A COST-BENEFIT ANALYSIS OF THE TRANSITION TO LPG IN HAITI

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Background

- 11 million inhabitants
- 3 out of 4 live with less than $2/day (UNDP 2012)
- 95% use mainly wood or charcoal for cooking
- 900,000 affected by HAP, 3,700 premature deaths annually (GACC 2012)
- Deforestation is a major issue
Intervention Strategy

- Sales operated through a network of 115 microfranchised retailers covering 5 of Haiti’s 10 departments.
- Range includes domestic and institutional LPG stoves, improved biomass stoves, solar lanterns and SHS.
- Best selling product: a three-burner table-top LPG stove which sells for HTG 7,320/ USD 115 (HTG 2,070 in 2004 real prices). This price includes the stove, consignment of the cylinder and accessories.
Current Scale

Sales of LPG stoves have grown rapidly and accounted for more than 60% of total sales (4,578 units) in 2017.
Key Impact Questions

- In 2016, EdM and PALMIS Enèji registered one of the first Gold Standard certified carbon finance projects delivering VERs for the transition from non-renewable biomass to LPG as a cooking fuel.

- The baseline & monitoring surveys conducted as part of the GS certification process have established that HHs transitioning to LPG reduce their GHG emissions by 8.76 tCO₂eq/year (90% CI: [6.66 ; 10.86]).

- However questions remain among investors and stakeholders about the cost of transitioning to LPG for users: the intuition is that cooking with LPG is more expensive than cooking with charcoal.
Data

- Study area: 6 municipalities of Port-au-Prince metropolitan area (urban only).
- Baseline sample of 280 households randomly selected through 3-stage cluster spatial sampling.
- Project sample of 123 households who purchased a table-top LPG stove from PALMIS Enèji.
- Fuel consumption measured with the kitchen performance test (KPT) protocol:
  - Baseline: 6 day KPT conducted with a sub-sample of 149 households in March 2014.
  - Project: 3 day KPT conducted with a sub-sample of 83 HHs in Feb. 2017.

Image credit: proyectomirador.org
Baseline Fuel Usage Pattern

In the study area, 89.3% of households use charcoal and 81.1% do so on a daily basis.

![Proportion of Urban Users and Daily Users per Cooking Fuel](chart)

- **Wood**: Users (any frequency) and Daily Users are both low, with Daily Users slightly higher than Users (any frequency).
- **Charcoal**: Users (any frequency) are high, with a slightly lower Daily Users proportion.
- **Kerosene**: Users (any frequency) and Daily Users are minimal.
- **LPG**: Users (any frequency) and Daily Users show a moderate usage.
- **Electricity**: Users (any frequency) and Daily Users are the lowest among the listed fuels.

95% CI bands are visible on the chart.
Baseline & Project Fuel Consumption Estimation

The average daily charcoal consumption decreases from 2.25 kg day\(^{-1}\) to 0.39 kg day\(^{-1}\). LPG consumption is 0.49 kg day\(^{-1}\) in the project sample.
Estimating the Annual Cost of Cooking

Price parameters:
- 6kg LPG refill: HTG 112 (Total’s price list).
- 1L of kerosene: HTG 25 (IHSI Monthly Consumer Price Index).
- Traditional charcoal stove: HTG 99 (field visits, spring 2018).
- 2-burner LPG stove (with cylinder): HTG 2071 (PALMIS Enêji’s price list).
- Single burner kerosene stove: HTG 541 (amazon.com)

All fuel prices are mean real prices for the Oct. 16-March 18 period computed with IHSI’s Consumer Price Index (base year: 2004). The total annual cost of cooking for household $h$ is computed as follows:

$$\text{TOT}_h = \sum_{f=1}^{3} E_{f,h}$$

where

$$E_{f,h} = (P_f \times C_{f,h} + A_f \times L_f) \times 365$$

$\text{TOT}_h$: Tot. annual cooking expenditure of household $h$

$E_{f,h}$: Annual expenditure of household $h$ for fuel $f$

$C_{f,h}$: Daily consumption of fuel $f$ in kg for $h$

$P_f$: Mean price of fuel $f$

$A_f$: Retail price of appliance $f$ in Mar. 18

$L_f$: Estimated lifespan of appliance $f$
Cost Comparison – Baseline vs. Project

