

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Implementation Plan & Milestone #2 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development (USAID)
Development Innovation Ventures**

July 2012



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
CBO	Community Based Organization
EFRDN	El Fasher Rural Development Network
ELF	El Fasher, Sudan
IC	Impact Carbon
IDP	Internally Displaced Person
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLT	Slow Life Trust
UMCOR	United Methodist Committee on Relief
VGS	Voluntary Gold Standard

INDICATOR DASHBOARD

	May 15, 2012	July 31, 2012
Total population with access to FES in targeted communities in Darfur (stoves distributed x avg. hh size of 6)	121,656	134,856
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A
Geographical Distribution of FES in Darfur	(See next table)	(See next table)
Geographical Distribution of FES in Ethiopia	N/A	N/A
Number of women with access to FES in Darfur (stoves distributed)	20,276	22,476
Number of women with access to FES in Ethiopia	N/A	N/A
CO2 Equivalent mitigated (tons) by using FES instead of traditional methods	78,063 revised to 41,298**	56,868
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Darfur	90%*	90%*
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A

Notes:

*Results reported are based on impact assessment survey conducted with 180 stove users in 2010. We continue to interview samples of stove recipients but have only analyzed baseline data. We did not interview every stove recipient/purchaser.

**Methodology revised to show estimated CO2 not emitted to date by stoves in the field (formerly counted total expected emissions reductions of stoves distributed over their 5-year lifetime). Assumes 96% adoption rate in year 1 and 10% annual attrition in years 2-5, with use completely ceasing after year 5.

Table 1: Geographic Distribution of FES in Darfur

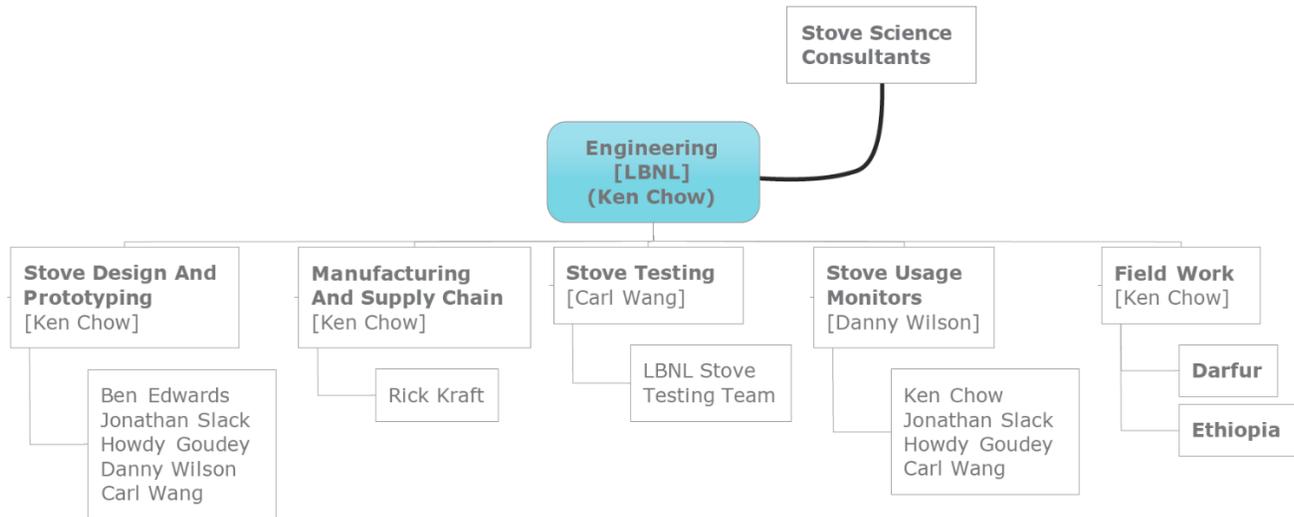
(New stoves distributed since last milestone report are highlighted in orange).

Batch	Region	Location	#	Distributed by	Version	Year
CHF	South	Otash	206	CHF	5	2007-9
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CHF	South	Yara	46	CHF	5	2007-9
CHF	South	Gussa	10	CHF	5	2007-9
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4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011
4500	North	Emergency	360	OA	14	2011
4500	North	Al Salaam	1000	OA	14	2011
1500	North	ZamZam	1500	Plan	14	2011
2200	North	ZamZam	2200	Plan	14	2012
Total Stoves Distributed			22,476			

MILESTONE UPDATES: July 31, 2012

1. Recruit Mechanical Engineering Postdoc

We have finalized the LBNL project engineering team. After interviewing different individuals and careful consideration of the project tasks at hand, we decided to assemble a team comprised of several individuals contributing their expertise on a part-time basis rather than one postdoc working full-time. An organizational chart for the engineering team is shown below:



The team is currently comprised of the following members:

- Ken Chow serves as the project manager and provides overall guidance and coordination for the engineering work.
- Carl (Yungang) Wang is head of the LBNL Cookstoves Laboratory. For this project he oversees all laboratory stove testing work, including testing of cool-to-touch prototypes, stove usage monitor holders, and Ethiopia stoves.
- Rick Kraft is in charge of the main fabrication shops at LBNL. For this project he is providing expertise in manufacturing.
- Danny Wilson is a PhD candidate at UC Berkeley. He is leading engineering efforts for the stove usage monitors and participates in stove design and prototyping.
- Jonathan Slack is a senior engineer at LBNL and is supporting stove design and prototyping and mounting designs for stove usage monitors.
- Howdy Goudey is in charge of the LBNL energy efficient windows shop. He is lending his design and engineering skills to this project and our project is using his shop space for prototyping.
- Ben Edwards is an engineering summer student assisting in developing computer 3D models of stoves and associated hardware.

Other team members may join the team as the project progresses. The engineering team consults with senior cookstove scientists as needed.

2. Prototype and test galvanized stove model

Our development progress on the cool-to-touch stove (see next section) combined with the risk of producing zinc fumes when using galvanized steel in cookstoves has led us to postpone work on prototyping and testing a galvanized stove model. The potential appeal of using galvanized sheet metal for the stoves is in its ability to maintain an attractive appearance even after repeated uses. We are now aiming to incorporate long-term attractiveness as a feature in our cool-to-touch designs. We believe such an approach will lead to greater improvements with minimum cost increase. We will resume development of a galvanized stove if it appears to be an attractive option in the future.

3. Prototype stove model that does not get hot to the touch (Darfur)

We have defined design criteria and requirements for adding or modifying the Berkeley Darfur Stove to be cool to touch, and have three different designs in a conceptual stage of development. Two of the designs incorporate the ability to customize or vary the external appearance, either with different colors, patterns, or materials. We have performed standard stove safety testing on the current Berkeley Darfur Stove (following Safety Guidelines and Testing protocol from the Partnership for Clean Indoor Air), and will be including additional modifications to the stove to maximize the stove's safety rating. With a low external surface temperature, many more material and surface finishing options can be made available in a cool-to-touch Berkeley Darfur Stove. We will be prototyping the most promising Cool Stove design option after further conceptual development and rating the design concepts against our design criteria.

4. Train WDAs in Savings & Fuel-Efficient Stove Use

Training women in proper use of fuel-efficient Berkeley-Darfur Stoves is ongoing. Each time we distribute a stove (and we have distributed 2,200 since our last report) the recipient participates in a training on proper use, which includes a live demonstration.

We are obtaining buy-in from the Oxfam America Sudan country director to implement a pilot project of Oxfam's renowned Saving for Change program in Darfur IDP camps. The Director of Saving for Change is writing a concept note to secure funding for the pilot and continuing to engage the Country Director in planning discussions. We hope to collaborate with Oxfam on this pilot in 2013.

For marketing trial update, please see last report (May 2012). We are still in the process of analyzing the customer satisfaction surveys from the trial.

5. Obtain Voluntary Gold Standard Certification (Darfur)

We achieved the first major milestone in obtaining Gold Standard certification through the voluntary carbon market, namely conducting a local stakeholder consultation (LSC). The LSC is a meeting that is held with the local community to inform stakeholders about the carbon finance project and give them the opportunity to discuss the impact the project will have on them. The goal is to improve project design based on stakeholder comments and increase the local ownership of the project. Potential Energy's local implementing partner, Sustainable Action Group held the LSC on June 2, 2012. There were 67 attendees representing local community based organizations, NGOs, and interested members of the public. The participants all had positive comments about the project and expressed a desire for more stoves to be available. The draft report of the consultation was submitted to the Gold Standard for feedback and will be shared with all participants once we have received Gold Standard's feedback.

In parallel to the LSC, we have been working on the Project Design Documentation (PDD). The PDD is the primary means to communicate about our emission reductions for validation and registration purposes. We aim to submit a draft of the PDD to the Gold Standard by the end of September 2012.

Finally, we are preparing to conduct baseline studies in three areas (one rural, one urban, and one in IDP camps). The surveys will measure, among other things, the amount of firewood consumed per day by Darfuri families in each of the areas. Per Gold Standard requirements, we plan to conduct 100 surveys and 40 Kitchen Performance Tests in each of the three areas (for a total of 300 respondents to the survey and 120 participants in the Kitchen Performance Tests).

Once the baseline studies are complete, and the PDD has been submitted and reviewed by the Gold Standard, the next step will be to engage an independent auditor to review and validate the project. We are targeting October/November for the auditor's visit to Sudan.

6. Coordinate Stove Production, Assembly, Distribution

Since our last milestone report in May, we have distributed 2,200 cookstoves via our partner, Plan Canada. As shown in the table above, these cookstoves were distributed in Zam Zam IDP camp.

This brings the total number of Berkeley-Darfur Stoves distributed to date to 22,476. In addition, we placed an order for 10,000 flat-kits to be produced by our manufacturer in Mumbai. We hope these kits will be ready to ship to Sudan in September, and all will be distributed by the end of 2012.

7. Field trip: Market research & partner outreach (Ethiopia)

Complete (See last milestone report).

8. Field trip: Manufacturing Feasibility Study (Ethiopia)

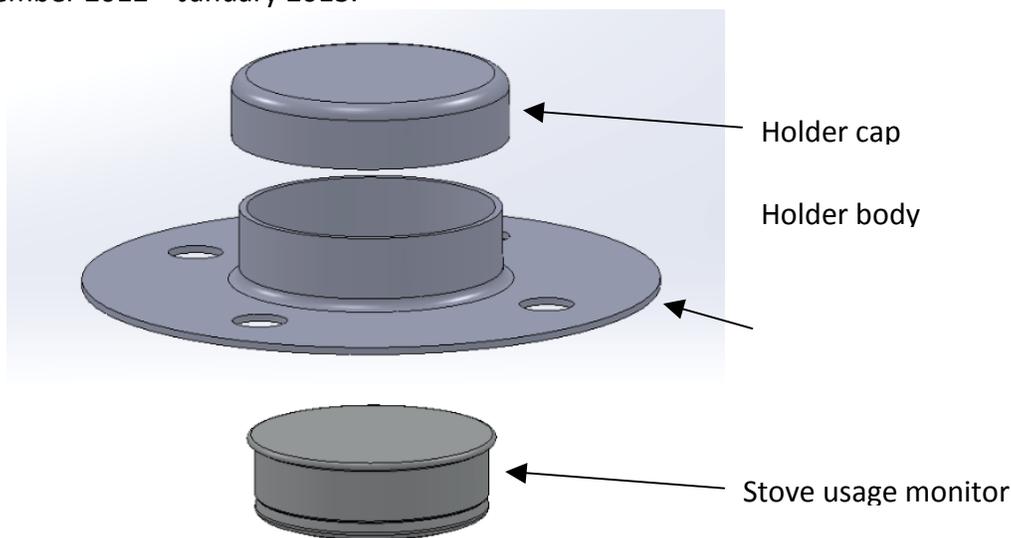
As described in the last milestone report, Potential Energy's Associate Director, Debra Stein, conducted an initial mission to Ethiopia in the fall of 2011 to conduct partnership outreach. The trip yielded a partnership with the Dutch NGO, SNV. Debra is in Ethiopia again at the time of this writing. The purpose of this trip is to visit with prospective manufacturing partners and to follow up on an initial 20 Berkeley-Ethiopia Stoves that were distributed by our R&D partner, LBNL, and World Vision in 2010. We decided to follow up on these stoves before ordering more from India for a pilot test this fall, so that we can already obtain some feedback from users and modify design or distribution plans before we launch the new pilot. LBNL Engineer, Ken Chow is planning to visit Ethiopia in October to follow-up with the manufacturing leads Debra has found during this trip. This will keep us on schedule for devising a go-to-market plan over the next year and scaling plan in year 3.

Milestone Updates – Ahead of Schedule

Conduct Randomized Controlled Trial

Stove Use Monitors

LBNL has designed a simple mount for attaching stove usage monitors (SUMs) to the Berkeley Darfur Stove. The holders protect the sensors in the field, provide a reliable thermal contact to the stove, and enable error-free field installation. Next steps are to prototype a handful of units for laboratory testing. Field data collection parameters for the SUMs are being developed in parallel to design and testing of the SUM holders. The figure below shows the current SUM holder design. We are now testing this holder and the SUMs in the lab to ensure they can withstand the high temperatures of the stove. We are also beginning to focus on experimental design, in partnership with CEGA (see below). We hope to deploy the first SUMs in December 2012 – January 2013.



Recruitment of CEGA Researcher

We have recruited a lead researcher via the Center for Effective Global Action (CEGA) for the randomized controlled trials we plan to conduct in 2013. Angeli Kirk is a PhD candidate in Agricultural and Resource Economics at University of California, Berkeley. Angeli has published a number of studies on the effectiveness of aid projects, notably one on technology adoption by adolescent girls and one on the Saving for Change program that Oxfam is considering piloting with our stove users in Darfur. Angeli has worked with Innovations for Poverty Action and the World Bank. Angeli's full CV is included as an appendix.

Appendix I: Angeli Kirk CV

ANGELI KIRK

2249 Bonar St Apt F ~ Berkeley CA 94702 ~ 202-486-9607 ~ angeli.kirk@berkeley.edu

EDUCATION

- PhD (exp 2015) Agricultural and Resource Economics, University of California at Berkeley
- MA (2006) International Development, American University, Washington, DC.
Concentration in Economic Evaluation and Analysis. GPA: 3.94
Master thesis: "Do conditional cash transfers impact time allocation for children and women? Evidence from PRAF II in Honduras." Supervisors: Paul Winters and Deborah Brautigam
- BA (2002) Spanish; Berry College, Mount Berry, Georgia
Minors in Biology, International Studies. GPA: 3.97
Study abroad: Center for Cross-Cultural Studies, Seville, Spain. Spring 2001
Study abroad: Estúdio Sampere, Cuenca, Ecuador. Summer 2002

RESEARCH INTERESTS

Economic development and poverty reduction, technology adoption, agricultural innovation and sustainability, agricultural policy, health and nutrition, HIV/AIDS, behavioral economics, impact evaluation

PUBLICATIONS AND WORKING PAPERS

"Non-Traditional Crops, Traditional Constraints: Long-Term Welfare Impacts of Export Crops among Guatemalan Smallholders," (2011), with Gero Carletto and Talip Kilic. *Agricultural Economics* 42(2011), supplement 61-75. Recipient of the "Best Paper in *Agricultural Economics*" award for 2011.

"Non-Traditional Crops, Traditional Constraints: The Adoption and Diffusion of Export Crops among Guatemalan Smallholders," (2010), with Gero Carletto, Benjamin Davis, and Paul Winters. *World Development* 38(6): 814-827.

"Making Smart Policy: Using Impact Evaluation for Policymaking," (2009), with Michael Bamberger. World Bank Doing Impact Evaluation Series #13.

COMMISSIONED PAPERS

"From Analysis to Action: Adolescent Girls and Agricultural Technology Adoption," (2011), with Daley Kutzman, Alain de Janvry, and Elisabeth Sadoulet. Commissioned draft for the Nike Foundation, July 8.

PROFESSIONAL EXPERIENCE (PAST 8 YEARS)

University of California at Berkeley, Berkeley, CA
Graduate Student Researcher (2010-present).

Kenya Life Panel Survey Round 3 Tracking Project, Busia, Kenya (5/2012 – 8/2012)
Supervisor: Ted Miguel

- Data quality systems and analysis, pre-analysis plan for vocational education intervention study

Adolescent Girls and Agricultural Technology Adoption Study, Berkeley, CA (12/2010 – 7/2011)
Supervisors: Alain de Janvry and Elisabeth Sadoulet

- Co-authored white paper on adolescent girls and technology adoption for the Nike Foundation
- Presented findings at the AAEA annual meeting in Pittsburgh and brownbag lunch at IFPRI in DC

Innovations for Poverty Action, Yale University, New Haven, CT

Research Assistant (9/2009 – 6/2010). Supervisors: Chris Blattman, Bram Thuysbaert, Dean Karlan

Ex-combatant reintegration and agricultural training program in Liberia, 2000 individuals

- Power calculations, baseline analysis, data management

Urban Youth cash grants and counseling program experiment in Liberia

- Project, questionnaire, and behavioral games design
- In-country survey pretesting, neighborhood mapping (Monrovia)

Oxfam Savings for Change program in Mali, 6000 households

- Data cleaning and analysis, preparation for presentation
- Baseline analysis, income and consumption aggregates using household and village data

Mumuadu Rural Bank crop price indemnity loan pilot in Ghana, 200 farmers

- Data cleaning, descriptive statistics, analysis, preparation for paper and presentations

World Bank, Development Economics (DEC) Research Group

Research Consultant (2006 - 2009)

Home-based HIV Counseling and Testing (HCT) Study, Western Kenya (2/2009 - 8/2009)

Supervisor: Markus Goldstein

- Management of baseline data collection for impact evaluation of AMPATH's HCT intervention in the Burnt Forest region and Teso District in western Kenya for 3,000 households
- Substantial contribution to survey instrument design
- Liaison/mediation between survey firm and host organization
- Enumerator recruitment and training, quality control, logistical oversight
- Coordinated efforts to incorporate economic measures into the host organization's clinical forms, to monitor changes in client base and in client welfare
- Oversaw preparations to link survey data to administrative data collected as part of the intervention and in regional clinics

Marriage Transitions in Malawi Study, Salima, Malawi (7/2008 - 10/2008, 7/2009)

Supervisors: Kathleen Beegle and Michelle Poulin

- Managed data collection for longitudinal of study on marriage, socioeconomic status, and HIV for 1,200 core adolescent respondents and their households
- Home-based HIV counseling and testing component for 660 respondents and spouses
- Data quality control for community, market, and health facility surveys
- Strategic tracking of respondents who relocated throughout Malawi
- CSPro data entry applications and conversion and checks in Stata

Schooling, Income, and HIV/AIDS Risk (SIHR) Study, Zomba, Malawi (10/2008, 6/2009)

Supervisors: Berk Ozler and Sarah Baird

- Assistance in baseline survey field preparations and survey design for impact evaluation of conditional cash transfer program for secondary school girls living around Zomba, Malawi

- Managed field preparations for follow-up survey that added testing for sexually-transmitted infections
- Substantial contribution to survey instrument design and management
- Trained testing counselor-enumerators and supervisors

Food and Agriculture Organization (FAO) and World Bank DEC Research Group, Washington, DC
Research Consultant (5/2006 - 6/2007, 1/2009 - 2/2009). Supervisors: Gero Carletto and Paul Winters

- Econometric analysis on adoption, sustainability, and welfare impacts of non-traditional cash crops
- Data cleaning of FAO/Nutritional Institute of Central America and Panama (INCAP) panel dataset for Guatemala, 1985 and 2005

World Bank, Poverty Reduction and Economic Management (PREM) Group, Washington, DC
Research Consultant (12/2005 - 1/2009). Supervisors: Markus Goldstein and Emmanuel Skoufias

- Conducted critical review of impact evaluations for the Impact Evaluation Database
- Provided technical assistance in impact evaluation planning clinics for operations
- Edited for Doing Impact Evaluation Series and other impact evaluation knowledge products
- Conducted research on labor market segmentation for the Jobs/Migration clusters
- Wrote and edited briefs for upper management and other “corporate” tasks
- Organized 350 person conference “Making Smart Policy: Using Impact Evaluation for Policymaking”

The American University, School for International Service, Washington, DC
Research Assistant (9/2004 - 5/2006). Supervisor: Robin Broad

- Globalization and social responsibility project research and publication support

TEACHING EXPERIENCE

Pwof Ansanm (NGO for teacher development), Jérémie, Haiti
Trainer, Evaluation Assistant (5/2005 - 9/2005)

Berry College Spanish Department, Rome, Georgia
Teaching Assistant (9/2001 - 5/2002)

Floyd County School System, Rome, Georgia
Adult Education English Teacher (1/2002 - 5/2002)

Cobb County School System, Marietta, Georgia
After School Program Spanish Teacher, Blackwell Elementary (5/2000 - 6/2000, 9/2003 - 6/2004)
Interpreter (9/2003 – 6/2004)

HONORS AND AWARDS

National Science Foundation Graduate Research Fellow, 2010-2013

“Best Paper in Agricultural Economics”, 2011

Presidential Management Fellowship Competition Finalist, 2006

American University Merit Scholarship, 2004-2006

“Heart of Berry” Service Award, 2002

Omega Delta Kappa- Service and Leadership Honor Society, 2001

Sigma Delta Pi Spanish Honor Society, 2002

Sigma Delta Pi Spanish Honor Society Scholarship, 2002

Larry Green Memorial Service Scholarship, 2000-2002

Alpha Chi Academic Honor Society, 2000
Berry College Presidential Scholar, 1998-2002
Georgia Governor's Scholar, 1998-2002

LANGUAGES AND INTERNATIONAL EXPERIENCE

Spanish: highly proficient; French and Haitian Creole: working knowledge; German and Swahili: basic
In-country professional experience: Liberia, Kenya, Malawi, Haiti

COMPUTER SKILLS

STATA, SPSS, CPro, Pendragon, LaTeX, Microsoft Office

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Implementation Plan & Milestone #3 Report

USAID Grant No. AID-OAA-G-12-00012

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Total Stoves Distributed			22,476			

MILESTONE UPDATES: October 30, 2012

1. Prototype and test galvanized iron stove model (Darfur)

As described in our previous Milestone Report, we are now incorporating long-term attractiveness as a feature in our cool-to-touch designs (see update #2, below). We believe such an approach will lead to greater improvements with minimum cost increase.

2. Prototype stove model that does not get hot to the touch (Darfur)

We converged on a Cool-to-Touch stove concept and have fabricated a laboratory prototype for testing purposes. The Cool Touch stove has a perforated metal shield around the stove body and eliminates the need for stove feet. Stove handles can be simplified as well and are attached directly to the mesh exterior. Laboratory testing is in progress and indicates that most of the exterior remains below 60 degrees C during normal stove usage. We are currently developing and testing design modifications to reduce the temperature of one remaining hot spot. We have shared our Cool-to-Touch design with our manufacturer and will be working with our manufacturer to modify the design for easy manufacturing and to reduce manufacturing cost.



Figure 1: Laboratory test prototype of mesh Cool Stove

3. Marketing Trial (Phase I) – Contracts with 300 stoves (Darfur)

Completed ahead of schedule. See Milestone Report 1 (May 2012) for summary.

4. Evaluate marketing trial (Darfur)

We have drafted a marketing trial report, including a section on Lessons Learned for internal use and future planning. We are submitting a draft (for internal use only) of this report with this Milestone Report.

5. Obtain Voluntary Gold Standard Certification (Darfur)

As described in our previous Milestone Report, we plan to conduct baseline studies in three areas (one rural, one urban, and one in IDP camps) for the purposes of obtaining Gold Standard Certification. The surveys will measure, among other things, the amount of firewood consumed per day by Darfuri families in each of the areas. Unfortunately, due to difficulty obtaining visas to travel to Sudan, the baseline surveys for the Gold Standard certification have been delayed. We are hopeful that the visas will be approved in time for our staff and partners from Impact Carbon to travel to Sudan in December. The team will train local enumerators on conducting the surveys, including the more technical Kitchen Performance Tests (KPTs).

Once the baseline studies are complete, and the Project Design Document (PDD) has been submitted and reviewed by the Gold Standard, the next step will be to engage an independent auditor to review and validate the project. While we had been targeting October/November for the auditor's visit to Sudan, we are now looking at early 2013. We are also working with our partner, Impact Carbon, to obtain permission from the Gold Standard to have the audit conducted by an Objective Observer that is already in Sudan. We are also coordinating with the two other stove projects in Darfur that are seeking Gold Standard Certification (Practical Action and UN World Food Program) to see if we can share some of the survey and monitoring costs and share best practices.

6. Coordinate Stove Production, Assembly, Distribution (Darfur)

The total number of Berkeley-Darfur Stoves distributed to date to 22,476. We have manufactured 10,000 more flat-kits since our last report in July, and these arrived at Port Sudan this month. They are currently being processed through Sudan customs, after which they will be trucked to Darfur and assembled in the BDS workshop. We have already received permission from the Government of Sudan to sell 5,000 of these stoves, so these will constitute Phase II of our marketing trial in Darfur.

7. Field trip: Manufacturing Feasibility Study (Ethiopia)

In September, LBNL's Principal Investigator, Ken Chow, visited Ethiopian artisan stove producers, small metal manufacturing shops, and large government-run manufacturing factories to assess in-country cook stove manufacturing options. Ken also interviewed candidates for in-country engineering support. Several options are available for sheetmetal and machined metal stove parts, ranging from large government operated manufacturing plants to smaller private metal fabricators. For cast iron the only option we found are large government-operated foundries. Small artisan stove fabricators are already producing stoves that are sold on the open market, but as is typical with artisan and craft products, the product

is inconsistent and fabrication techniques are labor-intensive with minimal fabrication tooling. We discussed the possibility of engaging with artisan producers for assembly of stoves using kits that are uniformly fabricated in metal manufacturing facilities.

Ken determined that a modified Berkeley-Darfur Stove does not appear to be an optimal fit as a locally manufactured stove for peri-urban regions in Ethiopia. LBNL will begin design and development of a new Berkeley-Ethiopia stove for pot cooking. We are aiming for a high-quality stove at a price point slightly higher than artisan-produced wood burning stoves current on the market.

8. Feasibility Report & Business Plan (Ethiopia)

Associate Director, Debra Stein spent 2.5 weeks in Ethiopia in October working with PE's partner, SNV to plan for the stove marketing trial. Debra and SNV's Renewable Energy Advisor completed an action plan for 2012-2013 that details the activities required to implement the marketing trial in early 2013, as soon as the new Berkeley-Ethiopia Stove prototype is complete (Please see Appendix I for details). This action plan is central to the success of the marketing trial and required discussing specific tasks, responsibilities and clarified roles within PE's partnership with SNV. Its development included determining the criteria for selecting appropriate sites for the marketing trial, communication with the Ministry of Water and Energy to ensure government approval of the project and a timeframe for stove R&D. Included in the action plan is a feasibility report, produced by SNV ensuring that their recommended marketing trial sites meet the determined criteria (i.e. firewood as main fuel source, connection to women's groups, buy-in from local government, etc.) A business plan will be completed in parallel with the marketing trial, as details such as local manufacturing and distribution networks are finalized.

UPCOMING MILESTONES

1. Conduct Randomized-Controlled Trial

We have fabricated 20 prototype holders for the stove usage monitors (SUMs) and have begun laboratory testing. Preliminary test results indicate the holders function as designed, provide good thermal contact to the stove, and are straightforward to install. We will be conducting further tests to determine reliability of the holders and its performance under adverse conditions. We have developed data collection parameters to enable field measurement of stove usage frequency, length of cooking time, and cooking type. The SUMs will incorporate different frequencies of measurement in order to fully capture the data of interest.

We are in the process of preparing an advance draft of the randomization level, statistical power, and overall strategy that we plan to pursue, and will share this with USAID DIV.

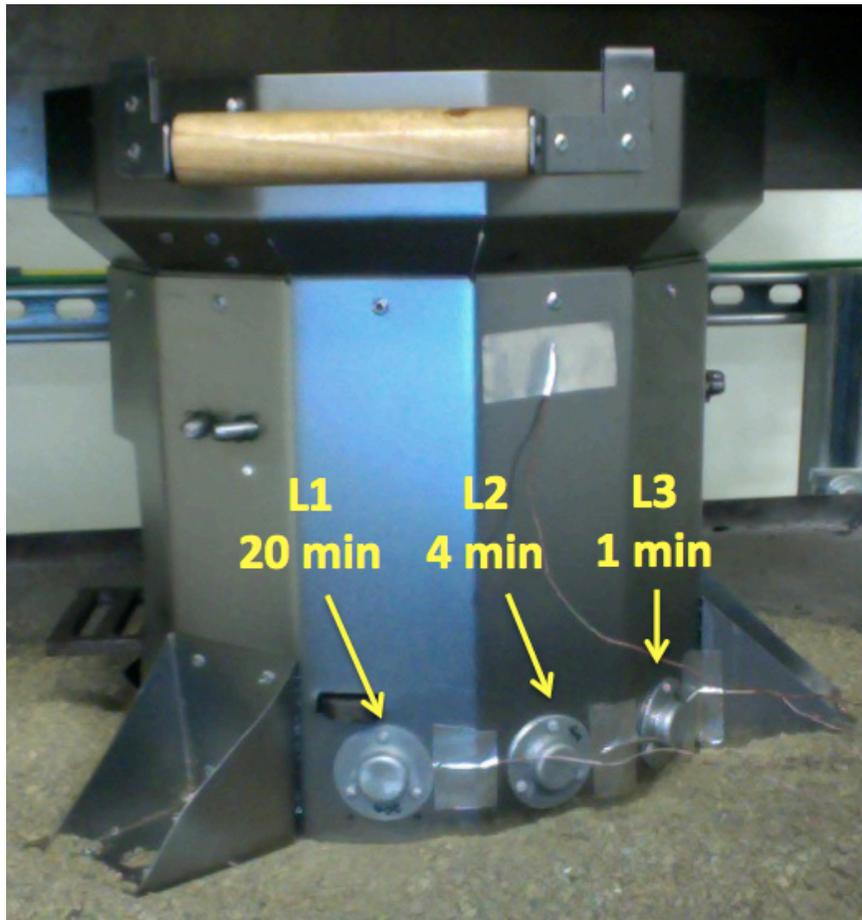


Figure 2: Berkeley-Darfur Stove with test SUMs and instrumented with thermocouples

Appendix I: Action Plan – Ethiopia Market Trial

Background

This Action Plan is prepared between Potential Energy (PE), located in Berkeley, California, USA and SNV Netherlands Development Organisation (SNV), located in Addis Ababa, Ethiopia. PE's technical partner, the Lawrence Berkeley National Laboratory, will be responsible for the design of a clean cookstove suited for Ethiopian cooking practices called the **Berkeley-Ethiopia Stove**. SNV has gained considerable experience with the design, development, set-up and implementation of a national biogas program in Ethiopia, is able to draw on its local presence, and is committed to making this presence and experience available for the preparation and implementation of similar initiatives aiming at addressing the renewable energy sector in Ethiopia. PE has gained considerable experience with clean cookstoves, having managed a similar project in the Darfur region of Sudan since 2007. Specific expertise includes: supply chain development; provision of manufacturing expertise and quality control; assembly and manufacturing shop set-up and training; technical assistance and training of trainers on conducting stove demonstrations and user education; quality assurance, survey methodology; and monitoring and evaluation training.

SNV and PE have developed this action plan to disseminate 1,000 Berkeley-Ethiopia Stoves with the endorsement of the Government of Ethiopia's Ministry of Water & Energy (MoWE). This Action Plan coincides with the one year Teaming Agreement (TA) between SNV and PE to conduct a market trial for the Berkeley-Ethiopia Stove. PE (in collaboration with PE's partner, the Lawrence Berkeley National Laboratory) will develop an appropriate stove and the stove will be tested with the cooperation of the MoWE. SNV and PE provide relevant capacity development and backstopping to support and carry out this stove testing. The marketing trial will take place in Addis Ababa and surrounding areas as well as the Nazareth/Adama area. Stove manufacturing will take place at a private workshop in Ethiopia following the release of a manufacturing Call for Proposals (CfP) by SNV and PE.

