BERKELEY AIR
MONITORING GROUP
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*Research Brief*

# Biomass Energy Initiative for Africa: Hawthorne Effect Investigation

## Introduction

The purpose of this research brief is to present findings relevant to the Hawthorne Effect and household energy studies. The Hawthorne Effect is the phenomenon in which individuals modify their behavior in response to being observed.[1] Originally identified in workplace studies, this effect is widely recognized in social science and behavioral research, including studies on household energy use.[2,3] When applied to stove performance assessments, the Hawthorne Effect suggests that households may alter their cooking behaviors—either consciously or subconsciously—when they are being monitored.

## Background

Accurately measuring how improved cookstoves are operated in real-world household settings is critical for assessing overall adoption, as well as for understanding their true impact on fuel consumption, emission reductions, and air quality. However, the Hawthorne Effect may influence these measurements in the following ways.

- Changes in Stove Usage Patterns: Households may increase or decrease their use of the improved cookstove relative to traditional stoves when they know they are being observed, leading to an inaccurate representation of normal stove usage.
- Fuel Consumption Variability: Participants might alter cooking practices, such as reducing overall fuel use or choosing different fuels than they would under typical conditions, leading to an overestimation or underestimation of fuel savings.
- Behavioral Shifts Toward Desired Outcomes: Users may adopt "ideal" cooking behaviors that align with perceived expectations from researchers or program implementers rather than using the stove as they normally would.

The potential impacts of the Hawthorne Effect on the Kitchen Performance Test (KPT),[2,] which is used to quantify fuel use for emission reduction calculations in clean cooking carbon projects, are especially important given recent concerns over a risk of over-crediting in the sector.[3] The

KPT involves measuring household fuel consumption before and after the introduction of new cookstoves and/or fuels to determine changes in fuel use. The Hawthorne Effect poses a potential challenge for the KPT for the following reasons.

- Short-term monitoring may not reflect long-term habits: Households might temporarily modify their stove usage during the monitoring period, making it difficult to determine sustained behavioral changes.
- Overestimation of fuel savings: If participants use the improved cookstove more frequently while under observation, for example, the measured fuel reductions may be inflated compared to real-world, unmonitored conditions.

Since carbon finance programs rely on measured fuel savings to calculate emission reductions, the Hawthorne Effect has been identified as a potential factor contributing to the over-crediting of cookstoves in the cooking sector. If reported fuel savings are artificially high due to behavior changes during monitoring, the actual climate benefits of these programs may be lower than claimed.

The Hawthorne Effect on household energy studies has been minimally researched. Thomas et al.[3] looked at how stove use monitoring impacted stove use patterns --blinding half of the study participants to the stove use monitor and having it visible to the other half --and found negligible differences in improved stove use. Simons et al.[4] looked at the impact of in-person visits on stove use and found that improved stove use increased by approximately 53% compared to stove use measurements when visits were not happening. Given the limited, and somewhat conflicting data on the Hawthorne Effect, there is a need for more study. Here, we present results from the Biomass Energy Initiative for Africa (BEIA), which provide additional insight into potential Hawthorne Effects on stove use patterns.

## BEIA project overview

Funded by the World Bank and conducted in collaboration with Winrock International, the Berkeley Air Monitoring Group evaluated the cookstove component of the Biomass Energy Initiative for Africa (BEIA). The assessment covered three stove projects in Uganda (natural draft gasifier), The Gambia (natural draft gasifier), and South Africa (mass-manufactured rocket stove). BEIA activities in The Gambia did not include data collection relevant for this analysis, so those results are not included here.

The primary objective was to assess stove performance in real-world household settings, focusing on household air pollution, fuel consumption, and stove usage. The studies also gathered qualitative insights on user practices, preferences, and perceived health and livelihood impacts. Field assessments were complemented by laboratory tests of stove emissions at the United States Environmental Protection Agency and durability evaluations at Colorado State University's Engines and Energy Conversion Laboratory.

