-constrained, intensive margin usage of electric appliances may be more amenable to change more widely. We instrument for the adoption of induction stoves based on whether the household received any subsidy treatment (high or low). Table 4 presents the intensive margin effects of adoption of induction cookstoves and cookware. The table shows an economically and statistically significant effect of adoption on the percentage of meals cooked using induction go up by almost 27 percentage points over the control group, and the incidence of electric cooking more broadly goes up as well. Table 5 separates households who use their subsidy to purchase cookstoves versus cookware. Household who adopt electric cookstoves have larger increases in use of electricity for cooking relative to those who adopt cookware. Notably, among the subsidy treatment groups, in addition to increasing their adoption of induction cookstoves, reduced their LPG fuel usage (although not statistically significant).

Table 7 further focuses on the intensive margin treatment effects of the subsidy treatments on time spent using LPG, using subsidies as IVs. The results show that subsidies significantly reduce the time spent using LPG for cooking. Households in either subsidy group, who switched to induction stoves, reduced their LPG cooking time by approximately 31 minutes per day compared to the control group. This indicates that subsidies for electric stoves not only promote adoption but also lead to meaningful shifts in cooking behavior, decreasing dependence on LPG. The fall in LPG usage is greater for groups that did not receive the information treatments compared to those that did (the difference is statistically significant with a t-statistic of 106.46). This result suggests a number of possibilities. One is that subjects may have overestimated impacts on health before, or that they overestimated the cost of LPG before receiving the treatment. Another possibility is the LPG remains a complement to electric cooking and so if cooking went up overall in response to an information treatment, LPG cooking may not have declined as much as expected.

8 Conclusion

For many countries, an important component of strategies to reduce carbon dioxide emissions incorporates the electrification of many residential end uses, from transportation to cooking. In settings where households commonly use gas for cooking, the shift to electric cooking can represent a way to both reduce CO2 emissions and to ameliorate concerns regarding indoor air pollution associated with gas cooking. In locations where electricity generation is relatively clean, such as in Nepal, governments are promoting efforts to increase the adoption of electric vehicles and electric stoves. Historically, Nepal suffered from substantial electricity constraints, reliability of supply served as a major impediment to the adoption of electric cooking.

With recent investments in additional generation and therefore less loadshedding, authorities look to increase electricity consumption overall. Doing so, while reducing CO2

emissions is a clear win-win for sustainable development goals. However, little has been known to date as to how best to increase the adoption and use of these technologies in a low and middle-income countries, where a number of constraints to adoption and use remain including the upfront costs of technology adoption, the recurring costs (and uncertainty around those costs) of technology use, and information constraints regarding the pollution and health effects of the (less-clean) alternative options for cooking fuels.

Through a randomized experiment conducted in Kathmandu, Nepal, we tested the effect of alleviating various constraints on adoption and use of electric cooking, including: subsidies of varying levels and information on the cost of electric cooking and the health and environmental benefits of shifting from LPG to electric cooking, and combinations of subsidies and information. We find evidence that subsidies had a significant effect on the adoption of both electric cook stoves and related cookware. Complementary evidence showing decreased LPG use and increased electricity consumption suggests significant decreases CO2 emissions. However we find little effect of either information intervention on electric stove adoption or use.

References

(2022). Kp industries bags contract to install underground electric cables in kathmandu.

Acharya, J., Manandhar, P., Shah, G., Khadka, B. S., and Sharma, R. D. (2024). *Powering Nepal: 5 Decades of ADB–Nepal Partnership in the Energy Sector*. Asian Development Bank.

Allcott, H. and Taubinsky, D. (2015). Behavior and energy policy. *Science*, 347(6224):208–210. Accessed: 2024-09-23.

Batchelor, S., Brown, E., Leary, J., Scott, N., Alsop, A., and Leach, M. (2018). Solar electric cooking in africa: Where will the transition happen first? *Energy Research Social Science*, 40:257–272.

Beltramo, T. and Levine, D. I. (2013). The effect of solar ovens on fuel use, emissions and health: results from a randomised controlled trial. *Journal of Development Effectiveness*, 5(2):178–207.

Bensch, G., Grimm, M., and Peters, J. (2015). Why do households forego high returns from technology adoption? evidence from improved cooking stoves in burkina faso. *Journal of Economic Behavior Organization*, 116:187–205.

Bensch, G. and Peters, J. (2015). The intensive margin of technology adoption – experimental evidence on improved cooking stoves in rural senegal. *Journal of Health Economics*, 42:44–63.

Berkouwer, S. B. and Dean, J. T. (2022). Credit, attention, and externalities in the adoption of energy efficient technologies by low-income households. *American Economic Review*, 112(10):3291–3330.

Bhandari, R. and Subedi, S. (2023). Evaluation of surplus hydroelectricity potential in nepal until 2040 and its use for hydrogen production via electrolysis. *Renewable Energy*, 212:403–414.

Daouda, M., Carforo, A., Miller, H., Ventrella, J., Tan, Y. A., Feliciano, M., Tryner, J., Hallward-Driemeier, A., Chillrud, S., Commane, R., Hernández, D., Johnson, M., and

Jack, D. (2024). Out of gas, in with justice: Findings from a gas-to-induction pilot in low-income housing. *Energy Research Social Science*, 116:103662. Accessed: 2024-09-23.

Dupas, P. (2011). Health behavior in developing countries. *Annual Review of Economics*, 3:425–449. Accessed: 2024-09-23.

Ghising, M. (2022). Kathmandu valley to see uninterrupted and qualitative electricity supply: Md ghising.

Giri, S. (2015a). Blockade, energy shortages goad country into looking for solutions. *The Kathmandu Post*. Accessed: 2024-09-23.

Giri, S. (2015b). Blockade, energy shortages goad country into looking for solutions. *Kathmandu Post*. Accessed: 2024-09-23.

Gould, C. F., Bejarano, M. L., Cuesta, B. D. L., Jack, D. W., Schlesinger, S. B., Valarezo, A., and Burke, M. (2023). Climate and health benefits of a transition from gas to electric cooking. *Proceedings of the National Academy of Sciences*, 120(34):e2301061120.

Guta, D., Baumgartner, J., Jack, D., Carter, E., Shen, G., Orgill-Meyer, J., Rosenthal, J., Dickinson, K., Bailis, R., Masuda, Y., and Zerriffi, H. (2022). A systematic review of household energy transition in low and middle income countries. *Energy Research Social Science*, 86:102463.

Hakam, D. F., Nugraha, H., Wicaksono, A., Rahadi, R. A., and Kanugrahan, S. P. (2022). Mega conversion from lpg to induction stove to achieve indonesia's clean energy transition. *Energy Strategy Reviews*, 41:100856.

Hanna, R., Duflo, E., and Greenstone, M. (2016). Up in smoke: The influence of household behavior on the long-run impact of improved cooking stoves. *American Economic Journal: Economic Policy*, 8(1):80–114.

IFC News (2019). Ifc, partners provide more than $450 million to support major hydroelectric plant in nepal. Accessed: 2024-09-23.

Jewitt, S., Atagher, P., and Clifford, M. (2020). "we cannot stop cooking": Stove stacking,

seasonality and the risky practices of household cookstove transitions in nigeria. *Energy Research Social Science*, 61:101340.

Kathmandu Post (2023). Behind the mega electricity deal. *Kathmandu Post*. Accessed: 2024-09-23.

Lebel, E. D., Finnegan, C. J., Ouyang, Z., and Jackson, R. B. (2022). Methane and nox emissions from natural gas stoves, cooktops, and ovens in residential homes. *Environmental Science Technology*, 56(4):2529–2539. Accessed: 2024-09-23.

Mobarak, A. M., Dwivedi, P., Bailis, R., Hildemann, L., and Miller, G. (2012). Low demand for nontraditional cookstove technologies. *Proceedings of the National Academy of Sciences*, 109(27):10815–10820.

Open Data Nepal (2022). List of currently operating ipps' hydro power projects - nepal electricity authority. Accessed: 2024-09-23.

Pattanayak, S. K., Jeuland, M., Lewis, J. J., Usmani, F., Brooks, N., Bhojvaid, V., Kar, A., Lipinski, L., Morrison, L., Patange, O., Ramanathan, N., Rehman, I. H., Thadani, R., Vora, M., and Ramanathan, V. (2019). Experimental evidence on promotion of electric and improved biomass cookstoves. *Proceedings of the National Academy of Sciences*, 116(27):13282–13287.