Overall objectives

- *To develop a new stove design which fits the needs of Ethiopian cooking practices*
- *To develop a market for the Berkeley-Ethiopia Stove*
- *To undertake a market trial for the dissemination of the Berkeley-Ethiopia Stove*
- *To improve resilience of (peri-urban) livelihood systems: Increased artisan level employment and income, cookstove sales and promotion opportunities for women, improved quality of life for households, reduced strain on natural resources/environment.*
- *To accelerate and sustain access to quality services for Berkeley-Ethiopia Stove construction, operation, application and after-sales services*
- *To demonstrate the impact of using the Berkeley-Ethiopia Stove on mitigating climate change by reducing harmful emissions resulting from burning biomass for cooking.*

Specific objectives

- *Performance testing of the Berkeley-Ethiopia Stove according to international standards*
- *Development of technical and promotional manuals*
- *Support activities to develop the market for the Berkeley-Ethiopia Stove*
- *Creating employment opportunities*
- *Improved quality of life for peri-urban households*
- *Identify and develop programme modalities that will lead to up-scaling and create opportunities for partnership and resource mobilization*

Action plan

s/n	What /activities	Who/responsible	When	Remarks
1	Stove Development	PE		
	<p>A. Berkeley-Ethiopia Stove 0.0</p> <p>1.1/ Finish design phase 1.2/ Finish prototyping phase 1.3/ Finish lab testing phase 1.3.1/ Facilitate linkage with stakeholders 1.4/ Finish getting manufacturing input 1.4.1/ Facilitate linkage with stakeholders</p> <p>B. Berkeley-Ethiopia Stove 1.0 (1st generation stove)</p> <p>1.1/ Finish design phase 1.2/ Finish prototyping phase 1.3/ Finish lab testing phase 1.3.1/ Facilitate linkage with stakeholders 1.4/ Finish getting manufacturing input 1.4.1/ Facilitate linkage with stakeholders</p>	<p>A.</p> <p>1.1/ PE (LBNL) 1.2/ PE (LBNL) 1.3/ PE (LBNL) 1.3.1/ SNV 1.4/ PE (LBNL) 1.4.1/ SNV</p> <p>B.</p> <p>1.1/ PE (LBNL) 1.2/ PE (LBNL) 1.3/ PE (LBNL)/SNV 1.3.1/ SNV 1.4/ PE (LBNL)/SNV 1.4.1/ SNV</p>	<p>A:</p> <p>1.1/ 16 Nov 2012 1.2/ 30 Nov 2012 1.3/ 21 Dec 2012 1.4/ 21 Dec 2012</p> <p>B:</p> <p>1.1/ 18 Jan 2013 1.2/ 1 Feb 2013 1.3/ 1 Mar 2013 1.4/ 15 Mar 2013</p>	<p>The initial plan was to modify the <i>Berkeley-Darfur Stove</i> to meet Ethiopian cooking conditions. Following LBNL engineer, Ken Chow visit to Ethiopia, a new stove design was proposed. The redesign of the stove is currently in progress.</p> <p>The majority of the stove design and development will take place at the Lawrence Berkeley National Laboratory (LBNL), Berkeley, California, USA. SNV will facilitate the production of the stove prototype, which will be manufactured in Ethiopia.</p>
2	Stove Performance Testing	PE/SNV		
	<p>2.1/ Formulation of team with regional representatives 2.2/ Draft and finalize a sound testing protocol 2.2.1/ SNV consults PE for input on testing protocol before submitting to MoWE 2.2.2/ PE will finalize protocol 2.3/ Take a representative sample of households in Addis Ababa and Oromiya Regional State with monitoring by MoWE 2.4/ Pre-test instruments, sharing and documenting findings 2.5/ Implement and supervise data collection 2.6/ Analyse data, preparing agreed upon tables and analyses. 2.7/ Summarize findings 2.8/ Preparation of testing report to share with stakeholders 2.9/ Share findings and present project update to MoWE</p>	<p>2.1/ SNV 2.2/ PE(LBNL)/SNV 2.2.1/ SNV 2.2.2/ PE 2.3/ SNV 2.4/ PE (LBNL) 2.5/ SNV/PE 2.6/ PE (LBNL) 2.7/ PE (LBNL) 2.8/ PE (LBNL) 2.9/ SNV</p>	<p>2.1/ 1st week of April 2013 2.2/ 1st week of April 2013 2.3/ 2nd week of April 2013 2.4/ 2nd and 3rd week of April 2013 2.5/ 3rd week of April 2013 2.6/ 3rd week of April 2013 2.7/ 4th week of April 2013 2.8/ 4th of week of April 2013 2.9/ 4th week of April 2013</p>	<p>Additional support provided by Addis-based engineer hired by LBNL</p> <p>Stove testing will be done in three stages: Testing at LBNL, testing at the Ministry of Water and Energy laboratory (upon approval by the MoWE and field testing by the MoWE.</p> <p>2.3/ Includes focus group. Monitoring conducted by MoWE</p>

s/n	What /activities	Who/responsible	When	Remarks
3	Stove Manufacturing 3.1/ Share design with MoWE 3.2/ Finalize manufacturing plan 3.3/ Create and release CfP for manufacturers 3.4/ Identification of private company 3.5/ Train manufacturer 3.6/ Prototype stove production 3.7/ Collect feedback 3.8/ Begin market trial stove production 3.9/ Develop standards for quality assurance 3.9.1/ Communicate with National Standards Authority to get endorsement 3.10/ Quality assurance site checks	SNV/LBNL 3.1/ SNV 3.2/ PE (LBNL) 3.3/ PE (LBNL/SNV) 3.4/ PE (LBNL/SNV) 3.5/ PE (LBNL) 3.6/ PE (LBNL) 3.7/ manufacturer 3.8/ PE (LBNL)/SNV 3.9/ PE (LBNL) 3.9.1/ SNV 3.10/ SNV/PE (LBNL)	3.1/ 4 th week of Jan 2013 3.2/ 15 Nov 2012 3.3/ 1st week of Dec 2012 3.4/ 15 March 2013 3.5/ 18 March 2013 3.6/ 18 March 2013 3.7/ 20 March 2013 3.8/ mid-March 2013 3.9/ Throughout project period 3.10/ March 2013 onward	3.2/ Considerations include central manufacturing vs. splitting manufacturing and assembly between different workshops/factor SNV will provide feedback during this process. 3.3/ Since PE is not registered, SNV will release the CfP but would state clearly that it is in partnership with PE. Start with CfP for sma order of version 1.0 of stove 3.5/ SNV will provide oversight and report back to PE 3.6/ SNV will provide oversight and report back to PE 3.8/ PE has \$12,500 USD allotted in the budget to cover the cost o stoves for the market trial. With an assumed production price of \$12/stove, it is possible to include approximately 1,000 stoves in t market trial with current funding. Please see the Teaming Agreeem budget for more details. 3.9/ SNV will present standards on a national level These activities will also be supported by Addis-based engineer hii by LBNL.
4	Funding A. Grants 4.1/ Seek new funding opportunities B. Carbon Finance 4.1/ Meet w/ carbon finance project developers C. Private Sector Support 4.1/ Identify potential private sector players 4.2/ Organize stakeholder consultation 4.3/ Organize training on BDS 4.4/Monitoring and coaching D. Government Support 4.1/ Assign focal person 4.2/ Involve in M&E 4.3/ Periodic report 4.4/ Seek funding from GoE for scale-up	PE/SNV A. 4.1/ PE/SNV B. 4.1/ PE C. 4.1/ SNV 4.2/SNV 4.3/SNV 4.4 SNV D. 4.1/ SNV 4.2/ SNV 4.3/ SNV 4.4/ SNV	A. 4.1/ Throughout project period B. 4.1/ Beginning in Nov 2012 C. 4.1/1 st week May - 4 th week June 2013 4.2/1 st week May - 4 th week June 2013 4.3/SNV1 st week May - 4 th week June 4.4 1 st week May - 4 th week June D. 4.1/1 st week of January 2013 4.2/May 2013 4.3/January onwards 4.4/ June onwards	D. MoWE consulted throughout

s/n	What /activities	Who/responsible	When	Remarks
7	Coordination 7.1/ Agree on conditions for Engineer and Field Rep positions 7.2/ Sign Teaming Agreement 7.3/Coordinate the project from SNV office with active participation of MoWE and district representatives 7.4 Formulation of cooperation with the MoWE and Oromiya Water Mines and Energy	SNV/PE 7.1/ SNV/PE 7.2/ SNV/PE 7.3/SNV/PE 7.4/SNV	(Throughout project period) 7.1/ 16 Oct 2012 7.2/ 18 Oct 2012 7.3/Throughout the project period 7.4/3 rd week of Apr	To ensure all actors play a role in testing, manufacturing, promotio monitoring and evaluation and private sector engagement. SNV offers to host the Field Rep and Engineer. Legal responsibility and office space: SNV. Funding for positions, reporting and scope work: PE. SNV will be the primary lead in coordinating local actors involved i this project when applicable. Potential Energy will lead all USA-ba activities in addition to participation in activities at the local level when applicable.
8	Creating Enabling Environment	SNV	Throughout project period	SNV will work with the MoWE and other stakeholders to create ar enabling environment for the production, distribution, promotion and private sector development of the stove.
9	Knowledge Exchange	SNV/PE	Throughout project period	Monthly reports, networking within the Ethiopian stove sector as well as on an international level, sharing experience in the field, bi annual sharing, develop case study, PE newsletter, Arrange presentation with TEA (Talk Energy Ahead) in Addis.
10	Represent Project on National Level	SNV	Throughout project period	The MoWE is currently aware that SNV and PE are working togeth SNV advises not presenting a formal project description to the Mo until the stove redesign process is complete, so that there is something concrete to show. SNV will ensure that the project is always presented as a partnersl with PE.
11	Project Management 11.1/ Create Marketing Trial budget	SNV/PE 11.1/ SNV/PE	11.1/ 15 Nov 2012 Throughout project period	11.1/ M&E budget included The project office for the marketing trial will be in SNV. The projec will be monitored by an MoWE focal person (as per MoWE standa procedure) regional representative. PE & SNV will adhere to a principle of direct communication and sharing of information. The project management team (Melis Teka, Debra Stein & Ken Ch will conduct quarterly calls/reports
12	Stakeholder Consultations	SNV	3 times during implementation (at the start of the project and finalization of the test, during launching of market trial and at the end of the market trial	SNV will organize consultative meetings at national, region and district level in order to run the market trial smoothly for 3 times during the project period.
13	Production target	SNV/PE	Apr 2013-Aug 2013	* See Production and Distribution Timeline below

14	Program Implementation Document (PID)	SNV/PE	1 Jul 2013	The PID is a detailed 2-5 year operational plan and this will be initiated during the marketing trial period. SNV and PE will both pl active roles.

* Production and Distribution Table

Activity	Month				
	April	May	June	July	Aug
Stove production	50	100	200	300	350
Stove dissemination		50	100	300	550
				Total	1,000

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Implementation Plan & Milestone #4 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

December 2012



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
CBO	Community Based Organization
EFRDN	EI Fasher Rural Development Network
ELF	EI Fasher, Sudan
IC	Impact Carbon
IDP	Internally Displaced Person
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLT	Slow Life Trust
UMCOR	United Methodist Committee on Relief
VGS	Voluntary Gold Standard

INDICATOR DASHBOARD

	May 15, 2012	December 30, 2012
Total population with access to FES in targeted communities in Darfur (stoves distributed x avg. hh size of 6)	121,656	134,856
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A
Geographical Distribution of FES in Darfur	(See next table)	(See next table)
Geographical Distribution of FES in Ethiopia	N/A	N/A
Number of women with access to FES in Darfur (stoves distributed)	20,276	22,476
Number of women with access to FES in Ethiopia	N/A	N/A
CO2 Equivalent mitigated (tons) by using FES instead of traditional methods	78,063 revised to 41,298**	56,868
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Darfur	90%*	90%*
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A

Notes:

*Results reported are based on impact assessment survey conducted with 180 stove users in 2010. We continue to interview samples of stove recipients but have only analyzed baseline data. We did not interview every stove recipient/purchaser.

**Methodology revised to show estimated CO2 not emitted to date by stoves in the field (formerly counted total expected emissions reductions of stoves distributed over their 5-year lifetime). Assumes 96% adoption rate in year 1 and 10% annual attrition in years 2-5, with use completely ceasing after year 5.

Table 1: Geographic Distribution of FES in Darfur

Batch	Region	Location	#	Distributor	Ver-sion	Year
CHF	South	Otash	206	CHF	5	2007-9
CHF	South	Kalma	55	CHF	5	2007-9
CHF	South	Dereig	95	CHF	5	2007-9
CHF	South	Yara	46	CHF	5	2007-9
CHF	South	Gussa	10	CHF	5	2007-9
CHF	South	Kass	136	CHF	5	2007-9
CHF	North	El Fasher	100	CHF	5	2007-9
CHF	North	Al Salaam	14	CHF	5	2007-9
CHF	South	Gereida	4720	ICRC	5	2007-9
CHF	North	Al Salaam	797	ACF	5	2007-9
CHF	South	Otash	109	ACF	5	2007-9
CHF	South	Al Sereif	113	ACF	5	2007-9
CHF	South	Ed Daein	225	UMCOR	5	2007-9
2900	North	ZamZam	573	OA	14	2009-10
2900	North	El Fasher rural areas	250	OA	14	2009-10
2900	North	El Fasher town	350	OA	14	2009-10
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10
2900	North	Mellit Rural Areas	1009	OA	14	2009-10
2900	North	Umasir	250	OA	14	2009-10
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10
4650	North	ZamZam	700	OA	14	2010
4650	North	Rural El Fasher	750	OA	14	2010
4650	North	El Fasher Town	1125	OA	14	2010
4650	North	Abasi & Goz	615	OA	14	2010
4650	North	Mellit Town	840	OA	14	2010
4650	North	Mellit Rural	695	OA	14	2010
4650	North	Control Group	25	OA	14	2010
4500	North	ZamZam Extension	1000	OA	14	2011
4500	North	Zam Zam Extension	500	OA	14	2011
4500	North	Abu Shouk	1000	OA	14	2011
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011
4500	North	Emergency	360	OA	14	2011
4500	North	Al Salaam	1000	OA	14	2011
1500	North	ZamZam	1500	Plan	14	2011
2200	North	ZamZam	2200	Plan	14	2012
Total Stoves Distributed			22,476			

MILESTONE UPDATES: December 30, 2012

1. Recruit and Train Local Sales Agents (Darfur)

We have decided to continue partnering with the same two Community Based Organizations that we worked with in the marketing trials: El Fasher Rural Development Network and African Charitable Society for Mothers and Child Care. Women members of these organizations will continue doing promotion and sales (on consignment) of the cookstoves. We are also looking to recruit a Potential Energy Field Representative based in Darfur, who can manage the sales and distribution, and coordinate with our assembly partner, Sustainable Action Group. We have written a position description and circulated it through local networks. We hope to hire someone by February 1, 2013.

2. Marketing Trial – Phase II – 1,000 Galvanized Iron Stoves (Darfur)

As discussed in previous milestone reports, we have abandoned the galvanized iron approach due to it melting under high temperatures. Instead, we have decided to address our dual goals of providing a stove that 1) does not get too hot to the touch, and 2) does not look rusty after limited usage through a single new model (which will be labeled v15). LBNL has continued to test the laboratory prototype in its stove testing lab, and has confirmed that no part of the stove gets hotter than 60 degrees C, qualifying it for the highest (Tier 4) rating for safety in the new standards for clean cookstoves. Our manufacturing contractor in Mumbai has made a manufacturing prototype and is sending several samples to LBNL in the U.S. for approval. Our plan is to include 500 in the next shipment of flat-kits, scheduled for April 2013. (We reduced the number of samples to send to Darfur from our original plan of 1,000, because we believe 500 will give us enough customer feedback to move forward with the product launch).

3. Exchange Visit – Marketing Officer to Toyola in Ghana (Darfur)

Unfortunately, we had to postpone this exchange visit until mid-2013. The marketing officer we were planning to send from Darfur to Ghana, Nazik Ismael, left the project in September. We felt it would be better for her successor, Dr. Adam Amin, to work on the project for several months before visiting a cookstove project in another country.

4. Obtain Voluntary Gold Standard Certification (Darfur)

In our last milestone report, we described how Potential Energy staff (along with our partners at Impact Carbon) were awaiting visas to be able to travel to Sudan in December to train local partners in conducting the baseline surveys required by the Gold Standard. Unfortunately, the visas were not approved in time (although we have now received approval for visas to travel in January). Because we were not able to visit the project site, we had to be creative in order to keep the process in motion and avoid further delays in the voluntary gold standard validation process. We managed this challenge by training our partners from a distance, and collaborating with the groups Carbon Clear and Practical Action to hold a joint workshop in Darfur. The workshop took place November 25-29, 2012, and we began surveys in the IDP camps on December 9th. There are two major components to the surveys:

- a) Kitchen Performance Tests: in this test, enumerators visit a randomly selected cohort of households at the same time of day for at least three consecutive days. The purpose of the test is to measure the impact of the Berkeley-Darfur Stove on household fuel consumption (using scales). A sample of families who have received the Berkeley-Darfur Stove is evaluated alongside a control group of families who have not received the stove.
- b) Kitchen Surveys: Kitchen Surveys are qualitative surveys that aim to develop a greater understanding of existing cooking methods and fuel use in the area.

The surveys are being conducted by six enumerators who were recruited specifically for this evaluation, as well as a Team Leader. The Team leader is a professor at the University of El Fasher, in North Darfur, and as such is independent from the project and experienced in conducting research. The Team Leader and the enumerators participated in the training workshop.

We have also completed another important step in the Gold Standard Certification process: transferring our stove tracking data to an electronic database. Previously, we kept all records of stove distribution and sales in hard copy documents written in Arabic. The Gold Standard registration process requires that these records be kept electronically, in English. Between June and December 2012, we transferred our hard copy records (for 6,000 stoves distributed in IDP camps since 2009) to an electronic database. We have also successfully established a process for using the electronic database for all stove sales moving forward.

Once the surveys have been completed in the IDP camps, and the data has been analyzed, we will engage an independent auditor (certified by the Gold Standard) to validate the information.

5. Coordinate Stove Production, Assembly, Distribution (Darfur)

The total number of Berkeley-Darfur Stoves distributed to date to 22,476. As reported on October 30th, 10,000 more flat-kits have been manufactured and shipped to Sudan. Since our October 30th report, these flat-kits were processed through customs and transported to the workshop in El Fasher, Darfur. Assembly of these kits began the last week in December. The delay was due to problems we had wiring money to Sustainable Action Group in Sudan. Despite successful transfers using our Office of Foreign Assets Control (OFAC) license in the past, we had several wire transfers rejected in October through December. This meant that Sustainable Action Group did not have the money on hand to pay the assembly workers and assembly had to be delayed. One of our transfers has finally arrived in Sustainable Action Group's bank account, and they have begun assembling the 10,000 stoves this week. We expect sales to begin in January 2013.

6. Conduct pilot study with sales target of 1,500 stoves (Ethiopia)

Planning for the pilot study (marketing trial) in Ethiopia is underway. The schedule for the pilot study was provided in our Milestone Report #3 (Appendix I – Action Plan). The schedule for this plan has been delayed by two weeks, owing to a delay in signing the final Teaming Agreement with our partner, SNV. The Agreement has now been signed, and we have accomplished the following since our last report at the end of October:

- Recruited an Ethiopian engineering firm, Ethio Resources Group (ERG), to be our field engineer partner.
- Interviewed candidates for field representative position (and now reposting the position in the newspaper in Addis Ababa to find more candidates)

- Completed laboratory prototype of the Ethiopia Stove; now sending it to the Ethiopian field engineer to bring to local manufacturing shops to get manufacturing feedback and quotes on production
- Organized a trip for two of our team members to travel to Ethiopia in January:
 - Danny Wilson is a PhD candidate in Mechanical Engineering and will be working with the Ethiopian field engineer, and conducting visits to manufacturers to begin getting quotes
 - Angeli Kirk is a PhD candidate in Agricultural and Resource Economics (working with Potential Energy through our collaboration with the Center for Effective Global Action at UC Berkeley). Angeli will be working with our partner, SNV, to finalize the experimental design for our marketing trial.

Angeli and Danny's terms of reference for their trip are included as an Appendix to this report.

Appendix – Ethiopia Field Trip Terms of Reference

Terms of Reference, Addis Ababa, Ethiopia – January 2013

Daniel Wilson, University of California at Berkeley (UCB), Lawrence Berkeley National Laboratory (LBNL), and Potential Energy (PE)

ASSIGNMENT PERIOD

Departure from DEN US: January 2, 2012; Arrival to Ethiopia: January 4, 2012
 Departure from Ethiopia: January 19, 2012; Arrival to SFO US: January 20, 2012

TIMELINE

	January, 2013																		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Transit																			
Daniel Wilson in Ethiopia																			
Angeli Kirk in Ethiopia																			
Primary Objective: Enable Sustainable Action Group (SAG) to deploy stove use monitoring system (SUMS) program																			
Primary Objective: understand current status of BDS manufacturing in Al-Fashir and areas for improvement.																			
Primary Objective: obtain SAG feedback about production of a new “Cool Stove” BDS in the Al-Fashir assembly shop.																			
Primary Objective: enable manufacturing of the Berkeley-Ethiopia Stove in Ethiopia.																			
Primary Objective: Develop Ethiopian Controlled Cooking Test Protocol (CCT).																			
Primary Objective: enable SNV to conduct market trial of the Berkeley-Ethiopia Stove.																			

OBJECTIVES

1. **Primary Objective:** enable Sustainable Action Group (SAG) to deploy stove use monitoring system (SUMS) program [January 5-6, key personnel: Daniel Wilson, Abdal Rahman (SAG)].
 - 1.1. **Sub Objective:** develop a shared vision between SAG, PE, UCB, and LBNL about the purpose and goals of the SUMS deployment program.
 - A. Train SAG representative about the goals of the SUMS deployment plan, namely to understand how women use their cookstoves.
 - B. Train SAG representative about the design of experiment and potential failure modes for the experiment.
 - C. Gather feedback from SAG to develop a more robust and realistic experimental design.
 - i. Develop a better understanding of SAG’s capabilities and concerns in terms of constructing SUMS-equipped stoves, identifying host community(s), marketing the

stove to host the community, distributing pre survey, selling stoves, collecting sensors, and distributing post survey.

- D. Revise experimental design with SAG feedback and verbally agree to execute revised SUMS program.

1.2. Sub Objective: enable SAG to install SUMS devices on Berkeley-Darfur Stoves (BDS) at their assembly shop in Al-Fashir.

- A. Transfer SUMS hardware to SAG representative including sensors, dummy sensors, and installation tools.
- B. Train SAG representative to in SUMS installation technique and requirements.

1.3. Sub Objective: enable SAG to program and download data from SUMS devices.

- A. Transfer SUMS programming hardware to SAG representative.
- B. Train SAG representative to programs SUMS hardware.
- C. Train SAG representative to download data from SUMS hardware.

2. Primary Objective: understand current status of BDS manufacturing in Al-Fashir and areas for improvement. [January 7, key personnel: Daniel Wilson, Abdal Rahman (SAG)]

2.1. Sub Objective: develop a plan to manufacture the BDS in Darfur more efficiently.

- A. Speak with SAG representative to understand what is going poorly with manufacturing of the BDS. Do tools or fixtures need to be updated or replaced?
- B. Understand what the primary production challenges are and develop plans to address these challenges.

3. Primary Objective: obtain SAG feedback about production of a new “Cool Stove” BDS in the Al-Fashir assembly shop. [January 7, key personnel: Daniel Wilson, Abdal Rahman (SAG)]

- A. What challenges does SAG anticipate with a new Cool Stove?
- B. What training or resources does SAG anticipate needing for a new stove design?
- C. Given the chance to “start from scratch,” what changes would SAG make to the way the Cool Stove is manufactured vs. the BDS v14?

4. Primary Objective: enable manufacturing of the Berkeley-Ethiopia Stove in Ethiopia. [January 8-14, key personnel: Daniel Wilson, Ethiopian machine shops (names?), and Ethiopian engineers (names?)]

4.1. Sub Objective: obtain quotes from Ethiopian machine shops on Berkeley-Ethiopia Stove components.

- A. Gather feedback from machines shops regarding cost and manufacturability improvements.
- B. Visit at least three machine shops to determine capabilities and limitations.

4.2. Sub Objective: secure engineering partnerships with local Ethiopian engineers.

- A. Meet with engineers identified by Ken Chow to vet talents and capabilities.

5. Primary Objective: Develop Ethiopian Controlled Cooking Test Protocol (CCT). [January 14-18, key personnel: Daniel Wilson, Angeli Kirk, Melis Teka, SNV staff (names?)]

5.1. Sub Objective: quantify Ethiopian fuel characteristics

- A. Determine wood species, mean diameter, diameter variance, lengths, and gathering methods.

- 5.2. Sub Objective:** quantify primary Ethiopian meals
 - A.** What are the primary food types and names?
 - B.** How long (mean and variance) do women spend cooking?
 - C.** What kind of cooking techniques (boil, roast, fry, sauté) do the women use?

- 6. Primary Objective:** enable SNV to conduct market trial of the Berkeley-Ethiopia Stove. [January 14-18, key personnel: Daniel Wilson, Angeli Kirk, Melis Teka, SNV staff (names?)]
 - 6.1. Sub Objective:** Support Angeli Kirk with activities such as household visits, stakeholder meetings, and questionnaire development.

Terms of Reference
Addis Ababa, Ethiopia – January 2013
Angeli Kirk, University of California at Berkeley/Potential Energy

Period of assignment:

Departure from US: January 7, 2012; Arrival to Ethiopia: January 9, 2012

Departure from Ethiopia: January 20, 2012; Arrival to US: January 21, 2001

Objective of the visit: Market trial preparations

- A. Internal meetings with SNV
 - a. Presentation on impact evaluation concepts and methodology (Jan 10)
 - b. Discussion of impact evaluation strategy (Jan 10, 15)
 - i. Site selection
 - ii. Sample selection, randomization strategy
 - iii. Survey plan: timing and staffing
 - iv. Cookstove promotion plans
 - v. Cookstove distribution and payment logistics
 - c. Recap of findings and working plan (Jan 17 or 18)
- B. Site selection
- C. Visits to local leaders (Jan 11-12, 14)
 - a. Informal briefing on project
 - b. Solicit advice on local outreach
 - c. Identify potential strategies for household recruitment
 - d. Visits and inquiries to firewood sellers (Jan 11-12, 14)
 - i. Classify, weigh typical bundles and prices
 - ii. Frequency of customer visits, quantities sold
- D. Household visits, interviews (Jan 11-12, 14)
 - a. Stove ownership
 - b. Cooking patterns
 - i. Stoves
 - ii. Foods
 - iii. Wood usage
 - c. Firewood purchases
- E. Cooking observations to inform lab testing in Berkeley (Jan 11-12, 14)
 - a. Stoves
 - b. Foods
 - c. Wood usage
- F. (Tentative) iButton trial
- G. Pretest and evaluate questionnaires (Wed, Jan 16)
 - a. Clarity of questions
 - b. Relevance on content

- c. Timing for various modules, to shorten as needed
- H. Additional meetings
 - a. Siqqee
 - b. Innovations for Poverty Action (tentative)
 - c. Statistical Office
 - d. Interviews with Potential Energy Field Representative candidate(s) (tentative)
- I. Photos/Video
 - a. Obtain photos and/or video footage for donor communication and reporting

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #5 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

April 2013



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, Sudan
IC	Impact Carbon
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLT	Slow Life Trust
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
VGS	Voluntary Gold Standard
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

	May 15, 2012	December 30, 2012	April 30, 2013
Total population with access to FES in targeted communities in Darfur (stoves distributed x avg. hh size of 6)	121,656	134,856	164,856
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A
Geographical Distribution of FES in Darfur	(See next table)	(See next table)	(See next table)
Geographical Distribution of FES in Ethiopia	N/A	N/A	N/A
Number of women with access to FES in Darfur (stoves distributed)	20,276	22,476	27,476
Number of women with access to FES in Ethiopia	N/A	N/A	N/A
CO2 Equivalent mitigated (tons) by using FES instead of traditional methods	78,063 revised to 41,298**	56,868	73,803
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Darfur	90%*	90%*	90%*
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A	N/A
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A	N/A

Notes:

*Results reported are based on impact assessment survey conducted with 180 stove users in 2010. We continue to interview samples of stove recipients but have only analyzed baseline data. We did not interview every stove recipient/purchaser.

**Methodology revised to show estimated CO2 not emitted to date by stoves in the field (formerly counted total expected emissions reductions of stoves distributed over their 5-year lifetime). Assumes 96% adoption rate in year 1 and 10% annual attrition in years 2-5, with use completely ceasing after year 5.

Table 1: Geographic Distribution of FES in Darfur

(Rows highlighted in **yellow** represent new distribution since the last Milestone Report).

Batch	Region	Location	#	Distributor	Version	Year
CHF	South	Otash	206	CHF	5	2007-9
CHF	South	Kalma	55	CHF	5	2007-9
CHF	South	Dereig	95	CHF	5	2007-9
CHF	South	Yara	46	CHF	5	2007-9
CHF	South	Gussa	10	CHF	5	2007-9
CHF	South	Kass	136	CHF	5	2007-9
CHF	North	El Fasher	100	CHF	5	2007-9
CHF	North	Al Salaam	14	CHF	5	2007-9
CHF	South	Gereida	4720	ICRC	5	2007-9
CHF	North	Al Salaam	797	ACF	5	2007-9
CHF	South	Otash	109	ACF	5	2007-9
CHF	South	Al Sereif	113	ACF	5	2007-9
CHF	South	Ed Daein	225	UMCOR	5	2007-9
2900	North	ZamZam	573	OA	14	2009-10
2900	North	El Fasher rural areas	250	OA	14	2009-10
2900	North	El Fasher town	350	OA	14	2009-10
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10
2900	North	Mellit Rural Areas	1009	OA	14	2009-10
2900	North	Umasir	250	OA	14	2009-10
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10
4650	North	ZamZam	700	OA	14	2010
4650	North	Rural El Fasher	750	OA	14	2010
4650	North	El Fasher Town	1125	OA	14	2010
4650	North	Abasi & Goz	615	OA	14	2010
4650	North	Mellit Town	840	OA	14	2010
4650	North	Mellit Rural	695	OA	14	2010
4650	North	Control Group	25	OA	14	2010
4500	North	ZamZam Extension	1000	OA	14	2011
4500	North	Zam Zam Extension	500	OA	14	2011
4500	North	Abu Shouk	1000	OA	14	2011
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011

4500	North	Emergency	360	OA	14	2011
4500	North	Al Salaam	1000	OA	14	2011
1500	North	ZamZam	1500	Plan	14	2011
2200	North	ZamZam	2200	Plan	14	2012
2013A	North	Kebkabiya	500	KWDA	14	2013
2013A	North	Kebkabiya	800	KSCS	14	2013
2013A	North	El Fasher, El Kuma, Mellit	1110	DARA	14	2013
2013A	North	El Fasher, Dar Es Salam, El Kuma, Kilimando	100	RVNHD	14	2013
2013A	North	Dar Es Salam	300	WDAD	14	2013
2013A	North	Kutum	40	SAG	14	2013
2013A	North	SAG Office	40	SAG	14	2013
2013A	North	(Locations being collected from field tracking data)	2110	SAG & CBOs	14	2013
Total Stoves Distributed			27,476			

MILESTONE UPDATES: April 30, 2013

1. Recruit and Train Local Sales Agents (Darfur)

In 2012 Potential Energy and our local Sudanese partner, the NGO Sustainable Action Group (SAG), collaborated with two community based organizations in North Darfur to sell stoves in our marketing trial: Fasher Rural Development Network (FRDN) and African Charitable Society for Mothers and Child Care (ACSMCC). In 2013, we suspended our partnership with ACSMCC due to challenges collecting repayment from this network. We have expanded our distribution network, recruiting an additional five Community Based Organizations (CBOs) for sales and distribution. A small number of stoves continue to be sold directly from SAG's office.

The five new distribution partners were selected based on the following criteria:

- A demonstrated interest in participating in the project;
- A strong reputation with NGOs/INGOs;
- Formal registration with the government of Sudan;
- Lack of any stated political, religious, or military agenda;
- Location in an area that is accessible to SAG based on security concerns

Thus, the seven distribution channels for the cookstoves in Darfur are:

1. Fasher Rural Development Network (FRDN) in rural localities of Fasher district
2. Darfur Development And Reconstruction Agency (DRA) cover 2 localities in North Darfur
3. Voluntary Network for Helping and Development (VNRHD, a local partner of Oxfam America) in Kilimando locality
4. Women Development Association Network (WDAN, network established by Practical Action) in El Fasher locality
5. Dar Es Salaam Development Association (DDA, established with support of Oxfam)
6. Kebkabiya Smallholder Charitable Society (KSCS) in Kebkabiya locality (established with the support of Oxfam)
7. Direct sales from SAG office

Leaders of these Community Based Organizations and Development Networks are on-boarded in training and sales through the following process:

1. SAG holds an initial meeting, in which they tell the CBO leaders about the benefits of the stoves, conduct a cooking demonstration, and provide the CBOs with several stove samples to bring back to their communities to promote with their members.
2. The CBO brings the stove samples back to their community and holds a demonstration for their members, conveying the benefits of the stove that they learned from SAG.
3. If there is sufficient interest from the community, the CBO signs a Memorandum of Understanding with SAG, which outlines each group's roles and responsibilities, financial incentives, and payment requirements.
4. The CBO takes orders from their members and remit the orders to SAG.

