CONSUMER ACCEPTABILITY STUDY
BIOLITE HOMESTOVE™
1. Executive Summary
2. Background & Rationale
3. Methodology
4. Baseline Summary
5. Stove Functioning
6. Stove Experience, Preference & Perceptions
7. Stove Costing and Willingness-to-Pay
8. Conclusion
EXECUTIVE SUMMARY

• All respondents used the BioLite HomeStove™ on average from 0.40 (peri-urban) to 1.11 (rural) times per day according to thermal data loggers (SUMs). Self reported usage resulted on average 2 times per day and remained consistent over the 4-week study period.

• 94% of respondents observed and appreciated a noticeable reduction in smoke emissions and fuel consumption, as well as less soot on pots and pans and an overall cleaner cooking experience. Fuel buyers expect to save money with this stove.

• A drawback of the BioLite HomeStove™ in the Cambodian cooking context is that it is perceived as ‘slow cooking’. This perception stems from several factors, incl. the batch feeding character of the stove; difficult ignition; a waiting period until fan operation starts; the height of the stove which is seen as creating too large of a distance between combustion chamber and pot; and the size of the combustion chamber/fuel opening which is seen as not holding enough fuel.

• Most respondents however state they would not be deterred by this from using the BioLite HomeStove™ regularly. Respondents consistently rank the BioLite HomeStove™ as ‘better than their old primary stove’.

• 8 rural households were given the stove after the trial and SNV offered to buy it back for $50 on the spot if they didn’t want to keep – 7 out of 8 households kept the stove.

• 5 out of 8 of the peri-urban study participants purchased the BioLite HomeStove™ at a discounted price of $40 at the end of the trial period. Some used payment plans.
BACKGROUND & RATIONALE
This report summarises findings from a Consumer Acceptability and Willingness-to-Pay Study for the BioLite HomeStove™ in Cambodia.

The purpose of the study was to assess the acceptance of the BioLite HomeStove™ among Cambodian households who use predominately wood for cooking on a daily basis. It aimed to gather qualitative information relating to the appreciation of the BioLite HomeStove™ in the Cambodian cooking context and quantitative data regarding stove usage.

The study was conducted over a 5-week period by SNV Netherlands Development Organisation in May/June 2014 with 16 selected households in 3 target market segments in rural and peri-urban areas in Cambodia.

The study is part of a series of assessments to evaluate the potential for commercial introduction of Advanced Biomass Stoves in the Cambodian consumer market.
PRODUCT SPECIFICATION

- High performance, fan-assisted forced-draft wood stove
- Designed by New York-based social enterprise BioLite LLC
- Designed to reduce cooking fuel consumption and household air pollution
- No Water Boiling Test (WBT) reports available
- The stoves performance tiers are currently unrated, but expected to meet Tier III or IV performance benchmarks (emissions, efficiency/fuel savings, indoor air emissions, safety not rated)
- Thermo-electric generator generates electricity for fan; charges LED lights & phones
- Body cast iron and stainless steel
- Estimated retail price in Cambodia based on current ex-factory price: USD $130
1. Selection of households from target market segments / test all stoves before they are deployed
2. Baseline survey
3. Stove Introduction (Group and Individual training)
4. One week follow-up survey / Placement of SUMS (thermal data loggers)
5. End-line Survey / Collection of SUMS / Willingness-to-pay experiment
6. Data Analysis and Reporting

Consumer Acceptability Research Questions:

• What are the desired attributes of the advanced biomass stove (ABS)?
• What are the perceived barriers and dislikes of the ABS? Are there feasible solutions to these barriers?
• Number of times and duration that ABS are used in households
• Willingness-to-pay and does offering instalment payments influence purchase?
• Validation of expected fuel savings
FIELD SCHEDULE

- **Week 0**
  - Household Selection, Stove preparation

- **Week 1**
  - Days 1-2: Baseline Questionnaires, Stove Introduction (group and individual)
  - Day 5: One-week Follow-up Survey and placement of SUMS

- **Week 2** [No Visits]

- **Week 3** [No Visits]

- **Week 4**
  - Day 25-26: End-line surveys, SUMs data collection, willingness-to-pay experiment
METHOD FOR SELECTING HOUSEHOLDS

- Households chosen from validated primary and secondary target market segments (identified as most likely adopters of Advanced Biomass Stoves through *End-User Market Assessment*)

- Qualifiers = geographic area + income level + type of primary fuel

- 3 priority segments for BioLite HomeStove™ Study:

  **Rural:**
  5. Firewood, top 1/3
     - Top 1/3 of firewood buyers who earn >$178
     - 23.1% rural population use firewood – subset buy [sub-set of 2,557k people]

  **Peri-urban:**
  2. Firewood, top 2/3
     - Firewood users in top 2/3 income >$194 month
     - 14.8% peri-u population [137,178 people]

  1. Charcoal, top 2/3
     - Charcoal users in top 2/3 income >$194 month
     - 10.6% peri-u population [98,249 people]

- Randomized household selection based on End-User Market Assessment survey data set

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1. *End-User Market Assessment for Advanced Biomass Stoves – Cambodia. May 2014*
METHOD TO DETERMINE STOVE ADOPTION