Puzzolo, E., Pope, D., Stanistreet, D., Rehfuess, E. A., and Bruce, N. G. (2016). Clean fuels for resource-poor settings: A systematic review of barriers and enablers to adoption and sustained use. *Environmental Research*, 146:218–234.

Saha, A., Razzak, M. A., and Khan, M. R. (2021). Electric cooking diary in bangladesh: Energy requirement, cost of cooking fuel, prospects, and challenges. *Energies*, 14(21).

Spotlight Nepal (2023). Nepal's energy transition: Gaps in the pathway. *Spotlight Nepal*. Accessed: 2024-09-23.

Sweeney, M., Dols, J., Fortenbery, B., and Sharp, F. (2014). Induction cooking technology design and assessment.

Timilsina, G. and Steinbuks, J. (2021). Economic costs of electricity load shedding in nepal. *Renewable and Sustainable Energy Reviews*, 146:111112.

U.S. Agency for International Development (2017). Nepal factsheet: Nepal hydropower development program.

Figures and Tables

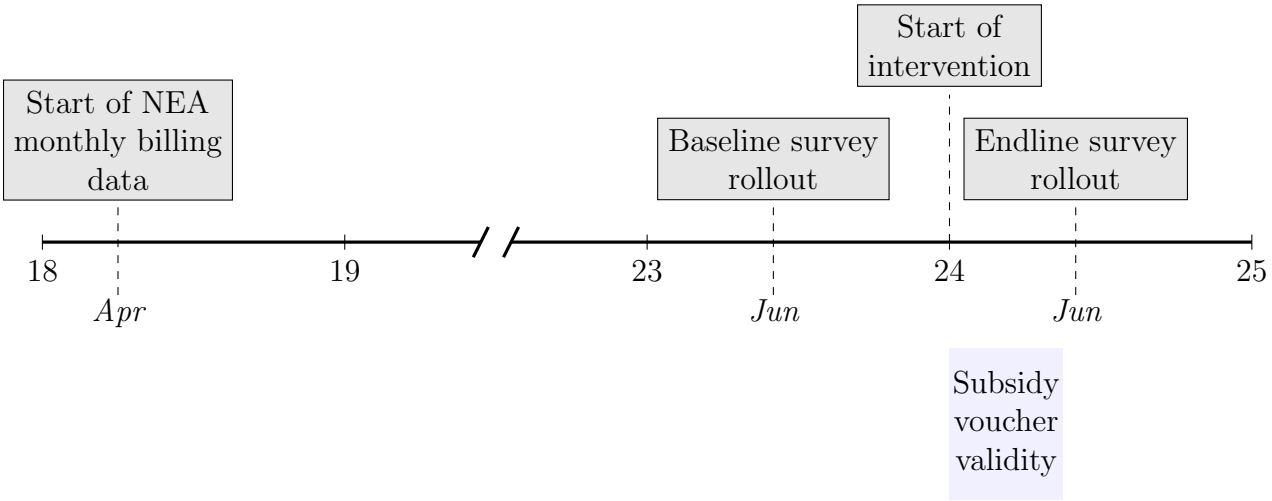


Figure 1: Timeline of surveys and key activities

Table 1: Household Random Assignment by Treatment

	Subsidy Treatments			
Info Treatments	High (3000 NPR)	Low (1000 NPR)	No subsidy	Info treatment totals
Induction Cooking Costs	195	181	576	952
Induction Cooking Health	191	201	585	977
No Info	184	196	585	965
Column totals	570	578	1746	2894

Notes: The information treatments and the subsidy treatments wee cross randomized. Each cell depicts the number of households randomly assigned to that combination of treatments. A total of 2,894 households were randomized across groups. This is from the 2,985 households surveyed in 2023 that consented to participate in the RCT.

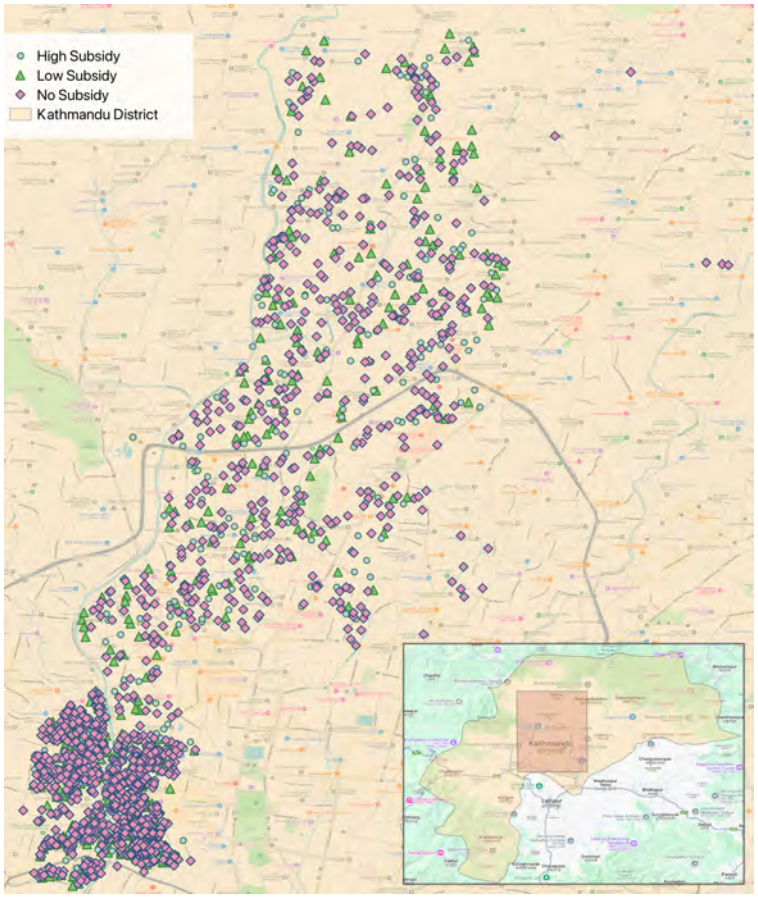


Figure 2: Spatial spread of households by subsidy treatment group

Source: Kathmandu district boundary is from 2015 and was obtained from Code for Nepal.

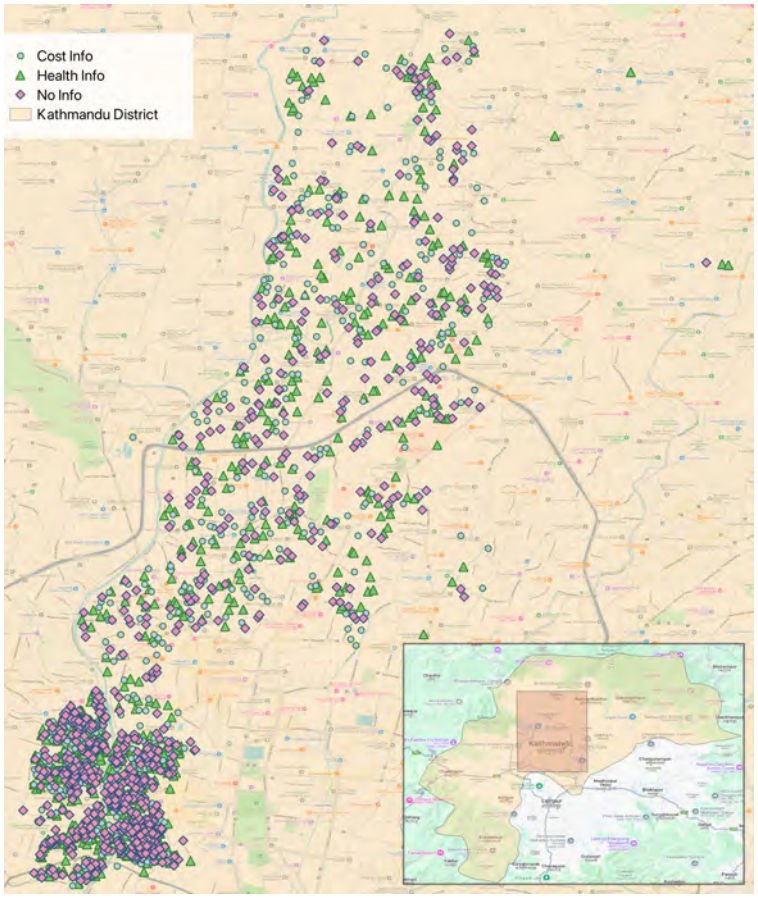


Figure 3: Spatial spread of households by information treatment group

Source: Kathmandu district boundary is from 2015 and was obtained from Code for Nepal.