5. A SAG staff member will accompany the stove delivery and conduct another training (directly for the stove purchasers) at the time they purchase their stoves.

In addition to the CBOs we partner with as sales agents, Potential Energy has also hired a part-time Country Representative, Omnia Amr Abbas. Omnia is based in Khartoum and travels to Darfur monthly to conduct training and oversight for Sustainable Action Group. Omnia is able to provide PE's staff in the U.S. with more frequent and detailed reports from the field than we have received in the past from our partners.

Omnia has extensive research experience in climate policy, environmental politics, and private governance. She has been involved in numerous projects dealing with environmental issues and sustainability, including launching Eco Options Egypt, the first environmental issues online magazine in Egypt, and acting as an Energy and Environment Program Consultant for the United Nations Industrial Development Organization in Italy (Cairo Office). Omnia has an MSc in Environmental and Resource Management from Vrije Universiteit Amsterdam and a BSc in Biology from the American University in Cairo.

2. Marketing Trial – Phase II – 1,000 Galvanized Iron Stoves (Darfur)

As described in previous milestone reports, we decided against galvanized and used the cool mesh to address both issues of "cool-to-the-touch" and appearance. In our December 2012 milestone report, we explained that we had ordered a manufacturing prototype of the cool-to-the-touch stoves from Shri Hari Industries. Those manufacturing prototypes arrived in Berkeley in early 2013 and laboratory testing at LBNL was completed in March. We have ordered 20 of these new "cool mesh" stoves to be sent to Sudan with the next shipment of 5,000 (these will be shipped in early June, and distributed this summer). We are testing out several heat-resistant paints (currently being tested for safety in the manufacturing facility) to determine which types are longest lasting and which colors are most appreciated by the stove users. After initial feedback has been received on this small quantity of cool-mesh stoves, we will order the remaining 980 to test out willingness to pay for the additional aesthetic and safety features.

3. Exchange Visit – Marketing Officer to Toyola in Ghana (Darfur)

Due to staff turnover at Sustainable Action Group, we did not send a marketing officer from SAG on an exchange visit to Ghana. Instead, in April 2013 we sent our Darfur Program Manager, Jan Maes to another successful cookstove project in Uganda, managed by our carbon finance partner, Impact Carbon. The main purpose of the exchange visit was to observe best practices for keeping records required for the carbon credits, and to learn from their experience setting up a robust stove tracking system. Now that we have hired a Country Representative in Sudan, Omnia Abbas, we hope to send her to visit another cookstove project as well (we are considering GVEP's project in Kenya or Toyola's in Ghana, as well as the Impact Carbon project in Uganda).

4. Obtain Voluntary Gold Standard Certification (Darfur)

Our partner for carbon finance project development, Impact Carbon, has made significant progress on conducting the baseline and project surveys required for registration with the Gold Standard. In February 2013, Impact Carbon sent a representative, Ellie Gomez, to Darfur, to follow up on the survey progress. The following table summarizes the survey work conducted by Impact Carbon to date (more information on the methodology, including the survey instruments, is included in the Evaluation Plan).

Table 2: Carbon Finance Monitoring Conducted to Date

	Abu Shouk	El Salam	ZamZam
Baseline (i.e. people without stoves)			
Household Kitchen Surveys	25	25	80
Kitchen Performance Tests	25	25	Postponed due to security concerns
Project (i.e. people with stoves)			
Household Kitchen Surveys	19	31	Postponed due to security concerns
Kitchen Performance Tests	19	31	
Usage	19	20	

As indicated in Table 2, the monitoring and evaluation had to be interrupted because of security concerns. As a result, Impact Carbon is conducting a cost-benefit analysis to see whether we should change the type of project we register from “large scale” to “micro Program of Activities (PoA).” With a micro-PoA, the number of credits earned depends on a very conservative default value and is less reliant on ongoing surveys.

The implication of the change is that the monitoring requirements would be fewer, exposing our staff and partners to fewer security risks; however, the paperwork required by the Gold Standard would be much greater. This is because with a micro-PoA we can only issue 10,000 tons at a time, and then would need to complete new documentation before each subsequent issuance. The total number of credits would not be limited, and this approach would be more compatible with the insecure environment where we work.

We are waiting for the Gold Standard to finalize the new protocol for micro-PoA projects (anticipated by the end of May) before we make our final decision. We still expect to issue the first “vintage” of carbon credits in the fall 2013.

5. Coordinate Stove Production, Assembly, Distribution (Darfur)

As shown in Table 1 above, 5,000 stoves have been assembled and distributed since our last milestone report in December 2012. All 5,000 of these stoves were sold via the CBO networks described above. The retail price was 50 SDG (about \$8) for customers who paid in full and 60 SDG (about \$10) for customers who chose to pay for their stove in installments (using the savings they collect from reduced firewood expenses). We are in the process of setting up a more detailed and robust stove tracking system in Darfur, which will enable us to have more resolution into the details of stove distribution and data that is

much closer to real-time. We expect to distribute at least 10,000 more stoves in 2013, including 20 or more “cool mesh stoves.” At the time of this writing 5,000 flat-kits are being assembled in Darfur, and 5,000 are being manufactured in India, expected to ship in early June. We are still negotiating with the Government of Sudan’s Humanitarian Action Commission (HAC) how many of these stoves we are permitted to sell (versus distribute for free). Government permission and import duties have been the main obstacle to stove sales to date, as there seems to be no shortage in demand for the stoves at the subsidized prices of \$8 and \$10 (prices are also capped by the government, making a fully commercial model unlikely in the near future).

6. Conduct pilot study with sales target of 1,500 stoves (Ethiopia)

Since our December 2012 report, Principal Investigator Ken Chow, Daniel Wilson (UC Berkeley Mechanical Engineering PhD candidate) and Ethiopian engineering consultants, Getnet Tesfaye and Hilawe Lakew of Ethio-Resource Group visited metal manufacturers and toured several facilities to request quotations for the manufacture of Berkeley-Ethiopia Stove parts. A range of manufacturers was visited, from smaller shops to large government-operated facilities. The visits included sharing part drawings and discussing methods of manufacture. All of the visits were highly informative and many were encouraging. However, when we requested quotations for part fabrication, we either received no bid responses or extremely high quotes. The lowest cost for a complete set of stove parts (not including assembly cost) was US \$167 per stove for 5,000 units and US \$195 per stove for 500 units, which is 13 to 15 times the current cost of Berkeley-Darfur Stove parts. Stainless steel was found to be about twice as costly in relation to mild steel than is typically seen in western or Asian countries. The only quotation received for cast iron grates came in at 30 times the cost of current Berkeley-Darfur Stove grates. *(Please see Appendix for full report on Berkeley-Ethiopia Stove Manufacturing Study).*

To obtain feedback from users in the short-term, we have revised our manufacturing plan to include the importation of a small quantity of fully assembled stoves for the marketing trial since importing small quantities of stoves will be several times lower cost than in-country manufacturing. We are in the process of ordering ten of the new “cool mesh” Berkeley-Darfur Stoves with modified pot rods to hold an Ethiopian coffee pot, an ash pan and coffee roasting tray. These stoves will be used immediately to obtain initial feedback from potential customers at our marketing trial sites. We are also in the process of ordering 400 of these stoves for the second phase of our marketing trial (described in detail below in Milestone 7), which should be available for sale in our target communities by September 2013.

After the market trial we anticipate transitioning to in-country stove assembly using imported kits, then moving to altering the supply chain in a phased manner so that different stove parts are manufactured in-country instead of imported. Sheet metal parts made of mild steel will be the first components to switch to in-country manufacturing, followed by stainless parts. The grate is the most challenging component to manufacture in-country and will most likely be the last stove component to transition to in-country manufacturing. Some part redesign may be needed in order to accommodate in-country manufacturing conditions but we maintain our longer-term aim of developing a stove that is 100% manufactured in Ethiopia. As demand for the stoves grows the supply chain will be shifted over time from imported parts to Ethiopian-manufactured on a part-by-part basis. With evidence of

demand, we believe that Ethiopian manufacturing partners will invest in the appropriate machinery required to manufacture the stove. Following feedback from the early phases of the marketing trial, modifications will be incorporated into the stove design. We are confident that importing the stoves in the short-term will expedite the marketing trial and enable us to gain valuable feedback from users about their willingness to pay for the stove.

In February we hired Getnet Tesfaye and Hilawe Lakew to jointly serve in Potential Energy's Country Representative position. Through their clean energy consultancy, Ethio Resource Group (ERG), they are now serving in both our Country Representative *and* Engineering Consultant roles. We anticipate their participation will aid in the transition to local manufacturing.

Getnet Tesfaye has worked for the Ethiopian Rural Energy Development and Promotion Center for 19 years as an energy planner, energy information officer and as a member of several sector strategy and policy development teams. His recent clean cooking related experience includes project development and coordination for the Nordic Climate Fund-supported project for clean cooking promotion in Ethiopia, and the development and implementation of the EU Energy Facility-funded Integrated Rural Household Energy project being implemented by Addis Ababa University. Getnet holds an MS in Energy Systems and the Environment from the University of Strathclyde, Glasgow, UK and a BS in Electrical Engineering from the Addis Ababa University.

Hilawe Lakew has many years of experience in energy engineering related to industrial, household, and rural energy programs, with particular emphasis on energy efficiency and the harnessing and utilization of alternative energy resources such as biomass, solar and micro hydro. Hilawe has been part of several clean cooking stove design and dissemination projects in Ethiopia, including the design and development of an improved charcoal stove and the development of the improved injera baking stove as a design expert at the Ethiopian Ministry of Mines and Energy. Hilawe obtained an MSc. in Renewable Energy and The Environment from The University of Reading, UK and a BS in Physics from Addis Ababa University.

With ERG joining the team as our on-the-ground representative in Ethiopia, we now have an even greater capacity to launch the marketing trial while simultaneously laying the groundwork for our long-term manufacturing plan.

7) Conduct randomized control trial evaluating marketing mix (Ethiopia)

With our field partner, SNV's guidance, two sites have been selected for the marketing trial: 1) Sebatah, in the outskirts of Addis Ababa and 2) Meki, approximately 100 kilometers from Addis Ababa. Both sites are located in the Oromia region of Ethiopia and are peri-urban. PE and SNV agreed to initially target peri-urban areas where: 1) firewood is the primary cooking fuel 2) we have existing relationships with local communities, and 3) the communities are relatively easy to access (to facilitate monitoring). These two areas were recommended by SNV because they have well-established biogas programs in both Sebatah and Meki and SNV reports that the majority of women are purchasing firewood. We believe these sites for the marketing trial will allow us to achieve our goal of understanding this market segment and gaining further insight into consumers' motivations

for purchasing the stove. SNV has obtained written permission from the district-level governments in both Sebatah and Meki to conduct the stove marketing trials in these areas.

Because the 400 stoves for the marketing trial will not be available for purchase in Ethiopia until September, we are taking the opportunity to spread out our evaluation activities into three phases to ensure that our trial is a success:

Phase I (June 2013): Approximately 10 stoves will be placed in households in rotation for heavy observation to learn more about potential customers' cooking habits and to test the survey questions. Households will be recruited based on interest in the stove.

Phase II (August 2013): Approximately 20 households will receive stoves and the baseline survey will be tested. Stove use monitors (SUMs) will also be used to learn more details about stove use. Stove promoters will be identified through CBOs, similar to our model in Darfur.

Phase III (October-November 2013): Conduct randomized control trial (RCT) with approximately 400 stoves.

Until the first phase of the trial begins in early June, we are working to refine the survey. A draft has been reviewed by ERG and will be tested in the field in the next month.

APPENDIX: Assessment of Berkeley-Ethiopia Stove Manufacturing in Ethiopia

Summary

We visited several metals manufacturers with our Ethiopian engineering consultants to tour facilities and request quotations for manufacture of Berkeley Ethiopia Stove parts. A range of manufacturers were visited, from smaller shops to large government-operated facilities. The visits included sharing our part drawings and discussing methods of manufacture. All the visits were highly informative and many were encouraging. However, when we requested quotations for part fabrication, we either received no bid responses or extremely high quotes. The lowest cost for a complete set of stove parts (not including assembly cost) was US \$167 for 5000 units and US \$195 for 500 units, 13 to 15 times the current cost of Berkeley-Darfur stove parts. Stainless steel was found to be about twice as high in relation to mild steel than is typically seen in western or Asian countries. The only quotation received for cast iron grates came in at 30 times the cost of current Berkeley Darfur stove grates.

Our current short-term manufacturing plan is to import small quantities of stoves for marketing trials with a longer term aim of developing a stove that is 100% manufactured in Ethiopia. As demand for the stoves grows the supply chain will be shifted over time from imported parts to Ethiopian-manufactured parts on a part-by-part basis. Some part redesign is expected in order to accommodate Ethiopian manufacturing conditions.

Details

1. Feedback was obtained on the feasibility of fully manufacturing and assembly of the Berkeley-Ethiopia Stove (BES) in Ethiopia. The feedback was obtained from the principals of Ethio Resource Group (ERG), a Ethiopian consultancy with experience developing cookstoves in Ethiopia. Visits to potential parts manufacturers were also conducted with ERG and price quotations for stove parts and stove assembly were requested.

1.1. Feedback from Ethio Resource Group about BES design

The option of using ceramic as the stove body was discussed. Ceramic is often selected as a material in stoves because it has 2 major advantages: low cost and good thermal insulation. However, ceramic also has the disadvantages of high thermal mass (thus absorbing much of the heat from the fire at the start of cooking) and consistent manufacturing quality. Whether ceramic is a good choice is typically based on the best compromise to meet specific stove needs. With Ethiopian cooking and manufacturing in mind, ERG expressed concern about a ceramic cookstove body for two reasons: (1) there are significant manufacturing challenges in Ethiopia related to durable ceramics and (2) the ceramic body would add a

significant amount of mass to the BES, making it difficult to move around the home (often a preference amongst Ethiopian cooks). Currently ERG is working on another cookstove production program. This particular cookstove is a rocket style stove and is made from clay. The body is about 20 cm in diameter by 60 cm tall and 6 cm thick. ERG has had difficulties getting this body made so that it will not crack. ERG recently found a woman who is highly skilled at clay ceramics manufacturing, and her organization is making the cookstove bodies for 250 Birr each. ERG says that even if the body is made so that it will not crack, there are concerns about acceptance by women if they cannot easily move the stove around the home.

We discussed the price point of the BES and what might be a reasonable cost. ERG says that the market price for many low-quality “improved” cookstoves is around 200 Birr (\$11). ERG says that if the BES will be differentiated as a premium cookstove, it is not unreasonable for it to also command a premium price. Additionally, ERG’s intuition is that it will not be possible to manufacture the BES in its currently designed form for 200 Birr.

Aluminum casting is very common in Ethiopia and many small shops do it. Therefore, cast aluminum parts are generally inexpensive and easy to come by. On the contrary, there are only a few facilities in Ethiopia with the equipment necessary to cast steel, and therefore cast iron/steel is quite expensive. ERG suggests that, if possible, we consider casting out parts out of aluminum rather than steel. Due to the low melting temperature of aluminum, however, it is not currently feasible to consider aluminum for the grates or upper stove components since they will experience very high temperatures.

Another option for the fire grate and pot grate could be sheet metal components. Durable sheet metal (thick gauge and perhaps stainless) could be stamped and then folded or forged into the desired part.

ERG also mentioned that it is quite common for the thin aluminum flat-bottomed pots to deform with age. As women constantly stir the pot over high heat, it will bulge on the bottom and no longer rest well on a flat surface. Additionally, many traditional clay pots used for cooking shiro and similar sauces have a gently curved bottom. For this reason, ERG recommends that we change the pot grate design to slope inward and potentially reduce the number of “legs” on the spider grate to three to ensure a stable cooking surface at all times.

ERG believes that manufacturing the BES in Ethiopia will be the best path. It seems that imports are not easy or cheap in Ethiopia. Also, ERG believes that the governmental support gained from manufacturing and product for Ethiopia with Ethiopian people and resources will be valuable. These criteria focus on Ethiopia’s need for the product and the feasibility of making it in Ethiopia.

1.2. Feedback and quotes from Ethiopian shops for cast parts on the Berkeley-Ethiopia Stove.

Four manufacturers were visited and quotations for cast stove parts were requested.

A. Visit to Radel Foundry

Overall Impression: Good capabilities and quality, but likely to be expensive and Managing director was somewhat dismissive of our inquiries and seemed uninterested in performing the work.

Summary of Visit: Radel Foundry is a large (~ 5 acre) complex about a 30-minute drive outside of Addis Ababa. Radel's facility sits behind two large steel gates and is guarded by at least 3 professional-looking guards. The yard just inside the gates is covered with scrap steel (likely for later melting). We were ushered inside by a young woman and taken to the sales office. There, we spoke briefly with a young man who looked over our drawings of the pot and fire grate. He indicated that a 7 mm minimum dimension was not a concern, and he pointed out some well-made storm drain caps cast from steel and fitted with a "mesh" to prevent debris from entering. While waiting for the managing director to arrive, I spoke briefly with a friend of the managing director and a native of Minnesota. He said that Radel Foundry does good work, but that it is not the cheapest.

Soon, the managing director, an Italian national, met with us. He seemed somewhat aloof and uninterested in the project. We asked for quotes for 10, 100, and 10,000 pieces. He let us know that they would "get back to us with information about whether they wanted to pursue the project." His attitude may have been soured by a previous experience with a cookstove program that requested a quote for 10,000 parts, ended up only ordering 500, picked up and paid for the first 300, then left him sitting on the last 200. The managing director noted that Radel has a >3 week startup delay for any cast part.

Overall, Radel seemed like a very professional operation with good capabilities, but the managing director's attitude and the likelihood of a high quote do not build my confidence in Radel.

B. Visit to Pagrik Ethiopia PLC

Overall Impression: Low quality casting business seems like a short-term response to the fact that the Ethiopian government will not longer let them melt down lead from batteries and export it to India.

Summary of Visit: Pagrik Ethiopia PLC is about a 1-hour drive outside of Addis Ababa in the Kaliti region. We were not given an address, so we were looking out for two tall smoke stacks. Pagrik sits on a ~3 acre plot and is guarded by a unprofessional-looking man in a makeshift "security" perch above the facility's main corrugated-steel gate. When we got out of the car, I took a photo of the facility's "Office" sign, and was immediately told not to take photographs by a rather severe-looking man. We were taken into the office to speak with Puneet, who did not present a title, but seems to be in charge. Puneet, who

was difficult to communicate with due to poor Amharic and English comprehension, looked over our drawings with his “technical expert,” and they seemed concerned about the 7 mm dimensions and the general detail of the parts. We asked for quotes on quantities 100, 1000, and 10,000 parts. They showed us some of their example parts including decorative iron gates, manhole covers, and what look like iron hubs for wooden wagon wheels. These parts were not as well-manufactured as the parts we saw at Radel, and exhibited significant pitting at “over-run” where material seemed to spill over its intended mold.

After some convincing, Puneet agreed to show us his foundry. The facility was a single large open warehouse with a large pile of lead in the middle. Apparently, until recently, Pagrik had been disassembling batteries, melting down the lead, and exporting it to India. However, the Ethiopian government had recently shut them down. I doubt this was because of environmental reasons, and rather suspect it was due to the fact that the Ethiopian government wants valuable materials kept within the country. My suspicion is that, once Pagrik’s lead export business was shut down, they turned to casting parts.

Overall, I felt like Pagrik was not a very professional operation and that the quality of their parts, specially selected to show customers, would not be sufficient for the BES.

C. Visit to Kotebe Metal Tools Factory/Nigat Mechanical Engineering S.Co.

Overall Impression: Professional and well-managed place with kind and courteous staff. However, considering the volume of tools they manufacture, we might not be a large enough customer for them to get interested. Their industrial hygiene and safety seemed a bit questionable as well.

Summary of Visit: We arrived through the professionally-guarded iron gate of Kotebe Metal Tools Factory and were shown inside by a kind woman whose door tag read “executive secretary.” She showed us a poster of the kinds forged of tools that Kotebe specializes in making (shovels, hoes, rakes, axes, etc.), and asked us to wait until Aseged was ready to see us.

When we met Aseged, I found him to be a very humble, polite and well-spoken man. He was clearly very well educated in metallurgy, and we conversed for a while on the various casting recipes including silicon and carbon makeup and how that would affect flow during casting as well as corrosion resistance. Aseged seemed interested in the cookstoves project but somewhat unsure about the probability of a high-quality cookstove being marketable in Ethiopia. After our technical conversation, Aseged agreed to look over our drawings with his technical staff and have quotes for 50, 500, and 5000 back to us by the week of January 14th, 2013.

Although it was lunch hour, Aseged agreed to have his head technical staff person show us around the factory. I was impressed with Kotebe’s

capabilities. Their foundry featured a large induction furnace with two 500 kg crucibles. At the time, they were making ingots for forgings as well as anvils. The stamping and forging building was also very well-equipped. Their shop featured many very large and seemingly well-maintained pieces of equipment for stamping and forging. However, the floor of the forging facility was dirt and uneven, and considering the enormous power of some of the forging machines, I was not impressed with the level of safety precautions (slag in large piles, loose scraps laying around, dimly lit, and no personal protective equipment that I could see).

I was also interested to see that Kotebe had many punching machines. These machines are typically used to punch blanks for tools like shovels that will later be forged into a final shape. We might consider re-contacting Kotebe to see if they would be interested in manufacturing die-cut sheet metal components.

Overall, I found Kotebe to be by far the best of the foundries that we visited. The knowledgeable and personable staff, significant manufacturing capabilities, and their willingness to lend their time to our inquiries were all well-received.

D. Visit to Akaki Basic Metals

Overall Impression: Large government owned and operated manufacturer. Very large operation that is part of the METEC government consortium.

Summary of Visit: We met the managing director in his office and discussed our interest in fabrication of cast iron parts for the BES. He described Akaki's organization. Akaki was recently grouped into the METEC consortium of government run factories, with Akaki itself being comprised of 4 factories: one for machined parts, one is a cast iron foundry, the third performs non-ferrous castings, and the fourth is a steel processing facility. The director provided a tour of three of the factories, including where the forgings and castings are performed. Each of the factories is about 300 meters by 150 meters. We saw examples of sand casting and they said that they can also do investment casting. We discussed our stove grate parts. They said that 7 mm thickness castings would not be a problem for them and they do not have minimum quantity requirements.

We subsequently provided fabrication drawings of our stove grates for quotations.

1.3. Visits and quotes from Ethiopian shops for stamped sheetmetal parts on the Berkeley-Ethiopia Stove.

A. Visit to Selam Vocational School

Capabilities: Metal fabrication of many kinds including machining, sheet metal, welding, and forming. No casting capabilities.

Overall Impression: Selam is a great place with a meaningful mission of providing Ethiopian orphans with valuable vocational skills. Selam also seems to have great technical capability and know-how; they are not just a “feel good” place, and they seem to know how to get large jobs done.

Summary of Visit: We first met Tewodros “Teddy” in Selam’s main office. There, we reviewed technical drawings with him and one of the technical staff members. For the purpose of this visit, we assumed that the body of the cookstove might be made from two layers of sheet metal stuffed with an insulating material. Based on the drawings provided, Teddy showed us around the facility and had us meet with the correct technical staff person for each manufacturing challenge.

Selam has impressive technical capabilities. The school has a full range of modern machining equipment, welding tools, sheet metal forming machines, and stamping machines. Additionally, the young men working on the machines all seemed competent and trained in proper technical and safety techniques. In general, the people working and going to school at Selam seem happy and well-adjusted.

One of the primary manufacturing challenges that Selam identified was the length of the sheet metal firebox and/or stove body components. The largest die punch at Selam has a table width of approximately 60 cm. The firebox has a width of 57 cm, and if the body were to be made from concentric sheet metal components, the “outer body” would have an overall length of about 85 cm. Selam was uncertain of their ability die cut parts this large. Cutting a 85 cm part from a larger sheet would require a die almost a meter long, and the cutting forces would likely deform the die on a 60 cm table. One way of getting around this is to cut the shapes to their “perimeter” size, and then use a combination of small dies and stops to cut specific features into the part. For example, the three “ports” for the fire grate’s tabs would all be cut with the same die but with the material in a different position.

Selam said they would take a closer look at the sheet metal components and have quotes for 50, 500, and 5000 parts back to us by the week of January 14th, 2013.

Overall, we found Selam a very pleasant, capable, and happy place. Selam seems like they can “walk the walk” of getting quality manufacturing work done while still having a bigger vision and purpose. I would be excited about working with Selam.

B. Visit to Vonall

Visit Date: 11 JAN 2013

Capabilities: Sheet metal work (mild steel, stainless, and aluminum) including MIG and TIG welding. Lathe work.

Overall Impression: Nice place that does high-quality custom counters, fume hoods, and welded boilers/pressure vessels. However, the high-dollar small-quantity jobs that I saw in the shop made me concerned about their ability to make 5000 parts inexpensively.

Summary of Visit: We spoke first with Mr. Terfaye who took a look at our engineering drawings. We assumed for the sake of this visit that the body of

the stove would be made out of concentric layers of mild steel. Mr. Terfaye did not seem concerned with any of the drawings and soon took us on a tour of his shop. We asked him for quotes for 50, 500, and 5000, and he said he would get back to us soon.

There were about 15 happy employees in the workshop busied with a variety of sheet-metal related tasks. It looked like they were making some decorative countertops as well as some large vessels for brewing alcohol. The tools in the shop all seemed well-maintained and the employees well-disciplined. However, there was lot of scrap sheet metal lying around on the ground, and it was somewhat difficult to navigate the place.

Vonall has all the tools necessary to make the sheet metal parts of the Berkeley-Ethiopia Stove. However, they will have the same problem with large parts/small presses that Selam would have. Vonall came to the same conclusion that multiple smaller dies and punching operations would be the way around this problem.

Vonall seemed like a shop that was more dedicated to sheet metal work than Selam, however, they seemed to be doing mostly high-dollar small-quantity jobs. This concerned me somewhat because I wondered if the shop would be able to deliver our parts at prices that would make the final cookstove's price competitive.

Overall, I found Vonall to be a professional operation. I would be happy to partner with them, but if quotes between Selam and Vonall were the same price, I think Selam has a better vibe and story to tell.

Quotations

Table assumes an exchange rate of 18.43 Ethiopian birr to 1 US Dollar.

Cast iron parts (grate and stove top):

	Component	Quotation (Birr)	Quotation in US\$	Notes
Radel Foundry	grate	1680	\$ 91.17	for qty 50
Radel Foundry	grate	1470	\$ 79.78	for qty 500
Radel Foundry	grate	1250	\$ 67.84	for qty 5000
Radel Foundry	stove top	2050	\$ 111.25	for qty 50
Radel Foundry	stove top	1740	\$ 94.43	for qty 500
Radel Foundry	stove top	1480	\$ 80.32	for qty 5000
Pagrik Foundry	grate and stove top	No bid		
Nigat (formerly Kotebe)	grate and stove top	No bid		
Akaki/METEC	grate and stove top	No bid		

Sheet metal parts:

	Component	Quotation (Birr)	Quotation in US\$	Notes
Selam	sheetmetal parts (SS firebox parts, 0.75mm mild steel for others)	2696.75	\$ 146.35	per stove regardless of quantity
Vonall Com	sheetmetal parts (SS firebox parts, 0.75mm mild steel of others)	350.75	\$ 19.04	for qty 5000 with die cost included
Vonall Com	sheetmetal parts (SS firebox parts, 0.75mm mild steel of others)	388.7	\$ 21.09	for qty 500 stoves, die cost not included
Vonall Com	die for stoves	27000	\$ 1,465.29	die cost for 500 stoves

Raw material prices:

	material	area	cost (Birr)	cost (US\$)
firebox tunnel	stainless	0.02238	39.165	\$ 2.13
firebox	stainless	0.12916	226.03	\$ 12.27
stove body	mild steel	0.18175	36.35	\$ 1.97
second stove body	mild steel	0.21325	42.65	\$ 2.31
total			344.195	\$ 18.68

Initial visits to manufacturers in Autumn 2012 had been promising; Akaki stated that they can certainly make the cast iron grates if they were at least 7 mm thick and gave reasonable costs for other similar-sized parts that had previously fabricated. However, upon supplying drawings and asking for formal quotations only 1 manufacturer out of 4 ultimately provided quotations on the cast iron parts. The costs were extremely high, even for a quantity of 5000 units.

Manufacturers for the sheetmetal parts were also encouraging during initial visits in Autumn 2012. After supplying drawings, we received quotations from 2 manufacturers. Upon receiving Selam's very high quotation we contacted them and confirmed the quote in case there was a misunderstanding of materials, sizes or quantities. The re-confirmed their quotation. Vonall's quotation was in-line with general expectations with the exception of the high cost for firebox parts. Upon receiving Vonall's quotation ERG investigated the cost of raw materials for the parts, based on the areas for each part. They confirmed that the main driver of the considerably higher cost for the firebox and firebox tunnel was due to the very high cost of stainless steel. In Ethiopia, stainless steel is almost 9 times higher in cost compared to mild steel as compared to 4 to 6 times for other countries.

Based on quotations received, the lowest cost for manufacturing stove parts is US\$167 per stove for a quantity of 5,000 units. Stove assembly and packing costs need to be added to the parts cost for a complete manufacturing cost per stove.

Since importing small quantities of stoves will be several times lower cost than in-country manufacturing, we are planning to import small quantities of stoves for market trials. After the market trial phase we anticipate transitioning to in-country stove assembly using imported kits, then moving to altering the supply chain in a phased manner so that different stove parts are manufactured in-country instead of imported. Sheetmetal parts made of mild steel will be the first components to switch to in-country manufacturing, followed by stainless parts. The grate is the most challenging component to manufacture in-country and will most likely be the last stove component to transition to in-country manufacturing. Some part redesign may be needed in order to accommodate in-country manufacturing conditions but over the long term we aim to have 100% of the stove manufactured and assembled in Ethiopia.

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #6 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

July 2013



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, Sudan
IC	Impact Carbon
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLF	Slow Life Foundation
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
VGS	Voluntary Gold Standard
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13
Milestone No.	1	2	3	4	5	6
Indicator						
Total population with access to FES in targeted communities in Darfur	121,656	134,856	134,856	134,856	164,856	194,916
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A	N/A	N/A	57
Geographical distribution of FES in Darfur	(see chart)					
Geographical distribution of FES in Ethiopia	(see chart)					
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	32,486
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10
CO2 Equivalent mitigated (tons) mitigated by using FES instead of traditional methods	41,298	56,868	56,868	56,868	73,803	78,613
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A	N/A	N/A	N/A	N/A
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A	N/A	N/A	N/A	N/A

Figure 1 below shows a graphic representation of the population with access to fuel-efficient stoves in targeted communities in Darfur.

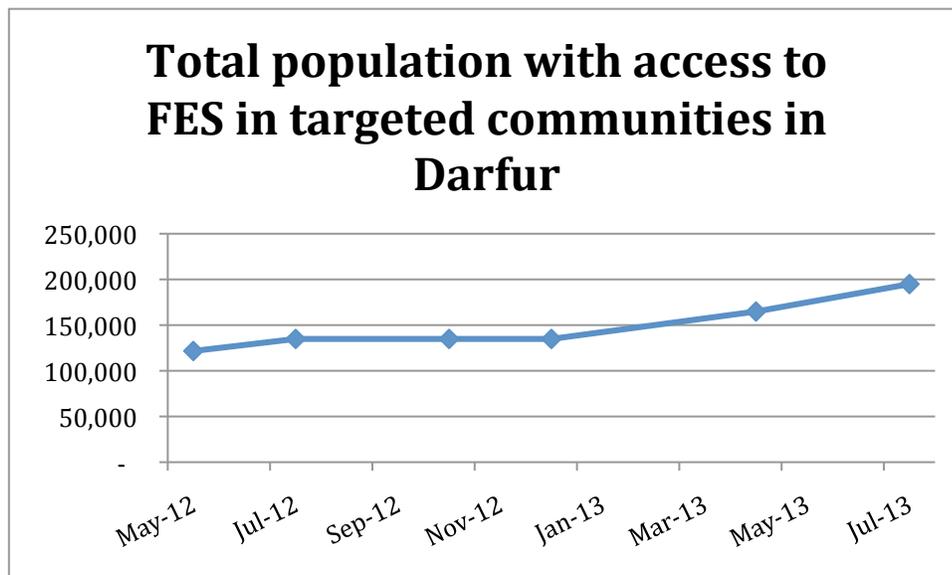


Figure 1: Population with access to fuel-efficient stoves in Darfur

Methodology for measuring indicators

We report 100% customer satisfaction in Darfur based on four factors:

- a) The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
- b) A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.
- c) The fact that no one has returned any of the 5,000 stoves that have been sold this year, and they continue to make payments.
- d) Preliminary data from our pilot of Stove Use Monitors (SUMS) in Darfur in July 2013. We found all 10 households who had sensors on their stoves used the stove for several hours per day. We discuss the findings from the pilot in greater detail below (see Summary of Achievements since last report and Milestone #8).