1. Self-reported use of stoves [Questionnaires]

2. Stove use monitoring system (SUMS)
   - SUMS record the stove temperature at selected time intervals (e.g. every five minutes); the resulting temperature profiles are analyzed to determine the frequency of “cooking events” (i.e. number of times the stoves were lit) per day

Placement
Of SUMS iButtons on the BioLite HomeStove™
SURVEY INSTRUMENTS AND DATA COLLECTION TOOLS

- Baseline Questionnaire
- One-week Follow-up Questionnaire
- End-line Questionnaire
- Willingness-to-pay method and script
- Stove introduction material (stove operation and maintenance manual translated to Khmer)
- Thermal data logger (SUMs) and data sheet
Preparation included ensuring that all stoves are in good operating order, and that the thermo-electric generator produces electricity for fan & phone charging.
Sample of 16 HHs from 2 geographic areas (rural & peri-urban); 3 target market segments

1. **Charcoal, top 2/3**
   - Charcoal users in top 2/3 income >$194 month
   - 10.6% peri-u population [98,249 people]

2. **Firewood, top 2/3**
   - Firewood users in top 2/3 income >$194 month
   - 14.8% peri-u population [137,178 people]

3. **Firewood, top 1/3**
   - Top 1/3 of firewood buyers who earn >$178
   - 23.1% rural population use firewood – subset buy [sub-set of 2,557k people]

Sample breakdown:

- **Rural, Firewood, Top 1/3**
  - 50% (8 HHs)

- **Peri-urban, Firewood, Top 2/3**
  - 37% (6 HHs)

- **Peri-urban, Charcoal, Top 2/3**
  - 13% (2 HHs)
# General Locations of Households

<table>
<thead>
<tr>
<th>Area</th>
<th>Target Segment</th>
<th>Province / District</th>
<th># of HH's / Stoves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>Top 1/3 of firewood buyers who earn &gt;$178</td>
<td>Kandal, Koh Thom</td>
<td>8</td>
</tr>
<tr>
<td>Peri-Urban</td>
<td>Firewood users in top 2/3 income &gt;$194 month</td>
<td>Phnom Penh, Mean Chey &amp; Dankor</td>
<td>6</td>
</tr>
<tr>
<td>Peri-Urban</td>
<td>Charcoal users in the top 2/3 income &gt;$194 month</td>
<td>Phnom Penh, Mean Chey</td>
<td>2</td>
</tr>
</tbody>
</table>
100% of respondents are female.

Average age of respondent is 45 (range 20-70 years).

All respondents are married, except 1 who is single, and 1 who is widowed.

All respondents - except the eldest - have attended school.

Average highest grade attended is 6th grade (ranging from 1 to 11).
Average household size of sample is 6 (ranging from 3 to 12)

Average number of females in households is 3 (ranging from 1 to 7)

Respondents’ house types indicate middle- & high income class

15 out of 16 respondents are connected to grid electricity
• All respondents are middle- to high-income earners

• Average monthly income is approx. $393 (ranging from $250 to $1,000)

• Average monthly household expenses are $275 (ranging from $82 to $600)
All survey households generate income from business or employment.

13 out of 16 respondents save some money.

Respondents mainly save for: medical treatment, retirement, children’s education, business & property investment, to invest in gold or gem stones.
Rescename's
House
In rural Kandal - wooden house with tile roof – indicates middle to high income class
On average, 2.7 family members contribute to HH income (ranging from 1 to 5) – mostly spouse and children

50% of respondents are in charge of spending on consumer goods

Respondents are in charge of spending on average up to $34 (ranging from $5 to $150)

2 respondents discuss all buying decisions with spouse/family
HOUSEHOLD PROFILE
-ASSETS-

- Respondents’ HHs own on average 1.75 motorbikes, 3.3 mobile phones, 1.3 television sets
- 6 households own an electric rice cooker
- 5 households own a refrigerator
- Only 5 households own a radio
- Only 3 households own cars
- Only 3 households own computers
- Only 1 household has internet access

Photo: Study participant in market segment ‘rural top 1/3 firewood user’
STOVES TYPES
- PRIMARY & SECONDARY STOVES -

**Primary Stove Type**
- Traditional Stove: 50%
- New Lao Stove: 32%
- LPG 200 ml: 6%
- LPG Large Gas Stove: 6%
- Three-stone Fire: 6%

**Secondary Stove Type**
- LPG 200 ml: 63%
- New Lao Stove: 13%
- Traditional Stove: 12%
- No secondary stove: 6%

- Average # of stoves per HH = 3.1 (= total of 50 stoves in 16 sample HHs)
- Average # of stoves used per meal = 2
- Main primary stove: Traditional Stove; New Lao Stove
- Main secondary stove: LPG 200ml single burner
Most frequently stated benefits of primary stove:

- 'cheap price'
- 'save money compared to LPG'
- 'safer than LPG'
- 'has wood fuel available'
- 'don’t spend money on fuel'
- 'easy to use'
- 'strong fire'
- 'many cooking methods'
- 'Strong flame'

*Word cloud represents 14 out of 16 respondents who use traditional stove types as primary stove*
Most frequently stated disadvantages of primary stove:

9 out of 14 respondents who use traditional stove types as their primary stove state: ‘produces a lot of smoke’, and ‘breaks easily’ as main disadvantages.