Household-level fuel efficiency was measured using the Kitchen Performance Test, and household air pollution was monitored simultaneously with small particulate matter and carbon monoxide loggers. To capture user perceptions and socioeconomic impacts, surveys assessed time savings, fuel cost reductions, health effects, and overall satisfaction. Participants also reported on stove use pattern behavior and barriers to exclusive use of the improved cookstoves.

## BEIA stove use and adoption methods

For the purposes of this report on the Hawthorne Effect, stove use is the key metric. Stove use monitors (SUMs) were deployed to objectively assess the use of the baseline and intervention stoves. This approach utilized temperature-logging sensors (iButton model DS1922T, Maxim, USA) affixed to each stove (see Figure 1) — including traditional wood, intervention, and any additional stoves present — as well as to the kitchen wall to subtract ambient temperature fluctuations.

The sensors recorded stove temperatures every 5 to 10 minutes throughout the monitoring period, which lasted between 2 to 30 weeks, depending on the project timeline. The collected temperature profiles were then analyzed to determine the frequency of cooking events. The implementation of this approach across the three projects is summarized in Table 1.

## Table 1: Direct stove use monitoring approach

| Method of Data Collection | Method Details | Location-Specific Details | Resulting Usage Information |
|---|---|---|---|
| Stove use monitoring (SUMs) | SUMs (iButtons) placed on the primary and secondary traditional stoves, and the intervention stove in a subset of homes in each location. Stove temperatures were recorded for 2-30 weeks, depending on project timeframe. | South Africa: SUMs placed on traditional stoves in 25 HH at baseline and added to the rocket stoves in follow-up phase.<br><br>Uganda: SUMs placed on traditional stoves in 24 HH and added to the gasifier stove for the follow-up phase. | Number of stove usages per day for the traditional and intervention stoves. |

**Figure 1: SUMs iButton installed on a charcoal stove in Uganda.**

## Investigation of potential Hawthorne Effects in BEIA results

This study provided a unique opportunity to examine potential Hawthorne Effects, as stove use was continuously monitored during and after multiple, relatively intensive monitoring periods. These periods included measuring household air pollution and fuel consumption (KPTs) and conducting surveys. The following sections present key findings on the impact of monitoring campaigns on stove use.

Figure 2 shows the stove use per day for the rocket, kerosene, and traditional stove over time during the SUMs monitoring campaign in South Africa (May-August 2012). The general pattern shows that the rocket stove became the primary stove after the baseline monitoring was conducted (the stove was not in homes until May 24th, 2012), averaging just over one usage event per day compared to 0.6 uses per day for the traditional stove. Uptake of the stove appeared to happen almost immediately, with little or no adjustment period, and was relatively constant for the duration of the monitoring period. After the rocket stoves were acquired, the traditional wood stoves were still used 0.3-0.8 times per day, and kerosene stoves 0.2-0.4 times per day during the monitoring period. The overall pattern, however, shows that the rocket stove was readily incorporated into the homes and used for the majority of cooking and/or heating tasks.