Table 2: Baseline balance across treatment groups

	(1) High Subs-Cost Info	(2) Low Subs-Cost Info	(3) No Subs-Cost Info	(4) High Subs-Health Info	(5) Low Subs-Health Info	(6) No Subs-Health Info	(7) High Subs-No Info	(8) Low Subs-No Info	(9) No Subs-No Info
Household size	4.61	4.28	4.34	4.31	4.24	4.35	4.26	4.49	4.42
	(.1572)	(.1353)	(.0878)	(.1431)	(.1394)	(.0876)	(.1375)	(.151)	(.0875)
	[0.29]	[0.39]	[0.55]	[0.54]	[0.29]	[0.56]	[0.34]	[0.69]	
HH head has no education	0.20	0.16	0.20	0.19	0.18	0.20	0.20	0.20	0.20
	(.0296)	(.0282)	(.0174)	(.0294)	(.0281)	(.0169)	(.03)	(.0296)	(.017)
	[0.92]	[0.25]	[0.91]	[0.82]	[0.54]	[0.96]	[1.00]	[0.92]	
HH head has higher education	0.17	0.20	0.20	0.17	0.18	0.19	0.19	0.20	0.19
	(.0274)	(.0308)	(.0174)	(.0281)	(.0278)	(.0167)	(.0294)	(.0296)	(.0166)
	[0.46]	[0.71]	[0.63]	[0.56]	[0.65]	[0.91]	[0.99]	[0.83]	
House has smart meter installed	0.70	0.69	0.70	0.69	0.67	0.69	0.69	0.69	0.68
	(.0336)	(.0353)	(.0198)	(.0345)	(.0344)	(.0196)	(.0348)	(.0343)	(.0198)
	[0.51]	[0.74]	[0.39]	[0.76]	[0.83]	[0.75]	[0.83]	[0.73]	
Electric cooking appliances #	0.55	0.53	0.54	0.52	0.61	0.52	0.55	0.53	0.58
	(.0575)	(.0608)	(.032)	(.0568)	(.0586)	(.0304)	(.0572)	(.0544)	(.0334)
	[0.69]	[0.46]	[0.37]	[0.40]	[0.69]	[0.17]	[0.63]	[0.41]	
Owns induction cookstove	0.27	0.28	0.27	0.30	0.31	0.29	0.27	0.26	0.31
	(.0328)	(.0343)	(.0193)	(.0341)	(.0338)	(.0191)	(.0332)	(.0328)	(.0196)
	[0.39]	[0.48]	[0.24]	[0.83]	[0.97]	[0.48]	[0.31]	[0.26]	
Houses #	186	172	535	181	188	560	179	182	557

Notes: The standard errors are in parentheses and p-values of the difference between the treatment and control in square brackets. Column 9 is the pure control group.

Table 3: Treatment effects on extensive margin (adoption)

	(1) Adoption	(2) Induction Cookware	(3) Induction Stove
High Subsidy	0.529***	0.413***	0.230***
	(0.000)	(0.000)	(0.000)
Low Subsidy	0.292***	0.233***	0.0439
	(0.000)	(0.000)	(0.144)
Information	0.0403	-0.000825	0.0225
	(0.067)	(0.966)	(0.218)
High Subsidy × Information	-0.0640	-0.0139	0.00236
	(0.150)	(0.723)	(0.949)
Low Subsidy × Information	-0.0621	0.0275	-0.0155
	(0.157)	(0.477)	(0.674)
Constant	0.147***	0.0844***	0.0880***
	(0.000)	(0.000)	(0.000)
Observations	2790	2790	2740

Notes: All dependent variables are dummies. Adoption (v2) indicates if the HH bought an electric induction, or induction compatible cookware. Bought induction compatible cookware indicates if the HH reported buying compatible cookware in the last 6 months before the endline interview. Lastly, the last variable indicates if the HH reported buying induction. Significance at 1%, 5% and 10% are indicated by ***, ** and *, respectively.

Table 4: Treatment effects on intensive margin (use of electric appliances) using all treatments as an IV

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: with baseline elec. stove ownership as control								
Adoption	0.303**	-3.509	-0.167*	-0.196**	-0.158	0.496**	67.29	-0.185
	(0.007)	(0.050)	(0.021)	(0.004)	(0.424)	(0.003)	(0.950)	(0.310)
HH own elec. stove (baseline survey)	0.214**	0.334	0.125**	0.137***	-0.00233	0.254**	572.6	0.267*
	(0.001)	(0.744)	(0.003)	(0.000)	(0.984)	(0.008)	(0.345)	(0.012)
Constant	-0.0590	12.32***	1.028***	1.047***	0.682***	0.122	1843.9***	0.744***
	(0.176)	(0.000)	(0.000)	(0.000)	(0.000)	(0.056)	(0.000)	(0.000)
F-statistic	37.07	42.83	37.07	36.73	37.07	37.07	41.73	37.07
Observations	2790	2730	2790	2780	2790	2790	2652	2790
Panel B: without baseline elec. stove ownership as control								
Adoption	0.330**	-3.450*	-0.151*	-0.177**	-0.159	0.528***	168.4	-0.151
	(0.003)	(0.033)	(0.029)	(0.006)	(0.387)	(0.001)	(0.861)	(0.384)
Constant	-0.000246	12.41***	1.062***	1.084***	0.681***	0.191*	1989.7***	0.818***
	(0.997)	(0.000)	(0.000)	(0.000)	(0.000)	(0.040)	(0.001)	(0.000)
F-statistic	29.87	36.89	29.87	29.76	29.87	29.87	35.89	29.87
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: We instrument any adoption (cookware or cookstove, in answer to the question on whether the household owns either of these items) with treatment assignment to any of the treatment arms (subsidy or information). We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table 5: Treatment effects on intensive margin (use of electric appliances) using subsidy treatment as an IV

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: IV for cookstove adoption								
Induction Stove (v2)	0.405***	-2.593	0.0129	0.00822	-0.0253	0.598***	-648.8	0.106
	(0.000)	(0.056)	(0.629)	(0.380)	(0.859)	(0.000)	(0.430)	(0.398)
HH own elec. stove (baseline survey)	0.444***	-2.002***	0.00368	-0.00115	-0.114***	0.613***	519.2**	0.157***
	(0.000)	(0.000)	(0.482)	(0.534)	(0.000)	(0.000)	(0.001)	(0.000)
Constant	-0.0249	11.47***	0.988***	0.998***	0.644***	0.197***	2004.3***	0.671***
	(0.158)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
F-statistic	95.40	96.12	95.40	96.12	95.40	95.40	95.84	95.40
Observations	2740	2730	2740	2730	2740	2740	2652	2740
Panel B: IV for cookware adoption								
Bought Ind. Compatible Cookware (v2)	0.163***	-1.045	0.00433	0.00263	-0.0107	0.240***	-263.1	0.0421
	(0.000)	(0.052)	(0.818)	(0.870)	(0.853)	(0.000)	(0.427)	(0.416)
HH own elec. stove (baseline survey)	0.369***	-1.520***	0.0286***	0.0250***	-0.0919***	0.510***	638.5***	0.156***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0287***	11.13***	0.963***	0.971***	0.623***	0.270***	1918.2***	0.666***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
F-statistic	510.0	516.5	510.0	512.5	510.0	510.0	502.6	510.0
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table 6: Treatment effects on intensive margin (use of electric appliances) using OLS

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
High Subsidy	0.0694*	-0.840*	0.0108	-0.00330	-0.0128	0.119**	40.24	-0.0132
	(0.017)	(0.036)	(0.431)	(0.778)	(0.761)	(0.006)	(0.871)	(0.729)
Low Subsidy	0.0763**	-0.715	-0.0316*	-0.0359**	-0.0706	0.0944*	-30.96	-0.0255
	(0.007)	(0.074)	(0.019)	(0.002)	(0.088)	(0.025)	(0.900)	(0.496)
Information	0.0181	-0.375	-0.0239**	-0.0275***	-0.0219	0.0330	81.28	-0.0313
	(0.302)	(0.123)	(0.004)	(0.000)	(0.390)	(0.202)	(0.587)	(0.174)
High Subsidy × Information	0.00358	0.996*	0.00503	0.0213	0.0146	-0.0366	-178.0	0.0515
	(0.919)	(0.042)	(0.763)	(0.135)	(0.776)	(0.484)	(0.555)	(0.269)
Low Subsidy × Information	-0.0598	0.287	0.0310	0.0403**	0.1000*	-0.0442	-98.56	0.0488
	(0.087)	(0.559)	(0.060)	(0.004)	(0.049)	(0.391)	(0.743)	(0.288)
Constant	0.159***	10.75***	0.989***	0.999***	0.605***	0.445***	2071.2***	0.745***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table 7: Treatment effects on time cooking using the subsidy treatments as IV