The remaining 5 out of 14 respondents who use traditional stove types as their primary stove claim the stove has ‘no disadvantage’.

It is worth noting that the respondents who see no disadvantage in their stove are all from target market segment ‘Rural Firewood Users’.

* Word cloud represents 14 out of 16 respondents who use traditional stove types as primary stove
SECONDARY STOVE -ADVANTAGES-

Most frequently stated benefits of secondary stove all relate to convenience:

'fast cooking'
'saving time'
'easy to ignite'
'use for meal heating when busy'

Word cloud represents 11 out of 16 respondents who use a type of LPG stove as secondary stove.
SECONDARY STOVE
- DISADVANTAGES -

10 out of 11 respondents who use a type of LPG stove as secondary stove state:

- ‘Can explode’
- ‘Spend money on LPG’
- ‘Expensive’

* Word cloud represents 11 out of 16 respondents who use a type of LPG stove as secondary stove
## STOVE TYPE
### SAMPLE OVERVIEW

<table>
<thead>
<tr>
<th>#</th>
<th>Market Segment</th>
<th>Primary Stove</th>
<th>Amount</th>
<th>Fuel used</th>
<th>Secondary Stove</th>
<th>Amount</th>
<th>Tertiary Stove</th>
<th>Amount</th>
<th>Total # stoves</th>
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<tbody>
<tr>
<td>1</td>
<td>1 5</td>
<td>New Lao Stove*</td>
<td>2</td>
<td>Wood</td>
<td>Traditional Stove</td>
<td>2</td>
<td>LPG Large Gas Stove</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
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<td>2 5</td>
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<td>Wood</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
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<td>LPG 200ml</td>
<td>-</td>
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<tr>
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<td>4 5</td>
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<td>Wood</td>
<td>LPG 200ml</td>
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<td>-</td>
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<td>3</td>
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<td>5 5</td>
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<td>Wood</td>
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<td>6 5</td>
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<td>LPG Large Gas Stove</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>9</td>
<td>9 2</td>
<td>Traditional Stove</td>
<td>2</td>
<td>Wood</td>
<td>LPG 200ml</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<td>1</td>
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<td>13 2</td>
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<tr>
<td>14</td>
<td>14 2</td>
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<td>Wood</td>
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<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>15 2</td>
<td>Three-Stone Fire</td>
<td>1</td>
<td>Wood</td>
<td>LPG 200ml</td>
<td>1</td>
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<td>-</td>
<td>3</td>
</tr>
<tr>
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<td>16 2</td>
<td>LPG Large Gas Stove</td>
<td>1</td>
<td>LPG</td>
<td>Traditional Stove</td>
<td>1</td>
<td>LPG 200ml</td>
<td>-</td>
<td>3</td>
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</tbody>
</table>

*used inside a fixed stove with chimney
Respondents purchased their most recent stove on average 15 months ago (ranging from 13 to 34 months ago).

Respondents paid an average of $3.40 for their primary stove (ranging from $0.75 to $4.25).

Respondents paid an average of $5.85 for their secondary stove (ranging from $2.5 to $10).

All respondents paid for their stove in cash for their most recent stove purchase.

Popular sales channels are markets and mobile sellers.
Primary fuel of sample group: wood (81%)
Secondary fuel of sample group: 200ml LPG canister (75%)
All firewood users in the sample group prefer firewood as primary fuel for the following reasons:

‘Can collect on her own, no need to pay’
‘Cheap price – easy to find’
‘Save money compared to LPG’

All users of LPG as a secondary fuel prefer this fuel for the following reasons:

‘cook fast’
‘use when busy’
‘easy to start fire’
‘easy to use in rainy season’
‘cook comfortable when she has visitors’
### FUELS TYPES

**-PURCHASING BEHAVIOR-**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Fuel Unit Name</th>
<th>Fuel Unit Price</th>
<th>Time spent to purchase / collect</th>
<th>Amount spent to transport</th>
<th>Duration fuel will last</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>&quot;1 Big Tree&quot;</td>
<td>$30</td>
<td>30 mins</td>
<td>$5</td>
<td>1 year</td>
</tr>
<tr>
<td>Wood</td>
<td>&quot;3 Trees&quot;</td>
<td>$30</td>
<td>2 hours</td>
<td>$0</td>
<td>180 days</td>
</tr>
<tr>
<td>Wood</td>
<td>1 Bag - 40kg</td>
<td>$0 (collected)</td>
<td>No answer</td>
<td>$0</td>
<td>10 days</td>
</tr>
<tr>
<td>Wood</td>
<td>1 Bag - 60kg</td>
<td>$19.50</td>
<td>20 mins</td>
<td>$0</td>
<td>30 days</td>
</tr>
<tr>
<td>Wood</td>
<td>4 cubic meters</td>
<td>$0 (collected)</td>
<td>2 hours</td>
<td>$0</td>
<td>1 year</td>
</tr>
<tr>
<td>Wood</td>
<td>1 Cart</td>
<td>$0 (collected)</td>
<td>20 mins</td>
<td>$1</td>
<td>90 days</td>
</tr>
<tr>
<td>Wood</td>
<td>20 bunches</td>
<td>$1.5</td>
<td>10 mins</td>
<td>$0.50</td>
<td>30 days</td>
</tr>
<tr>
<td>Wood</td>
<td>10 bunches</td>
<td>$2.5</td>
<td>30 mins</td>
<td>$0.60</td>
<td>20 days</td>
</tr>
<tr>
<td>Charcoal</td>
<td>Cart (300kg)</td>
<td>$35</td>
<td>1 hour</td>
<td>$0</td>
<td>150 days</td>
</tr>
<tr>
<td>Charcoal</td>
<td>Bag (20kg)</td>
<td>$5</td>
<td>3 mins</td>
<td>$0</td>
<td>15 days</td>
</tr>
<tr>
<td>LPG</td>
<td>Large LPG Canister (15kg)</td>
<td>$21</td>
<td>30mins</td>
<td>$0</td>
<td>30 days</td>
</tr>
<tr>
<td>LPG</td>
<td>Medium LPG Canister (4kg)</td>
<td>$6</td>
<td>10mins</td>
<td>$0</td>
<td>60 days</td>
</tr>
</tbody>
</table>