We calculate tons of CO2 equivalent offset in the following way:

We assume each stove offsets 1.485 tons of CO2 equivalent per year (based on laboratory testing conducted at the Lawrence Berkeley National Lab). To be conservative, we assume that 4% of people who purchase (or receive for free) their stove never use it, and that from the remaining 96% that do use it, an additional 10% stop using it after each year (this is much more conservative than actual usage rates we have found through our impact

surveys). When we issue credits via the Gold Standard, we will have an external, independent assessment of how we should be discounting stove use over time. However, in the meantime, we are trying to be conservative in our assumptions so as not to inadvertently overstate our impact.

Table 2: Geographic Distribution of FES in Darfur

Note: Rows highlighted in **yellow** show stoves distributed since last Milestone Report

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash

4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSC	14	2013	Installments
2013 A	North	Kebkabiya	0	KWD	14	2013	Installments
2013 A	North	Dar es Salam	300	DAD	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DRA	14	2013	Cash
2013 A	North	Kutum	120	NIC	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVN	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DRA	14	2013	Cash
2013 B	North	Data being checked for quality assurance	4892		14	2013	Free
TOTAL			32476				

Table 3: Geographic Distribution of FES in Ethiopia

Batch	Region	Location	#
2013A	Oromia	Sebeta	5
2013A	Oromia	Meki	5

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Since our April 2013 Milestone Report, we distributed 5,000 stoves in Darfur and 10 “sample” stoves in Ethiopia, bringing the total number of stoves distributed 10,010 in 2013 and 32,486 in total.

The purpose of the small-scale Ethiopia distribution was to gain feedback on willingness to pay for stoves. We held three auctions in our trial sites of Sebeta and Meki, where we found that as in Sudan, the women in Ethiopia expressed a greater willingness to pay for stoves if they have the option of paying in installments. The highest bids were 150 birr for cash (almost \$8) and 200 birr for installments (\$10.50). The auctions were held at the end of focus group discussions, in which we gathered feedback on the stove design and user preferences and our new “cool mesh” design feature (which is on the Ethiopia as well as the Darfur version of the stove). We learned that the women appreciate the cool mesh feature. In the words of one focus group participant, “I like that the exterior does not get hot so I won’t have to worry about my children getting burned when they cook. The bright orange color also makes the stove more visible so my younger children will not trip over the stove.”

In Darfur, our focus has been on rolling out our evaluation of stove usage using small sensors. We implemented a preliminary study with 12 sensors placed on 10 stoves for four days. The purpose of the preliminary study – in which we observed 101 cooking events - was to test our systems so that we identify any flaws before the larger rollout with 190 sensors (which is now in process). The preliminary study confirmed that:

1. SUMS programming was successful
2. the maximum temperature the sensors can read will not be a constraint
3. the team can effectively install and collect the sensors
4. the team can correctly upload the data and transmit it to Berkeley
5. the algorithm created accurately interprets the data

While the primary purpose was to test our systems, the data that was collected is illuminating. We found that all 10 stoves distributed were used – for an average of 3 hours and 46 minutes per day and an average of 2.375 cooking events per day. Seven of the women started using their new stove the day they received it and three started using it the second day. All the women continued to use the stove until the sensors were removed four days after the stove distribution. Now that we have confirmed the process works smoothly, we are rolling out 190 sensors on 170 stoves, which will collect data over the next four months.

Below we discuss progress made against the specific milestones outlined in our fixed obligated grant agreement. In addition, we have added a milestone update related to the rollout of the Stove Usage Monitoring System in Darfur, which provides more details about the results of the pilot test and next steps.

MILESTONE UPDATES: July 31, 2013

1. Recruit and Train Local Sales Agents (Darfur)

All local sales agents in Darfur have been recruited and trained. We have recruited a sufficient number of sales agents to meet our forecast distribution of 15,000 stoves this year.

While we have completed training sales agents on the benefits and proper usage of the stove, we continue to provide training about managing the revolving loan fund that we are establishing with support from the Global Alliance for Clean Cookstoves. During the week of July 22, 2013, Potential Energy convened a workshop for the participating Community Based Organizations and Women's Development Associations. The participating groups elected a steering committee for the revolving loan fund composed of leaders from each organization. The CBOs at the meetings agreed that if any CBO performs poorly, they will not be eligible to participate in the future. The training also covered reinforcing messages at the customer-level so that users understand that the stove saves them money so that they should have that money to pay their installment payments. The ultimate result of these customer trainings is to convey that once the stove is paid back they will have savings that they can use to acquire assets or start income-generating activities. The steering committee will also be making suggestions on what kind of training is needed.

2. Expand sales based on findings from marketing trials (Darfur)

We have distributed 5,000 stoves since our last Milestone Report in April 2013. Based on our learning from our 2012 trial (in which we sold 640 stoves), in 2013 we began selling stoves in Darfur on a larger scale. We obtained permission from the Government of Sudan's Humanitarian Aid Commission to sell 50% of the 10,000 stoves we distributed from January – June 2013. Thus, we sold 5,000 stoves and distributed 5,000 for free in the first half of 2013.

3. Replicate assembly shop (West Darfur)

We have put on hold our plans to replicate our assembly shop, for two reasons:

1. We have not yet reached maximum capacity in North Darfur assembly shop
2. There have been recent violent clashes in West Darfur, leading us question whether we could assure the safety of our personnel in the area and the security of our inventory.

4. Build distribution channels (West Darfur)

There is still evidence of demand for the stoves in West Darfur, so we are testing the market there on a small scale to prepare for the possibility that the violence there will subside and we will be able to expand our efforts in the area. Through one of our distribution partners, Darfur Development and Reconstruction Agency, we distributed 300 stoves in West Darfur this year as an initial entrée into the market.

5. Coordinate Stove Production, Assembly, Distribution (Darfur)

In addition to the 10,000 stoves distributed since January, our manufacturer has produced another 5,000 flat-kits and shipped them to Port Sudan. These flat-kits arrived in July and will be assembled this summer and distributed before the end of the year. We have obtained permission from the Government of Sudan to sell 70% of these stoves (and distribute 30% for free). Will make 15,000 stoves this year.

A major focus for the capacity building of our local partner, Sustainable Action Group (SAG), has been helping them establish organized documentation of stove sales. We have created a documentation guide and trained SAG's staff in completing the forms.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

As described in our previous milestone report, we are still in the planning stages for the randomized control trial in Ethiopia. As a first step, we tested out willingness to pay and gathered feedback on a small sample of stoves.

Thus, in July 2013, ten fully-assembled Berkeley-Ethiopia Stoves were shipped to Ethiopia in order to gather women's feedback and conduct willingness-to-pay exercises with potential customers. These stoves included the new "cool mesh" design coated in bright orange paint which addresses feedback we received regarding the stove's attractiveness as well as burn prevention. In addition to the readjusted pot-rods that hold the traditional Ethiopian coffee pot, these stoves included an ash pan and coffee roasting tray.



Berkeley-Ethiopia Stove with colored cool-mesh, ash pan and coffee roasting tray.

PE's Associate Director and Field Representatives brought these sample stoves to four areas in the Oromia region of Ethiopia: peri-urban Sebeta, rural Sebeta, peri-urban Meki and rural Meki.¹ In each area, our contacts at the local energy bureau gathered a group of women in the community at one household (usually the head of a local women's group). At each site, the PE team conducted a stove demonstration, which included preparing a meal of the staple food, *shiro wot* on a Berkeley-Ethiopia Stove alongside an open fire in order to compare fuel consumption, cooking time and smoke emitted. In addition, a local woman was asked to prepare coffee on a second Berkeley-Ethiopia Stove to demonstrate the stove's versatility. These women were not paid to participate in the demonstration. However, PE paid for the firewood, *shiro wot*, coffee and sugar so that everyone participating received a free meal. While enjoying the meal and coffee, a focus group discussion was conducted (please see below for the focus group questions provided by UC

¹ These sites, all located within the Oromia region of Ethiopia, were recommended by SNV-Ethiopia which operates biogas projects in these areas and has already established relationships with the local energy bureaus and familiarity with these communities.

Berkeley PhD candidate and CEGA affiliate, Angeli Kirk). Finally, one of two willingness-to-pay exercises was conducted (also provided by Angeli Kirk):

Option 1: The individuals in a group have the option to bid on the cookstove during a demonstration meeting. After speaking about the cookstove and giving a cooking demonstration, each woman is asked to write down how much she would be willing to pay to keep the cookstove. (Or two numbers, how much she would be willing to pay as a lump sum, and how much she would be willing to pay over a set of installments.² The woman with the highest bid wins the cookstove, but she only has to pay the second-highest bid value (which is explained in advance), over the number of installments announced. The women are told that they will only have to pay the second-highest price, so that they can say their real valuation without any incentive to play the game of trying to put down something lower than their actual valuation but higher than they think the next person will bid.

Option 2: After holding a demonstration meeting, allow the members of the group each to take turns with a trial with the cookstove for 2-3 days. Then either have a follow-up meeting where everyone makes a bid or simply collect a bid when you collect the cookstove to pass to the next home. You could even ask them to say what they think it might be worth before the trial (knowing there will still be an auction, so what they say isn't binding), and then see if this changes after they use it. Again, the highest bidder pays the second-highest price and keeps the cookstove.

The team conducted demonstrations, focus group discussions and Option 1 in rural Sebeta and rural Meki. The demonstration, discussion and Option 2 were conducted in peri-urban Sebeta with two stoves.³ A demonstration and discussion were held in peri-urban Meki without holding an auction.⁴

Auction Results: Out of the exercises conducted, the highest bids were 150 ETB to pay for the stove up front (~\$8) and 200 ETB to pay for the stove in four installments (~\$10.50). In both cases where Option 1 was conducted, the winners paid 100 ETB (~\$5.25), which were the second highest bids. Our Field Representatives will return to peri-urban Sebeta, where Option 2 was conducted this week to follow-up with the women who have had a free trial with the stove in order to receive their bids.

Focus Group Discussion Questions:

1. Where do you do most of your cooking/baking? What share of the time/meals do you cook here?
2. In what other locations do you sometimes cook/bake? What share of the time/meals do you cook/bake here? Why do you sometimes use these locations instead of the main one?
3. What kinds of cookstoves are currently present in your house?

² Based on four installments, which is what the women were already familiar with through a government-supported *Mirt* (injera-baking cookstove) program.

³ Because Option 2 required returning to the site for a follow-up visit ten days later, peri-urban Sebeta was selected because it is the closest to Addis Ababa. The other three sites are at least a 90 minute drive from the capital.

⁴ The team decided not to hold an auction in peri-urban Meki. Several of the women left early in the demonstration because it was held on a Saturday, which is also market day in Meki. Of the two women who remained for the entirety of the demonstration and discussion, both emphasized their interest in charcoal stoves.

4. Which cookstove do you use the most often? Why? Least often?
5. How frequently do you have more than one cookstove (including three-stone) lit at the same time?
6. When do you have more than one cookstove lit? (For example, on days when making injera, on holidays when making multiple dishes, etc.)
7. How often are there injuries related to cooking? What are the primary causes? What about injuries related to fuel collection or preparation?
8. Do you experience health problems that you associate with cooking/baking? How common/serious are these? Is this different at different ages?
9. Which fuels do you use the most? Rank these. Which fuels do you prefer to use? Why?
10. In purchasing a new cookstove, which characteristics are most important? Please rank these.
11. If there is a new cookstove for sale, who in your household could make the decision to buy it?
12. Heating for you home: Please describe how/when/where you heat your home.

These focus group questions helped us to determine that two of the four sites were better-suited for the Berkeley-Ethiopia Stove. The other two primarily used charcoal for non-*injera* cooking and even electricity.

7. Develop local manufacturing capacity (Ethiopia)

Our Ethiopia Field Representatives are currently exploring three options for the next 400 Berkeley-Ethiopia Stoves:

- 1) Import flat-kits from India and have them assembled in Ethiopia (by our Field Representatives)
- 2) Import the one or two most expensive stove parts (cast iron grate and stainless steel firebox) and manufacture the rest of the stove in Ethiopia
- 3) Fully manufacture the stove in Ethiopia

This decision will be finalized by September 1, 2013. Our Field Representatives are currently working with local manufacturers to try to replicate the stove to identify challenge areas. In conjunction, they are speaking with our collaborators at the Lawrence Berkeley National Laboratory and our stove manufacturer in India, Shri Hari Industries, to price and acquire the necessary assembly equipment that they will need for any of the above options.

8. Employ Stove Usage Monitors to measure effectiveness (Darfur)

In Darfur, we are placing small sensors on a subset of the stoves we distribute over the next few months. This evaluation, known as the Stove Use Monitoring System (SUMS), seeks to answer the following questions:

- Are our stoves being used?
- How frequently are they being used?
- How are they being used?
- Do surveys produce consistent and similar results as measurement?

In early July, we conducted a pilot study that collected data over four days for 10 stoves (with 12 sensors and two “dummy sensors;” several stoves were outfitted with more than one sensor). After 102 hours of data collection, 101 cooking events were observed for the 10 stoves. The pilot study affirmed that our goals for the larger study are attainable. A major factor in this was assessing the experimental limitations. The iButton sensors were programmed such that the maximum temperature that can be recorded is 140 C and the maximum sampling cadence is 15 minutes. Through the preliminary study, we determined that this set up is adequate and will not deteriorate the integrity of our results.

After collection and analysis, our initial results predict a positive outcome for the full deployment and have given us preliminary data to analyze. The data showed that all 10 of the households adopted the BDS; however, 3 did not begin using their stoves until the second day (but continued to use is throughout the rest of the collection period). The stoves were all used with varying frequency, some women using their stoves more than others. The median number of cooking events on average was 2.375 events per day.

The stoves were also used for variable durations of time with one woman using her stove for a an average of 9 hours and 53 minutes per day and another using hers an average of 1 hour and 29 minutes per day. The median of average daily cooking time was three hours and 46 minutes.

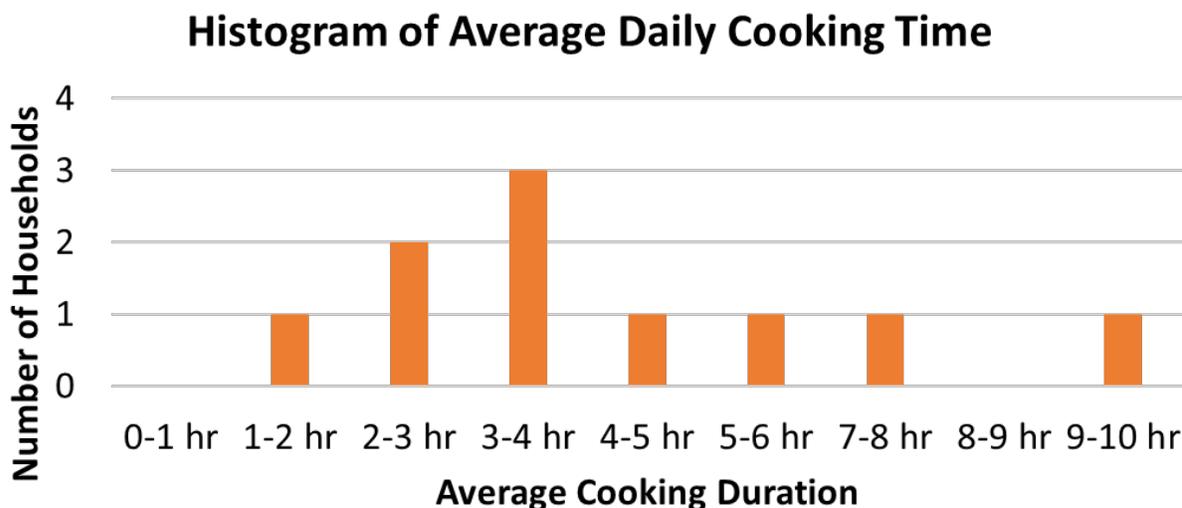


Figure 2: Average Daily Cooking Time

Looking at Figure 2, we see the beginnings of a Gaussian distribution for the average cooking duration and expect greater precision with 190 SUMS. Breaking down the total cooking time for one day into duration of cooking events, we see that different types of meals are being made.

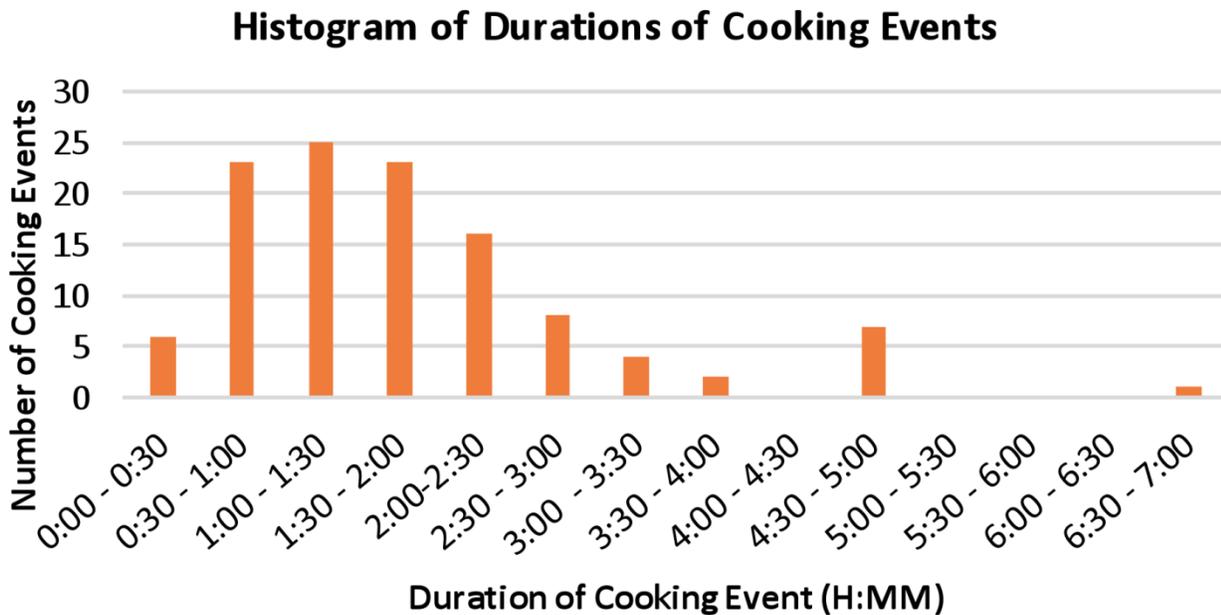


Figure 3: Duration of cooking events

Once again, we see the forming of a Gaussian distribution and expect one with sample size larger than 101 cooking events.

For all of the data sets, we observed only 1 out of 101 cooking events that surpassed the 140 C temperature limit. This allows us to conclude that the limit will not diminish the integrity of our experiment. In addition, no events were shorter than 15 minutes in duration, the shortest being 25 minutes. Therefore, we predict that our maximum sampling cadence of 15 minutes will allow us to detect every cooking event.

The full SUMS deployment will be over a 3-month period and collect data from 170 stoves. This study will feature 2 iButton sensors on each stove where 190 will be activated and 448 will be inactive. The sensors can hold a total of 8192 data points and are programmed to have different sampling cadences in order to simultaneously collect data over a long duration of time and at a higher frequency. This will allow us to get a view of the full spectrum of cooking events while maintaining a large sample size. After each sensor has been filled to maximum capacity with data, it will be immediately collected and a survey will be administered. The survey’s content will cover the households cooking habits over the testing period and be compared to the SUMS results.

Daniel Wilson (UC Berkeley Mechanical Engineering PhD candidate) travelled to Ethiopia in mid-July to train our Sudanese partners to implement the study.

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #7 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

October 2013



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
IC	Impact Carbon
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLF	Slow Life Foundation
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
VGS	Voluntary Gold Standard
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard

Date Milestone No.	May-12 1	Jul-12 2	Oct-12 3	Dec-12 4	Apr-13 5	Jul-13 6	Oct-13 7
Indicator							
Total population with access to FES in targeted communities in Darfur	121,656	134,856	134,856	134,856	164,856	188,856	194,856
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A	N/A	N/A	57	57
Geographical distribution of FES in Darfur	(see chart)	(see Figure 1)					
Geographical distribution of FES in Ethiopia	(see chart)	(see Figure 2)					
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10
CO2 Equivalent mitigated (tons) by using FES instead of traditional methods	41,298	56,868	56,868	56,868	66,643	70,111	70,978
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A						
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A						

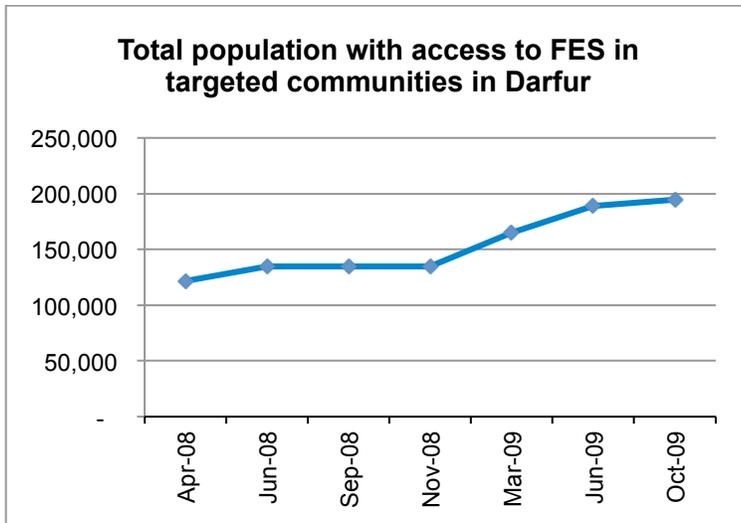


Figure 1: Total population with access to FES in targeted communities in Darfur

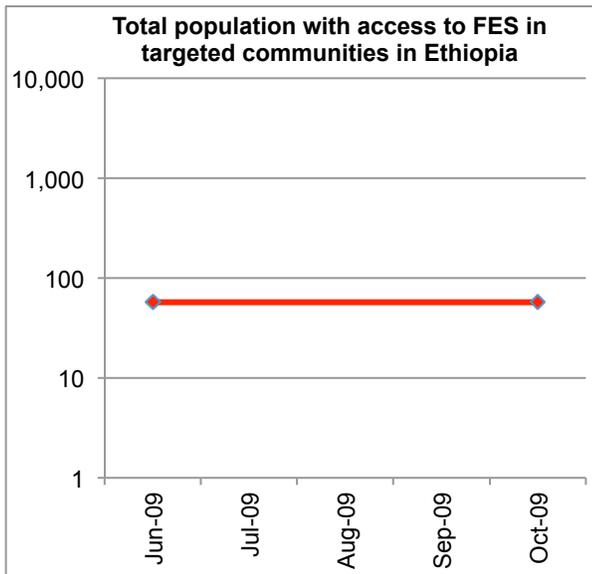


Figure 2: Total population with access to FES in targeted communities in Ethiopia

Notes on Indicator Dashboard

A) We continue to report 100% customer satisfaction in Darfur based on:

1. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
2. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.

3. The fact that no one has returned any of the stoves that have been distributed this year, and those who purchased them continue to make payments.
4. However, it should be noted that following analysis of the recently collected data using Stove Use Monitors (SUMs), this figure will change and will be noted in future Milestone Reports. As an organization that values transparency as well as learning, we look forward to these results to further improve our work.

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

C) We calculate tons of CO2 equivalent offset by assuming each stove offsets 1.485 tons of CO2 equivalent per year (based on laboratory testing conducted at the Lawrence Berkeley National Lab). To be conservative, we assume that 4% of people who purchase (or receive for free) their stove never use it, and that from the remaining 96% that do use it, an additional 10% stop using it after each year (this is much more conservative than actual usage rates we have found through our impact surveys). When we issue credits via the Gold Standard, we will have an external, independent assessment of how we should be discounting stove use over time. However, in the meantime, we are trying to be conservative in our assumptions so as not to inadvertently overstate our impact

Table 2: Geographic Distribution of FES in Darfur

Note: Rows highlighted in yellow show stoves distributed since last Milestone Report

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free

4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
TOTAL			32476				

Table 3: Geographic Distribution of FES in Ethiopia

Batch	Region	Location	#
2013A	Oromia	Sebeta	5*
2013A	Oromia	Meki	5
2013A	Oromia	Debre Zeit	1*

*One stove that was on loan in Sebeta was returned and taken to Debre Zeit for stove demonstrations

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Below we discuss progress made against the specific milestones outlined in our fixed obligated grant agreement. In addition, we have updated the milestone that relates to the rollout of the Stove Usage Monitoring (SUMs) system in Darfur.

Since our July 2013 Milestone Report, we distributed 4,892 stoves in Darfur, bringing the total number of stoves distributed in Darfur in 2013 to 9,892. In Ethiopia we have not distributed additional stoves since our last report, as we put into place our manufacturing, distribution and evaluation plan while our 600 stove flat-kits for our marketing trial are produced in Mumbai. We are on track to distribute a total of 15,000 stoves in Darfur by the end of this year, which will bring our total number of stoves distributed to 37,486. It should be noted that while our total number of stoves distributed in Darfur remains the same, we have revised the Indicator Dashboard (noted in red) above based on updated records provided to us by our partner in Sudan, Sustainable Action Group. We should emphasize that the number and location of stoves distributed is accurate but were reported in our previous Milestone Report when the stoves were allocated but not yet delivered or documented. In this Milestone Report, we detail our capacity building efforts with Sustainable Action Group to improve the stove tracking and reporting process.

MILESTONE UPDATES: October 31, 2013

1. Recruit and Train Local Sales Agents (Darfur)

All local sales agents in Darfur have been recruited and trained. We have recruited a sufficient number of sales agents to meet our forecast distribution of 15,000 stoves for this year. While we have completed training sales agents on the benefits and proper usage of the stove, we continue to provide training about managing the revolving loan fund that we are establishing with support from the UN Foundation's Global Alliance for Clean Cookstoves. Also emphasized in the training were the environmental and health benefits of the stove and encouragement to phase out old inefficient stoves upon purchase of the Berkeley-Darfur Stove. Updated training material was introduced to the community-based organizations (CBOs) to share with their on-the-ground retailers to deliver to stove owners. The ultimate goal of the updated material is to emphasize the efficiency of the stove and encourage users to utilize it more and eventually phase out older more harmful and less efficient stoves/open fires for better health, economic and environmental results.

2. Expand sales based on findings from marketing trials (Darfur)

We have distributed 4,892 stoves in Darfur since our last Milestone Report in July 2013. Based on our learnings from our 2012 marketing trial in which we sold 640 stoves, in 2013 we began selling stoves in Darfur on a larger scale. We obtained permission from the Government of Sudan's Humanitarian Aid Commission to sell 50% of the stoves we distributed from January – June 2013. The Commission supported this shift in strategy as they understand the stove has demonstrated exceptional economic, health and environmental value and demand has been rising from different communities and segments of society. The Commission was supportive of

our efforts to support our local partner, Sustainable Action Group in establishing more sustainable operations while marketing to a larger target market. With the other 50% of the stoves during this time period, we continued with free distribution to those who were deemed fit by local community leaders.

Our Sudan Field Representative and SAG have since spoken with the Commission to increase the percentage of stoves sold versus distributed for free (detailed below in Milestone 5: Coordinate Stove Production, Assembly and Distribution). Due to high inflation rates resulting from Sudan's economic volatility, the net revenue for SAG per unit has lowered significantly since the beginning of the year. It will become imperative to increase the number of stoves sold to increase the sustainability of their operations.

3. Replicate assembly shop (West Darfur)

We continue to put our plans on hold to replicate our assembly shop, for two reasons: 1) We have not yet reached maximum capacity in our North Darfur assembly shop and 2) there have been recent violent clashes in West Darfur, leading us to question whether we could assure the safety of our personnel in the area and the security of our inventory. Nonetheless, as both South and West Darfur seem like promising areas for expansion due to the similarity in cooking habits and climate we have started outreach for new partnerships. To reach out we have leveraged our contacts in North Darfur and Khartoum to guide us into quality partnerships. Furthermore, we are in the process of signing a Memorandum of Understanding (MoU) with different government agencies, including Sudan's Higher Council for Environment and Natural Resources (HCENR), the Forest National Corporation (FNC), and the National Energy Research Center (NERC), which pledged to assist us in the expansion of our program. Their technical and research assistance will enable us to pinpoint the most suitable partner outside of North Darfur, so that we may begin assembly and distribution outside of North Darfur.

4. Build distribution channels (West Darfur)

As referenced in our previous report, one of our distribution partners, Darfur Development and Reconstruction Agency (DARA), distributed 300 stoves in West Darfur this year as an initial entrée into the market. Based on this introduction of the stove, there is evidence of demand in West Darfur so we are testing the market there on a small scale to prepare for the possibility that the violence there will subside and we will be able to expand our efforts in the area. We have also been contacting rural development centers that could identify possible partners in other Darfur states. We will continue to scout for new partners and test out the markets. Our outreach entails inquiring from potential partners about the market size in IDP camps, rural and urban parts of West Darfur where wood is the primary fuel. We are also determining whether there are strong CBO networks that can reach communities and assist in supporting the process of collecting installment plans. In 2014, we will continue to focus on an assembly and distribution plan for West Darfur with a constant eye on security to support a safe expansion.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

In addition to the almost 10,000 stoves distributed since January, our manufacturing partner in Mumbai produced another 5,000 flat-kits and shipped them to Port Sudan. These flat-kits arrived at the end of July and assembly began in late October. The reason for this delay was that the kits arrived shortly before the holy month of Ramadan, which led to many delays due to shortened work hours and two major national holidays. Additionally, the bill of lading form was mistakenly sent from the stoves manufacturer in the name of Oxfam America instead of Sustainable Action Group (SAG), although Oxfam America is no longer directly involved in the stove supply chain process. This caused additional delays until SAG was able to retrieve the kits from the port. Further delays resulted from infrequent transportation schedules between Khartoum and El Fasher due to the volatile security situation. However, assembly of these 5,000 flat-kits is currently underway and all 5,000 stoves will be distributed before the end of this year.

We have obtained permission from the Government of Sudan to sell 70% of these 5,000 stoves (and distribute 30% for free), which will result in a total of 15,000 stoves distributed in Darfur in 2013.

A major focus of our capacity building efforts with SAG has been helping them establish organized documentation of stove distribution. We created a documentation guide and trained SAG's staff in completing the forms that we created. Since July, the team has engaged with SAG to improve tracking, which has resulted in a growing database of stove tracking records.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

We are currently finalizing evaluation plans for our trial that will launch in early 2014. PE and its partners will conduct a rigorous evaluation of sales and usage promotion strategies in order to explore the use of low-cost complementary mobile technologies to boost adoption rates, and the impact of improved cookstove usage on women and their families. This research will provide data to effectively address Ethiopia's current lack of customer demand "attributed to product gaps, ineffective marketing, high prices, and limited distribution networks," (Accenture, 2012). The incorporation of mobile technology offers a second bonus, providing a new source of high-frequency data to complement traditional survey methods. In addition to contributing proven methodologies to Ethiopia's national cookstove efforts, the research conducted during the marketing trial of the Berkeley-Ethiopia Stove will serve as a case study for the entire cookstove sector, testing forward-looking practices for marketing, user support, and ongoing measurement-based learning.

PE and our partner/Ethiopia Field Representatives, Ethio-Resource Group (ERG) are working together to balance the twin goals of widespread, long-term usage of beneficial technologies and operational sustainability. In addition, we are now in the process of forming a new partnership with the mobile accounting firm InVenture, which will incorporate technologies that support these objectives through low-cost marketing/information diffusion as well as provide new opportunities for global learning about the dynamics of cookstove adoption.

The marketing trial will provide important feedback on uptake of the Berkeley-Ethiopia Stove resulting from 1) application of a low-cost mobile accounting service to boost demand (and willingness to pay) by improving personalized predictions of savings, and 2) differing timing and intensity of follow-up services. This feedback will enable us to focus on the most effective strategies as we scale up from our marketing trial. Over time, evidence showing the determinants of widespread cookstove adoption and the ways that women using clean cookstoves make use of their time and money savings, while also advancing the current state of knowledge for data collection in cookstove research, will strengthen the cookstove sector as a whole.