	(1) LPG Stove	(2) LPG Stove	(3) LPG Stove
Adoption	-31.00**	-29.03*	-33.85*
	(0.003)	(0.033)	(0.031)
HH own elec. stove (baseline survey)	-9.060	-9.192	-9.346
	(0.143)	(0.250)	(0.340)
Constant	137.8***	136.7***	139.4***
	(0.000)	(0.000)	(0.000)
Info Treatment		Yes	No
P-val of difference		0.000	0.000
F-statistic	170.4	96.69	75.48
Observations	2731	1814	917

Notes: All the dependent variables are in minutes and indicate how much time is spent on cooking using the appliance/stove on an average day when the household uses it. Each of the regression specifications shows the coefficient of cookware/cookstove adoption, instrumented by being treated with one of the subsidy arms. Column 1 presents estimates for the full sample, Column 2 presents estimates for the sub-sample that also received an information treatment (health of cost), and Column 3 presents estimates for the sub-sample that did not receive an information treatment (health of cost). The p-value term refers to the p-value parameter when conducting a t-test for the difference in coefficients between columns 2 and 3.

ONLINE APPENDIX

A Additional Maps

A1 For Sampling Strategy Using Transformers

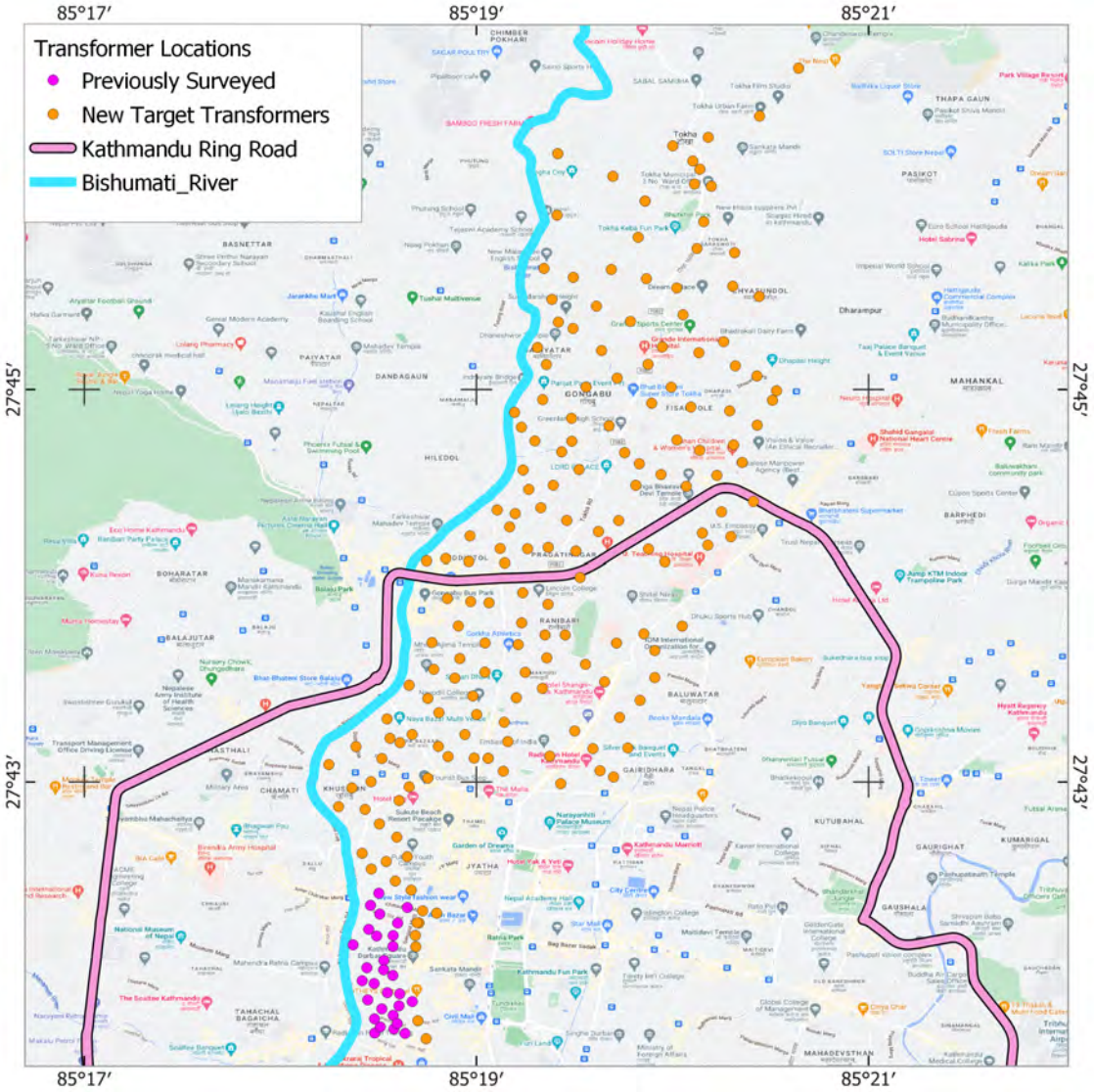


Figure A1: Map of Transformers Used in the Sampling Strategy

Notes: This map shows the locations of transformers located with 1000 m to the east of the Bishnumati River.

B The Intervention

B1 Text Regarding Phone Credit for Continued Study Participation

The following message was read to all study participants (including those assigned to the control group) approached in January through February 2024 during the intervention:

"Namaste, my name is XXXXXX and I am from New ERA, which is a Kathmandu based research organization. I am here to thank you again for your continued support in the study conducted by Asian Development Bank in collaboration with Nepal Electricity Authority and New ERA. The study is being conducted to understand electricity use including electric cooking by the households and too understand electricity related needs and concerns of the households, as well as to support Nepal in improving its electricity transmission and distribution system. Also, we would like to provide you with a token of appreciation in the form of a recharge card worth Rs 100 on behalf of Asian Development Bank for giving us your valuable time in the previous survey and for your support in the next round of survey to be conducted around June/July, 2024."

B2 Regarding Cost of Electric Cooking

The cost message, which was printed on the pamphlets given to study participants randomly assigned to received them, states: "CAN YOUR COOKING NEEDS BE MET FOR LESS MONEY? Did you know that induction and electric cooking could result in savings for your household? Find out if electric cooking is suited to your household needs and you could save hundreds of rupees ! With a one-time investment into an electric or induction cookstove, you can easily transition your cooking needs to electric. If you have an existing connection with the NEA (15 amp connection or above), and purchase an electric cookstove with over 66% efficiency, shifting your cooking medium could result in hundreds of rupees of savings per month!"

An image of the message provided through the intervention regarding the cost of electric cooking is on the left side of Figure B1.

B3 Regarding Pollution from Electric Cooking

The health message, which was printed on the pamphlets given to study participants randomly assigned to received them, states: "DID YOU KNOW THAT ELECTRIC COOKING IS THE "CLEANEST" WAY TO COOK IN NEPAL? Studies in Nepal have shown that electric cooking creates less household air pollution (fine particulate matter, PM2.5) than cooking with the other currently available fuels, including kerosene, biomass (dung, firewood, etc), and even LPG. This is important as studies show that burning fuels is harmful to health and associated with increased risk of disease."

An image of the message provided through the intervention regarding the pollution and

health effects of cooking is on the right side of Figure B1.



Figure B1: Messages Regarding Cost (left) and Health (right) of E-Cooking

Notes: These graphics depict information pamphlets provided to study participants randomly assigned to receive them. The cost message is on the left and the health message is on the right.

B4 Subsidy Treatments

Households that were randomly assigned to the subsidy treatment, received a coupon card, as shown in Figure B2.