- Sample HHs obtain primary fuels in varying quantities and units of measurement
- Sample HHs appear to have greatly varying rates of consumption
8 out of 16 respondents obtain their primary fuel free-of-charge and claim to have $0 monthly fuel expenditure for their primary fuel.

The remaining 8 respondents who pay for their primary fuel have an average monthly expenditure of $9.95 (ranging from $1.5 to $33.75).

This includes 4 respondents who buy wood as a primary fuel (avg. $2.75/month), 2 respondents who buy charcoal as a primary fuel (avg. $13.94/month), and 2 respondents who buy LPG as a primary fuel (avg. $9.12/month).

Respondents who use LPG as a secondary fuel report to have an average monthly fuel expenditure of $2.10 for their secondary fuel.

Photo: 200ml LPG cans at local sundry shop.
COOKING HABITS

- Average number of meals cooked per day = 2.3
- Average number of dishes per meal = 2.4
- Average dishes per day = 6
- Average # of stove meals per day = 3.69
- Most common cooking methods = boiling; grilling; stir-fry, frying on both sides
- Average time spent cooking per meal = 40 mins (ranging from 30 mins to 90 mins)
COOKING HABITS
-PLACEMENT OF STOVE-

Is the kitchen separate from the main living area?

- Yes 75%
- No 25%

18.75% under the house
6.25% inside the main dwelling

- 4 wall structure 8%
- 3 wall structure 25%
- In the open courtyard 59%
- 2 wall structure 0%
- no walls, covering above 8%
- In the open, courtyard 59%

- 12 (75%) out of 16 kitchens in the sample are separate from the main living area

- The 12 separate kitchens are of the following types:
  - In the open courtyard (7)
  - 3-wall structure (3)
  - 4-wall structure (1)
  - No walls, covering above (1)
Traditional Kitchen in a 3-wall structure close to the main dwelling, with one window and one door.
When you are cooking, where are your children under 5?

- Not in the kitchen - in a separate building: 36%
- Not in the kitchen - but in the same building: 9%
- Near me in the kitchen: 0%
- Coming in and out of the kitchen: 46%
- Other: 9%
- On my back: 0%

- 11 out of 16 sample HHs have children under 5
- Children are present in the vicinity of the kitchen
- 100% of respondents who have children under 5 think that smoke affects their child
- All respondents think that the effect of smoke on the children is ‘cough’, ‘sore throat’, ‘watery eyes’
Does your stove produce any smoke?

- A lot: 88%
- Some: 6%
- Hardly any: 6%
- None: 0%

The majority of respondents claims that their stove produces 'a lot of smoke'
Are there any good things that come from the smoke of the stove?

- None of the respondents thinks that there are any good things that come from the smoke of the stove

Do you think that smoke from your stove is at all a problem?

- All of the respondents think that smoke from their stove is a problem
When asked how exactly they think smoke is a problem, almost all respondents name:

- Makes utensils dirty (16/16)
- Makes kitchen dirty (16/16)
- Difficulty breathing (15/16)
- Stinging eyes (14/16)
- Cough (13/16)
- Headaches (11/16)

Other ways respondents are affected by their cookstove are: ash, sparks, temperature
REASONS FOR PARTICIPATION

- All respondent were enthusiastic about their participation in this study.
- Reasons for participating all related to wanting to ‘try something new’ and learning about ‘the qualities of the new stove’.
Stove Introduction

The BioLite HomeStove™ stove is introduced in a small group setting in the study participants’ homes.
• All respondents received initial hands-on instruction for lighting and operating the BioLite HomeStove™

• In spite of detailed instruction, 6 out of 15 respondents did not fully follow the instructed procedure during the first week of their study participation

Most common variations of the instructed procedure were:
- Putting the pot on before the green light turns on (fan starts)
- Using rubber or plastic to light the fire
- Not removing ash from the combustion chamber
When asked the open-ended questions “How has it been using the stove?” and “How do you like it?”, respondents frequently stated positive aspects such as:

- ‘Easy to use’
- ‘Less smoke’
- ‘Less fuel’

However, this questions also revealed issues with stove operation: Several respondents felt that the BioLite HomeStove™ ‘cooks slower’ than their old stove.