Using the most conservative hypothesis (weight of charcoal sack = 40kg), cooking is approximately 30% cheaper in the project scenario than in the baseline scenario.
Cost Comparison – Baseline vs. Project

- The comparison of means between baseline and project households is subject to selection bias because project households aren’t randomly assigned to the project group.
- Indeed, a comparison of the mean useful energy consumption per day between baseline and project shows that project households seem to consume less energy than baseline households on average (13.9 MJ day$^{-1}$ vs 17.2 MJ day$^{-1}$).
- In order to address this issue, we conduct the same comparison of means using Ordinary Least Squares (OLS) regression and controlling for useful energy consumption as well as some household characteristics.
- The estimated savings on the annual cost of cooking fall down to HTG 977 in 2004 prices with this more robust estimation strategy (significant at the 99% level).
- This represents a 12.8% reduction in cooking expenses compared to the baseline or savings corresponding to 10 days of work paid at the minimum Haitian legal salary.
## OLS Estimation of the Reduction in Annual Cooking Expenditure

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<tr>
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<tbody>
<tr>
<td></td>
<td>Charcoal Sack 35kg</td>
<td>Charcoal Sack 40kg</td>
</tr>
<tr>
<td>Log Annual Cooking Expenditure</td>
<td>-0.237***</td>
<td>-0.137***</td>
</tr>
<tr>
<td></td>
<td>(0.0394)</td>
<td>(0.0379)</td>
</tr>
<tr>
<td>Project Household</td>
<td>0.0419***</td>
<td>0.0423***</td>
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<tr>
<td></td>
<td>(0.00401)</td>
<td>(0.00395)</td>
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<tr>
<td>Usefulness Energy Consumed</td>
<td>0.0805*</td>
<td>0.0742*</td>
</tr>
<tr>
<td></td>
<td>(0.0456)</td>
<td>(0.0440)</td>
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<tr>
<td>Log Household Size</td>
<td>0.0536</td>
<td>0.0620</td>
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<tr>
<td></td>
<td>(0.131)</td>
<td>(0.127)</td>
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<tr>
<td>Proportion of Male HH Members Aged 15-60</td>
<td>-0.205</td>
<td>-0.189</td>
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<tr>
<td></td>
<td>(0.143)</td>
<td>(0.137)</td>
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<tr>
<td>Proportion of Female HH Members Aged 15-60</td>
<td>8.033***</td>
<td>7.914***</td>
</tr>
<tr>
<td></td>
<td>(0.112)</td>
<td>(0.109)</td>
</tr>
<tr>
<td>Constant</td>
<td>8.033***</td>
<td>7.914***</td>
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<tr>
<td></td>
<td>(0.112)</td>
<td>(0.109)</td>
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<tr>
<td>Observations</td>
<td>231</td>
<td>231</td>
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<tr>
<td>R-squared</td>
<td>0.772</td>
<td>0.780</td>
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Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Conclusion

- The data collected by PALMIS Enèji as part of its Gold Standard certification process provides compelling evidence that there is an economic case for the switch to LPG as a domestic cooking fuel in the urban areas of the Port-au-Prince metropolitan area.

- Taking into account the cost of fuel consumption as well as the amortization cost of the cooking appliances, project households seem to be spending significantly less money for a given amount of useful energy than they would if they were following the baseline cooking pattern.

- The savings achieved seem to be sizable when compared to the local price of labor.

- This suggests that helping Haitian urban households to switch to LPG with specific credit offers or discounts on the price of the appliance could achieve significant economic development impacts in addition to the expected reduction in GHG and SLCP emissions.
Thank you