**Evaluating the Impacts of Clean Cooking Technology in Laos**

**Pre-Analysis Plan**

**January 2023**

# Introduction

The aim of this pre-analysis plan is to define the methodology that we will follow to conduct our analysis. The first section of the plan will provide an overview of the study, including a description of the interventions, the sampling process, data sources and sample size calculations. The second section will describe the hypotheses that we will be testing and how we are defining the variables that will test the hypotheses. The final section will discuss the methodology and specifications to be used in the analysis.

Studies using qualitative or descriptive analysis show that access to improved cooking technology can decrease the amount of time spent on cooking, cleaning utensils and collecting fuel, compared to traditional solid fuels such as firewood and charcoal (Malla et al., 2011; Habermehl, 2007; Habermehl, 2008; ADB, 2009; Christianensen and Heltberg, 2012; Djedje, 2009). Clean cooking technologies also can help reduce greenhouse gas emissions and lower levels of household air pollution (HAP). Hence, access to clean cooking technologies could provide significant health benefits and release time constraints that can make it challenging to balance both domestic tasks and market work. As women are typically responsible for most of the cooking and other household work, access to clean cooking technologies could have a particularly important impact on their health and ability to participate in income generating activities.

Some rigorous studies have found some encouraging results of access to clean cookstoves on self-reported health outcomes and fuel consumption (Bensch and Peters, 2012; McCracken et al., 2007; Smith-Siversten et al., 2009). However, a growing body of literature has cast a doubt on the effectiveness of clean cookstove technology in reducing the inhalation of harmful substances, improving health outcomes, and reducing fuel use when tested in everyday household use (Hanna et al., 2016; Burwen and Levine, 2011; Romieu et al., 2009). There are a few different explanations for the underperformance of clean cooking technologies when they are observed in the field rather than in the laboratory. On the one hand, take-up and consistent use of the technology is lower than may be expected, due to breakage, need for repairs, or challenges in using them. On the other hand, households may use the stoves improperly, which does not lead to a reduction in smoke, as most studies focus on stoves that still burn wood or charcoal.

# Overview of the study

The East Asia and Pacific Gender Innovation Lab (EAPGIL) is carrying out an impact evaluation of more advanced clean cookstove technology—a gasifying wood stove that is considered tier 5 on CO and PM 2.5 to meet WHO guidelines on HAP, and a minimum tier 4 on thermal efficiency, safety, and durability according to the Voluntary Performance Targets set by the International Organization for Standardization (ISO5). This study will contribute to the body of literature by testing in a household environment a different type of cookstove that is more efficient and easier to use. Most RCTs of clean cookstove interventions have focused on improved technology that still uses wood-burning fuels (Bensch and Peters, 2012; Romieu et al., 2009; Burwen and Levine, 2011; Hanna et al., 2016; McCracken et al., 2007; Smith-Siversten et al., 2009). Only a few RCT studies have examined impacts of accessing to cleaner cooking technologies, like a forced-draft gasifier cookstove. For instance, a study from urban Rwanda that reports to evaluate a similar cooking technology, biomass burning stove the Mimi Moto (Jagger et al., 2019). Therefore, this impact evaluation would contribute significantly by exploring the impacts of more advanced technology that can be a great solution to reduce HAP. Moreover, this type of cookstove could reduce the time-burden associated with cooking, as it reduces the time needed to collect fuel, takes less time to start and prepare food, and keeps cooking utensils cleaner than traditional solid fuels (reducing the time needed for cleaning). Its adaptability to Laotian cooking styles can facilitate a behavioral change to switch to this technology.

## Description of the interventions

This innovative project, led by the Ministry of Energy and Mines and supported by the World Bank, will distribute 50,000 forced-draft gasifier cookstoves to urban households that are likely to continue using solid fuels to meet their cooking and heating needs. The main criteria for household identification are: (1) the household must be willing to pay for the stove, (2) the household’s source of fuel has to be charcoal, (3) the household must commit to using the stove 80 percent of the time for cooking and heating, and (4) the household must agree to the rigorous monitoring during the project implementation period.