Respondents linked this to the size of the stove, which is further illustrated on the next slide.
STOVE OPERATION

What would you change about the BioLite HomeStove™?

- None of the respondents physically modified the BioLite HomeStove™ stove to accommodate for their cooking style.
- Respondents’ suggestions for changes about the BioLite HomeStove™ all relate to size of the stove, size of the fuel opening and size of the fuel chamber.
- Particularly, a number of respondents felt that the stove is too tall – and that this creates too large of a distance between fuel chamber and pot, and as a result the ‘flame is not strong enough’.
- Respondents’ assumption is that if the stove fuel chamber/fuel opening was bigger, it could hold more fuel, and would therefore cook faster.

- NA: 18%
- Bigger chamber: 29%
- Bigger fuel opening: 29%
- Bigger USB lamp: 12%
- Shorter stove: 12%
STOVE OPERATION

- During the first week of use, several respondents felt that the stove was ‘difficult to light’.
- When this was further explored and tested by the study team, it was found that where firewood has a high moisture content – which is the normal case in Cambodia – the stove is indeed difficult to light.
- Study participants were instructed to use drier wood where available.
- The stove is likely better suited for drier, arid climates or for households that store firewood in dry places where it cannot absorb moisture.

Photo: Study participant practicing stove ignition during initial group training.
Adoption Rate & Usage Patterns

- All respondents reported they used the BioLite HomeStove™ on a daily basis, on average 2 times per day. Usage remained consistent over the 4-week study period.

- All respondents reported using their old primary stove on a daily basis, on average 1.2 times per day in the first study week, and 1.69 times per day by the end of the study.
Rural Households

- Reported use of the BioLite HomeStove™ collected via thermal data loggers (SUMS)\(^1\) showed that stoves were used on average 1.11 times per day across the first 20 days of the trial, reducing to 0.97 times per day across the following 17 day period.

- Stoves were not used every day in the two sampling periods. On the days that the stoves were used, average use was 1.66 per day and 1.61 per day respectively.

Peri-Urban Households

- SUMS data showed that stoves were used on average 0.75 times per day across the first 9 days of the trial, reducing to 0.40 times per day across the following 10 day period.

- Stoves were not used every day in the two sampling periods. On the days that the stoves were used, average use was 1.23 per day and 1.28 per day respectively.

\(^1\)SUMS: SUMS consist of thermal data loggers, and other equipment and software used to monitor stove usage.

- Thermal data loggers were placed on all stoves one week after the stoves were first introduced, and recorded data over a two month period.

- The thermal data loggers were placed on the outside surface of the stove, underneath the pot rest, right above the power pack.

- Cooking event algorithm: all temperatures more than 20° C above minimum are cooking times.
STOVE USAGE IN JUNE
-STOVE USE MONITORING SYSTEM (SUMS) -
-RURAL HOUSEHOLDS-

5/24/2014 12:00 AM to 6/12/2014 11:59 PM (5760 Samples, Sample Frequency 3 minutes)

<table>
<thead>
<tr>
<th>Household #</th>
<th>Days in Sample</th>
<th>Number of Cooking Days</th>
<th>Number of Cooking Events</th>
<th>Avg. Number of Cooking Events per Cooking Day</th>
<th>Avg. Number of Cooking Events per Days in Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
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<td><strong>17</strong></td>
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<tr>
<td><strong>SD</strong></td>
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6/14/2014 12:00 AM to 6/30/2014 11:59 PM (3497 Samples, Sample Frequency 7 minutes)

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<th>Avg. Number of Cooking Events per Cooking Day</th>
<th>Avg. Number of Cooking Events per Days in Sample</th>
</tr>
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<tbody>
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### STOVE USAGE IN JUNE

**-STOVE USE MONITORING SYSTEM (SUMS)-**

**-PERI-URBAN HOUSEHOLDS-**

6/11/2014 12:00 AM to 6/20/2014 11:59 PM (1851 Samples, Sample Frequency 7 minutes)

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<th>Avg. Number of Cooking Events per Cooking Day</th>
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6/21/2014 12:00 AM to 6/30/2014 11:59 PM (4800 Samples, Sample Frequency 3 minutes)

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<th>Avg. Number of Cooking Events per Cooking Day</th>
<th>Avg. Number of Cooking Events per Days in Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
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<td>1.67</td>
<td>0.50</td>
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<tr>
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<td>2.00</td>
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</tr>
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<td>1.20</td>
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<td>0.30</td>
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<tr>
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<td>0.10</td>
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<td><strong>1.38</strong></td>
<td><strong>0.40</strong></td>
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<td><strong>0.24</strong></td>
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</table>
Observed Differences

Study participants report noticeable reductions in smoke emissions and fuel consumption.
Respondents were asked after 1 week of using the BioLite HomeStove™ to answer freely “Do you notice anything different about your household since you started using this stove?”