B4.1 Regarding Lower Subsidy

The lower subsidy message, which was printed on the pamphlets given to study participants randomly assigned to received them, states: "Your household has been randomly selected to receive a 1000 NPR subsidy to purchase an induction stove!!!!! If you already have an induction stove, you can use this voucher to purchase a second stove or new pots and pans that are appropriate for and compatible with an induction stove. These vouchers can be used at your local Bhat Bhateni store in Kathmandu Valley. To use the subsidy, you must bring this voucher to the customer service desk in the Bhat Bhateni store. This voucher is for your house and should not be given to others. To use this voucher, the customer from your household will need to be a member of BBSM Clubcard. If your household is not already a Clubcard member, that is ok! You can sign up at the Customer Service Desk of any BBSM

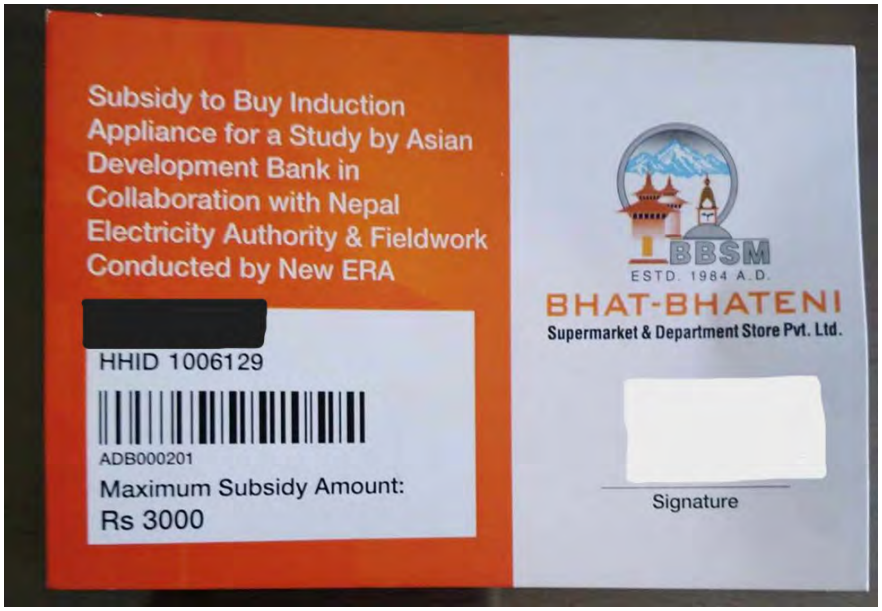


Figure B2: Example of Subsidy Card Provided

Notes: This is an example of the actual subsidy card received by those households randomly assigned to receive one. The name of the household member that was the survey respondent is printed in the rectangle marked in black. The signature of that person is in the rectangle marked in white.

branch. This voucher subsidy is valid until April 30th, 2024. All details are printed on the voucher."

An image of the voucher for this lower subsidy is on the left side of Figure B3.

B4.2 Regarding Higher Subsidy

The higher subsidy message, which was printed on the pamphlets given to study participants randomly assigned to received them, states: "Your household has been randomly selected to receive a 3000 NPR subsidy to purchase an induction stove!!!!! If you already have an induction stove, you can use this voucher to purchase a second stove or new pots and pans that are appropriate for and compatible with an induction stove. These vouchers can be used at your local Bhat Bhateni store in Kathmandu Valley. To use the subsidy, you must bring this voucher to the customer service desk in the Bhat Bhateni store. This voucher is for your house and should not be given to others. To use this voucher, the customer from your household will need to be a member of BBSM Clubcard. If your household is not already a Clubcard member, that is ok! You can sign up at the Customer Service Desk of any BBSM branch. This voucher subsidy is valid until April 30th, 2024. All details are printed on the voucher."

An image of the voucher for this higher subsidy is on the right side of Figure B3.

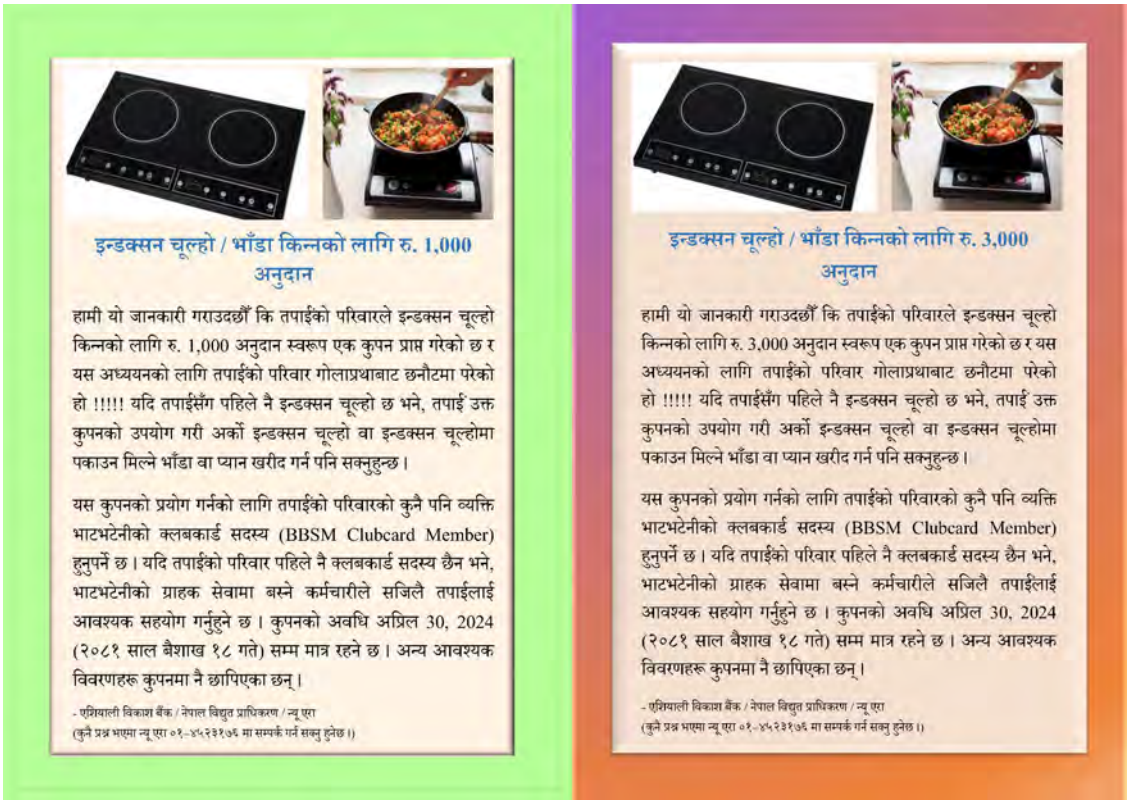


Figure B3: Messages Regarding Subsidies

Notes: These graphics depict pamphlets on the subsidies for electric cooking provided to study participants randomly assigned to receive them. The lower subsidy (1000 NPR) message is on the left and the higher subsidy (3000 NPR) message is on the right.

B5 Treatments Not Delivered

Despite consenting to future participation, 57 households were not reachable at the time of the intervention. We show the breakdown of these by treatment group in the table that follows.

Table B1: Intervention Undelivered, by Treatment Group

Treatment	Frequency	Percent
High subsidy-cost info	3	5.26
low subsidy-cost info	5	8.77
no subsidy-cost info	20	35.09
High subsidy-health info	2	3.51
low subsidy-health info	4	7.02
no subsidy-health info	15	26.32
low subsidy-no info	8	14.04
Totals	57	100.00

Notes: A total of 2,894 households were randomized across groups these are the only households to which the treatment was unable to be delivered.

B6 Bhat Bhateni Super Store Locations in Kathmandu Valley

Bhat Bhateni stores are spread out across the region under study (see Figure B4), providing easy access to participating households. Subsidy vouchers could be used at any of these stores to purchase an induction stove or induction-related cookware.