With a commitment to building stronger evidence on the interactions between women and improved cookstove technologies, the proposed study (designed by UC Berkeley PhD candidate in Agriculture and Resource Economics, Angeli Kirk) will investigate:

- **(Component 1) Impacts of mobile accounting technology on cookstove purchase rates:** impacts on adoption rates of enrollment into a low-cost mobile accounting program prior to participation in a free cookstove trial with new cookstove owners in their community;
- **(Component 2) Impacts of mobile outreach on cookstove usage after purchase:** impacts of mobile reminders and usage tips on measures of sustained usage;
- **(Component 3) Impacts of stove use:** impacts of cookstove usage on women and their households' firewood consumption, time use and a range of measures such as expenditures on food and assets, comfort in one's cookspace, and perceived changes in smoke-related irritation;
- **(Component 4) High frequency mobile data verification:** validation and calibration of standard low-frequency, survey-based, self-reported data on high-priority household outcomes compared to high-frequency mobile-based data, to learn how to reduce bias in assessments of cookstove impact and;
- **(Component 5) Objective sensor-based usage data verification:** validation and calibration of self-reported data on stove usage compared to objective temperature-logging sensor data, (using SUMs) to learn how to reduce bias in cookstove usage research.

Expected mechanisms of impact:

There has been a growing concern about low and unsustainable adoption of improved cookstoves globally, despite large potential benefits. Current research and our own experience working in Darfur suggest that the most significant barriers to technology adoption by the poorest are:

- Mismatch of features to needs
- Lack of product availability in the market
- High price for desired features
- Lack of liquidity
- Fear the product will not do what it says
- Fear the product will break
- Intrahousehold dynamics that may prevent women's ability to make purchase decisions
- Major behavior change required to use the technology

The development and distribution processes of the Berkeley-Ethiopia Stove will directly focus on relieving these constraints. We are currently working to minimize the first three challenges in the design and production stage. We are working to address the challenge of market availability and price by building manufacturing capacity in-country. The final price levels will be confirmed during the pretest phase, to ensure that price points are not too high for widespread uptake or too low for what the market will bear.

Overview of key activities

In order to estimate the impacts of a mobile learning intervention on cookstove uptake, we will begin by recruiting households to participate in the voice-based mobile accounting program, *Insight* by InVenture. For households with both male and female heads, we will randomly assign either the man or the woman to enroll.¹ The enrollment process includes answering a series of basic demographic questions, followed by daily requests for expenditures on food, fuel, etc., to which we will add questions about time spent collecting wood and about smoke-related illness. Until the point when cookstove purchase decisions have been made, we will randomly select half of the households to receive a “placebo” version, which asks the same initial enrollment questions but does not begin requesting daily expenditure reports until after the initial uptake decision has been made and does not offer predictions on fuel costs savings. The *mobile treatment* group will receive the full program and reports. After two weeks, participating households will be invited to a cookstove demonstration and asked if they would be interested in participating in a free trial for a fuel-saving cookstove, with an option to purchase through a payment plan. The teams will explain during recruitment that of those households interested, a lottery will be used to decide who is able to participate, which will generate a natural comparison group. We will continue registration until we have at least 1,200 registered in the lottery for a free trial, conduct a baseline survey and then assign half to treatment.² All households registered to be eligible for a free trial will then be asked to complete a baseline survey before any cookstove distribution begins. After the baseline survey, a lottery will be used to determine which households will have a free trial (this will be the *cookstove treatment* group), culminating in a sales offer with a payment plan, which the household can either accept or reject.

Among households who choose to purchase the cookstove, mobile encouragements will be sent after the households have made their purchasing decision, with randomly-assigned timing and intensity. After a lag of six months after purchase, we will revisit all households for a follow up survey. Throughout the study period, all BES cookstoves will be instrumented with temperature logging stove usage monitors (SUMs), and after the purchase, all households (treatment groups and control) will report daily expenditures through the mobile accounting program, allowing an unusually fine-grained dataset of cookstove use and expenditure over time.

¹ Given resource limitations, we cannot guarantee that we will have sufficient statistical power to make “statistically significant” claims about effects across genders, but at this stage we consider it an exploratory exercise that may still offer important

² We are still accessing whether it would be feasible to offer free trials to everyone but then randomize who is actually allowed to purchase. This would increase the statistical power for detecting effects of the mobile accounting treatment but may be less acceptable socially. For now, we plan for the more conservative approach of randomizing who can participate in the free trial.

In addition to finding ways to maximize adoption, the central priority for the study is to assess the impacts of actual usage of the BES cookstove on women and their households. The impacts we are focusing on are firewood consumption, reallocation of time use, and other indicators that may correspond to wellbeing such as food consumption, health and beliefs about healthful behaviors, pride or comfort in one's cooking space, social connectedness, expenditure on assets or education, etc.

A more detailed version of the research design summarized above will be included in Potential Energy's Evaluation Plan, which will be submitted to USAID DIV in November 2013.

7. Develop local manufacturing capacity (Ethiopia)

We are continuing our work to address the challenge of market availability and price in Ethiopia. Since our previous report in July, our team made the decision to import 600 Berkeley-Ethiopia Stoves (with the protective cool mesh shield) to Ethiopia for assembly. These stoves will be shipped by boat from Mumbai to Djibouti and then transported overland to Addis Ababa. PE's Field Representatives, Ethio-Resource Group (ERG) have been collaborating with Lawrence Berkeley National Laboratory and our stove manufacturer in India, Shri Hari Industries, to price and acquire the necessary assembly equipment that they will need for the assembly shop. By the end of this year, Shri Hari Industries will produce a training video to be used in Ethiopia that will provide detailed instructions on the stove assembly process. We are confident that training by video will suffice, as our Ethiopia Field Representatives from ERG both have university degrees in engineering and have worked in the cookstove sector for 20+ years. Our Field Representatives will in turn, train the assembly shop workers they hire at their own facility.

Manufacturing of the 600 Berkeley-Ethiopia Stove flat-kits will commence in November. Unfortunately, this process has been delayed due to money transfer issues from Ethiopia to India. Due to Ethiopian finance regulations, the payment for the stoves must be sent from Ethiopia directly to India (as opposed to Potential Energy placing the order). For our partners to place the order, they are required to receive several permits to allow them to accept the imported flat-kits when they arrive at customs. To avoid further delays, ERG has asked an Ethiopian company, OPES Trading and Investment PLC, already in possession of these permits, to place the order. At the time of this report, OPES and ERG received the proforma invoice for the flat-kits. OPES has applied for transfer of payment to Shri Hari Industries in India. Their request is currently in queue at the Central Bank of Ethiopia for the foreign currency to be made available for the transfer to Shri Hari Industries.

In parallel with our efforts to import the 600 flat-kits and set up assembly, we continue to conduct research into establishing full manufacturing in Ethiopia. Potential Energy created a financial model for ERG, LBNL and Shri Hari Industries to input data into that will help us determine at which point it makes the most financial sense to transition from assembly to full manufacturing in Ethiopia.

We continue to lay the groundwork for our marketing trial as we develop a plan for local manufacturing. ERG has maintained contact with the communities that received the 10 Berkeley-Ethiopia Stoves in July as well as expanded outreach to new areas. The team has made the decision to conduct the marketing trial in the areas of Sebetah and Debre Zeit, both within the Oromia region of Ethiopia. These two areas were selected because of their higher percentage of households purchasing wood for cooking. ERG is currently exploring a partnership in Debre Zeit with a local women's and youth development organization called Ratzan, which has an established presence in the community, already has income-generating projects and is well-respected by local government. ERG and Ratzan will continue talks in the coming month to determine the best partnership structure, possibly with Razan facilitating the collection of stove payments.

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

Training:

Daniel Wilson (UC Berkeley Mechanical Engineering PhD candidate) travelled to Ethiopia in July for an intensive 1-week training in Addis Ababa with our Sudanese partners. This training focused on the skills, planning, and personnel necessary for implementing the SUMs on 170 cookstoves in Darfur. Additionally, as part of an effort to expedite survey data processing and improve survey data quality, the Berkeley team trained the Sudanese team about the use of Open Data Kit (ODK), a cell phone-based surveying tool. Following this training of Sudanese project leadership, the Sudan-based team returned to perform hiring, training, and technical tasks. A complete Darfur-based staff including six enumerators, enumeration supervisors, SUMs data collection staff, and SUMs hardware installation staff was hired, trained, and prepared for the deployment of the SUMs project by July 26th, 2013.



Figure 3: training the SUMs leadership in Addis Ababa, Ethiopia. From left: Daniel Wilson, Mohammed Idris Adam, Debra Stein, and Omnia Abbas.



Figure 4: the Darfur-based SUMs implementation team. *Top left:* Nada Abdalla Mohammed, Afaf Adam Abdallah, Mohammed Idris Adam, Eissra Hamid Gamer El ddin, Abel Rahman Abdalla Addoma, Aziza Mohammed Tugod, Fatima Adam Ibrahim, Om Alhosein Ali Garbo. *Bottom left:* Idris Ibrahim Adam, Abdalla Mohammed Suleiman, Adam Abdalla Amin.

Baseline Survey and Stove Deployment

As is regular practice for stove distribution, Sustainable Action Group contacted the *omdas* (local leaders) from the administration of El Salam Internally Displaced People’s (IDP) Camp. It was the responsibility of these *omdas* to select which women would receive stoves for the SUMs study. 180 women were selected for this study, each part of a group of 36 women from five distinct administrative units: Korma, El Fasher Rural, Dar Zagawa, Jebel Si, and Tawilla. Administrative units in El Salam IDP Camp represent the regions of Darfur from which the camp’s residents originated. Each of these regions have distinct cultural characteristics including cooking habits.

As mentioned in our July 2013 Milestone Report, between July 28th and August 1st, 180 stoves were distributed to women from the five administrative units. Of these 180 stoves, 170 were outfitted with SUMs and, for experimental design purposes, the remaining 10 had 8 “dummy” SUMs. At the time of dissemination, each woman was asked to participate in a baseline survey about household composition and cooking habits. The survey was administered to each participant by a team of two enumerators, one with a paper and pencil survey and the other using an Android-powered cell phone running the same survey on ODK. These ODK surveys were sent back to secure servers in Berkeley in real time which allowed for fast iteration and quality control on enumeration techniques. A summary of baseline survey data is provided in Figure 5 through Figure 8.

Primary cooks in the SUMs experiment (typically the women receiving the stove at the time of the baseline survey) have ages ranging from 18 to 75 with a median age of 34.5. Household size, defined as “number of people who eat from the same pot,” ranged from 3 to 20 with a median of 7 members. Most households had similar numbers of men/women and boys/girls (under 14) with a median household having 2 women, 2 men, 1 girl, and 1.5 boys.

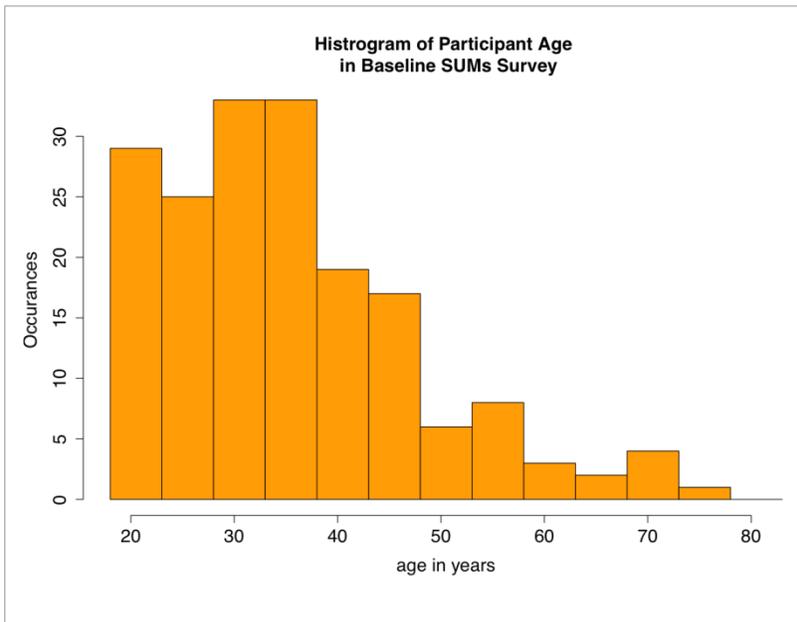


Figure 5: ages of participants in the SUMs study (n=180)

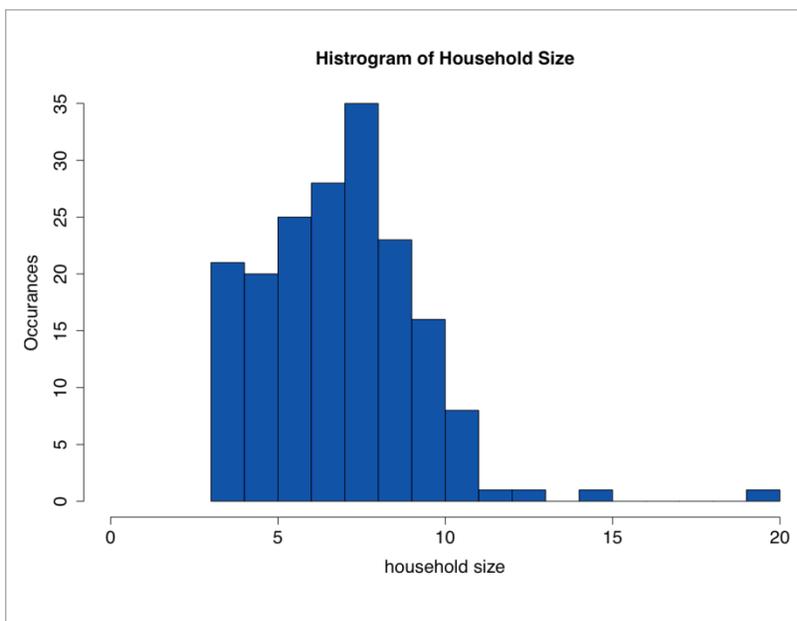


Figure 6: household size of participants in SUMs study (n=180)

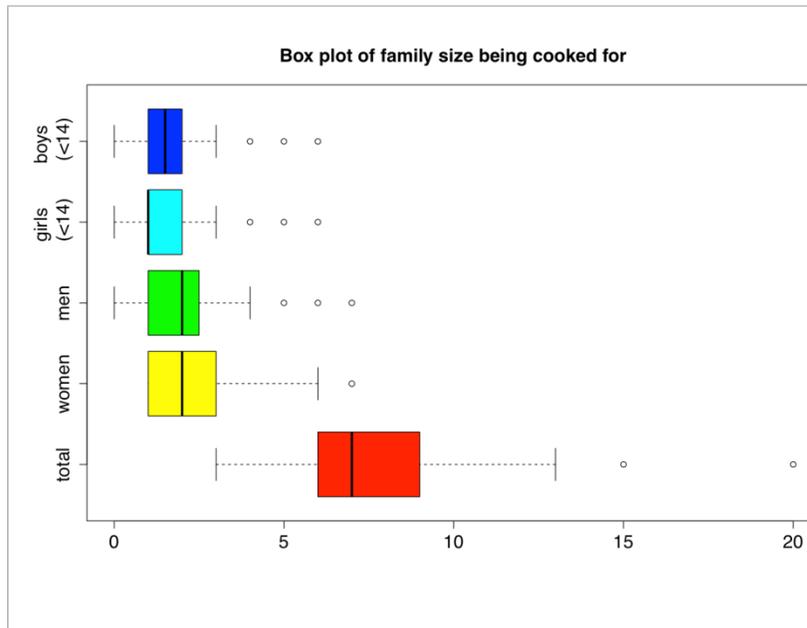


Figure 7: household makeup for participants in SUMs study (n=180)

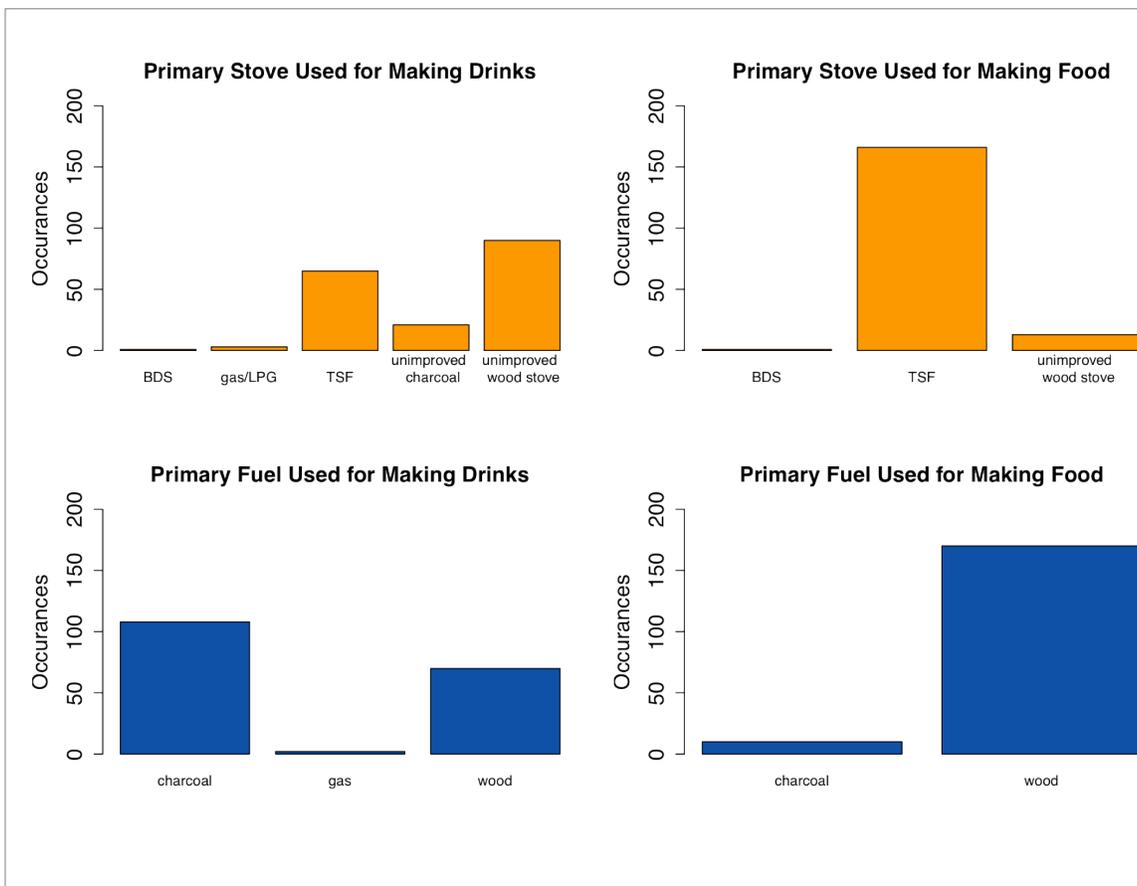


Figure 8: baseline cooking stoves and fuels for participants in SUMs study (n=180)

Follow Up Data (still in progress)

Between one and three months after the baseline survey and stove dissemination, SUMs data was downloaded and follow up surveys were conducted with each of the five administrative units. Again, surveys were administered redundantly on paper and using ODK. SUMs data was downloaded using Maxim Integrated’s OneWireViewer interface running on a laptop with a DropBox folder shared with the team in Berkeley. In this way, the Berkeley team was again able to do real-time quality control and feedback on both the survey and SUMs data. On multiple occasions, small mistakes or omissions of data were caught and corrected before there was too long of a delay to rectify the problem.

To date, follow up surveys have been conducted with four of the five administrative units. These four units represent 144 women who received stoves and agreed to participate in the SUMs study. Of these 144 participants, we have been able to follow up with 139 (96.5%) with the five missing women not returning for follow up typically due to travel outside the IDP camp to their rural farms. The 139 respondents also had 139 sensors mounted to their stoves.³ Of these 139 sensors on respondents’ stoves 26 overheated, were lost, or otherwise malfunctioned (19% loss).

Primary analysis of SUMs data to date shows that roughly 2/3 of women are using their BDS, while, of the first 140 surveys collected, 139 respondents claim the BDS is their primary stove and that they use it daily.

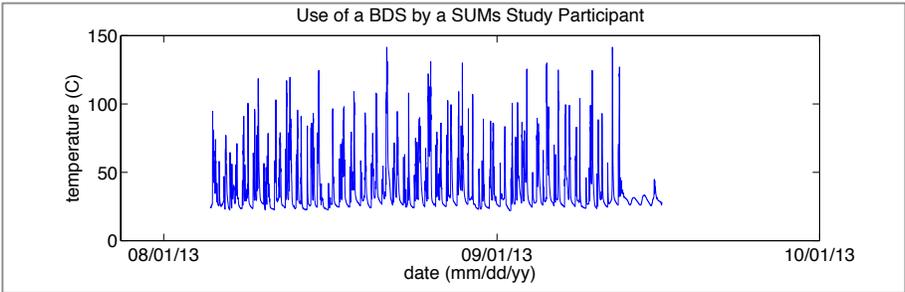


Figure 9: heavy use of a BDS by a SUMs study participant

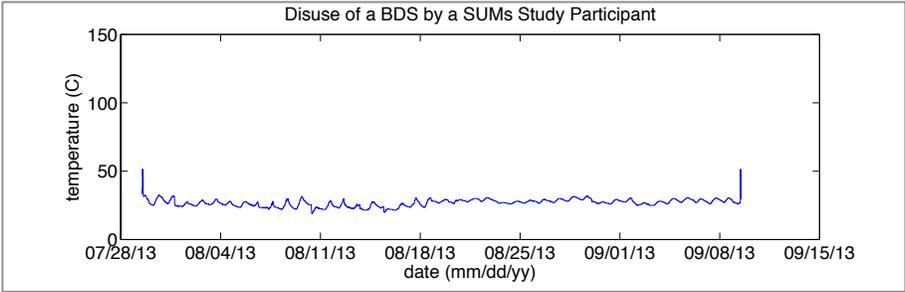


Figure 10: total disuse of a BDS by a SUMs study participant

³ Some participants had two redundant sensors, and some had only dummies, so it is only a coincidence that the number of respondents is equal to the number of sensors.

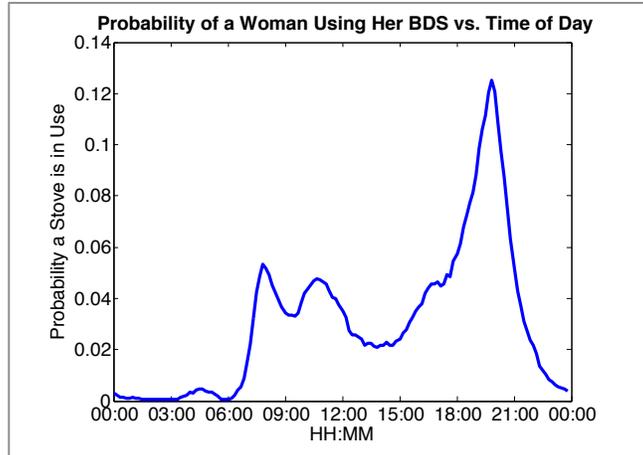


Figure 11: an example of the power of aggregated data shows the probability of any given woman in the SUMs study using her stove versus time of day. For example, around 8 p.m. on any given day, there is a 12.5% probability that any given BDS will be in use. Four distinct cultural cooking times can also be seen: just before sunrise, just after sunrise, a mid-morning event, and an evening event.

Although the experiment is still in progress and all of the data has not yet been processed, these findings point towards the clear need for this kind of physics-based verification of cookstove utilization. Our team looks forward to learning from the data and reporting on our findings as the data is analyzed.

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #8 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

January 30, 2014



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
IC	Impact Carbon
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group (Sudanese NGO partner)
SfC	Saving for Change
SLF	Slow Life Foundation
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
VGS	Voluntary Gold Standard
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14
Milestone No.	1	2	3	4	5	6	7	8
Indicator								
Total population with access to FES in targeted communities in Darfur	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A	N/A	N/A	57	57	57
Geographical distribution of FES in Darfur	(see chart)	(see Figure 1)	(see Figure 1)					
Geographical distribution of FES in Ethiopia	(see chart)	(see Figure 2)	(see Figure 2)					
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10
CO2 Equivalent mitigated (tons) by using FES instead of traditional methods	41,298	56,868	56,868	56,868	66,643	70,111	70,978	73,997
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A						
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A						

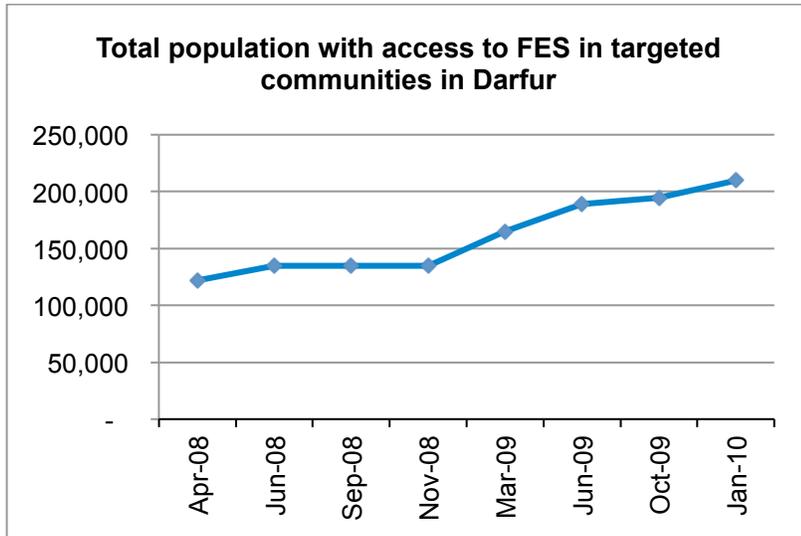


Figure 1: Total population with access to FES in targeted communities in Darfur

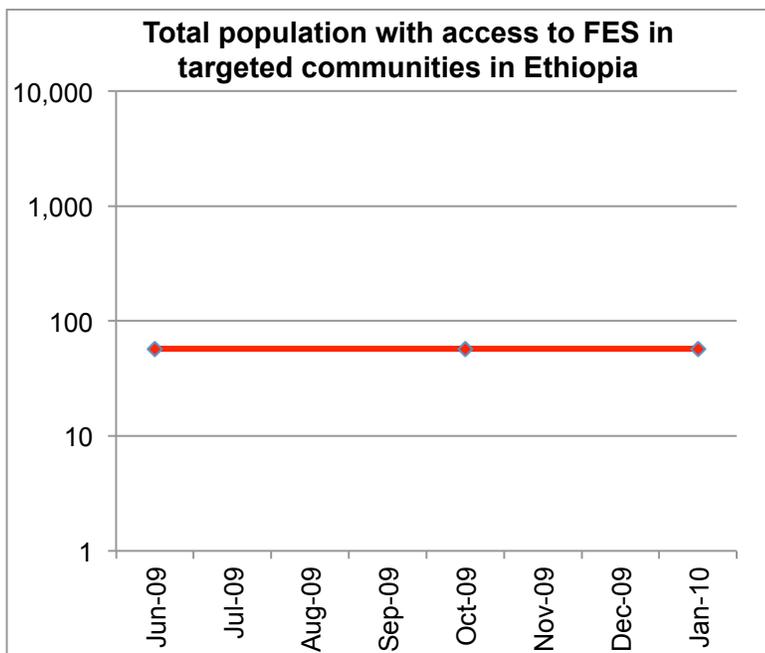


Figure 2: Total population with access to FES in targeted communities in Ethiopia

Notes on Indicator Dashboard

A) We continue to report 100% customer satisfaction in Darfur based on:

1. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
2. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.
3. The fact that no one has returned any of the stoves that have been distributed this year, and those who purchased them continue to make payments.
4. However, it should be noted that following analysis of data using Stove Use Monitors (SUMs), this figure will change and will be noted in future Milestone Reports. As an organization that values transparency as well as learning, we look forward to these results to further improve our work.

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

C) We calculate tons of CO₂ equivalent offset by assuming each stove offsets 1.485 tons of CO₂ equivalent per year (based on laboratory testing conducted at the Lawrence Berkeley National Lab). To be conservative, we assume that 4% of people who purchase (or receive for free) their stove never use it, and that from the remaining 96% that do use it, an additional 10% stop using it after each year (this is much more conservative than actual usage rates we have found through our impact surveys). When we issue credits via the Gold Standard, we will have an external, independent assessment of how we should be discounting stove use over time. However, in the meantime, we are trying to be conservative in our assumptions so as not to inadvertently overstate our impact

Table 2: Geographic Distribution of FES in Darfur

Note: Rows highlighted in **yellow** show stoves distributed since last Milestone Report

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash

2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013C	North	Rural El Fasher	2450	CBOs*	14	2013	Revolving Loan Fund/ installment payment plan
TOTAL			34,926				

***Breakdown of Batch 2013C Stoves:**

	Name of Community Based Organization (CBO)	# of stoves received
1	Ayadi Al Rahma	200
2	Women Development Association (Dar El Salam)	200
3	Sudanese Agency for Dar El Salam Locality Development	200
4	Om Al Qora Women Development Association (Koma)	100
5	Om Dul Association (Dar El Salam)	200
6	Rifai Association (Om Kidada)	850
7	Seekar Association	100
8	Al Mawada wal Rahma Association (Mellit)	200
9	Women Development Association (El Sereif)	400
TOTAL		2,450

Table 3: Geographic Distribution of FES in Ethiopia

Batch	Region	Location	#
2013A	Oromia	Sebeta	5*
2013A	Oromia	Meki	5
2013A	Oromia	Debre Zeit	1*

*One stove that was on loan in Sebeta was returned and taken to Debre Zeit for stove demonstrations

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Below we discuss progress made against the specific milestones outlined in our fixed obligated grant agreement. In addition, we have updated the milestone that relates to the rollout of the Stove Usage Monitoring (SUMs) system in Darfur.

Since our October 2013 Milestone Report, we distributed an additional 2,450 stoves in Darfur, bringing the total number of stoves distributed in Darfur to 34,926. In Ethiopia we have not distributed additional stoves since our last report, as we put into place our manufacturing, distribution and evaluation plan while our 600 stove flat-kits for our marketing trial were produced in Mumbai. We are happy to report that the 600 flat-kits are slated to depart from Mumbai this week.

In December/January members of our team conducted field visits to both Ethiopia and Sudan. PE's Director of Strategy and Partnerships, Jan Maes visited Ethiopia in early December with the goal of applying the lessons learned from his work setting up our sales trial in Darfur in the context of our new project in Ethiopia.

In order to determine our marketing strategy in Ethiopia, Jan's research included exploring the most likely marketing mix scenarios in terms of sales offer, distribution channel and promotion. Through discussions with our Ethiopia Country Representatives and outreach to potential partners on the ground, we are planning 1-2 small marketing trials (up to 100 stoves each), which will also build the local capacity (in stove promotion, distribution and sales) to conduct a planned Randomized Control Trial with 600 Berkeley-Ethiopia Stoves.

Between December 11 and January 17, PE's Sudan Country Representative, Omnia Abbas returned to Sudan to conduct a ten day visit to El Fasher, North Darfur and three week stay in Khartoum. The purpose of the trip was to coordinate documentation efforts, report on the progress of our Revolving Loan Fund, meet with potential partners for expansion into other regions of Darfur, and implement a stove usage survey in accordance with Gold Standard certification requirements in order to receive carbon credits.

In addition to field visits, we also hired a new Executive Director, who joined the team on January 16. Her name is Michelle Kreger, and she will be based out of our headquarter offices in Berkeley, CA. Michelle comes to PE most recently from Kiva.org, where she ran their social enterprise portfolio, which included investments in energy organizations working with cookstoves, micro-solar solutions, and other

affordable technologies. She is familiar with the market, and also with distribution and end-consumer finance strategies that have worked for peer organizations in sub-Saharan Africa.

Finally, in regards to our Stove Use Monitors (SUMs) research in Darfur, all data has been conducted and preliminary analysis of the results is provided in this Milestone Report.

MILESTONE UPDATES: January 30, 2014

1. Recruit and Train Local Sales Agents (Darfur)

Throughout the last few years, our Sudanese partner, Sustainable Action Group (SAG) has been able to work with over 20 CBOs to distribute stoves. With the onset of our revolving loan fund project funded by the UN Foundation's Global Alliance for Clean Cookstoves, an assessment of these CBOs' performance was conducted in terms of: effective stoves distribution to different geographical ranges, timely financial reporting and commitment in submitting distribution lists with beneficiaries' information. A total of 9 community-based organizations (CBOs) were selected to participate in the revolving loan fund. All representatives of these CBOs have completed training on the benefits and proper usage of the stove. To support CBOs in their distribution efforts by discussing challenges and solutions early on, SAG held its first quarterly meeting with all CBO representatives to support ongoing efforts to train local sales agents.

2. Expand sales based on findings from marketing trials (Darfur)

We have distributed 2,450 stoves in Darfur since our last Milestone Report in October 2013. Based on our learnings from our 2012 marketing trial in which we sold 640 stoves, in 2013 we began selling stoves in Darfur on a larger scale. We obtained permission from the Government of Sudan's Humanitarian Aid Commission to sell 50% of the stoves we distributed from January – June 2013. The Commission supported this shift in strategy as they understand the stove has demonstrated exceptional economic, health and environmental value and demand has been rising from different communities and segments of society. The Commission was supportive of our efforts to support our local partner, Sustainable Action Group in establishing more sustainable operations while marketing to a larger target market. With the other 50% of the stoves during this time period, we continued with free distribution to those who were deemed fit by local community leaders.