This clean cooking technology uses pellets that gasify wood and other biomass, rather than burning it directly like in an open fire or in a chimney. The extracted gasses burn much more cleanly than when burning traditional solid fuels. These types of super clean cookstoves decrease emissions by 99 percent, thereby emitting little or no greenhouse gasses, PM 2.5, black carbon, and CO. There is reason to believe that this type of technology could produce greater impacts than the less advanced types of clean cooking technologies that have been rigorously tested in household situations. On the one hand, this technology burns cleaner fuels in addition to burning the fuel more efficiently, reducing emissions by 99 percent compared to traditional stoves, whereas previous evaluations have studied stoves that divert smoke from traditional fuels or enable them to burn more efficiently. On the other hand, the stoves are made from more resistant materials and designed to last for a long time. As such, they will likely not face the same issues in terms of the need for maintenance and frequency of repairs as other types of technology that use more fragile materials like clay.

The private sector implementing entity was contracted by the Ministry of Energy and Mines to sell the forced-draft gasifier cookstoves that meet the project’s criteria to eligible households at a subsidized rate and provide after-sales services and ensure a pellet supply. The implementing entity planned to implement the stove distribution in two phases: Phase 1 (or Proof of Concept) to distribute 300 stoves to test the viability of a local market for this clean cooking technology, and Phase 2 (or commercial implementation) to deliver the 50,000 cookstoves. The impact evaluation will take place during the Proof of Concept phase.

The 300 stoves during the Proof of Concept phase were distributed between May 17th, 2022 and June 27th, 2022 through a marketing event or self-pickup. The implementing entity conducted the marketing event to promote the stove and raise household awareness across seven districts[[1]](#footnote-1) in Vientiane Capital for 14 days (2 days per district) and invite households from the list given by the World Bank team to attend the activities. Prior to the events, the implementing entity utilized a variety of approaches, including phone calls, WhatsApp messaging, flyers, mobilization with district and village heads, and efforts to contact households. After the marketing events, households still can contact the implementing entity at their local distribution center in Xaythany to express their interests in obtaining the stove. Figure 1 shows the distribution of stoves and dates in each district.

Figure 1: Distribution of stoves across seven districts in Vientiane Capital

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Chanthabouly** | **Sikhottabong** | **Xaysetha** | **Sisatanak** | **Hadxayfong** | **Naxaythong** | **Xaythany** |
| Distribution date | 17.05.22 | 19.05.22 | 22.05.22 | 23.05.22 | 24.05.22 | 25.05.22 | 21&27.05.22 |
| Number of stoves distributed | 32 | 35 | 49 | 21 | 30 | 47 | 86 |

The stove and pellets were offered in a subscription model, where participating households had to sign an agreement to lease the stove and sign up for a pellet subscription. This subscription package allows households to receive one stove and an amount of pellets that is suitable for one month's use. A minimum monthly subscription is 60,000 LAK where households will receive 30kg of pellets in return; however, they have an option to purchase additional pellets at the cost of 30,000 LAK per bag (2,000 LAK per kg) throughout the month if needed. At the end of every month, subscribers will return to the implementing entity’s pellet distribution center in Xaythani district to pay for the pellets consumed together with collect pellets for the following month. If households do not use all the pellets they have purchased throughout the month, and have some remaining, they also have the option to purchase additional pellets separately. Households will have the option to renew the agreement after the completion of the contract.

The Implementing Entity will provide up-front financing for the stoves and will recuperate their investment through the sale of Certified Emission Reductions (carbon finance mechanism). In parallel, the government of Laos is exploring the feasibility of fostering the development of local pellet production. Evidence in the literature suggests that ensuring a well-functioning market for both cookstove fuel such as pellets and for repair services is essential to ensuring that households may continue using the stoves. For example, Thurber et al. (2014) found that only 9% of households who had purchased clean cooking stoves were using them due to a lack of fuel supply. The number of stoves to be distributed will create a large enough market to incentivize further private sector engagement in the domain and enable the private sector entity to reach economies of scale. If proven effective, the program would therefore be sustainable and scalable. Moreover, the lessons learned from the impact evaluation will inform the government about potential tweaks to the program design that are needed to ensure a successful and inclusive scale up of the program.

## Description of the sampling process

The impact evaluation will use a randomized design in a subset of project villages to identify the impacts of the super clean cookstoves on the outcomes of interest (e.g. health, time use, household fuel expenditures, cooking practices, etc.). The original randomized design was planned in 2019 and was expected to be done at two levels: first at the village level and later at the household level. However, it was developed prior to the receipt of the implementing entity’s business plan. Some activities were completed in parallel to the contracting of the implementing entity in order to ensure that there would be no delays for the project implementation.