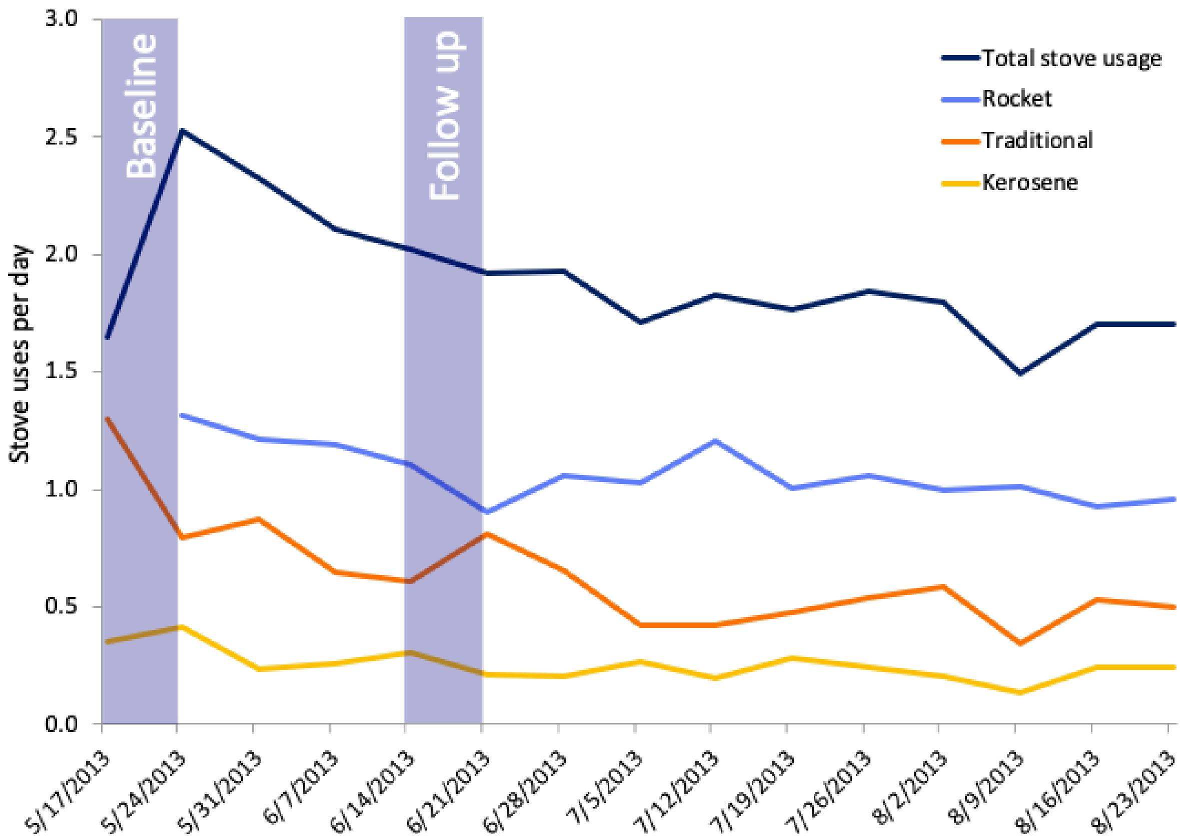


**Figure 2: Measured stove use over time for the rocket stove project in South Africa. The intensive baseline and follow-up household air pollution and fuel consumption monitoring campaigns are indicated with light blue bars.**

Figure 3 shows the number of stove uses per day for the gasifier, three-stone fire, and charcoal stoves measured over time during the SUMs monitoring campaign in Uganda. The general pattern shows that three-stone fires and charcoal stoves were the dominant stoves being used over the long term, combining for approximately 90% of the stove usage events during the campaign, with the gasifier providing the remaining 10%. Immediately following the introduction of the gasifier, an initial peak of just over 0.5 gasifier usages per day can be observed, which likely reflects users' excitement in trying the new stove. After the initial peak, the gasifier usage ranged from 0.1-0.4 usages per day for the remainder of the monitoring period, and it did not vary substantially until the rainy period at the end of May, during which gasifier usage stopped due to the high moisture content of available wood fuel. The range of gasifier usage for individual homes averaged 0.02 to 0.8 usages per day when averaged over the course of the monitoring period.