Our Sudan Field Representative and SAG have since spoken with the Commission to increase the percentage of stoves sold versus distributed for free to high inflation rates resulting from Sudan's economic volatility, the net revenue for SAG per unit has lowered significantly since the beginning of

the year. It will become imperative to increase the number of stoves sold to increase the sustainability of their operations.

3. Replicate assembly shop (West Darfur)

We continue to proceed with caution to replicate our assembly shop, for two reasons: 1) We have not yet reached maximum capacity in our North Darfur assembly shop and 2) there have been recent violent clashes in West Darfur, leading us to question whether we could assure the safety of our personnel in the area and the security of our inventory. Nonetheless, as both South and West Darfur seem like promising areas for expansion due to the similarity in cooking habits and climate we have started outreach for new partnerships. To reach out, we have leveraged our contacts in North Darfur and Khartoum to guide us into quality partnerships.

During our Sudan Country Representative's recent visit to Darfur, she consulted with representatives from our North Darfur stove assembly shop. The assembly shop workers and SAG presented the idea of a creating a mobile workshop, based on the suggestion by CBOs working in El Fasher's peripheries, where transportation costs have become unfavorable due to inflation. Many of these CBOs operate exclusively in remote areas in North Darfur and have seen a high demand for stoves, claiming that thousands of stoves can be sold in one area, which would make a mobile workshop more cost-effective and efficient.

An additional facet to the mobile workshop concept was SAG's suggestion of creating a rotating maintenance workshop in our near one of the IDP camps in which we operate, where stove users are invited to bring in their stoves for repair by the assembly shop workers. This would enable some of the older stove users to continue to use it optimally, and new users would gain confidence in the warranties they received with their stoves. We are currently in discussions with SAG to determine next steps and budget reallocation to establish our first mobile workshop.

4. Build distribution channels (West Darfur)

Since our last Milestone Report, we have made progress in our outreach to potential partners for our expansion into other Darfuri states, including South and West Darfur. Outreach to several possible partners was conducted during our Sudan Country Representative's December/January trip to Sudan:

Darfur Development and Reconstruction Agency (DRA):

A meeting was held with Samia Ibrahim Dafallah, Livelihoods Project Coordinator at the Darfur Development and Reconstruction Agency (DRA) in El Fasher to discuss a possible partnership with PE to distribute stoves through DRA's West Darfur office, which specializes in research and training in marketing and trading. Through their current programs, DRA is already working with several CBOs in West Darfur, which could be used as a network for stove distribution.

Malam Darfur Peace and Development Organization:

Our Sudan Country Representative met with Malam Darfur's President, Lukman Ahmed and discussed possible collaboration by extending our current stove distribution network to Malam and other neighboring areas in South Darfur. (Malam is approximately 75 km north of Nyala, the capital of South Darfur and 75 km south of El Fasher, the capital of North Darfur). The organization was created to deliver a wide range of resources to the Malam ethnic group and works with an extensive network of indigenous Malam people, including returning refugees. They have focused education and microfinance, and plan to re-open the Malam Market in February 2014. Mr. Ahmed expressed interest in conducting a small trial and is willing to receive a virtual training so that he can properly manage distribution and documentation. In addition, if a workshop is to be opened in Malam, he offered work shop space and agreed to recruit locals and capitalize on their existing network of CBOs to support wider distribution efforts.

NIDAA:

A meeting was held with several NIDAA Program Officers in Khartoum in early January to discuss incorporating a stoves project into NIDAA's existing programs in Central and West Darfur. The organization's main operations are in the village of Addar (18 km West Darfur's capital, Ginena). A metal workshop has been set up to train local men on metalworking skills. NIDAA has three officers running operations in Addar focused on livelihoods and foods security.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

As previously mentioned, 2,450 stoves have been distributed to our revolving loan participants since our last Milestone Report. An additional 50 stoves are reserved for a 10th CBO, which plans to participate in the revolving loan fund. The remaining 2,500 of this batch of 5,000 are to be distributed for free to selected beneficiaries (fire, flood and other disaster victims, widows, special needs people, the chronically disabled or ill, single parents and child-headed households.) This free vs. sold distribution is based on SAG's agreement with the Government of Sudan's Humanitarian Aid

Commission of 50% free distribution for 2013.) Although there were initial discussions with HAC to increase the quota of sold stoves to 75%, this may face a delay due to inflation. On January 27, an additional 5,000 flat-kits arrived at the El Fasher assembly shop (Batch 2014A).

During our Sudan Country Representatives field visit, she conducted a meeting with assembly shop representatives to discuss their needs for 2014. The assembly workshop has been efficient and running smoothly since its establishment. In 2013, they reported that on average, workers produced 92-120 stoves per day. In addition, a quality control assessment was conducted. On a tour of the workshop, they demonstrated that some equipment will soon need to be replaced, to ensure quality output. The list of replacement tools has been relayed to both LBNL and the flat-kit manufacturers in India, Shri Hari Industries to determine if changes can be made to the flat-kit manufacturing process to further improve the stove assembly process.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

We continue to lay the groundwork for our randomized control trial (RCT), now planned for March 2014. In order to ensure that the process runs as smoothly as possible, our M&E project manager, UC Berkeley PhD candidate, Angeli Kirk created an RCT operational timeline. Please see below for details.

Cookstove Impact Evaluation/RCT Steps:

To be iterated until there are 600 households who have purchased the Berkeley-Ethiopia Stove:

1. (Preferred, depending on feasibility) Make a list of groups to target with cookstoves, take the sample from this list:
 - This could be geographically-based such as samples within Enumeration Areas (EAs) delineated by the Statistics Office, neighborhoods, communities, villages, etc.; or it could be function-based: funeral savings groups, women's groups, coffee collectives, etc.
 - The goal is to make sure that the list is at least as large as would be needed to make sure that the number of households who purchase a stove is 600 (accounting for the fact that for every household that purchases a stove, we have one control household that would have purchased a stove if allowed to do so).
 - This list can be thought of as the first groups of households that Potential Energy would want to target if, for example, there were 2,000-3,000 cookstoves to be sold instead of 600.
 - Ideally the point of recruitment (community/geography, group, etc.) should reflect a likely strategy that Potential Energy would employ in the future for recruiting new customers. (Any who aren't used for the study can provide a ready list of potential clients.)

- It's also important to note that the study will be representative of the kinds of households successfully recruited to the study.
- (Preferred, depending on feasibility) Put the list of group (communities, savings groups, etc.) in random order (specifically, not in order from most likely to buy to least likely to buy)

Inventure: (mobile phone data collection, helping individuals aggregate costs and savings, looking for gender differences in reporting and uptake)

2. Start with the first group to be targeted and make a list of households to recruit to Inventure
 - Must have a mobile phone or daily access to a mobile phone, since Inventure is phone-based
 - Ideally, these would also be households that rely heavily on wood for cooking
 - This could be households in a community, funeral savings group, women's group, coffee collective, etc.
 - (Preferred for representativeness) If only doing a subset of eligible households within a group or community, make a list of all eligible households and select the sample using an approved randomization strategy
 - If eligibility (mobile phone access, for example) is not initially known, list potentially-eligible households
3. With the list of households to be recruited, randomly select half of the households for which the male head of household is recruited to participate in Inventure and half for which the female head of household (ideally this is also the primary cook) is recruited to participate in Inventure
Angeli Kirk will do the randomization using Stata.
 - If we find that acceptance rates between men are very different in the first group, in subsequent groups we can alter the percentage of men and women who are targeted to be enrolled in Inventure, to try to reach close to equal numbers of men and women enrolled.
4. Verification of eligibility and willingness to participate in Inventure:
 - Contact the men and women on the recruitment list
 - (Script to be developed) Basic idea of script: "We are enrolling individuals in a mobile phone system that collects information about daily life of men and women and their households in this community. You have been selected to participate if you are willing. [Basic explanation

of how Inventure works: If you choose to participate, you will receive automated calls that ask you information about household expenses and earning] No cost to the household. Data will be used for research, but first all information that could be used to identify the individual or the household will be removed. Sometimes the frequency of calls could be as often as every day, but each call will be kept to a minimum length, to respect the individual's time. The recruiter will never know any of the information reported by phone. No member of the community will ever know any of the information reported. You may choose not to answer any specific questions you choose and may quit at any time. (If feasible, we could set up a practice call.) If you don't mind, may I show you a demonstration of how the program works? [Demo call, to answer a few questions and practice answering. The enumerator can provide the answers, so there is no personal information, and we can see if they know how to do it, since we know the right answer.] Are you willing to participate? "

- If yes: Have the participant sign/mark consent form
 - If willing to participate, request permission to note the names and education level of the male and female head of household, the age and gender of all members of the household, and which member is the cook (name optional)
 - If not willing to participate, request permission to note the ages and education of the male and female head, and then number of adults and children by gender, or as much information as the respondent is willing to provide.
 - If the household does not have access to a mobile phone, thank them for their time and mark them as ineligible because of the lack of mobile phone.
5. With list of men and women who agree to participate, randomly assign half of the men and women each to "Inventure treatment" and "Inventure placebo" (randomization conducted separately to ensure equal percentages treatment and control within men and women). Within the treatment groups, individuals will either be assigned InvT1 (daily questions) or InvT2 (weekly questions). Angeli Kirk will do this randomization, and the various treatments within Inventure will be rolled out within Inventure – that is, the individuals doing the Inventure recruitment and the cookstoves sales do not need to worry about or even know which inventure group an individual is assigned to.
- Enrollment (all):
 - Receive welcome message, including additional explanation of Inventure
 - Inventure standard demographic questions

- Does your household use [wood, charcoal, dung, kerosene, LPG, electricity] for cooking or baking?
- How much did members of your household spend on [wood, charcoal, dung, kerosene, LPG, electricity] for cooking in the past 7 days?
- Did any members of your household collect [wood, dung] last week?
- Give top-up bonus for joining
- Inventure “control”, InvC (50%):
 - [Optional: ask some demographic or social questions only to placebo, to give basic stats on the Inventure population.]
 - Use Inventure’s system of points and rewards, possibly include jokes or proverbs.
- Inventure treatment:
 - InvT1 (25%):
 - Each day, ask for earnings and expenditures, including fuel by type
 - Each day, ask for time (hours) spent collecting fuel (wood or dung) by members of the household
 - InvT2 (25%):
 - Each week, ask for earnings and expenditures, including fuel by type
 - Each week, ask for time (hours) spent collecting fuel (wood or dung) by members of the household
 - InvT1 and InvT2:
 - After two weeks: give report for past two weeks
 - Give 1 year prediction on expenditures, if past 2 weeks were typical

Cookstove Trials and Sales (Impacts of Stove Use):

1. In favor of giving everyone a free trial (if they want) and then randomizing who among the willing buyers is allowed to purchase:

- Can observe two weeks of cookstove use for everyone (have power to detect any very short term impacts on expenditures at that size, with the benefit of seeing everyone as without-BES, then with-BES, and then half without-BES again
- Twice as many observations of stove trials gives a better chance of detecting whether predicting individualized savings from fuel expenditures before and during the stove trial increases willingness to buy the new cookstove

2. In favor of randomizing free trial:
 - Only manage half as many free trials
 - If either of the above measures look promising, we can test them with more stove trials without doing the full impact evaluation and surveys

3. Recruit for lottery for free trial: Two weeks after Inventure enrollment, invite participant to take part in lottery for a free trial of a fuel-saving wood cookstove with the option to purchase through a payment plan. (Two weeks after Inventure enrollment was chosen to be enough time to collect expenditure data and make predictions about annual expenses but also not create too much delay before the cookstove trials.) Invite to participate in a free trial for a fuel saving cookstove. Explain that if they enroll in the lottery for the free trial, the household will participate in one survey now and a follow up survey in several months. If they win a free trial, they will be allowed to buy one on a payment plan. There is no cost to enter the lottery. Only pay (with payment plan) if they are chosen for a trial and want to keep a stove afterward.

4. Baseline survey: Administer before free trial lottery and cookstove demonstration among those who want to enter the lottery. A percent can be given the full version in order to give a good description of the study population (for research purposes and for marketing needs), the rest can be given a shorter version, focusing primarily on variable we expect to change or variables that can help us identify subgroups within the study population (for example, households with young children, etc.).

5. Cookstove demonstration: For those who are selected to receive a free trial in the lottery: After the baseline survey has been administered, then the respondent and primary cook attend a group meeting for a lesson/demonstration and the explanation of the terms. The trial cookstoves can be delivered during this meeting (or whatever seems most feasible).

6. Interaction with Inventure treatment (InvT1 and InvT2)
 - Continue the daily (InvT1) or weekly (InvT2) Inventure accounting questions
 - At the end of the trial period (two weeks, unless pretests suggest it should be different), give the new expenditure report. For InvT1 and InvT2 who are given free trial, report fuel savings over two weeks (and possibly average savings for the group, after pretesting) and predicted savings over a year, assuming the same usage as during the trial

7. Purchase decision: At the end of the free trial, the Inventure participant (man or woman) is asked whether he or she would like to purchase the new cookstove. If yes, the participant makes first payment and either keeps the cookstove or returns the trial stove (if we have specific trial stoves) and receives a new one .
8. Repeat steps 2-10 until 600 cookstoves have been sold.

Usage Promotion (Testing Means of Enhancing Frequency and Good Usage):

This section reflects questions that have arisen from our experience in Darfur and can be adjusted according to what we learn from marketing tests in Ethiopia:

- Can repeated interactions boost usage?
 - Could automated phone interactions be as effective as in-person interactions?
 - Is it more effective to apply some social accountability (asking whether desired behaviors have been performed) relative to simply offering information?)
9. Cookstove usage-promotion treatments (using randomization and regression-discontinuity design):
Households will receive reminders and tips to encourage regular and proper usage of their new cookstove
 - Main messages (to be confirmed during testing)
 - Regular usage
 - Wood broken/cut to correct size
 - Correct amount of wood used
 - To be determined: begin messages either two or four weeks after cookstove delivery (a delay allows for a regression-discontinuity comparison)
 - Randomization (each of the following to be randomized independently)
 - Reminders and hints only (50%) vs. Reminders and compliance questions (for example, “Do you break down your wood into thin pieces for cooking with your new cookstove?” or “Last week, did your household break down wood into thin pieces for cooking with the new cookstove?”) (50%)
 - Mobile messages every two weeks (50%) vs. four weeks (50%)
 - In person messages every two weeks (50%) vs. four weeks (50%)
 - Mobile and in-person reminders don’t have to last through the whole study

- [FOR THE TEAM TO THINK ABOUT: If the visits or reminders work, having a few reminders or visits shortly before the follow-up survey may maximize the measured impacts from usage]

Measurement:

10. SUMs: The in-person visits allow for rotation of real and fake Stove Usage Monitors (temperature loggers)
 - All trial stoves can be outfitted with SUMs (if we use designated trial stoves)
 - Ideally, all new stoves would have a real SUM for the first seven or nine weeks (to try to observe changes that come with messages)
 - This will require rolling out the new cookstoves in stages, since the number of available SUMs will be 300 or fewer (not a problem if free trial stoves are used – they’ll have to roll out in stages anyway)
 - The rest of the time, the SUMs will occasionally be rotated (real to fake, fake to real, real to real)
11. Inventure after the free trial period: The Inventure control group is also assigned to daily or weekly expenditure reporting
12. Follow-up survey (in person): Preferred timing would be at least one month after payment plan is finished, to be able to observe and ask about expenditures for one month when the households are experiencing fuel savings and no longer allocating any income to repayment. Treatment and control groups from the same group should be interviewed around the same time as each other.

A more detailed version of the research design summarized above is included in Potential Energy’s Evaluation Plan, submitted to USAID DIV in November 2013.

7. Develop local manufacturing capacity (Ethiopia)

As we lay the groundwork for our program in Ethiopia, we continue to make progress in determining the logistics and costs associated with in-country manufacturing of the Berkeley-Ethiopia Stove. Our team in Ethiopia is currently preparing their workshop for the assembly of the 600 stove flat-kits that will be sent from Mumbai in the next week. It should be noted that while we are exploring manufacturing scenarios in Ethiopia, no major equipment purchases or decisions will be made until we have

determined that the current model of the Berkeley-Ethiopia Stove (with cool mesh) is well-received and does not need modification before being produced on a larger scale.

After factoring in additional information collected by Jan Maes on his visit to Ethiopia in December, we have further developed our manufacturing cost scenarios. The three scenarios we are considering are:

- 1) **Full manufacturing in India** of flat-kits and materials with assembly in Ethiopia (i.e. the same model as Sudan). *The initial estimated cost is +/- \$25. However, further research is required.*
- 2) **Full manufacturing in Ethiopia** (all components are manufactured or sourced in Ethiopia, using stainless steel to substitute for the cast iron grate, which cannot be produced affordably in Ethiopia). *The initial estimated cost is +/- \$18. However, further research is required.*
- 3) **Hybrid manufacturing** with most parts manufactured in Ethiopia. Specific parts that cannot be produced cost-effectively in Ethiopia would need to be imported instead, such as the cast iron grate. *The initial estimated cost is +/- \$22. However, further research is required.*

Please note that the costs stated above are estimates, with some numbers still needing to be verified and validated. In addition to further exploring costs (particularly at varying quantities), we are currently consulting with a scientist from LBNL to determine if it is feasible to replace certain parts of the stove with less expensive materials without compromising quality. For example, we have asked him to look into if it is possible to make the inner grate of the stove out of stainless steel instead of cast iron, which is highly durable but also greatly adds to the cost of the stove.

Since our last Milestone Report, we have also further developed our options for distribution and retail channels. Retail channels considered so far are local outlets (wholesale/retail), such as existing stove producers, hardware/household product shops, women's groups and cooperatives. According to ERG, women's groups and cooperatives appear to be the most feasible for rapid distribution of stoves, as these groups would have access to microfinance to purchase the stove. ERG recommends approaching these groups through partnerships with local NGOs and unions, with retailers serving as suppliers of stoves to these groups.

One potential partner that could be promising is Ratson, (http://www.corhaethiopia.org/ratson_women_youth_children.html) a local NGO based in Debre Zeit, which is located 45 km south of Addis Ababa. They are very interested in clean cookstoves and have expressed serious interest in partnering for distribution and promotion. They are involved in women's,

vulnerable youth and children’s programs, and have helped them to form women’s savings/loan groups as well as youth groups. They have at least 60 women’s groups in urban Debre Zeit and even more groups in rural areas. Each group consists of 20-30 women. They do baseline needs surveys in most locations where they work, and bias toward rural districts located relatively close to Debre Zeit town because of the transportation challenges. This might indicate that they are reaching a proportionally high percentage of households who purchase (instead of collect) firewood.

We are currently in discussions with Ratson about collaborating on stoves distribution for the marketing trial and are working with ERG to collect necessary baseline data on potential customers in Ratson’s area of operations. We continue to explore other partnership opportunities for sales and distribution in addition to exploring a collaboration with Ratson.

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

Background, Training, and Baseline Data:

In early July 2013, Daniel Wilson and Debra Stein met with implementation partners from Sudan for an intensive 1-week training in Addis Ababa, Ethiopia. This training focused on the skills, planning, and personnel necessary for implementing a Stove Use Monitoring program with 180 participants in Darfur. Additionally, as part of an effort to expedite survey data processing and improve survey data quality, the Berkeley team trained the Sudanese team about the use of Open Data Kit (ODK), a cell phone-based surveying tool. Following this training of Sudanese project leadership, the Darfur-based team returned to El-Fasher to perform hiring, training, and technical tasks.



Figure 3: left: Berkeley-based personnel training the SUMs leadership in Addis Ababa, Ethiopia, right: the Darfur-based SUMs implementation team.

In Darfur, local leaders selected 180 women to receive stoves free of charge. Although our team desired to sell a portion of the cookstoves for this study, selling stoves was not possible under the particular political timing and circumstances of this study. The group of 180 women were made up of five groups of 36 from distinct administrative units: Korma, El-Fasher Rural, Dar Zagawa, Jebel Si, and Tawilla. Administrative units in El Salam IDP Camp represent the regions of Darfur from which the camp’s residents originated.

Between July 28th and August 1st, 180 stoves were distributed to women from the five administrative units. Of these 180 stoves, 170 were outfitted with SUMs sensors and, for experimental design purposes, the remaining 10 had only “dummy” SUMs. 190 SUMs were mounted onto the 170 instrumented stoves with 20 stoves having redundant “piggyback” sensors used for high-frequency verification of primary SUMs data. At the time of dissemination, each woman was asked to participate in a baseline survey about household composition and cooking habits. The survey was administered to each participant by a team of two enumerators, one with a paper and pencil survey and the other using and Android-powered cell phone running the same survey on ODK. A summary of base cooking stove and fuels is shown in Figure 4:

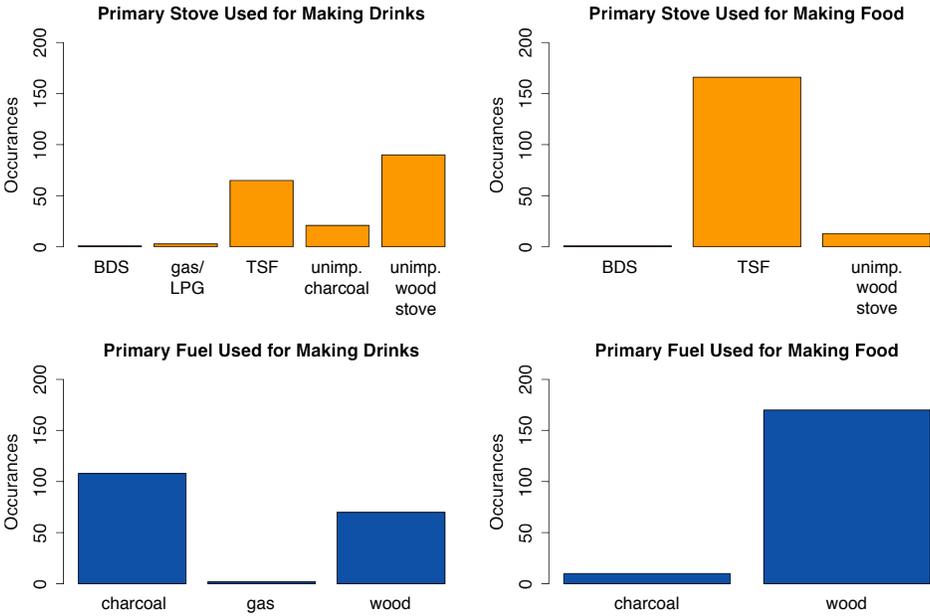


Figure 4: baseline cooking stoves and fuels for participants in SUMs study (n=180)

Follow Up Data:

Between one and three months after the baseline survey and stove dissemination, SUMs data was downloaded and follow up surveys were conducted with each of the five administrative units. For three of the five administrative units, SUMs were reinstalled on cookstoves and disseminated for another two weeks before being recovered at a second follow up session. The second follow up was only for removal of the SUMs, and no survey was administered. As of November 7th, 2013, all follow-ups, surveys, and secondary follow-ups have been completed.

Of the 190 sensors sent to Darfur for the program, 137 survived to the first follow up. These 137 SUMs represent 122 unique cooks; 15 of the surviving sensors were redundant “piggyback” sensors. Figure illustrates the fate of the 190 sensors. By far, the greatest contributor to loss of SUMs was unrecoverable data due to dead batteries or unreadable iButton memory chips. Maxim Integrated, the manufacturer of the iButton, states that the most likely reason for these failures was overheating of the iButton; overheating can substantially shorten iButton battery life, destroy memory chips, or both. Staff from Lawrence Berkeley National Laboratory had performed a substantial number of experiments to determine appropriate placement of the SUMs to prevent overheating (Figure), therefore the loss of so many SUMs to apparent overheating was confusing. However, upon further investigation, our team has determined that many cooks invert the BDS and fill the bottom with charcoal. This innovation by users allows cooks to utilize the BDS as an improved charcoal stove, but this behavior also heats a portion of the stove that would typically remain relatively cool to temperature above which the SUMs will not survive.

One ramification of the unrecoverable data from overheated SUMs is that users who exhibit behaviors that overheat their SUMs are systematically underrepresented in SUMs data. For example, a population of cooks using their cookstoves often, at high temperature, and inverted are likely to have a much higher burnout rate than customers who do not use their stove regularly. Another way to think about this is that women who do not use their stove will never burn out their sensors and are, therefore, overrepresented. For this reason, we believe that the data we show herein generally underestimates the utilization of the BDS by a random population.

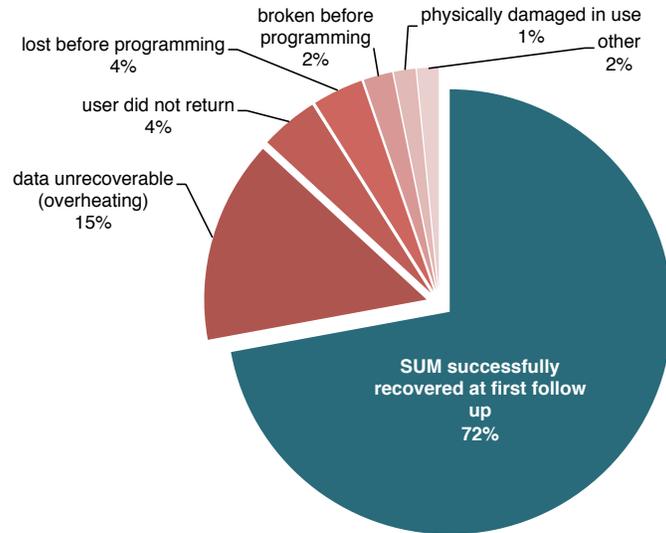


Figure 5: the fate of the 190 SUMs deployed to Darfur



Figure 6: Infrared photograph of the Berkeley-Darfur Stove to determine optimum SUMs placement without overheating.

The first challenge in analyzing SUMs data was to define what constitutes a cooking event. As a preliminary algorithm, the duration of a cooking event was determined as follows: the start of a cooking is defined as the sample data point preceding a sample where the stove’s temperature exceeds ambient temperature by more than 5°C. The preceding data point is chosen to account for the fast temperature ramping rate; if this were not done, the cookstove could already be more than 20°C above ambient temperature by the time cooking “started.” This algorithm for defining the start of a cooking event requires a definition of ambient temperature. In order to accomplish this, for every 30 minute window from July 28th until November 7th, the 25th percentile of the distribution of cookstove temperatures was taken as to be the baseline ambient temperature in region of the IDP camp. Then, to account for sensor calibration offsets, a corrected ambient temperature curve was calculated on a per-

stove basis by adding a constant temperature offset to the baseline ambient temperature that minimized the sum of squares error between all sensor values lower than 35°C and the corrected ambient temperature curve. Finally, the end of the cooking event is defined as the time after which all subsequent temperatures decrease monotonically until the sensor's temperature is lower than 5°C above the corrected ambient temperature. After this cooling threshold has been reached, a new cooking event can start. An examples of this algorithm in effect is shown in Figure 7a.

Using this definition of a cooking event, a determination was made between cookstove “users” and “non-users.” The distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) shown in Figure 7b was created that ranks the 122 unique users by the proportion of days they used the cookstove. In order to account for “courtesy” uses to make stove appear well-used just before a follow up, a two-day period preceding the first follow up survey was ignored when creating this CDF. For the purposes of this analysis, a demarcation between “user” and “non-user” was made at 0.1 proportion of stove use days (i.e. if a participant used the stove less than 1 in 10 days, she is categorized a “non-user”). This classification is somewhat arbitrary and used only as a rough metric by which to separate women who regularly use the stove and those who use it little or not at all. Using this classification, 78% (95 participants) are categorized as “users” and 22% (27) as “non-users.” Figure 7c and Figure 7d show histograms of mean cook events per day and mean cooking hours per day for population broken down into “users” and “non-users.”

Analysis of the full data set leads to interesting insights about the studied population's behavior. For example, Figure 8 demonstrates population-wide daily cooking behaviors by plotting the proportion of women using their stoves as a function of the time of day. Conversations with partners at SAG confirm the findings of Figure 8 women typically make two to three meals per day: an early-morning tea just before or after the sun rises, a mid-day “breakfast” of which a portion will be saved and eaten later in the day, and an evening dinner.

Finally, for the subset of the population where SUMs were reinstalled on the stoves after the first follow up and recollected two weeks later at a second follow up, our intent was to determine if the follow up had an effect on users' behavior. No training on stove use or pressure to use the stove was administered during the first follow up; women simply answered questions such as “how many times per week do you use your stove?” while in the presence of roughly 35 peers who were individually answering the same questions with enumeration teams. Figure 9 clearly shows the effects of pre follow

up “courtesy” use of the cookstove as well as a sustained boost in use post follow up. In fact, the boost in post follow up use for the non-user group (whose designation as non-users was defined by their pre follow up behavior) causes their average hours per day to eventually exceed the average hours cooked per day of the “users.” This finding points strongly towards the importance of making a second encounter with women who receive the BDS; it seems social pressure to try using the BDS regularly can lead to sustained and regular use.

Moving forward, the algorithm for determining cooking duration will be refined in order to produce more precise data about cooking times. Additionally, statistical analysis will be performed on the pre/post follow up behavior of users and non-users to determine the statistical effect of the follow up on use. Finally, survey data will be analyzed for participants’ self-reported cookstove hourly use and uses per day and these self-reported values will be compared with SUMs data.

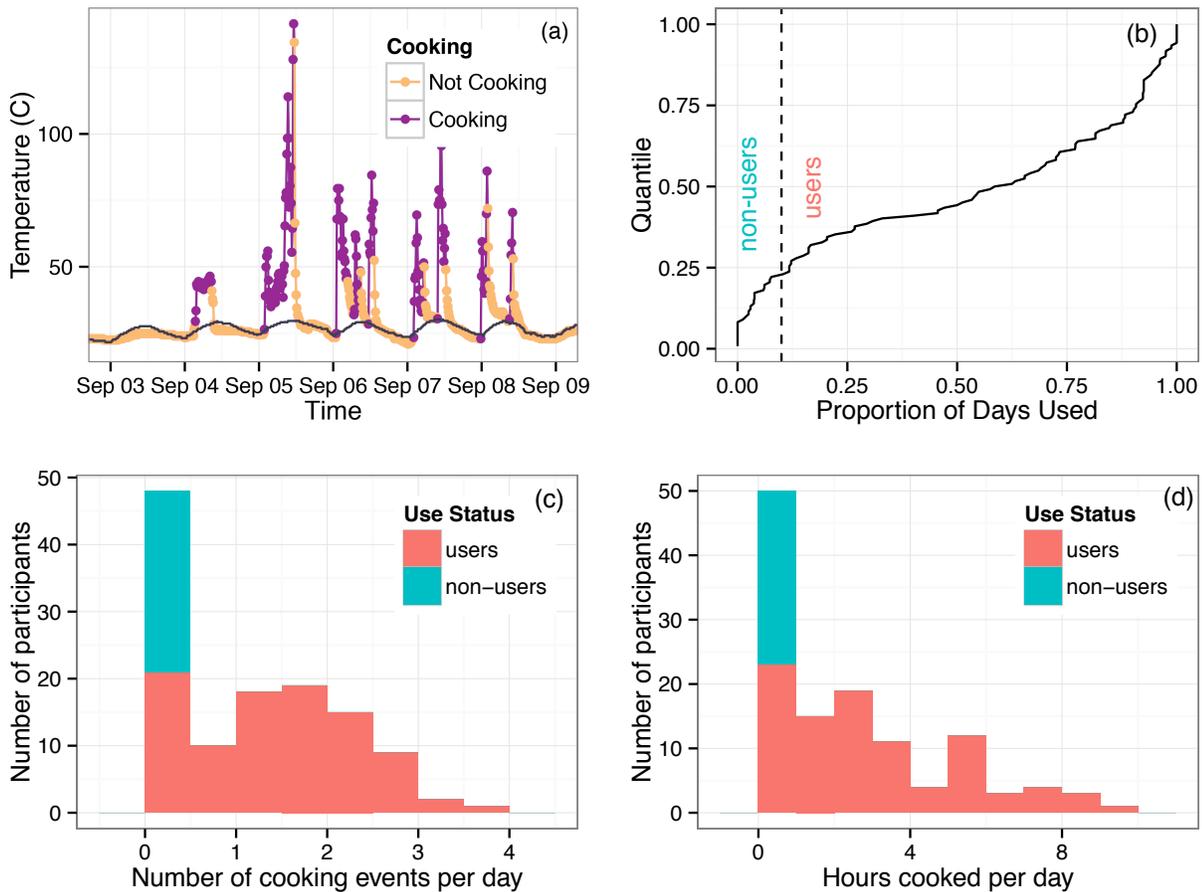


Figure 7: clockwise from top left: (a) event detection is illustrated over a one-week period for a particular SUM with ambient temperature shown as a black line, non-cooking shown in light orange, and cooking events shown in purple, (b) cumulative distribution of the proportion of days the stove was

used with the delineation between “user” and “non-user” drawn at 10% of days used, (c) a histogram of the mean quantity of cook events per day from dissemination until 24 hours before the first follow up, and (d) a histogram of the mean hours of cooking per day. Figures b-d are shown for the time period from dissemination until the one full day before the first follow up.