A village level lucky draw was organized in the presence of ministry, district, and village-level officials to determine areas where the project would be rolled out first and areas where it would be rolled out later. A household listing, which runs like a market research survey, was also conducted in order to help form the sample frame for the baseline survey by identifying households who are interested in the stoves and assessing their willingness to pay. 3,447 households were interviewed, but they did not commit to purchasing a stove. This household listing took place within 11 districts[[2]](#footnote-2) across 3 Lao PDR provinces: Vientiane Capital, Champasak and Savannakhet.

The revised impact evaluation design took advantage of these activities that have already been completed while harmonizing the design with the implementing entity’s proposed work plan. Since the implementing entity proposed to deploy a limited number of stoves only in Vientiane Capital during the proof of concept stage, the impact evaluation can be done without relying on the earlier-later village design and the randomization can be done at the household level.

The sample was drawn from an existing list of households who resided in Vientiane Capital (narrowed to 7 districts from 11 districts), were willing to share their contact information with the implementing entity, and who noted interest in the stove during the market research survey, and from a list of households obtained through a random walk within the project villages. The existing list of households was contacted by telephone given the COVID-19 pandemic in Vientiane at the beginning of 2022. However, given the low response rate on the phone survey and the fact that the health situation in Vientiane had significantly improved by March 2022, the random walk method was later added to ensure that at least 1,000 households could be reached. Households that cook with charcoal and who use at least 20 kilograms of charcoal per month for cooking were included in the sample.[[3]](#footnote-3) After the completion of the baseline survey and the removal of unqualified households, a household lucky draw will be performed to divide the sample into 4 groups: 1) 311 treatment households; 2) 311 control households; 3) 163 reserve treatment households; and 4) 163 reserve control households. Since the implementing entity intended to distribute only 300 stoves during the proof of concept phase, there was a need to divide the sample into initial and reserve groups where the implementing entity will approach the initial list of households before the reserve list of households. The replacement households from the waitlist will be provided when some households on the initial list refuse to sign up for the stove. The first list of the treatment households was immediately shared with the implementing entity once we reached the 300 targeted households. Nonetheless, because the implementing entity planned to deploy the marketing events only 2 days per district, we eventually provided the full list of households (311 treatment and 163 reserve treatment households) to the implementing entity in advance to facilitate the process of stove distribution and increase a likelihood of stove adoption at the marketing events. Even though, we shared the full list of treatment households, we explicitly informed the implementing entity to exhaust the initial list of households before contacting the households on the reserve list.

To ensure equal representation of target groups, we stratified the sample into strata based on location and median charcoal consumption in their respective districts.

## Take-up rate

Overall, the interventions had an average take-up rate. 63.29% of individuals assigned to the treatment group took up the stove. The IE provided a list of 474 treatment households to the implementing entity for the stove distribution to the treatment households, while we reserved another list of 474 control households for comparison purposes. The implementation entity was able to distribute all 300 available stoves for the PoC stove to the given list of the treatment households.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Randomized group** | **List assigned** | **Take-up during the PoC stage** | **Initial list of households** | **Reserve list of households** |
| **Treatment households** | 474 | 300 | 228 | 72 |
| % | 100% | 63.29% | 73.31% | 44.17% |
| **Control households** | 474 | 0 | 0 | 0 |
| % | 100% | 0% | 0% | 0% |

## Description of the data sources

The analysis will be conducted using two rounds of survey data. The baseline survey was conducted between January, 14th 2022 and April, 20th 2022. The survey was implemented in two ways: telephone survey and an in-person survey. The phone survey started on January 14th, 2022, while the face-to-face survey began on February 4th, 2022. The private data collection firm initially conducted the telephone interview with eligible households from the existing list of market research survey households. Nevertheless, due to challenges in reaching households by phone, the face-to-face interview using a random walk method within the project villages was later performed in order to reach the target number of households (at least 1,000 households). 1,017 households were contacted and interviewed: 459 households from the telephone survey and 558 households from the face-to-face survey. Targeted households were interviewed using either one of these methods. However, only 948 households were eligible to meet the project’s requirement to form baseline treatment and control groups. The baseline survey in both formats lasted approximately 30–60 minutes and included questions on household characteristics, cooking practices, fuel consumption, intra-household bargaining, and health outcomes.

|  |  |  |
| --- | --- | --- |
| **Randomized group** | **Telephone interview** | **Face-to-face interview** |
| **Treatment households** | 208 | 266 |
| % | 52.66% | 48.1% |
| **Control households** | 187 | 287 |
| % | 47.34% | 51.9% |

The endline survey is expected to take place in November to December 2022 (approximately 5 months after treatment households received stoves). It is expected to last approximately 60 minutes and will cover indicators on a wide range of outcomes, including household characteristics, cooking practices, fuel consumption, intra-household bargaining, and health outcomes.