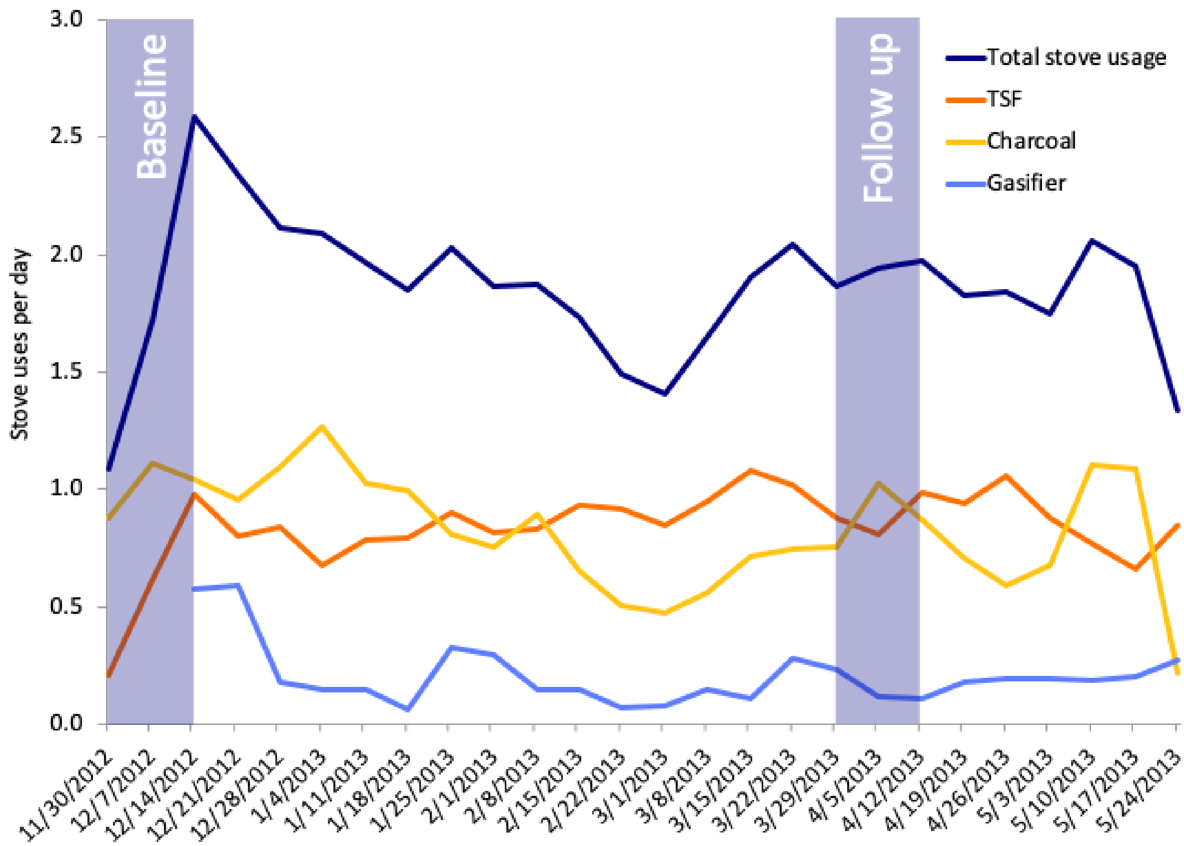


**Figure 3: Measured stove use over time for the gasifier project in Uganda. The baseline and follow-up household air pollution and fuel consumption monitoring campaigns are indicated with light blue bars.**

## Conclusion

No discernible difference in stove use rates was observed in the two studies where stove use data were available for comparison between high-intensity monitoring (KPT, HAP, and surveys) and SUMs-only monitoring. This consistency was true for both high-utilization and low-utilization scenarios. If any trend emerged, it was that the new stoves were used slightly less during the high-intensity follow-up monitoring periods compared to non-intensive SUMs-only monitoring. This pattern contradicts what would typically be expected if social desirability bias were influencing behavior.

The absence of a clear Hawthorne Effect in these studies does not negate findings from other research, such as Simons et al.[2], but rather suggests that factors beyond study personnel visits may influence cooking behaviors. Cultural dynamics, stove technology, fuel availability, food availability, the independence of the monitoring team, and the nature of participant interactions with researchers could all play a role in shaping stove use during intensive monitoring periods.

Despite these findings, our understanding of these effects remains limited, and drawing strong conclusions — whether confirming or dismissing the Hawthorne Effect — would be premature. Further research is needed, particularly in the context of carbon projects, where stove use monitoring and KPTs provide valuable opportunities to compare stove use behaviors during and after fuel measurement periods.

## References


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