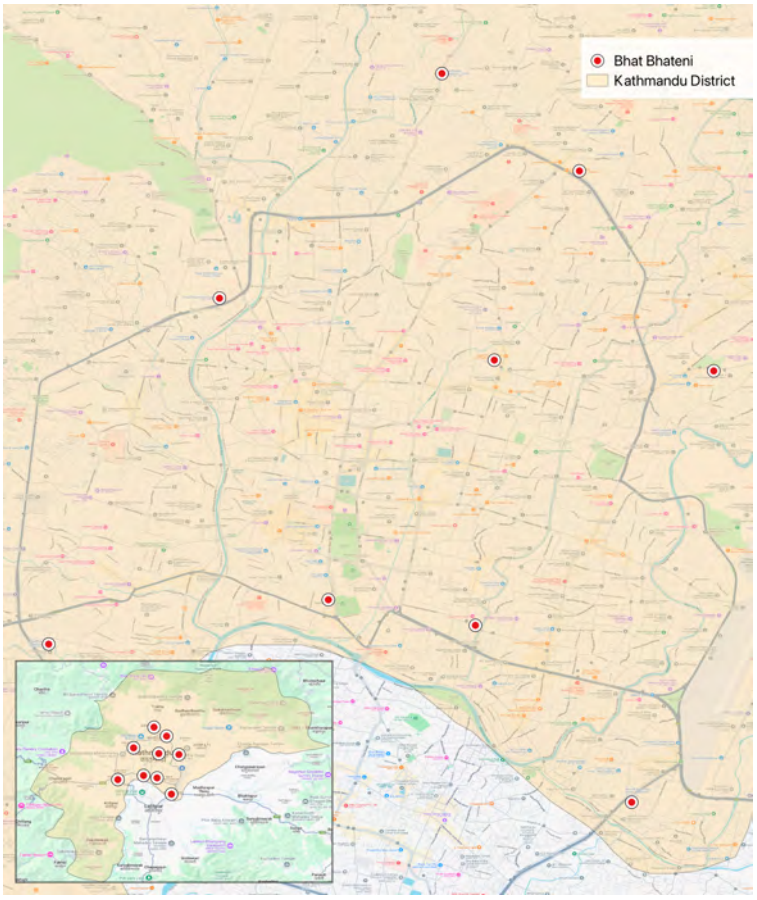


Figure B4: Locations of Bhat Bhateni stores in Kathmandu

Source: Store names from Bhat Bhateni's website were used to search their locations on Google Maps.

C Cost Comparison between LPG and Electric Cooking

Given that an LPG cylinder costs NRs. 1,895 in Nepal, it is cheaper for all consumer types, irrespective of their current monthly electricity consumption, to switch to electric cooking. Detailed calculations are provided in Table C1 and Table C2 using heat values of 51 MJ/kg for LPG[9] and 3.6 MJ/kWh for electricity. According to Nepal Gas, a big cylinder contains 14.2 kg of LPG[10], which means a cylinder holds 724.2 MJ of heat energy in it. Using an efficiency of 90%[11] for Induction Heat stoves and a conservative estimate of 55%[12] for gas stoves, it was found that one cylinder of LPG is equivalent to 122.9 kWh of electricity.

Initial Monthly Consumption (kWh)	Min Charge (NRs.)	Energy Charge (NRs.)	Initial Bill (NRs.)	One Cylinder Equivalent Additional Consumption (kWh)	Min Charge (NRs.)	Energy Charge (NRs.)	Revised Bill (NRs.)	Marginal Cost of One Cylinder Equivalent (NRs.)
20	50	80	130	142.9	125	1187.9	1312.9	1182.9
30	75	145	220	152.9	125	1282.9	1407.9	1187.9
50	75	305	380	172.9	125	1472.9	1597.9	1217.9
100	100	780	880	222.9	125	1947.9	2072.9	1192.9
250	125	2205	2330	372.9	175	3557.3	3732.3	1402.3
400	175	3855	4030	522.9	175	5207.3	5382.3	1352.3
650	175	6605	6780	772.9	175	7957.3	8132.3	1352.3

Table C1: Cost calculations of shifting one cylinder equivalent cooking from LPG stove to Induction Heat stove with a 15 amp electricity connection

Initial Monthly Consumption (kWh)	Min Charge (NRs.)	Energy Charge (NRs.)	Initial Bill (NRs.)	One Cylinder Equivalent Additional Consumption (kWh)	Min Charge (NRs.)	Energy Charge (NRs.)	Revised Bill (NRs.)	Marginal Cost of One Cylinder Equivalent (NRs.)
20	75	100	175	142.9	150	1207.9	1357.9	1182.9
30	100	165	265	152.9	150	1302.9	1452.9	1187.9
50	100	325	425	172.9	150	1492.9	1642.9	1217.9
100	125	800	925	222.9	150	1967.9	2117.9	1192.9
250	150	2225	2375	372.9	200	3577.3	3777.3	1402.3
400	200	3875	4075	522.9	200	5227.3	5427.3	1352.3
650	200	6625	6825	772.9	200	7977.3	8177.3	1352.3

Table C2: Cost calculations of shifting one cylinder equivalent cooking from LPG stove to Induction Heat stove with a 30 amp electricity connection

[9] A heat value of LPG represents the energy released when one kilogram of LPG is combusted. A heat valye of 51 MJ/kg is a conservative estimate taken from the World Nuclear Association and corroborated from the International Energy Agency.

[10] The cylinder capacity is reported on the Nepal Gas website.

[11] This statistic on efficiency was taken from Sweeney et al. (2014).

[12] This is a conservative estimate taken from: https://tcdorji.wordpress.com/2022/01/19/electric-stove-vs-lpg-stove-which-cooking-technology-is-more-cost-effective/.

D Additional Tables

Table D1: Summary Statistics

	Mean	S.D.	Min	Max	N
Prop. with smart meter	0.69	0.46	0	1	2740
Cash/Cheque for Elec. Bill	0.37	0.48	0	1	2740
Credit for Elec. Bill	0.63	0.48	0	1	2740
Know Most Recent Elec. Expense	0.97	0.18	0	1	2740
Recent Elec. Expense (NPR)	2090.24	2816.51	14	60000	2652
Know Most Recent Elec. Consumption	0.54	0.50	0	1	2740
Recent Elec. Consumption (KWh)	203.91	268.47	0	7189	1479
Avg. Elec. Outages (per week, Normal Months)	1.26	2.33	0	21	2685
Avg. Elec. Outages (per week, Bad Months)	5.52	4.58	0	30	1803
Voltage Fluctuation in 12 Months	0.33	0.47	0	1	2740
Elec. Fluctuation $\geq$ Once/Week	0.08	0.26	0	1	836
Appliance for Voltage Fluctuation	0.20	0.40	0	1	2740
Prop. that heat house	0.33	0.47	0	1	2740
Prop. with AC	0.03	0.16	0	1	2740
# of light bulbs per HH	21.78	15.23	1	223	2740
# of EE bulbs per HH	20.83	15.04	0	223	2740
# of Elec. appliances per HH	16.95	7.29	1	65	2740
Prop. with fan	0.84	0.37	0	1	2740
Prop. with fridge	0.89	0.32	0	1	2740
Prop. with rice cooker	0.42	0.49	0	1	2740
Prop. with pressure cooker	0.01	0.08	0	1	2740
Prop. with induction stove	0.35	0.48	0	1	2740
Prop. with microwave	0.31	0.46	0	1	2740
Prop. with washing machine	0.48	0.50	0	1	2740
Prop. with AC	0.03	0.17	0	1	2740
Prop. with kettle/pot	0.64	0.48	0	1	2740
Prop. with an EV	0.03	0.16	0	1	2740
Hours spent on cooking (last week)	13.50	5.41	0	44	2716

Notes: The variables used to generate this table are from the baseline survey.

Table D2: Treatment effects on ownership variables

	(1) Adoption	(2) Compatible Cookware	(3) Induction Stove	(4) NonInduction Stove	(5) # Ind. Compatible Cookware
High Subsidy	0.316***	0.224***	0.244***	0.0243	0.327*
	(0.000)	(0.000)	(0.000)	(0.084)	(0.043)
Low Subsidy	0.132***	0.117***	0.0697*	-0.0135	0.302
	(0.000)	(0.001)	(0.026)	(0.326)	(0.056)
Information	0.0223	0.0186	0.0210	-0.00909	-0.0578
	(0.278)	(0.389)	(0.276)	(0.284)	(0.553)
High Subsidy × Information	-0.0543	-0.00266	-0.0295	-0.0183	0.387*
	(0.190)	(0.951)	(0.449)	(0.286)	(0.049)
Low Subsidy × Information	-0.0177	0.00814	-0.0281	0.0114	0.00523
	(0.666)	(0.850)	(0.466)	(0.500)	(0.979)
HH own elec. stove (baseline survey)	0.574***	0.545***	0.662***	0.0428***	2.573***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.288***	0.273***	0.131***	0.0180*	0.664***
	(0.000)	(0.000)	(0.000)	(0.013)	(0.000)
Observations	2790	2790	2790	2790	2790

Notes: Variables from column (1) to (4) are dummy variables. In particular, the variable adoption equals to one if the HH reported having an electric stove (induction or noninduction) or induction compatible cookware at endline survey. The variables compatible cookware, induction stove and noninduction stove equal to one if the HH reported having the respective appliance/cookware at endline survey. Significance at 1%, 5% and 10% are indicated by ***, ** and *, respectively.