## Power calculations

We conducted the power calculations to detect the impacts of the stoves on various primary outcomes of interest: overall health status, having eye irritation, having headache, quantity of charcoal used, expenditures of charcoal used, overall time spent on cooking time and related activities, time spent on cooking using the means and standard deviations from the baseline survey data, our sample size, and a 62% take up rate. The below table shows the minimum effect size that we could detect with 80%.

|  |  |  |
| --- | --- | --- |
| **Variables** | **Impact detected with 63% take up** | **Power** |
| *Health* | | |
| Symptoms subscale of the SGRQ | -42.6% | 80% |
| Activities subscale of the SGRQ | -31.7% | 80% |
| Impact subscale of the SGRQ | -42.2% | 80% |
| Overall health status | 8.2% | 80% |
| Eye Irritation | -45.6% | 80% |
| Headache | -40% | 80% |
| *Time spent on cooking and cooking-related activities* | | |
| Total time all household members | -18.6% | 80% |
| Total time spent preparing meals yesterday | -21.2% | 80% |
| Time primary cook spent cooking in past 7 days | -20.3% | 80% |
| Time all household members spent cooking in past 7 days | -21.7% | 80% |
| Time primary cook spent washing dishes in past 7 days | -34.8% | 80% |
| Time all household members spent washing dishes in past 7 days | -31.6% | 80% |
| Time primary cook spent cleaning the kitchen in past 7 days | -33.3% | 80% |
| Time all household members spent cleaning the kitchen in past 7 days | -32.1% | 80% |
| Time all household members spent gathering fuel in the past 7 days | -75.8% | 80% |
| Time primary cook spent cooking for sale over the past 7 days | -61.1% | 80% |
| Time all other household members spent cooking for sale over the past 7 days | -124% | 80% |
| *Use of charcoal* | | |
| Number of kg of charcoal used in the past month | -31.3% | 80% |
| Cost of charcoal consumption in past month | - 37.4% | 80% |
| Charcoal stove is primary stove | - 13.4% | 80% |
| Charcoal stove is used daily | -10.1% | 80% |

# Hypotheses and variable definitions

## Groups of hypotheses:

A: Impact of the adoption of clean cooking technologies on primary outcomes

B: Impact of the adoption of clean cooking technologies on secondary outcomes

C: Process and Mechanisms

D: Heterogeneity of impacts

## Group A: The impact of clean cooking technologies on primary outcomes

### Hypothesis A1: Clean cookstoves improve the health of the primary cook.

The primary outcome variable for testing this hypothesis will be the primary cook’s overall score on the Saint George’s Respiratory Questionnaire (SGRQ), calculated according to the instructions in the [SGRQ Manual.](https://www.sgul.ac.uk/research/research-operations/research-administration/st-georges-respiratory-questionnaire/docs/SGRQ-Manual-March-2022.pdf) We will also test this outcome by exploring impacts on each of the following indicators separately and on a standardized z-score measure aggregating the following indicators[[4]](#footnote-4):

* Symptoms subscale of the SGRQ, calculated as described in the manual
* Activities subscale of the SGRQ, calculated as described in the manual
* Impact subscale of the SGRQ, calculated as described in the manual
* Overview of health status experienced by the primary cook (HM1)
* Eye Irritation experienced by the primary cook (HM2\_1)
* Headache experienced by the primary cook (HM2\_2)

### Hypothesis A2: Clean cookstoves reduce the time spent on cooking and cooking-related domestic work.

The two primary outcome variables for testing this hypothesis will be:

* Total time the primary cook spends on cooking for the household, washing dishes, and cleaning the kitchen, and gathering fuel in the past 7 days (sum of CP4\_1, CP4\_3, CP4\_5, CP4\_7, CP4\_9, CP4\_11, CP2\_13)
* Total time spent preparing meals yesterday (sum of CP3\_4)

### Hypothesis A3:Clean cooking technologies reduce use of charcoal

The primary outcome for this hypothesis will be the number of kg of charcoal used in the past month (CP2\_4\_2+CP2\_4\_3).