Most common positive answers were:
- Creates less smoke
- Uses less fuel
- Creates less ash
- Cleaner kitchen/house

Most common negative answer was:
- Cooks slower
**OBSERVED DIFFERENCES**

**-SAMPLE OVERVIEW-**

"Do you notice anything different about your household since you started using the *BioLite HomeStove™*?" (one-week follow up)

<table>
<thead>
<tr>
<th>#</th>
<th>Observation 1</th>
<th>Observation 2</th>
<th>Observation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>healthier</td>
<td>less smoke</td>
<td>less ash</td>
</tr>
<tr>
<td>2</td>
<td>less smoke</td>
<td>less fuel</td>
<td>good flame</td>
</tr>
<tr>
<td>3</td>
<td>less smoke</td>
<td>provide electricity for charging phone and light during cooking</td>
<td>Less ash</td>
</tr>
<tr>
<td>4</td>
<td>clean house</td>
<td>less smoke</td>
<td>less ash and dust</td>
</tr>
<tr>
<td>5</td>
<td>use less fuel</td>
<td>kitchen is cleaner than before</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>less smoke</td>
<td>less fuel</td>
<td>kitchen is cleaner than before</td>
</tr>
<tr>
<td>7</td>
<td>healthier</td>
<td>no smoke and ash</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>cook slow</td>
<td>less fuel</td>
<td>the pot is dirtier than before</td>
</tr>
<tr>
<td>9</td>
<td>create less smoke</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Takes much time to push the wood into the stove</td>
<td>save wood</td>
<td>cook slow</td>
</tr>
<tr>
<td>11</td>
<td>less smoke</td>
<td>cook slow</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>create less smoke</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>cook slower than old stove</td>
<td>save more fuel than old stove</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>save fuel</td>
<td>less smoke</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>save fuel</td>
<td>save money</td>
<td>create less smoke</td>
</tr>
<tr>
<td>16</td>
<td>more smoke when start up</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Colour highlights indicate most common answers*
OBSERVED DIFFERENCES

- OBSERVED DIFFERENCES IN HH -

Do you notice anything different about your household?

- Less smoke: 34%
- Less fuel: 27%
- Clean kitchen/house: 19%
- Cook slower: 8%
- Save money: 4%
- Pot dirtier than before: 4%
- Pot cleaner than before: 4%

Observations remained positive and largely unchanged over the study period.

Most common answers were:

- Creates less smoke
- Uses less fuel
- Cleaner kitchen/house

Endline Survey
OBSERVED DIFFERENCES
-SAMPLE OVERVIEW-

“Do you notice anything different about your household since you started using the BioLite HomeStove™?” (endline survey)

<table>
<thead>
<tr>
<th>#</th>
<th>Observation 1</th>
<th>Observation 2</th>
<th>Observation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>the same as before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>less smoke</td>
<td>cleaner kitchen</td>
<td>save wood</td>
</tr>
<tr>
<td>3</td>
<td>save wood</td>
<td>slower cooking</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>less smoke</td>
<td>less fuel</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>save money from fuel</td>
<td>cleaner kitchen</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>less smoke</td>
<td>everything is cleaner than before</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>cooks slower than before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>less smoke</td>
<td>less fuel</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>the same as before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>save wood but the pot is dirty than before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>no smoke, pot cleaner than before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>this stove create less smoke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>she can save fuel, less smoke, clean kitchen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>she said new stove can produce charcoal for using with old stove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>save fuel</td>
<td>less smoke</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>less smoke</td>
<td>the house is cleaner than before</td>
<td></td>
</tr>
</tbody>
</table>

Colour highlights indicate most common answers
Cooking Methods

Respondents found the BioLite HomeStove™ suitable for making most dishes they would usually prepare.
Most respondents agreed on the same ranking of cooking methods the BioLite HomeStove™ is best suited for:

1. Boiling water
2. Making soup
3. Cooking rice
4. Frying
5. Stir-frying

- None of the respondents made any modifications to their cooking style or methods in order to use the BioLite HomeStove™
- Most respondents used the BioLite HomeStove™ for making most dishes they would have otherwise prepared on their old stove
- Most respondents agreed on the same ranking the of cooking methods the BioLite HomeStove™ is best suited for
- All respondents agreed that the stove is not suited for grilling (without additional appliances)
COOKING METHODS

If you always had an improved stove like this one, would you use it for every meal, most meals or only for specific meals?

- Every meal: 37%
- Most meals: 50%
- Only specific meals: 0%
- Other: 13%

• Most respondents state they would prepare every or most meals on the BioLite HomeStove™ if they owned one.

• However, some respondents felt that due to the observed issues with cooking speed, the stove was not suited for large pots / getting large amounts of liquids (soups) to boiling point.
In the final survey, all respondents stated that food prepared on the BioLite HomeStove™ tastes the same or better as when cooked on their own stoves.