Table D3: Treatment effects on adoption variables

	(1) Adoption (v2)	(2) Bought Ind. Compatible Cookware (v2)	(3) Induction Stove (v2)	(4) Noninduction Stove (v2)
Panel A: with baseline elec. stove ownership as control				
High Subsidy	0.515***	0.415***	0.228***	0.0218
	(0.000)	(0.000)	(0.000)	(0.097)
Low Subsidy	0.286***	0.227***	0.0536	-0.00354
	(0.000)	(0.000)	(0.069)	(0.786)
Health Info.	0.0265	-0.00362	0.0201	-0.00793
	(0.302)	(0.870)	(0.330)	(0.386)
Cost Info.	0.0489	-0.00218	0.0329	-0.000195
	(0.059)	(0.922)	(0.115)	(0.983)
High Subsidy × Cost Info.	-0.101	-0.0309	-0.0601	-0.00938
	(0.052)	(0.489)	(0.150)	(0.612)
High Subsidy × Health Info.	-0.0128	0.00155	0.0668	-0.0139
	(0.806)	(0.972)	(0.110)	(0.453)
Low Subsidy × Health Info.	-0.0322	0.0440	-0.00846	0.0137
	(0.529)	(0.316)	(0.838)	(0.454)
Low Subsidy × Cost Info.	-0.0892	0.0241	-0.0448	-0.00263
	(0.087)	(0.590)	(0.288)	(0.888)
HH own elec. stove (baseline survey)	0.0452**	0.116***	-0.138***	0.0297***
	(0.009)	(0.000)	(0.000)	(0.000)
Constant	0.152***	0.0455**	0.134***	0.0134*
	(0.000)	(0.006)	(0.000)	(0.048)
Observations	2790	2790	2740	2739
Panel B: without baseline elec. stove ownership as control				
High Subsidy	0.515***	0.413***	0.230***	0.0213
	(0.000)	(0.000)	(0.000)	(0.106)
Low Subsidy	0.288***	0.233***	0.0439	-0.00140
	(0.000)	(0.000)	(0.143)	(0.915)
Health Info.	0.0271	-0.00221	0.0174	-0.00731
	(0.292)	(0.921)	(0.408)	(0.426)
Cost Info.	0.0500	0.000610	0.0279	0.000918
	(0.054)	(0.978)	(0.189)	(0.921)
High Subsidy × Cost Info.	-0.0986	-0.0244	-0.0668	-0.00798
	(0.058)	(0.589)	(0.116)	(0.667)
High Subsidy × Health Info.	-0.0147	-0.00319	0.0730	-0.0153
	(0.779)	(0.944)	(0.086)	(0.411)
Low Subsidy × Health Info.	-0.0342	0.0389	-0.000318	0.0119
	(0.504)	(0.381)	(0.994)	(0.517)
Low Subsidy × Cost Info.	-0.0926	0.0153	-0.0319	-0.00545
	(0.076)	(0.736)	(0.458)	(0.771)
Constant	0.167***	0.0844***	0.0880***	0.0234***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2790	2740	2739

Notes: All dependent variables are dummies. Adoption (v2) indicates if the HH bought an electric induction and non induction stove, or induction compatible cookware. Bought induction compatible cookware indicates if the HH reported buying compatible cookware in the last 6 months before the endline interview. Lastly, the last two variables indicates if the HH reported buying induction or non induction electric stoves, respectively. Significance at 1%, 5% and 10% are indicated by ***, ** and *, respectively.

Table D4: Using all treatments as IVs

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: with baseline elec. stove ownership as control								
Adoption	0.303**	-3.509	-0.167*	-0.196**	-0.158	0.496**	67.29	-0.185
	(0.007)	(0.050)	(0.021)	(0.004)	(0.424)	(0.003)	(0.950)	(0.310)
HH own elec. stove (baseline survey)	0.214**	0.334	0.125**	0.137***	-0.00233	0.254**	572.6	0.267*
	(0.001)	(0.744)	(0.003)	(0.000)	(0.984)	(0.008)	(0.345)	(0.012)
Constant	-0.0590	12.32***	1.028***	1.047***	0.682***	0.122	1843.9***	0.744***
	(0.176)	(0.000)	(0.000)	(0.000)	(0.000)	(0.056)	(0.000)	(0.000)
F-statistic	37.07	42.83	37.07	36.73	37.07	37.07	41.73	37.07
Observations	2790	2730	2790	2780	2790	2790	2652	2790
Panel B: without baseline elec. stove ownership as control								
Adoption	0.330**	-3.450*	-0.151*	-0.177**	-0.159	0.528***	168.4	-0.151
	(0.003)	(0.033)	(0.029)	(0.006)	(0.387)	(0.001)	(0.861)	(0.384)
Constant	-0.000246	12.41***	1.062***	1.084***	0.681***	0.191*	1989.7***	0.818***
	(0.997)	(0.000)	(0.000)	(0.000)	(0.000)	(0.040)	(0.001)	(0.000)
F-statistic	29.87	36.89	29.87	29.76	29.87	29.87	35.89	29.87
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: The first stage of the 2sls uses the adoption variable as the dependent variable and the subsidy and information treatments as dependent variables. We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table D5: Treatment effects on intensive margin: reduced form impacts of adoption and treatment assignment using all treatments including an interaction term with baseline cookstove ownership

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: first stage controlling for and interacting with baseline elec. stove ownership								
Any treatment	0.0283	-0.372	-0.0320***	-0.0349***	-0.0207	0.0518*	-100.2	-0.0636*
	(0.087)	(0.168)	(0.001)	(0.000)	(0.469)	(0.038)	(0.550)	(0.012)
HH own elec. stove (baseline survey)	0.370***	-1.453***	0.000116	-0.00268	-0.0977*	0.521***	356.8	0.0618
	(0.000)	(0.000)	(0.994)	(0.826)	(0.026)	(0.000)	(0.163)	(0.115)
interaction	0.0217	-0.218	0.0364*	0.0351**	0.00604	0.0194	315.2	0.124**
	(0.445)	(0.638)	(0.022)	(0.010)	(0.902)	(0.652)	(0.269)	(0.005)
Constant	0.0345*	11.23***	0.989***	1.000***	0.638***	0.270***	1949.9***	0.724***
	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790
Panel B: second stage controlling for and interacting with baseline elec. stove ownership								
Adoption	0.148***	-0.0523	0.0519***	0.0457***	-0.0220	0.331***	113.9	0.114***
	(0.000)	(0.816)	(0.000)	(0.000)	(0.351)	(0.000)	(0.413)	(0.000)
HH own elec. stove (baseline survey)	0.0115	0.803	0.0562*	0.0457*	0.0679	0.141*	524.6	0.0679
	(0.786)	(0.261)	(0.022)	(0.029)	(0.373)	(0.025)	(0.229)	(0.315)
interaction	0.305***	-2.522***	-0.0594*	-0.0488*	-0.155	0.216**	22.98	0.0287
	(0.000)	(0.001)	(0.021)	(0.027)	(0.052)	(0.001)	(0.960)	(0.686)
Constant	0.000149	10.96***	0.944***	0.954***	0.630***	0.185***	1825.5***	0.630***
	(0.985)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: We instrument any adoption (cookware or cookstove, in answer to the question on whether the household owns either of these items) with treatment assignment to any of the treatment arms (subsidy or information). The baseline survey was conducted in 2023. The outcome variables were collected during the 2024 survey. We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table D6: Treatment effects on intensive margin: reduced form impacts of cookstove adoption and treatment assignment using subsidy treatments including an interaction term with baseline cookstove ownership