Due to noise in the primary outcome variable, we will also test three additional indicators:

* Cost of charcoal consumption in past month (CP2\_6\_2+CP2\_6\_3)
* Charcoal stove is primary stove (dummy variable taking the value of 1 if CP1\_2=2 or 3)
* Charcoal stove is used daily (dummy variable taking the value of 1 if CP1\_8=1)

## Group B: The impact of the adoption of clean cooking technologies on secondary outcomes

### Hypothesis B1: Clean cooking technologies improve the health of household members

This hypothesis will be tested using the following indicators:

* Incidence of eye irritation among household members (HO6)
* Incidence of headaches among household members (HO7)
* Incidence of chest troubles among household members (HO8)

These regressions will be run on a long-form of the dataset that has one line per household member.[[5]](#footnote-5) The primary cook will not be included in these regressions, as the primary cook’s health is assessed in Hypothesis A1. Standard errors will be clustered at the household level.

### Hypothesis B2: Clean cooking technologies may change the primary cook’s general life satisfaction.

* Overall life satisfaction (UW1)
* Expected life satisfaction in the next one year (UW2)

### Hypothesis B3: Clean cooking technologies lead to cost savings for the household

This hypothesis will be tested using the following indicators:

* Total cost of fuel consumed in the past month (CP2\_6\_2+CP2\_6\_3+CP2\_11+CP2\_18\_CP2\_12)
* Total cost of stove repairs and replacements over the past 6 months

## Hypothesis group C: Testing the theory of change

The impacts of the stoves may only be realized under certain conditions. First, impacts may only be detected if households adopt and use the stove. Second, impacts of the stoves may be minimal if they primarily replace other types of clean cooking technology or if households continue to use dirtier cooking fuels alongside the new technology. Third, the impacts of the stoves may only be realized if households are using the stoves with the appropriate fuel.

### Hypothesis C1: Households in the treatment group adopt and use the stove

This hypothesis will be tested through descriptive statistics on the following indicators:

* Administrative data from the implementing entity on households that adopt the stove
* Administrative data from the implementing entity on the amount of pellet purchases
* Self-reported data on whether the household has ever had the stove (SE1)
* Self-reported data on whether the household still has the stove in their household (SE3)
* Frequency with which the household uses the stove (SE7)
* The primary stove used for cooking is the CSI stove (dummy taking the value of 1 if CP1\_2=10)

### Hypothesis C2: Households use the new stove as an alternative to dirtier technologies

This hypothesis will be tested by running regressions to test the impact of treatment assignment on the following indicators:

* Household uses charcoal
* Household uses firewood, crop residues, twigs or leaves
* Total expenditures on charcoal, firewood, crop residues, twigs, or leaves
* Primary stove uses charcoal or firewood (CP1\_2=1,2,3)

### Hypothesis C3: Households use the appropriate type of fuel in the stove

This hypothesis will be tested using descriptive statistics of the following indicator for treatment households:

* Household has not used fuels other than CSI pellets with the stove (SE8b=2)

## Hypothesis group D: Clean cookstoves will have different effects on different types of households.

For each of the hypotheses D1-D3 mentioned below, we will test the heterogeneous effects of the treatment on the primary and secondary outcomes specified in hypothesis group A and group B above.

### Hypothesis D1: Impacts of clean cookstoves will be stronger for those who used more charcoal at baseline

To test this hypothesis, we will interact the treatment variable with a continuous variable for the number of kg of charcoal used at baseline.

### Hypothesis D2: Impacts of clean cookstoves will be stronger for those whose charcoal stoves were inside at baseline

To test this hypothesis, we will interact the treatment variable with a dummy variable that takes the value of 1 if CP1\_4\_2=1,2 OR if CP1\_4\_3=1,2 at baseline. We expect that hypotheses A1 and B1 may be most sensitive to baseline location of charcoal stoves.