11 out of 15 respondents (69%) consistently report throughout the study period that their pots and pans remain cleaner with the BioLite HomeStove™.
Many respondents felt that the cooking time with the BioLite HomeStove™ increased in comparison with their old primary stove. This perception changed only slightly over the course of the study period. This perception stems from several factors, incl.:

- the height of the stove which is seen as creating a too large distance between combustion chamber and pot
- the size of the combustion chamber/fuel opening which is seen as not holding enough fuel
- difficult ignition and a waiting period until fan operation starts
- the batch feeding character of the stove (requires more tending)
It should be noted that despite respondents’ perception that the BioLite HomeStove™ cooks slower than their own primary stove, this is ultimately not reflected in the time estimates provided by the respondents:

- Average reported baseline time spent cooking per meal was 40 mins (ranging from 30 mins to 90 mins)
- Average reported time spent cooking with the BioLite HomeStove™ was 41.5 mins (ranging from 20 mins to 120 mins)
- It is assumed that the initial waiting period until the fan starts; difficulties faced with ignition of the stove; and more frequent tending all add to respondents’ perception that cooking on the BioLite HomeStove™ takes longer.
Half of the respondents report that the BioLite HomeStove™ requires more attention and tending than their old primary stove.

Respondents state that this mainly relates to more frequent fuel feeding (pushing wood sticks manually in the fuel chamber) for which respondents have to stay near the stove.

Most respondents, however, state they would not be deterred by this from using the BioLite HomeStove™ regularly.
Fuel Use
94% of respondents state that the BioLite HomeStove™ uses less fuel than their own primary stove.
94% of respondents stated that the BioLite HomeStove™ uses less fuel than their own primary stove.
Smoke

94% of respondents state that the amount of smoke in their kitchen is less with the BioLite HomeStove™ compared to their own stove.
**HOUSEHOLD AIR POLLUTION**

- 15 out of 16 respondents noticed a difference in the amount of smoke in their kitchen or home.
- This observation remained unchanged over the course of the study period.
- 94% of respondents state that the amount of smoke in their kitchen or home is less than with their old primary stove.
- Respondents lauded the smoke reductions of the BioLite HomeStove™ and see it as a key benefit.
Personal Perceptions

Respondents experienced a sense of pride using the BioLite HomeStove™ and generally spoke very positive about it to others.
All respondents agreed that the stove made them more modern, admired by their family, and gave them a better standing in their community.
PERSONAL PERCEPTIONS

All respondents had talked to someone about the BioLite HomeStove™, mainly their neighbours and relatives.

Respondents most frequently talked about: the advantages/qualities of the stove (specifically: 'uses less fuel, creates less smoke, generates electricity').

What did you tell others about the BioLite HomeStove?

- Easy to use, less fuel, less smoke (40%)
- Has electricity that is easy to use for the household at countryside (40%)
- Easy to use, has power pack for charging phone (20%)
- Creates less smoke and has power pack for charging phone
- Has power pack than can convert heat to electricity, less smoke, less fuel
- Easy to use for small family, can convert heat to electricity that can charge phone and lamp

Other:

- Easy to use, less fuel, less smoke
- Has electricity that is easy to use for the household at countryside
- Has power pack than can convert heat to electricity, less smoke, less fuel
- Easy to use for small family, can convert heat to electricity that can charge phone and lamp
All respondents had talked to someone about the BioLite HomeStove™, mainly their neighbours and relatives.

Most frequently asked questions others related mainly to where the stove can be bought, how much it costs, whether it’s easy to use and what its advantages are.
PERSONAL PERCEPTIONS

When asked what kind of person would use an improved stove like the BioLite HomeStove™, respondents’ most common answers were:

- Rich person/family (5x)
- Lucky person (2x)
- Everyone can use (2x)
- Poor family (1x)

Rich person
Modern person
Smart person
Respondents think that main reasons for others – like their neighbours – to buy the BioLite HomeStove™ would be:

- Saves fuel
- Less smoke
- Has electricity
- Looks nice
- Kitchen/pots stay cleaner

Respondents think the main reasons for others not to buy the stove are ‘too expensive’, ‘cooks slower’, ‘stove is too tall’
12 out 16 study participants prefer the BioLite HomeStove™ over their own primary stove.
All study participants think that the BioLite HomeStove™ is a ‘good stove’
STOVE PREFERENCE

Study participants think the following qualities are important to have in a stove:

- Uses little fuel
- Creates less smoke
- Well manufactured
- Generates electricity
- Keeps pot/kitchen clean
- Looks nice
- Is safe

94% of respondents think that the BioLite HomeStove™ has most of these qualities.

What qualities do you think are important to have in a stove?

- Uses little fuel: 32%
- Keeps pot/kitchen clean: 15%
- Looks smart/modern: 10%
- Cooks fast: 8%
- Food tastes good: 0%
- Other: 35%

Does the BioLite HomeStove have all, most, some, few or none of these qualities?

- All: 100.00%
- Most: 0.00%
- Some: 0.00%
- Few: 0.00%
- None: 0.00%
12 out of 16 respondents prefer the BioLite HomeStove™ over their old primary stove. This preference remained unchanged over the course of the study period.
Respondents’ most stated reasons for preferring the BioLite HomeStove™ over their old primary stove were:

- Uses less fuel
- Emits less smoke
- Looks nice
- Well manufactured
- Cleaner kitchen/house

Participants’ most stated reasons for preferring the BioLite HomeStove™ over their baseline stove:
- Uses less fuel, emits less smoke, looks nice

The most frequently ‘Other reason’ stated for preferring the BioLite Stove: ‘provides electricity for mobile phone charging & light’
6 out of 16 respondents were not able to identify any dislikes about the BioLite HomeStove™ after 1 week of use.