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: first stage controlling for and interacting with baseline elec. stove ownership								
Subsidy treatment	0.0480***	-0.283	0.00495	0.000648	-0.000862	0.0707***	-160.3	-0.00695
	(0.000)	(0.207)	(0.516)	(0.921)	(0.971)	(0.001)	(0.249)	(0.741)
HH own elec. stove (baseline survey)	0.382***	-1.562***	0.0332***	0.0250***	-0.0901***	0.528***	530.5***	0.137***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
interaction	0.0149	-0.185	-0.0101	0.000612	-0.00757	0.0220	200.2	0.0592
	(0.517)	(0.623)	(0.433)	(0.956)	(0.849)	(0.526)	(0.387)	(0.095)
Constant	0.0380***	11.05***	0.962***	0.972***	0.622***	0.284***	1934.4***	0.676***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790
Panel B: second stage controlling for and interacting with baseline elec. stove ownership								
Induction Stove (v2)	0.279***	-0.478	0.00448	0.000775	-0.0193	0.482***	226.2	0.131***
	(0.000)	(0.078)	(0.404)	(0.682)	(0.501)	(0.000)	(0.178)	(0.000)
HH own elec. stove (baseline survey)	0.427***	-1.709***	0.00229	-0.00235	-0.111***	0.621***	596.1***	0.167***
	(0.000)	(0.000)	(0.556)	(0.086)	(0.000)	(0.000)	(0.000)	(0.000)
interaction	-0.0121	0.0821	0.00321	0.00235	-0.0364	-0.372***	695.2	-0.107
	(0.753)	(0.901)	(0.806)	(0.609)	(0.601)	(0.000)	(0.084)	(0.082)
Constant	0.00119	11.04***	0.990***	0.999***	0.643***	0.221***	1823.8***	0.666***
	(0.869)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2740	2730	2740	2730	2740	2740	2652	2740

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table D7: Treatment effects on intensive margin: reduced form impacts of cookware adoption and treatment assignment using subsidy treatments including an interaction term with baseline cookstove ownership

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
Panel A: first stage controlling for and interacting with baseline elec. stove ownership								
Subsidy treatment	0.0480***	-0.283	0.00495	0.000648	-0.000862	0.0707***	-160.3	-0.00695
	(0.000)	(0.207)	(0.516)	(0.921)	(0.971)	(0.001)	(0.249)	(0.741)
HH own elec. stove (baseline survey)	0.382***	-1.562***	0.0332***	0.0250***	-0.0901***	0.528***	530.5***	0.137***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
interaction	0.0149	-0.185	-0.0101	0.000612	-0.00757	0.0220	200.2	0.0592
	(0.517)	(0.623)	(0.433)	(0.956)	(0.849)	(0.526)	(0.387)	(0.095)
Constant	0.0380***	11.05***	0.962***	0.972***	0.622***	0.284***	1934.4***	0.676***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790
Panel B: second stage controlling for and interacting with baseline elec. stove ownership								
Bought Ind. Compatible Cookware (v2)	0.176***	-0.848**	0.0325***	0.0341***	0.0331	0.301***	-68.26	0.108***
	(0.000)	(0.003)	(0.001)	(0.000)	(0.274)	(0.000)	(0.699)	(0.000)
HH own elec. stove (baseline survey)	0.367***	-1.519***	0.0319***	0.0312***	-0.0571*	0.553***	647.8***	0.162***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)
interaction	0.00352	-0.0794	-0.0224	-0.0342**	-0.138**	-0.174***	-104.5	-0.0459
	(0.892)	(0.855)	(0.134)	(0.007)	(0.003)	(0.000)	(0.695)	(0.263)
Constant	0.0263***	11.09***	0.958***	0.966***	0.616***	0.259***	1882.9***	0.655***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2790	2730	2790	2780	2790	2790	2652	2790

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table D8: Treatment effects on extensive margin (adoption) by baseline e-stove ownership

	(1) Adoption	(2) Induction Cookware	(3) Induction Stove	(4) Adoption	(5) Induction Cookware	(6) Induction Stove
High Subsidy	0.534***	0.372***	0.326***	0.520***	0.506***	0.0205
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.578)
Low Subsidy	0.279***	0.189***	0.0690	0.305***	0.286***	0.0220
	(0.000)	(0.000)	(0.103)	(0.000)	(0.000)	(0.512)
Information	0.0656*	0.0173	0.0258	-0.00845	-0.0398	0.0232
	(0.015)	(0.435)	(0.299)	(0.823)	(0.273)	(0.284)
High Subsidy × Information	-0.0793	0.00497	-0.0249	-0.0371	-0.0643	0.0804
	(0.143)	(0.911)	(0.616)	(0.634)	(0.388)	(0.071)
Low Subsidy × Information	-0.0910	0.0312	-0.0292	0.00259	0.0512	-0.0152
	(0.098)	(0.490)	(0.570)	(0.972)	(0.463)	(0.715)
Constant	0.130***	0.0459*	0.116***	0.182***	0.160***	0.0321
	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)	(0.073)
Baseline induction stove	No	No	No	Yes	Yes	Yes
Observations	1817	1817	1767	973	973	973

Notes: All dependent variables are dummies. Adoption (v2) indicates if the HH bought an electric induction, or induction compatible cookware. Bought induction compatible cookware indicates if the HH reported buying compatible cookware in the last 6 months before the endline interview. Lastly, the last variable indicates if the HH reported buying induction. Significance at 1%, 5% and 10% are indicated by ***, ** and *, respectively.

Table D9: Treatment effects on intensive margin (use of electric appliances) using OLS (did not own induction stove at baseline

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
High Subsidy	0.0550**	-0.399	0.0108	0.000452	-0.00669	0.140**	-336.3	-0.0522
	(0.007)	(0.413)	(0.578)	(0.979)	(0.895)	(0.004)	(0.254)	(0.286)
Low Subsidy	0.0416*	-0.716	-0.0501*	-0.0604***	-0.0987	-0.000705	-114.6	-0.0982*
	(0.046)	(0.161)	(0.012)	(0.001)	(0.057)	(0.989)	(0.711)	(0.050)
Information	0.00532	-0.278	-0.0415***	-0.0423***	-0.0244	0.0200	-23.67	-0.0723*
	(0.670)	(0.355)	(0.001)	(0.000)	(0.432)	(0.498)	(0.896)	(0.016)
High Subsidy × Information	0.0105	0.544	0.0209	0.0258	0.0270	-0.0471	187.9	0.0916
	(0.676)	(0.365)	(0.381)	(0.221)	(0.664)	(0.426)	(0.604)	(0.127)
Low Subsidy × Information	-0.0120	0.272	0.0523*	0.0657**	0.127*	0.0480	13.24	0.113
	(0.639)	(0.662)	(0.031)	(0.002)	(0.045)	(0.425)	(0.972)	(0.064)
Constant	0.0345***	11.23***	0.989***	1.000***	0.638***	0.270***	1949.9***	0.724***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1817	1761	1817	1811	1817	1817	1697	1817

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.

Table D10: Treatment effects on intensive margin (use of electric appliances) using OLS (owned induction stove at baseline

	(1) % of Meals with induction stove	(2) LPG (KG)	(3) Use LPG cooking	(4) % of months with LPG usage	(5) Boil/warm water (LPG)	(6) Use Elec. cooking	(7) Elec. Exp. (NPR)	(8) Boil/warm water (Elec.)
High Subsidy	0.120*	-1.859**	0.0107	-0.0115	-0.0313	0.103	855.1	0.0736
	(0.046)	(0.006)	(0.404)	(0.091)	(0.679)	(0.055)	(0.055)	(0.191)
Low Subsidy	0.0773	-0.469	-0.00282	0.00314	-0.0131	0.168***	20.11	0.0788
	(0.157)	(0.450)	(0.808)	(0.613)	(0.849)	(0.001)	(0.960)	(0.123)
Information	0.0225	-0.426	0.00818	-0.000423	-0.0125	0.0302	231.5	0.0405
	(0.523)	(0.286)	(0.276)	(0.915)	(0.779)	(0.339)	(0.372)	(0.219)
High Subsidy × Information	-0.0233	1.960*	-0.0238	0.0150	-0.00412	-0.0265	-944.0	-0.0330
	(0.748)	(0.017)	(0.123)	(0.067)	(0.964)	(0.683)	(0.078)	(0.626)
Low Subsidy × Information	-0.0807	0.0310	-0.00242	0.000423	0.0436	-0.106	-181.1	-0.0372
	(0.234)	(0.968)	(0.867)	(0.956)	(0.610)	(0.081)	(0.716)	(0.558)
Constant	0.405***	9.780***	0.989***	0.997***	0.540***	0.791***	2306.7***	0.786***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	973	969	973	969	973	973	955	973

Notes: We asked households (HH) about the appliances/stoves they used to cook breakfast, lunch, afternoon snacks, and dinner during the three days prior to the endline interview. With this information, we generated the percentage of meals that included an induction stove in the cooking process (column 1). In column 2, we have the household's fuel usage for the last month. For columns 3 and 6, we asked households if they used LPG/electricity for cooking in the last 12 months. The variable in column 4 equals the reported number of months in which the household used LPG, divided by 12. Columns 5 and 8 equal 1 if the household reported using LPG and electricity for warming/boiling water, respectively. Lastly, column 7 represents the household's self-reported electricity expenses for the last month.