Table 2: Summary data for the entire population, users, and non-users separated into pre and post follow up behavior.

		All Participants			Users			Non-Users		
		n	mean	sd	n	mean	sd	n	mean	sd
Pre 1st follow up	daily cooking hours	122	2.4	2.4	95	3.0	2.3	27	0.051	0.088
	daily cooking events	122	1.1	1.0	95	1.5	0.86	27	0.037	0.042
Post 1st follow up	daily cooking hours	61	3.5	2.9	49	3.5	3.0	12	3.7	2.6
	daily cooking events	61	1.7	1.0	49	1.6	1.0	12	2.0	1.1

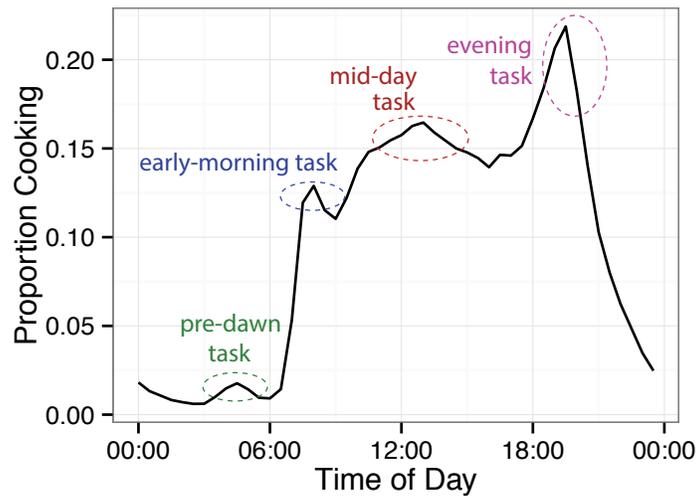


Figure 8: the average proportion of women cooking on their BDS as a function of the time of day for the duration of the SUMs experiment. Particular activities are apparent including pre-dawn cooking tasks, early-morning, mid-day, and evening tasks. The most common time for women to use their Berkeley-Darfur stove is around 8 p.m.

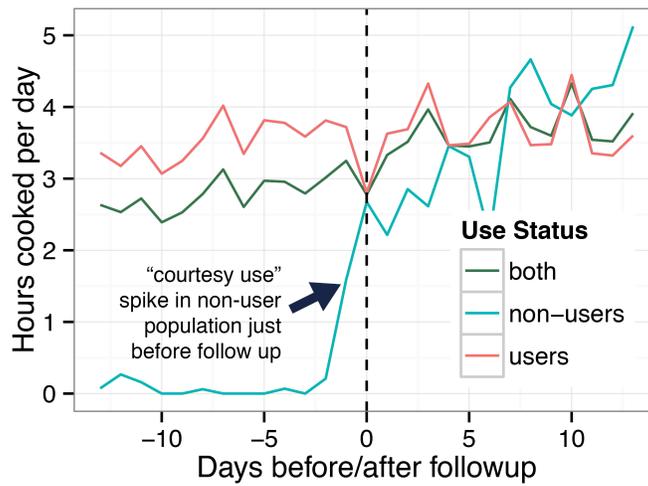


Figure 9: hours of average cooking per day in the two weeks preceding and following the follow up. The average cooking time for the entire population is shown in green while non-users and users are shown in teal and salmon, respectively. The population of non-users begin to use their stove roughly two days before the first follow up, presumably as a “courtesy” to make the stove appear well-used.

**Testing and Developing a Sustainable Model for
Cookstoves in Darfur and Ethiopia**

Milestone #9 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development
(USAID) Development Innovation Ventures**

April 30, 2014



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
BDS	Berkeley-Darfur Stove
BES	Berkeley-Ethiopia Stove
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
HAC	Humanitarian Aid Commission of Sudan
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group
SUM	Stove Use Monitor
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard¹

Date Milestone No.	May-12 1	Jul-12 2	Oct-12 3	Dec-12 4	Apr-13 5	Jul-13 6	Oct-13 7	Jan-14 8	Apr-14 9
Indicator									
Total population with access to FES in targeted communities in Darfur	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556	226,056
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A	N/A	N/A	57	57	57	57
Geographical distribution of FES in Darfur	(see chart)								
Geographical distribution of FES in Ethiopia	(see chart)								
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926	37,676
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10	10
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%	90%

¹In this Milestone report, we've opted to exclude a row that was previously included in our Indicator Dashboard: "CO2 Equivalent mitigated (tons) by using FES instead of traditional methods." The reason for this exclusion is that we are currently in the process of changing Project Developers for our Carbon Offset Programming as our current developer, Impact Carbon, is winding down all of their carbon programming. We are in discussions with the funder of our carbon offset documentation activities to identify a new Project Developer. Once we identify and contract with a new one, we will re-evaluate if the calculations we were using for this report are consistent with their methodology, and we will re-incorporate reporting as appropriate.

Objectively measured usage:										73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approximately 1.5 hours per day.
Derived from Stove Use Monitor (SUMs) data analysis	N/A									
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A									
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A									

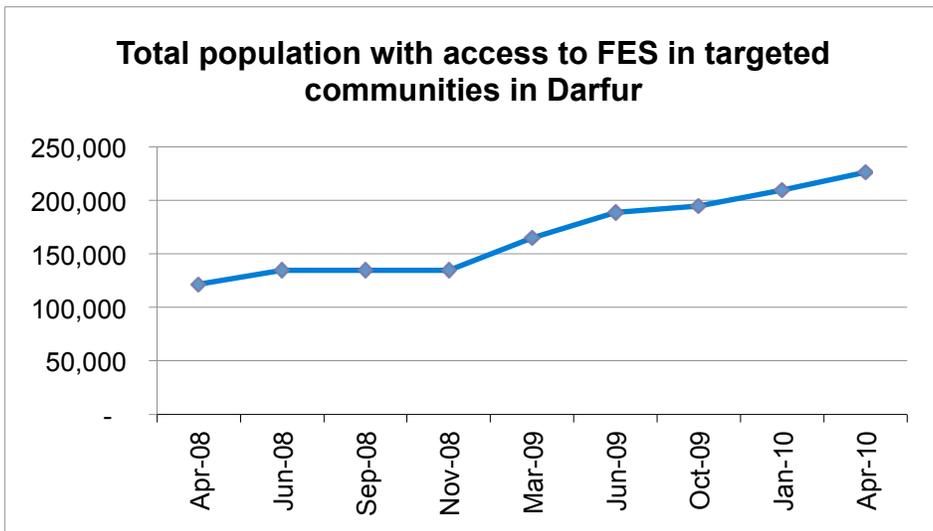


Figure 1: Total population with access to FES in targeted communities in Darfur

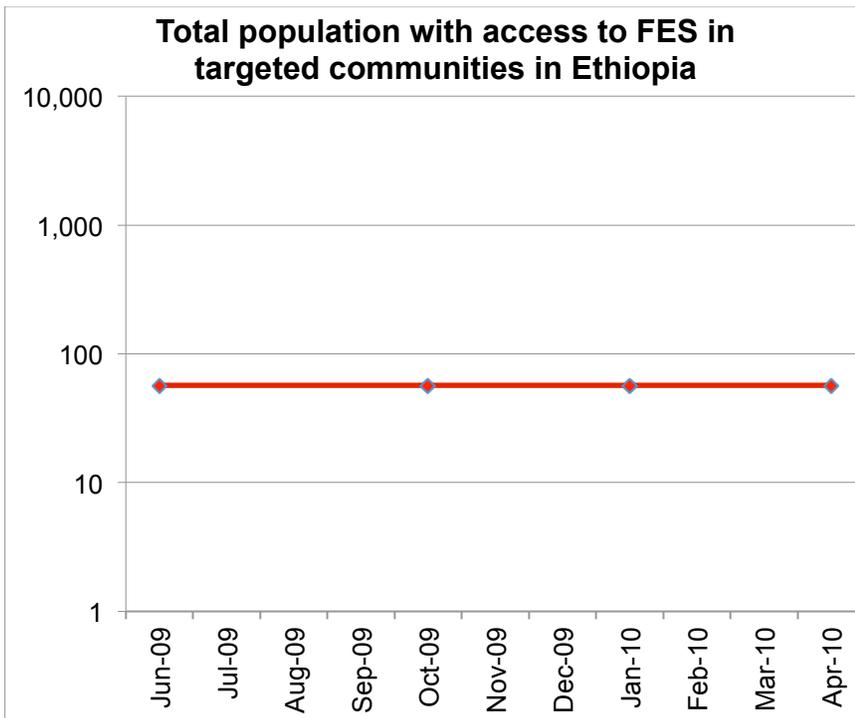
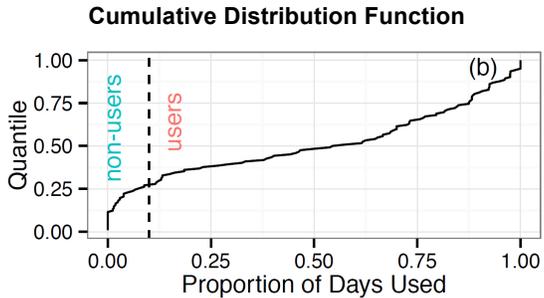


Figure 2: Total population with access to FES in targeted communities in Ethiopia

Notes on Indicator Dashboard

A) We report customer satisfaction levels in Darfur based on:

1. Data analysis from the Stove Use Monitors (SUMs) research supported by USAID DIV.
 - a. It should be noted that this SUMs research was conducted with recipients of free Berkeley-Darfur Stoves. In the future, we plan to conduct SUMs research with stove purchasers to compare usage data.
 - b. *Objectively Measure Usage (new row in the above table)*: There is no industry standard on what defines a stove user. Our distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) (shown below) was created that ranks the 122 unique cooks by the proportion of days they used the stove. In order to account for “courtesy” uses immediately before a follow up, a two-day period preceding the first follow up survey was ignored. For the purposes of this analysis, **a demarcation between “user” and “non-user” was made at 10% of possible stove-use days during the observed period (i.e. if a participant used the stove less than 1 in 10 days, she is categorized as a “non-user”). This classification is arbitrary and used only as a metric by which to separate women who regularly use the stove and those who use it very little or not at all.** Using this classification, 73% (89 participants) are categorized as “users” and 27% (33) as “non-users.” To obtain an upper bound on the bias effect from higher SUMs failure rates with “user” cooks, we recalculate this percentage assuming that all the thermally-failed SUMs were with the “users” group. This leads to an upper bound estimate of 78% (118) users and 22% (33) non-users.



- c. 73% of our participants use the stove on more than 10% of ownership days.
2. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
 3. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.
 4. The fact that no one has returned any of the stoves that have been distributed this year, and those who purchased them continue to make payments

- B) Average household sizes:
1. Darfur = 6
 2. Ethiopia = 5.7

Table 2: Geographic Distribution of FES in Darfur

Note: Rows highlighted in **yellow** show stoves distributed since last Milestone Report

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free

1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013C	North	Rural El Fasher	2450	CBOs*	14	2013	Revolving Loan Fund/installment payment plan
2013C	North	Rural El Fasher	2750	CBOs*	14	2014	Revolving Loan Fund/installment payment plan
		TOTAL	37,676				

***Breakdown of Batch 2013C Stoves:**

Name of Community Based Organization (CBO)	# of stoves received
Ayadi Al Rahma	200
Women Development Association (Dar El Salam)	200
Sudanese Agency for Dar El Salam Locality Development	200
Om Al Qora Women Development Association (Koma)	100
Om Dul Association (Dar El Salam)	200
Rifai Association (Om Kidada)	850
Seekar Association	100
Al Mawada wal Rahma Association (Mellit)	200
Women Development Association (El Sereif)	400
Rifai Association	850
Ayadi Al Rahma	200
Al Mawada Wal Rahma	200
Om Dul	200
Seekar	100
Women's Development Association (Dar El Salam)	200
Om al Qura (Kuma)	100
Om Al Kiram	200

Midoub Mountains	100
Women's Development Association (Siref)	200
Hafizat (Saraf Omra)	200
Sudanese Agency for Development	200
TOTAL: 5,200	

Table 3: Geographic Distribution of FES in Ethiopia

Batch	Region	Location	#
2013A	Oromia	Sebeta	5*
2013A	Oromia	Meki	5
2013A	Oromia	Debre Zeit	1*

*One stove that was on loan in Sebeta was returned and taken to Debre Zeit for stove demonstrations

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Since our January 2014 Milestone Report, we distributed an additional 2,750 stoves in Darfur, bringing the total number of stoves distributed in Darfur to 37,676. In Ethiopia we have not distributed additional stoves since our last report, as we put into place our distribution and evaluation plans while our 600 stove flat-kits for our marketing trial are en route from our manufacturer to Djibouti, where they will then be imported by our Ethiopian Field Representatives.

In late March/early April, our Sudan Field Representative returned to Sudan along with our new Executive Director to conduct partner outreach and to follow up with our current partner, Sustainable Action Group (SAG) on stove assembly, sales, documentation and on-the-ground operations. Due to recent reports of increased violence in Darfur, PE staff members were not able to visit Darfur on this trip, but we were able to facilitate the travel of several members of SAG's Darfur-based staff to Khartoum in order to conduct meetings. Strategic meetings were conducted in person to discuss pricing of the BDS as well as to begin work on a plan that is intended to transition SAG to full or near-full cost-recovery from stove sales by the end of 2015.

In addition to working with SAG, PE Staff met with and vetted several prospective distribution partners as well as visited Al-Afhad University for Women to explore opportunities to involve Sudanese graduate students in field research. There is a great deal of interest from additional distributors within Sudan, and we are optimistic about our ability to diversify our distribution channels and reduce key partner risk in SAG in the medium term. More updates on these discussions are detailed below in the milestone updates.

Finally, the PE team underwent a strategic planning process, which included a review of our current operations, potential for expansion into Ethiopia, and potential for expansion to new markets in Sub-Saharan Africa where the BDS or similar stoves could have a powerful impact on health, environmental and economic outcomes. The strategic plan was authored by PE staff, was reviewed by internal and external stakeholders, and was approved by PE's Board of Directors in April 2014.

MILESTONE UPDATES: April 30, 2014

1. Recruit and Train Local Sales Agents (Darfur)

In early 2014, PE signed an MOU with a new pilot partner in South Darfur, Malam Darfur Peace and Development Organization (MDPD). As part of a pilot partnership agreement, MDPD purchased 1,000 stoves from Potential Energy at their full cost. The PE team then trained MDPD staff on how to conduct stove demonstrations, how to train users on the BDS (which is critical to ensuring fuel savings and safety), and on best practices for documenting stoves sales and user information in order to track distribution and conduct follow-up visits. The training was successful and the sales pilot is now underway.

2. Expand sales based on findings from marketing trials (Darfur)

During our Executive Director and Sudan Field Representative's recent visit to Sudan, stove sales were discussed in detail with SAG and our new pilot partner in South Darfur, MDPD. Due to inflation and the rising cost of transportation within Sudan, the initial sales price for the stove has become outdated, leading SAG and potential future distribution partners to incur additional costs for assembly, storage and transport.

SAG and Potential Energy agreed to increase the price of stoves that are sold through SAG and their partners by approximately 30 SDG. This increase in price will help offset transport costs, and a percent of additional sales revenue will be earmarked for SAG to send directly to PE's stove manufacturer in India to offset the cost of raw materials of the stove. The decision to have SAG partially cover raw materials costs helps set SAG on a more concrete path toward sustainability (previously raw materials costs had been covered fully by Potential Energy). In addition, the volume of stoves that will be sold versus donated will also increase with Batch 3 for 2014, from 50-50 to 60-40 (ratio represents sold versus free distribution).

PE's pilot partner, MDPD, conducted a market survey that revealed substantial opportunity for fuel-efficient stove sales in the areas in which they operate. As noted above, they purchased an initial set of stoves and are currently conducting a sales pilot. If the pilot is successful, PE and MDPD will evaluate how our organizations can collaborate to scale stove operations and diversify import and distribution channels.

3. Replicate assembly shop (West Darfur)

We continue to put our plans on hold to replicate our assembly shop because we have not yet reached maximum capacity in our current shop. With a pilot partnership in South Darfur underway, we plan to explore opportunities for assembly shop replication after potential partner(s) have completed sales pilots.

During the recent visit by PE staff to Sudan, equipment was delivered to SAG to improve assembly shop efficiency at the current location. The equipment will enable SAG to initiate mobile assembly and repair activities in the IDP camps near El Fasher, North Darfur. In addition to the tools that PE staff brought to Sudan, additional new tools will be sent with the next shipment of flat-kits. These include rivet solutions; The current riveting technology in place at the assembly shop consists of hand-riveting tools. While these are cost effective, they can be challenging to use repeatedly for an extended period of time as they require a great deal of manual labor. PE worked with engineers from LBNL to modify an electric rivet tool so that it can be charged by a solar panel. Electric tools are easier to use and the

assembly shop team has requested them. This new solar powered rivet gun will also be included in the next stove shipment to Sudan.

4. Build distribution channels (West Darfur)

PE continues to explore the potential for expanding stove distribution beyond North Darfur into other Darfuri states. PE's Executive Director and Sudan Field Representative conducted meetings with various local, regional and international organizations during their time in Khartoum in March/April. The following are highlights from meetings with organizations interested in distribution of the Berkeley-Darfur Stove (BDS). PE is currently assessing the partnership potential with each organization. The next steps will involve PE and the new partner(s) designing a pilot distribution plan to be implemented and training new pilot partners.

Pilot Partner: Malam Darfur Peace and Development Organization (MDPD)

Since our last Milestone Report, we signed a pilot partnership agreement with MDPD to conduct a marketing and sales trial in the Malam area of South Darfur. The trial includes 1,000 stoves. MDPD planned and is in the process of executing a media campaign, which has included meeting with Sudan's largest newspapers as well making appearances on TV and radio shows. While this media coverage has been focused on MDPD's previous achievements, they also highlighted their upcoming projects including fuel-efficient stove distribution.

As part of this campaign, MDPD provided free stoves to key social figures in Nyala (the capital of South Darfur) and Malam to promote future sales opportunities. MDPD reports demand for the stove in villages in South Darfur as well as larger institutions that cater to IDPs in the area. Due to strong demand and high transport costs, MDPD has expressed interest in opening discussions on how to scale beyond their pilot. PE will engage in these discussions once initial sales data is received, and we can review progress.

Potential Pilot Partner: Nidaa

Nidaa is an NGO focused on building young graduates' capacity. They have offices in West Darfur, South Darfur and West Kordofan. They have partnered with the Japanese and German embassies as well as Oxfam America and CHF International on various environmental and health programs. Two of their past projects include training sales agents to sell health and agricultural supplies. Given that they already have experience working with sales agents, there could be an opportunity to leverage this model to also promote and increase stove sales. Nidaa will likely launch a small pilot with PE (approximately 100 stoves), and they intend to pilot the sale of the stove at full price. They will report back on the results to Potential Energy in May/June, and we hope to share more information about future partnership viability in the next milestone report.

Potential Pilot Partner: The Sudanese Environmental Conservation Society (SECS)

SECS focuses on conservation and sustainable development. They currently work with international organizations such as UNEP and UNDP. SECS is interested in exploring a partnership with PE to assemble and distribute the BDS to conflict-affected populations in rural areas and slums in Khartoum.

SECS is currently assessing the BDS and reviewing their financial situation. They will reach back out to Potential Energy if they are interested in advancing the conversation.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

As previously mentioned in Section 3, PE delivered new tools to SAG for the stove assembly shop & mobile repair activities. In addition, PE met with SAG leadership to discuss the logistics of increasing stove production from 15,000 to 25,000 in 2015. If production is increased in the coming year, PE will work with SAG to enhance training for assembly shop workers.

Upon completion of their marketing and sales trial, if successful (success will be co-defined by PE and MDPD), MDPD would like to enter into negotiations with the government of Sudan's Humanitarian Aid Commission (HAC) to pursue an import exemption in order to eventually establish their own assembly shop in South Darfur within the next year. If the marketing and sales trial is successful, PE will work with MDPD to determine the costs associated with doing this, and will explore cost-sharing scenarios as well as how to facilitate appropriate hiring and training of assembly shop workers.

Based on results from sales efforts this year, SAG is pursuing a new technical agreement with HAC for 2015 that should formalize an increase in the maximum allowable percentage of stove sales from 50% to 60% (with the remaining 40% dedicated to free distribution). As we move forward, we are confident in sales of the BDS based on reports from SAG of high demand, particularly as the price of wood continues to increase in Darfur.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

We have progressed in our efforts to conduct a randomized control trial (RCT) in peri-urban areas of the Oromia region of Ethiopia. During her visit to Ethiopia earlier this month, PE's Executive Director delivered the Stove User Monitors (SUMs) to our Ethiopia representatives, Ethio-Resource Group (ERG). She also worked with our in-country team to define their workplans and map out the activities that will be necessary to execute during the sales trial and RCT work.

In the coming weeks, a training will be conducted over Skype on the proper installation of SUMs onto the stoves. In addition, the UC Berkeley PhD student managing the evaluation will finalize an activity plan for the RCT with specific deliverables and dates for ERG and our marketing trial partners to implement.

Since the last milestone report, PE began working with VOTO Mobile, a voiced-based mobile accounting company as our partner on the mobile phone aspect of our evaluation in Ethiopia. This decision was made for several reasons, including: high quality customer service and the availability of a voice-based service.²

Outline of VOTO Mobile Activities

First we will recruit households to participate in a voice-based mobile accounting program provided by VOTO Mobile. We will randomly select ¼ of the households to experience a "placebo" enrollment

² Potential partner, Inventure was only able to offer a text-based program. PE was concerned that obtaining customer data via text message would be unreliable due to low literacy rates.

process (control group), which simply asks basic demographic questions, while the mobile treatment groups will also receive weekly requests for information about fuel expenditures and smoke-related symptoms (or both), as well as predictions for cost savings from using a cookstove. By randomizing these treatments we can look at how data collection and savings predictions alter purchasing decisions.

After two weeks, a randomly-selected ½ of participating households will be invited to a stove demonstration. After the demonstration, ½ of these households will be offered the opportunity to purchase the stove through a payment plan and ½ will be offered a free trial of the stove with the subsequent option to purchase.

Households that purchase a stove will receive ongoing mobile voice messages about the stove. We will randomize various message elements in order to learn how to best structure mobile contact: 1) “information push” only (reminders, usage tips) vs. an additional “accountability question” (asking if the reminder/tip was acted upon); 2) frequency of reporting prompts; 3) gender of the respondent; 4) “previews” of upcoming questions vs. none. All stoves will be instrumented with SUMs; follow-up surveys will occur after 6-month study period.

In parallel with our efforts regarding the RCT, we have pinpointed the key questions that need to be addressed in our marketing trial in order to determine next steps for PE to go to scale in Ethiopia:

1. Customer opinions on stove:

- Do they find it durable?
- Do they like the design?
- Can they tell it is high quality?
- How do they find this compares to other stoves they have seen/used?

2. Price Point:

- What is the highest price customers are willing to pay in cash? In installments?
- How much does willingness to pay increase with a charcoal insert?
- How does offering a free trial change willingness to pay?
- How does showing customers their fuel expenditures change willingness to pay?

3. Distribution Strategy

- Which of the following work best as sales channels, as measured by highest percentage of people who purchase a stove as compared to those who learned about it:
 - Women’s Commercial Groups
 - Women’s Savings & Credit Groups
 - NGO Reps doing the direct sales
 - Youth Groups
 - Small Shops in regional towns (Ag, clean energy, other)
 - Community Leaders
 - Other?
- Which of the above can successfully collect installment payments?

7. Develop local manufacturing capacity (Ethiopia)

In preparation for the 600 stove kits arriving for the marketing trial, PE’s Executive Director delivered all tools required for stove assembly that could not be obtained locally. Stove assembly will take place in

the shop owned by Ethio-Resource Group (ERG) that is used for their electric stove business. In addition to our progress on stove assembly, we also obtained crucial information about manufacturing in Ethiopia, which will help us make a decision after the 600 stove trial, and the RCT, about the resourcing associated with further scaling in-country.

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

There are several important updates to the SUMs data stemming primarily from refinement of the SUMs event detection algorithm. The original algorithm had two scenarios that sometimes confounded it: (1) because the Berkeley-Darfur Stove (BDS) is often in proximity to other cooking fires in the household (e.g. “ladayas” or three-stone fires), the SUMs might some times detect elevated temperatures that were not caused by cooking on the BDS, and (2) long cool-down periods for stoves were sometimes misinterpreted as cooking. In our data analysis, both of these confounding factors are now handled with much more refinement.

This change has generally led to more cooking event detections and shorter average events. These phenomena are due to the algorithm no longer misinterpreting a cooking event, cool down, and then another event as a single long event (events get shorter, but there are more of them). Figures and tables previously presented have been updated below to represent the refinement in this algorithm.

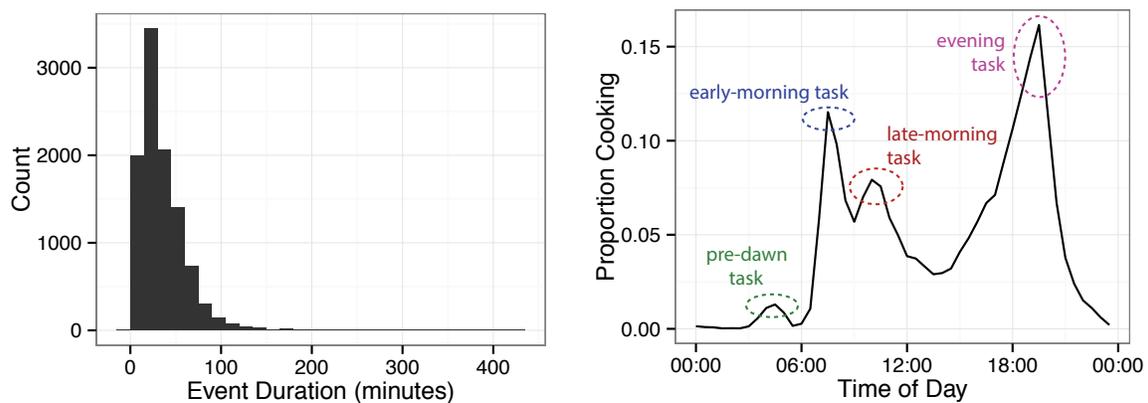


Figure 1. Left: Histogram of the duration of 10,280 individual cooking events. Right: the average proportion of women cooking on their BDS as a function of the time of day for the duration of the SUMs experiment preceding follow up. Apparent activities include pre-dawn cooking tasks, early-morning, mid-morning, and evening tasks. The most common time for women to use their Berkeley-Darfur stove is roughly 20:00 (8 p.m.).

Table 2. Summary data for all participants, users, and non-users separated into pre and post follow up behavior.

		All Participants			Users			Non-Users		
		n	Mea	sd	n	mea	sd	n	mea	sd
Pre 1st	daily cooking	12	1.1	1.	89	1.5	0.9	33	0.02	0.04

follow up	daily cooking	12	1.4	1.	89	2.0	1.3	33	0.03	0.05
Post 1st	daily cooking	61	1.6	1.	44	1.6	1.3	17	1.7	1.3
follow up	daily cooking	61	2.1	1.	44	2.0	1.6	17	2.2	1.5

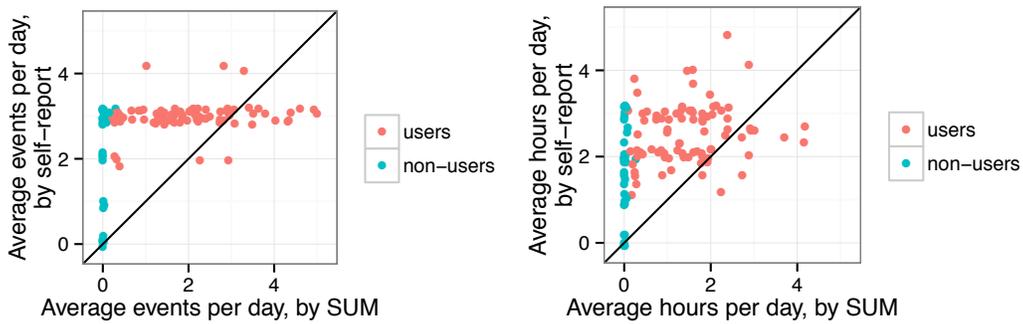


Figure 2. Daily events (left) and hours of BDS use (right) are shown as scatterplots of SUMs-measured versus self-reported data. The scatter plot shows the 1:1 line that data would fall on if users perfectly reported adoption as measured by the algorithm. Points above the 1:1 line denote participants who overestimate their usage (81% of users and 85% of non-users over report cooking events, and 85% of both users and non-users over report cooking hours), and points below the line are participants who tend to underestimate their usage. To avoid overplotting, plot points are “jittered” with random noise on the y-axis ± 0.2 events or hours for the left and right graphs, respectively.

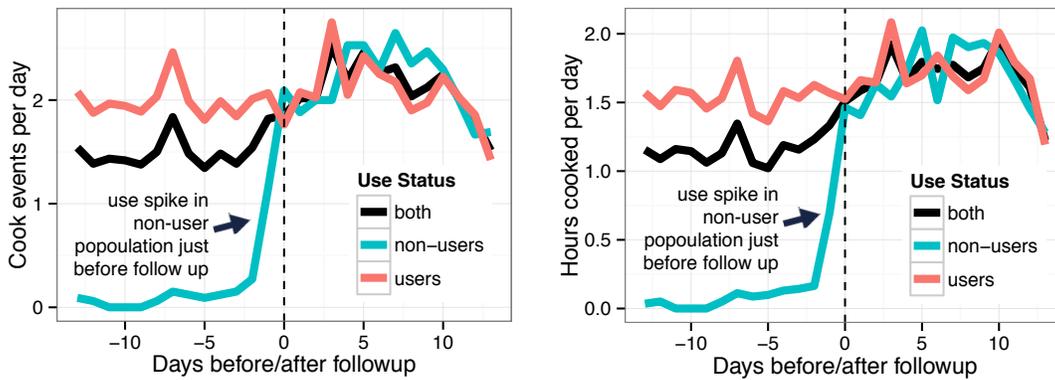


Figure 3. Events and hours of cooking per day in the two weeks preceding and following the follow up. The average cooking time for the entire population is shown in black while non-users and users are shown in teal and red, respectively. The population of non-users begins to use their stove roughly two days before the first follow up, presumably as a “courtesy” to make the stove appear well used or to become familiar with the stove prior to being interviewed in the follow up.

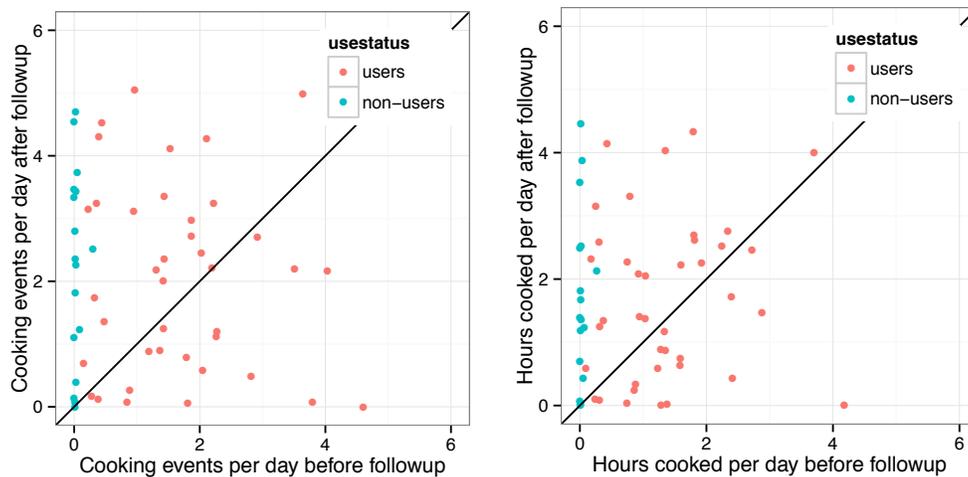


Figure 4. Post versus pre follow up SUMs data of events and hours of cooking per day. Points falling along the 1:1 line represent participants whose behavior was unchanged by the follow up. Points above the 1:1 line represent participants who use their stove more after the follow up; points below the 1:1 line belong to participants who use their stove less after the follow up. A large increase in cookstove adoption after the follow up interview is indicated for prior non-users – 94% of teal dots are above the diagonal line. A slight increase even among prior users is indicated by 55% of red dots above the diagonal line.