Dislikes identified by the remaining 10 respondents were:

- ‘Takes more time to cook’
- ‘Fuel chamber too small’
- ‘Stove is too tall – not enough heat to cook’
- ‘Difficult to light’
- Cannot fit big pot’

What do you **NOT** like about the BioLite HomeStove™?
(One-week Follow-up)

- Takes more time: 25%
- Stove is too tall: 25%
- Difficult to light: 12%
- Other: 25%
- Not proper size: 13%
- Cannot fit big pot (1x)
- Fuel chamber too small (3x)
STOVE PREFERENCE

What do you **NOT** like about the BioLite HomeStove™?

(Endline Survey)

All respondents identified on average 1 dislike after 4 weeks of use

Dislikes remained largely unchained after 4 weeks:

- ‘Takes more time to cook/Needs more tending’
- ‘Stove is too tall/Not proper size’
- ‘Difficult to light’

Cannot grill
Needs more tending
OVERALL SATISFACTION

Taking all factors into account, respondents stated that they are overall satisfied with the BioLite HomeStove™.
EXPECTED IMPACT

- When asked how they think the BioLite HomeStove™ would change their every-day life, respondents most frequently stated:
  - Save money on fuel (mentioned by 11 respondents)
  - Less smoke (mentioned by 10 respondents)
  - Cleaner kitchen (mentioned by 9 respondents)
  - Less time collecting fuel (mentioned by 3 respondents)
  - Cleaner clothes (mentioned by 3 respondents)
  - Be more modern (mentioned by 2 respondents)
  - Shorter cooking time (mentioned by 2 respondents)
  - No change (mentioned by 2 respondents)
  - Save money on electricity (mentioned by 1 respondent)
COSTING & WILLINGNESS-TO-PAY

ACCS
Advanced Clean Cooking Solutions

SNV

SMART DEVELOPMENT WORKS
STOVE COST

- When assessed individually, respondents expected to pay an average retail price of USD $25 for the BioLite HomeStove™ (ranging from USD $5 to USD $55)
- 6 out of 10 respondents were willing to pay $30, 2 respondents were willing to pay $50, and 1 respondent was willing to pay up to $100
- 11 respondents claim they would be the person who would make the decision to purchase the stove
Where would you get the money to purchase a new stove?

- Half of the respondents stated that if they were to buy the stove, they would use their existing savings
- The remaining half would get the money from family members
- 7 respondents would aim to pay the stove in full all at once
- 10 respondents would be more comfortable making the purchase if they can pay for the stove in instalments
- The average desired monthly instalment size is $5.30 (ranging from $2 to $15)
Willingness-to-Pay Experiments

- All 8 respondents from the rural segment were given the choice to keep the provided sample stove (owning it free of charge as reward for their participation in the study) or to sell the stove back to SNV for USD $50 cash on the spot.

  7 out of 8 rural respondents opted to forgo the cash reward and instead kept the stove.

- All urban and peri-urban respondents were offered the sample stove at a discounted price of USD $40 (since it was now in used condition) and were offered various payment plans to pay off the amount over time.

  5* out of 8 respondents decided to buy the stove for $40 and opted for a payment plan (1 pays $6.68/month over 6 months, 4 pay $3.34/month over 12 months).

* From market segments: High income firewood peri-urban (4x); High income charcoal peri-urban (1x)
CONCLUSION

- On the basis of the data collected, it can be concluded that the BioLite HomeStove™ was well accepted and appreciated among study households.

- In particular, study participants recognised and appreciated significant reductions in smoke emissions and fuel consumption, as well as less soot on pots and pans and an overall cleaner cooking experience. Fuel buyers expect to save money with this stove.

- A drawback of the BioLite HomeStove™ in the Cambodian cooking context is that it is perceived as ‘slow cooking’. This perception stems from several factors, incl. the batch feeding character of the stove; difficult ignition; a waiting period until fan operation starts; the height of the stove which is seen as creating a too large distance between combustion chamber a pot, and the size of the combustion chamber/fuel opening which is seen as not holding enough fuel.

- These user perceptions reveal important ‘cultural expectations’ with regards to cookstoves prevalent in Cambodia. These must be sufficiently taken into account and addressed by market interventions that seek to introduce new technologies that require users to change their fuel feeding and stove tending habits.

- Despite the drawbacks, most respondents state they would not be deterred by this from using the BioLite HomeStove™ regularly. Respondents consistently rank the BioLite HomeStove™ as ‘better than their old primary stove’.

- 8 rural households were given the stove after the trial and SNV offered to buy it back for $50 on the spot if they didn’t want to keep – 7 out of 8 households kept the stove.

- 5 out of 8 of the peri-urban study participants purchased the BioLite HomeStove™ at a discounted price of $40 at the end of the trial period. Some used payment plans.
SNV Cambodia offers Consumer Acceptability Testing services to stove suppliers wishing to enter the Cambodian market.

SNV Cambodia can introduce and assess the acceptance of just stoves or stoves in combination with new fuels.

All research staff (local and international) have been trained and have applied these research methods on multiple occasions in Cambodia.

Contact us to request further information.
SNV Cambodia

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