### Hypothesis D3: Impacts of clean cookstoves will be stronger for those who spend more time cooking at baseline

The primary way we will test this hypothesis is interacting the treatment variable with a continuous variable measuring the time the primary cook spent cooking at baseline (CP4\_1). We may also explore interacting the treatment variable with a continuous variable measuring the total time that the primary cook and all other household members spent on cooking, cleaning the kitchen, and washing dishes at baseline (CP4\_1+CP4\_3+CP4\_5+CP4\_7+CP4\_9+CP4\_11)

# Methodology

## Identifying the treatment effect

For the variables for which we have baseline values, we will also calculate the intent to treat effect to estimate the program impact on those assigned to treatment using the following ANCOVA estimation:

(E1)

is the outcome variable measured post-treatment.

is an indicator that equals 1 if the household was in the treatment group.

will measure the intent-to-treat effect of being assigned to the treatment group compared to the control group.

 is the baseline value of the outcome variable

 is a dummy variable for the final stratification variable

 is the error term

For the outcomes for which we do not have baseline values, we will calculate the intent to treat effect using the following regression:

(E2)

The interpretations of the variables are the same as for the previous equation.

For both equations, Huber White standard errors will be used.

In addition to calculating the intent to treat effect, we will also estimate the treatment on the treated effect by instrumenting the stove adoption with the random assignment to the treatment group. This estimate will enable us to control for non-compliance with treatment assignment. At the time of writing the pre-analysis plan, we expect to use the administrative data on whether or not the household received the stove as the primary indicator of compliance. However, depending on the descriptive analysis about take-up conducted in Hypothesis C1, the team may also test alternative indicator(s) of stove adoption that my be more appropriate given stove usage around the time of the endline survey.

## Dealing with multiple outcomes

There are two challenges when working with a large number of outcome variables. First, the volume of outcome variables can make it more difficult to interpret results. Second, analysis of multiple outcomes can increase the risk of type 1 error if the significance tests are not adjusted appropriately.

To deal with these risks, we will employ the following strategies:

1. We have clearly identified a set of primary outcomes in hypothesis group A and limited the number of outcome variables for each hypothesis tested.
2. For hypotheses with multiple outcomes of interest tested, we will follow the methodology of Kling, Katz and Liebman (2007) to test the significance of families of outcomes in a single aggregate. To calculate z-score indices for families of outcomes, we will:

1) Convert all outcomes so that the sign of all of the variables in a family goes in the same direction

2) Calculate the z-score of each variable by subtracting the control group mean and dividing by the control group standard deviation

3) Take an average of the z-scores in the family

## Addressing missing data and questions with limited variation

### Survey attrition

If Ai represents whether individual i attrits from the study because the individual cannot be found or refuses to participate, we will estimate the following equation to test whether survey attrition is related to treatment status:



where C is a vector of control variables used during the stratification (district and being above/below the median charcoal consumption of their district).

If treatment status does not affect survey attrition at the 5% significance level, then we will not adjust the estimates for attrition.

If treatment status does have a statistically significant effect on survey attrition, we will test the robustness of our results using Lee bounds (Lee 2008).

### Outliers

We will test for the sensitivity of our results on fuel consumptions and expenditures to outliers by estimating windsorized versions of these variables at the 99th percentile.

## Inflation

Since the rate of inflation in Lao PDR in 2022 is running rampant, we will convert the nominal values to real values using the consumer price index published by Bank of the Lao PDR.

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1. Sikhottabong, Chanthabouly, Xaysettha, Sisattanak, Naxaithong, Hadxaifong, and Xaythany districts [↑](#footnote-ref-1)
2. 7 districts in Vientiane: Sikhottabong, Chanthabouly, Xaysettha, Sisattanak, Naxaithong, Xaythany, and Hadxaifong. 2 districts in Champasak: Pakse and Champasak. 2 districts in Savannakhet: Kaysone Phomvihane and Outhoumphone. [↑](#footnote-ref-2)
3. This is a project requirement due to the expected generation of Certified Emissions Reductions [↑](#footnote-ref-3)
4. The aggregated z-score will not include the overall SGRQ score, as it includes the 3 sub-scales that make up the overall score. [↑](#footnote-ref-4)
5. We do not expect the treatment to change the number of people who live in the household, and household size is balanced across treatment and control at baseline. If the treatment is shown to change the number of people who live in the household, we may adjust the specification to avoid bias. [↑](#footnote-ref-5)