Significant intellectual effort and time has been put into the development of an *ad hoc* algorithm for defining cooking events. To further refine our own algorithm as well as create capacity for future groups to analyze their own data without sophisticated programming skills, we are now developing a sophisticated machine learning tool that will “learn” what a cooking event is based on what an expert labeler defines cooking to be. This tool simply requires the expert to highlight certain sections of a temperature curve that represent cooking, and the algorithm then slowly “learns” how to define cooking on its own. In this way, any expert or technician highly-capable of labeling cooking event data (either via intuition or time-stamped diary logs of cooking behavior) will be able to analyze vast quantities of SUMs data by only hand-labeling a very small subset of that data.

Finally, our team is beginning to work on in-depth analysis of survey responses and their correlation with SUMs-observed cooking behaviors. With these data, our team will determine if there are any correlations between SUMs-observed data and survey data. For example, do larger families use their BDS more often than smaller families? Or, do older respondents answer more truthfully about behavior than younger respondents? These are the types of questions we are currently interested in answering.

**Testing and Developing a Sustainable Model for Cookstoves in
Darfur and Ethiopia**

Milestone #10 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development (USAID)
Development Innovation Ventures**

July 30, 2014



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
BDS	Berkeley-Darfur Stove
BES	Berkeley-Ethiopia Stove
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
HAC	Humanitarian Aid Commission of Sudan
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
MDPD	Malam Darfur Peace and Development
OA	Oxfam America
PE	Potential Energy, Inc.
SAG	Sustainable Action Group
SUM	Stove Use Monitor
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard¹

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14	Apr-14	Jul-14
Milestone No.	1	2	3	4	5	6	7	8	9	10
Indicator										
Total population with access to FES in targeted communities in Darfur	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556	226,056	226,056
Total population with access to FES in targeted communities in Ethiopia	N/A	N/A	N/A	N/A	N/A	57	57	57	57	57
Geographical distribution of FES in Darfur	(see chart)									
Geographical distribution of FES in Ethiopia	(see chart)									
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926	37,676	37,676
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10	10	10
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

¹In this Milestone report, we've opted to exclude the row that was previously included in our Indicator Dashboard in Milestone Reports 1-8: "CO2 Equivalent mitigated (tons) by using FES instead of traditional methods." The reason for this exclusion is that we are currently in the process of changing Project Developers for our Carbon Offset Programming as our previous developer, Impact Carbon, discontinued their services. We have identified a new Project Developer and once we are under contract with the new one, we will re-evaluate if the calculations we were using for this report are consistent with their methodology, and we will re-incorporate reporting as appropriate.

Objectively measured usage: Derived from Stove Use Monitor (SUMs) data analysis	N/A	73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approximately 1.5 hours per day.	73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approximately 1.5 hours per day.								
Proportion of targeted population who report cost savings from using FES instead of traditional methods in Ethiopia	N/A	N/A									
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A									

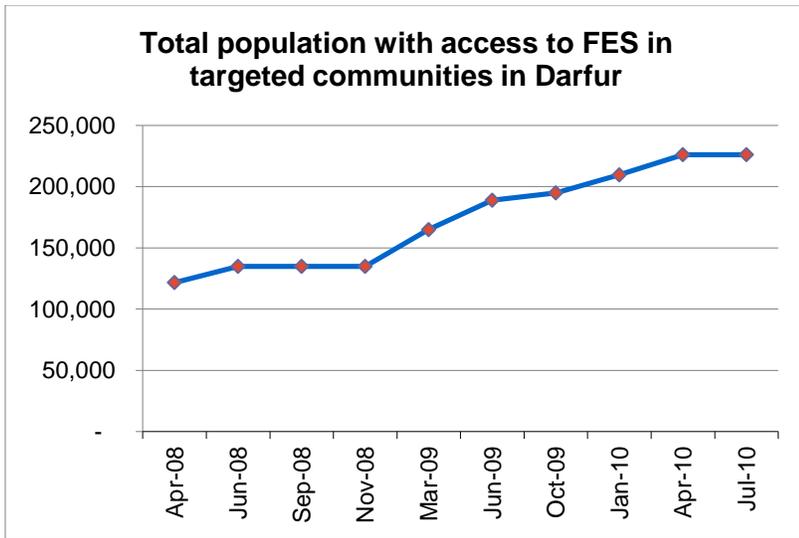


Figure 1: Total population with access to FES in targeted communities in Darfur

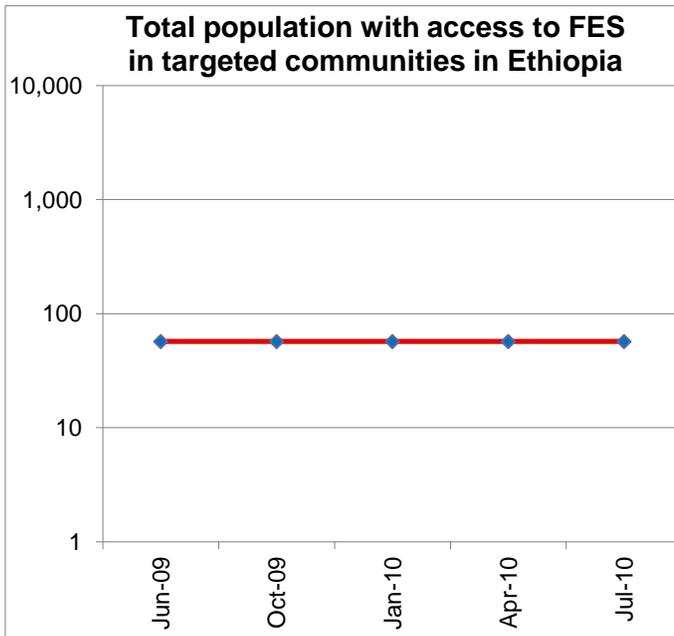


Figure 2: Total population with access to FES in targeted communities in Ethiopia

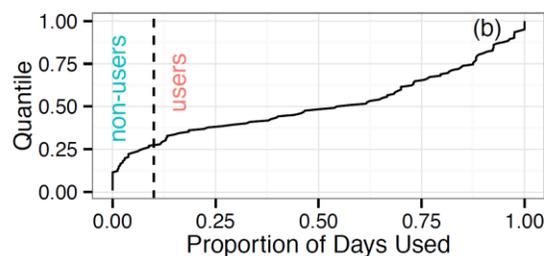
Notes on Indicator Dashboard

A) We report customer satisfaction levels in Darfur based on:

1. Data analysis from the Stove Use Monitors (SUMs) research supported by USAID DIV.

- a. It should be noted that this SUMs research was conducted with recipients of free Berkeley-Darfur Stoves. In the future, we plan to conduct SUMs research with stove purchasers to compare usage data.
- b. *Objectively Measure Usage:* There is no industry standard on what defines a stove user. Our distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) (shown below) was created that ranks the 122 unique cooks by the proportion of days they used the stove. In order to account for “courtesy” uses immediately before a follow up, a two-day period preceding the first follow up survey was ignored. For the purposes of this analysis, **a demarcation between “user” and “non-user” was made at 10% of possible stove-use days during the observed period (i.e. if a participant used the stove less than 1 in 10 days, she is categorized as a “non-user”). This classification is arbitrary and used only as a metric by which to separate women who regularly use the stove and those who use it very little or not at all.** Using this classification, 73% (89 participants) are categorized as “users” and 27% (33) as “non-users.” To obtain an upper bound on the bias effect from higher SUMs failure rates with “user” cooks, we recalculate this percentage assuming that all the thermally-failed SUMs were with the “users” group. This leads to an upper bound estimate of 78% (118) users and 22% (33) non-users.

Cumulative Distribution Function



- c. 73% of our participants use the stove on more than 10% of ownership days.

2. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
3. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.
4. The fact that no one has returned any of the stoves that have been distributed this year, and those who purchased them continue to make payments

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

Table 2: Geographic Distribution of FES in Darfur

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments

2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013C	North	Rural El Fasher	2450	CBOs	14	2013	Revolving Loan Fund/installment payment plan
2013C	North	Rural El Fasher	2750	CBOs	14	2014	Revolving Loan Fund/installment payment plan
TOTAL			37,676				

Table 3: Geographic Distribution of FES in Ethiopia*

Batch	Region	Location	#
2013A	Oromia	Sebeta	5
2013A	Oromia	Meki	5
2013A	Oromia	Debre Zeit	1

*Assembly of 600 stoves is currently underway in Ethiopia

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

After many serious delays with customs, international money transfers, stove production & shipping, we're excited to inform the DIV team that the 600 Berkeley-Ethiopia Stove flat-kits arrived in Addis Ababa and are currently being assembled in the shop owned by our Ethiopian partners, Ethio-Resource Group (ERG). The ERG shop has been equipped with the appropriate tools needed for BES assembly and we expect all stoves to be market ready within the next month. This timing puts us right at the end of the rainy season in Ethiopia, which is a better time to trial a wood-burning, smoke-reducing stove than the summer as wood will be drier and therefore will burn more efficiently than during the rains.

The PE team has been working closely with ERG and our research partners to lay the groundwork for a trial that will help test willingness to pay as well as experiment with various sales and marketing techniques. While we're excited to test the market, we are re-thinking a bit of the evaluation that we have been planning to do in-country so that we can focus more on pricing and less on additional interventions. The reason for this is that we're increasingly concerned that 1) the costs associated with importing goods – even those that are unassembled, and 2) the overall cost of doing business in

Ethiopia, may be prohibitively high to build a stove business at scale. As such, we're in active discussions with our partners to see what the best research design will be. We intend for final decisions to be lean from a cost perspective while still yielding useful results that will inform our marketing and sales efforts. We will be in touch with the DIV team, both in the Milestone Reports and also in between reporting via email as needed to keep you informed of our efforts on this front.

In Darfur, we have continued efforts to improve the collections capacity of our primary partner, Sustainable Action Group's (SAG), in Darfur. While improving, their team, in conjunction with the CBOs that serve as distributors and primary collections agents, are still lacking in their ability to ensure timely stove repayments. This is due in part to lack of training and skills, but it is also due to the challenges that Darfur has faced over the past months; Since February 2014, the entire Darfur region, including the state of North Darfur, suffered from renewed fighting between rebels and government forces. This has affected transport routes and access to the rural communities using the Berkeley-Darfur Stove.

Despite these challenges, we continue to work with our distributors and partners to strive for excellence in stove financing and collections. PE's Sudan Field Representative, Omnia Abbas is currently in Khartoum and will travel to Darfur to meet with partners to improve systems for the documentation of stove sales and payment collection. In addition to working with SAG and the CBOs, we've also been actively involved in diversifying our partner base through pilot trials in West Darfur and soon in Central Darfur. The pilots are early but we should have some good results on customer and partner interest in the product by the Fall or Winter of 2014.

In addition to working with partners on collections, Omnia is also working to contract a local consultant to do a new baseline survey on South, Central and West Darfur in order to understand household behaviors, including fuel usage, typical household expenditures, existing cooking practices and general interest in improved stoves. This information will inform our expansion and will help us understand the economic impact of our work in new regions.

We have been experiencing delays from our manufacturer in India for the 1st and 2nd batch of stoves destined for Darfur for 2014. While we placed the order for the first batch 3+ months ago, the stoves are just now leaving the port. This is largely due to the inability of our manufacturer to produce the cast-iron grate in-house. Our engineers, led by Daniel Wilson, have been working with the manufacturer to trouble shoot this issue so that we can minimize delays in future shipments. Because of this, the stove numbers have not changed since the last report.

Finally, we've been actively exploring new regions beyond Sudan and Ethiopia in order to lay the groundwork for further expansion in Sub-Saharan Africa. Potential Energy launched a Fellowship Program and currently has highly qualified MBA and MPH candidates conducting market research, focus groups and general ground-truthing in Burkina Faso, Benin and Cameroon. Based on the results of the Fellows' work this summer, Potential Energy intends to do an ultra-clean stove pilot project in the most viable (from a market and impact perspective) of these three markets.

And, its worth noting that since the last Milestone Report, Potential Energy's Executive Director, Michelle Kreger met with the USAID-DIV team in Washington, DC to provide an in-person update on our work in Sudan and Ethiopia and discuss our strategy in the coming years. She really enjoyed meeting the team!

MILESTONE UPDATES: JULY 30, 2014

1. Recruit and Train Local Sales Agents (Darfur)

Based on our experiences from the first round of our “Revolving Loan Fund” project (funded by the UN Foundation’s Global Alliance for Clean Cookstoves), Potential Energy’s Sudan Field Representative is currently working with our partners to compile a set of best practices for both current and prospective Community-Based Organizations (CBOs) that serve as our local sales agents. A preliminary list of Potential Energy’s policies and practices regarding the recruitment and training of local sales agents in Darfur includes:

- Only CBOs that have collected at least 90% of payments for stoves from the previous financing round will be invited to continue participating in PE’s stove sales program
- Only CBOs that can demonstrate that they are willing and able to designate internal personnel to manage money collection & documentation will be invited to participate
- CBOs with demonstrated successful previous experience with micro-lending or household product sales will be given preference
- In conjunction with Sustainable Action Group (SAG), PE will experiment with various non-monetary incentives for high performing CBOs, such as:
 - Granting successful CBOs certificates for good performance
 - Granting successful CBOs 1-2 Cool Mesh stoves as a reward for good performance
- SAG will contact local chiefs in communities that have low stove payment rates and request that they encourage borrowers to repay so the community would continue to be able to participate in PE’s stove program
- CBOs leaders must commit to attending all trainings along with at least 50% of their sales agents

We plan to refine these policies with the input of SAG, as well as our new partners as we expand our reach to other parts of Darfur.

2. Expand sales based on findings from marketing trials (Darfur)

Since PE’s last Milestone Report, longtime partner Sustainable Action Group (SAG) and our new partner, Malam Darfur Peace and Development (MDPD), have deepened their communication and knowledge sharing about best practices for selling and distributing stoves in their respective regions. PE facilitated a discussion between the two organizations in order to share the challenges and lessons learned from promoting, distributing and selling stoves in Malam, a region that is 75 kilometers north of Nyala, the capital of South Darfur.

MDPD purchased 1,000 stoves from PE, which were manufactured by SAG and transported from El Fashir to Malam. MDPD promoted the stoves in their community through various means; radio, TV, events held at the community center and the like. The project was received with enthusiasm. MDPD originally promoted the stove at an unsubsidized cost (150 Sudanese pounds (SDG)). While there is some willingness to pay, the sales price in North Darfur is still subsidized so when customers got word of this they were less likely to be interested. Following discussions between PE, SAG and MDPD, MDPD agreed to sell the stoves at a standardized (still subsidized) price of 90 SDG for now, with the intention to do away with the subsidy within the next 6-9 months as the 2014 batches arrive.

3. Replicate assembly shop (West Darfur)

We continue to put our plans on hold for replicating an assembly shop in West Darfur since we have not yet reached maximum capacity at our North Darfur assembly shop. We are considering alternative plans for this assembly shop given the continued ability of the North Darfur shop to meet production and assembly needs; we will keep DIV updated about any changes on this front.

4. Build distribution channels (West Darfur)

PE continues to build distribution channels by recruiting new partners and training them in a variety of skills including: conducting stove demonstrations, marketing, tracking sales and reporting. PE's Sudan Field Representative is currently in Sudan working with MDPD (South Darfur), NIDAA (West Darfur) and is conducting outreach for potential partners in Central Darfur. In the coming weeks, we plan to hire a consultant to conduct a baseline survey of households in these communities in an effort to understand the characteristics of the market, including cooking practices, household expenditures, and current stove usage. This baseline survey will help us penetrate these new markets in as thoughtful and holistic a way as possible, and it will help us capitalize on lessons learned from PE's operations in North Darfur.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

Opportunities for distribution throughout Darfur continue to grow for our stove assembly shop in El Fasher, North Darfur. Two shipments of flat-kits from our manufacturer in India are currently being finalized and will ship soon. Each of these shipments has 5,000 stove flat-kits, thus we should see the arrival of 10,000 stoves to Port Sudan within the next 1-2 months. Upon arrival the assembly shop workers will be busy with assembly and distribution to partners and CBOs.

The 2 upcoming shipments will both contain samples of the new BDS "cool mesh" design that has not yet been promoted in Sudan. We are excited to experiment with new and increased pricing for this new design, and to gain feedback from a wide base of actual and potential "cool mesh" buyers. On her July 2014 field visit, PE's Sudan Field Representative will provide a training video with instructions on assembling this modified version of the stove to assembly shop workers in El Fashir.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

As BES assembly is underway, the team has been ramping up activities in preparation for the randomized control trial (RCT) that has continued to be postponed due to the delayed arrival of the stoves. In June, PE facilitated a training over Skype between engineering consultant, Daniel Wilson and Ethio-Resource Group (ERG) in order for ERG to be trained on how to properly install Stove Use Monitors (SUMs) on stoves. The training was successful and ERG will soon initiate SUMS installation in preparation for the data collection period.

In terms of additional activities, the short survey to be conducted over VOTOMobile's voice-based technology was translated and recorded in Amharic, and the in-person household baseline surveys will be uploaded on smart tablets in the coming week. In August, ERG will hire enumerators from the roster of graduate students and field researchers that they regularly work with. As mentioned in a previous

Milestone Report, an MOU was signed with the field partner, Ratson at the market trial site in Debre Zeit. Discussions are currently underway with Mary Joy, a potential field partner in the market trial site of Awassa.

7. Develop local manufacturing capacity (Ethiopia)

After the delays mentioned above, the shipment of 600 Berkeley-Ethiopia Stove flat-kits arrived from India (via Djibouti). ERG facilitated the transport of the kits once they arrived in Ethiopia and retrieved them from customs in Addis Ababa. While awaiting the arrival of the flat-kits, we worked with ERG to prepare their shop by providing the necessary equipment and training on assembly procedures. For equipment that was too cumbersome to bring from the US (and not available in Ethiopia) such as the bending brake required for BDS assembly, we consulted with ERG so that they were able to build these materials on their own. Assembly of the 600 stoves is underway at rate of 10 stoves per day, which should increase as the capacity of the assembly workers improves.



Figure 3: The first Berkeley-Ethiopia Stove (w/ “cool mesh”) assembled in Ethiopia

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

SUMs results were presented by engineering consultant and UC Berkeley Mechanical Engineering PhD candidate, Daniel Wilson from June 3-7 at the 2014 International Technology for Development Conference (Tech4Dev) at EPFL University in Lausanne, Switzerland. An accompanying paper titled “Comparing Cookstove Usage Measured with Sensors Versus Cell Phone-Based Surveys in Darfur, Sudan” was accepted to the conference. Additionally, the paper was recently nominated to become a book chapter as a part of the conference proceedings.

Ongoing analysis of the data is focusing on the remaining portion of the survey data set as well as improvements on the algorithmic data labeling procedure. Survey data contains additional valuable information such as self-reported fuels, cookstoves in use other than the BDS, and commonly cooked foods. An analysis of correlation between survey responses and BDS adoption is underway. Finally, as part of a continuing effort to make sophisticated algorithmic labeling accessible to non-software experts, Daniel is attempting to write code that will allow non-experts to hand-label a subset of data, essentially training a software algorithm to automatically label remaining data.

**Testing and Developing a Sustainable Model for Cookstoves in Darfur and
Ethiopia**

Milestone #11 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development (USAID)
Development Innovation Ventures**

October 30, 2014



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ACRONYMS

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Table 1: Indicator Dashboard¹

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Milestone No.	1	2	3	4	5	6	7	8	9	10	11
Indicator											
Total population with access to FES in targeted communities in Darfur ²	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556	226,056	226,056	244,056
Total population with access to FES in targeted communities in Ethiopia ³	N/A	N/A	N/A	N/A	N/A	57	57	57	57	57	91
Geographical distribution of FES in Darfur	(see chart)										
Geographical distribution of FES in Ethiopia	(see chart)										
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926	37,676	37,676	40,676
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10	10	10	16
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

¹In this Milestone report, as in the previous one, we've opted to exclude the row that was previously included in our Indicator Dashboard in Milestone Reports 1-8: "CO2 Equivalent mitigated (tons) by using FES instead of traditional methods." The reason for this exclusion is that we are currently in the process of changing Project Developers for our Carbon Offset Programming as our previous developer, Impact Carbon, discontinued their services. We will re-evaluate these calculations with are new Project Developer to determine if these calculations are consistent with their methodology, and will re-incorporate reporting as appropriate.

² This number is calculated by multiplying the total number of stoves distributed in Darfur by an average household size of 6.

³ This number is calculated by multiplying the total number of stoves distributed in Ethiopia by an average household size of 5.7.

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14	Apr-14	Jul-14	Oct-14
Milestone No.	1	2	3	4	5	6	7	8	9	10	11
Indicator											
Objectively measured usage: Derived from Stove Use Monitor (SUMs) data analysis	N/A	73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approx.1.5 hours/day.	73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approx.1.5 hours/day.	73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approx.1.5 hours/day.							
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia	N/A	N/A	N/A								

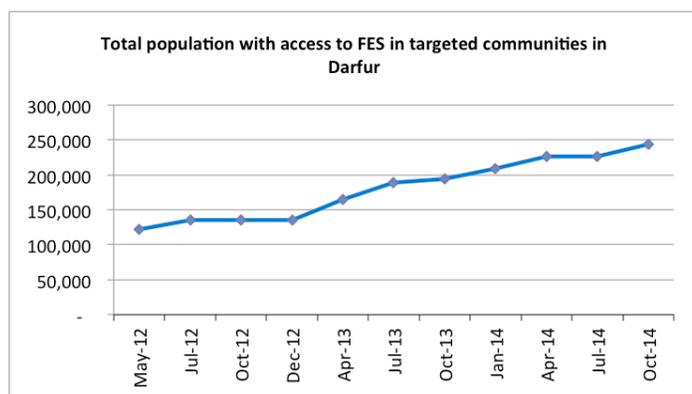


Figure 1: Total population with access to FES in targeted communities in Darfur

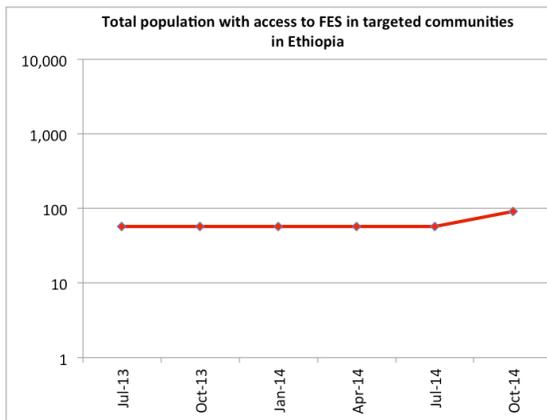


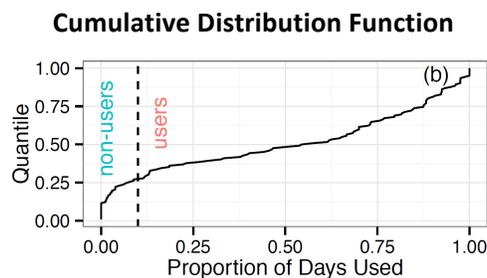
Figure 2: Total population with access to FES in targeted communities in Ethiopia

Notes on Indicator Dashboard

A) We report customer satisfaction levels in Darfur based on:

1. Data analysis from the Stove Use Monitors (SUMs) research supported by USAID DIV.

- a. It should be noted that this SUMs research was conducted with recipients of free Berkeley-Darfur Stoves. In the future, we plan to conduct SUMs research in Darfur with stove purchasers to compare usage data.
- b. *Objectively Measure Usage:* There is no industry standard on what defines a stove user. Our distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) (shown below) was created that ranks the 122 unique cooks by the proportion of days they used the stove. In order to account for “courtesy” uses immediately before a follow up, a two-day period preceding the first follow up survey was ignored. For the purposes of this analysis, **a demarcation between “user” and “non-user” was made at 10% of possible stove-use days during the observed period (i.e. if a participant used the stove less than 1 in 10 days, she is categorized as a “non-user”). This classification is arbitrary and used only as a metric by which to separate women who regularly use the stove and those who use it very little or not at all.** Using this classification, 73% (89 participants) are categorized as “users” and 27% (33) as “non-users.” To obtain an upper bound on the bias effect from higher SUMs failure rates with “user” cooks, we recalculate this percentage assuming that all the thermally-failed SUMs were with the “users” group. This leads to an upper bound estimate of 78% (118) users and 22% (33) non-users.



c. Between 73% and 81% of our participants use the stove on more than 10% of ownership days.

2. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
3. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it.
4. The fact that no one has returned any of the stoves that have been distributed since receiving DIV funding, and those who purchased them continue to make payments.

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

Table 2: Geographic Distribution of FES in Darfur

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free

4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013 C	North	Rural El Fasher	2450	CBOs	14	2013	Revolving Loan Fund/installment payment plan
2013 C	North	Rural El Fasher	2750	CBOs	14	2014	Revolving Loan Fund/installment payment plan
2013 C	North	Kassab Camp (Kutum)	2000	CBOs	14	2014	Free
2013 C	South	Malam rural area	400	MDPD	14	2014	Free and installments
2013 C	South	Nyala (urban and rural)	300	MDPD	14	2014	Installments, Cash
2013 C	West	ElGinena (urban and rural)	300	Nidaa	14	2014	Cash
		TOTAL	40,676				

Table 3: Geographic Distribution of FES in Ethiopia*

Batch	Region	Location	#
2013A	Oromia	Sebeta	5
2013A	Oromia	Meki	5
2013A	Oromia	Debre Zeit	1
2014A	Oromia	Debre Zeit	5

*Assembly of 600 Berkeley-Ethiopia Stoves is nearly complete and stoves are slowly being introduced in Debre Zeit as part of our RCT; see below for additional details.

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Since our last report, Potential Energy successfully completed sales trials in West Darfur and South Darfur. Leveraging the knowledge and experience gained from our USAID-supported work, PE received additional funding from AECOM to explore opportunities for expansion in new Darfuri states. For this project, 600 stoves were sold to rural, urban and peri-urban households in El Genina, West Darfur and Nyala, South Darfur. In addition, 360 baseline surveys were conducted in order to better understand household demographics, cooking practices, fuel usage and to inform PE on the potential demand for improved cookstoves in these regions.

In the past few months, Potential Energy has spent a significant amount of time working to improve our systems for tracking stove distribution. In close consultation with Sustainable Action Group, PE's Sudan Field Representative reviewed paperwork and created an improved central database to store all sales receipts, customer information and stove distribution locations. As part of this process, we held off on reporting a change in stove distribution numbers to USAID in our previous Milestone Report as we wanted to ensure we had complete confidence in the numbers. We are now pleased to report that to date, 40,676 stoves have been distributed in Darfur.

Since our last Milestone Report, we've experienced delays on the manufacturing side, and well as at the port in Sudan. In India, our manufacturer has had difficulty obtaining cast-iron grates at a reasonable cost. In the short-term, PE addressed this issue by placing all orders through the end of 2014 so that the grates can be made in bulk. As a long-term solution, PE is exploring other materials for the stove grates. We are also conducting outreach with potential manufacturing partners in order to reduce our reliance on one partner. In Sudan, we currently have 5,000 stoves that are sitting at the Port of Sudan and have yet-to-be released due to government hold-ups that are being experienced by all organizations with customs exemptions. As of last week, we received notice from Sustainable Action Group that the Ministry of Finance's review process is now complete, and that the Ministry and other government officials have approved the stoves' release. The team in Sudan is thus preparing for a major ramp-up of stove distribution in Darfur, with the assembly of 5,000 flat-kits to begin in November and the production of 10,000 additional Berkeley-Darfur Stove flat-kits underway in India.

In Ethiopia, our Randomized Control Trial (RCT) is underway. The location we have selected is Debre Zeit, located approximately 50 kilometers from Addis Ababa. Several groups of households have participated in recruitment meetings and have received stoves for free two-week trials. Assembly of the 600 "cool mesh" Berkeley-Ethiopia Stoves is nearly complete and these stoves are gradually being incorporated into the sales trial. We have prepared our local partner, an Ethiopian organization called Ratson, by creating a training manual and providing paperwork to track stove sales.

In this report, Potential Energy has included two new milestones that we propose to include in all future reports to USAID: "Iterate on Stove Financing Structures" and "Test Improved Exterior Stove Design for Customer Interest and Willingness to Pay." As finance is such a critical piece of adoption, we are actively evolving on our stove financing strategy by experimenting with installment plan finance in Ethiopia and tightening our policies in Darfur. As we work to increase the price of the Berkeley-Darfur Stove, we are experimenting with finding ways to improve the aesthetics of the stove design in order to increase the perception of the stove as an aspirational product. The "cool mesh" design we've introduced to Ethiopia has not yet been trialed in Darfur, but the batch of stoves that are about to be released from the Port of Sudan contain samples of the new design that we hope to introduce to the market in late 2014 and early 2015. The cool mesh stoves will be offered at a higher price point,

and we will survey customers during the sales and acquisition process to gather feedback and iterate on the product design.

MILESTONE UPDATES: OCTOBER 30, 2014

1. Recruit and Train Local Sales Agents (Darfur)

As part of our “Revolving Loan Fund” project supported by the Global Alliance for Clean Cookstoves, PE and our Sudanese partner, Sustainable Action Group (SAG) recruited and trained representatives from more than 20 Community-Based Organizations (CBOs) in North Darfur to sell the Berkeley-Darfur Stove. Since our last Milestone Report, PE conducted an assessment of the project and discussed lessons learned with CBOs who participated in this pilot. Based on these discussions, several recommendations were made that will inform PE’s future sales efforts throughout the region. These include:

- Only CBOs that have collected at least 90% of installment payments will be invited to continue participating in PE’s stove sales program
- Only CBOs that can demonstrate that they are willing and able to designate internal personnel to manage money collection & documentation will be invited to participate
- CBOs demonstrating successful previous experience with micro-lending and/or household product sales will be given preference, and larger volumes
- PE and SAG will experiment with various non-monetary incentives for high performing CBOs, including:
 - Issuing certificates for good performance to successful CBOs
 - Providing successful CBOs with free samples of our new “Cool Mesh” Berkeley-Darfur Stove as a reward for good performance
 - Contacting local chiefs in communities that have low repayment rates to encourage borrowers to make payments and explain that link between repayment rates and future participation in the program

In the first quarter of 2015, PE and SAG will coordinate another workshop with participating CBOs to assess this project and establish a set of best practices to replicate as we expand stove sales throughout the region.

2. Expand sales based on findings from marketing trials (Darfur)

In July 2014, PE launched sales trials in Nyala, South Darfur and El Genina, West Darfur with support from AECOM-Sudan. For these two trials, PE recruited partners in both locations, and trained them in stove promotion and sales. In conjunction with the sale of 600 stoves, a baseline survey was conducted in a total of 360 households in order to gain insight about fuel usage, household expenditures and cooking patterns in urban, peri-urban and rural communities in both Darfuri states.

Given the short time period that the Berkeley-Darfur Stove was promoted in these areas (September-October), we consider these sales trials to be an immense success. The 2 partners are MPDP and NIDAA. Due to the humanitarian context – where many aid items are distributed for free – potential customers were initially hesitant to purchase the BDS. However, after our partners conducted stove demonstrations and responded to questions about BDS use, price, benefits and maintenance, 300 stoves were sold in each area. Both MDPD and NIDAA expressed interest in long-term partnerships, with demand for the stoves greatly exceeding the 600

stoves made available for this project. PE is currently determining next steps for expansion by analyzing the survey data collected and assessing both partners' capacity to implement a larger stove project in their communities.

3. Replicate assembly shop (West Darfur)

When we started this project, we had recently set up the assembly shop in North Darfur, and were still in the process of understanding the capacity for assembly. Since 2012, we have outfitted the shop with improved tools, and have enhanced our workflows and training. As a result, we have seen an increased capacity as well as ability to store and transport stoves throughout the region. Our current shop has the capacity to assemble 28,000+ stoves per year, and with our current sales and distribution rates we are only at 53% of capacity. Because of this, we do not yet see a need to replicate our assembly shop in the next 1-2 years.

4. Build distribution channels (West Darfur)

Since our last milestone report, PE has established distribution channels in both West and South Darfur through sales trials conducted in El Genina and Nyala. Market size, logistics, security, access to potential customers, potential partner capacity and interest levels are among the factors that are being considered by the PE team before investing in full expansion into a new state in Darfur.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

Opportunities for distribution throughout Darfur continue to grow for our stove assembly shop located in El Fashir, North Darfur. Production of two batches of 5,000 flat-kits each is currently underway, which we hope will arrive in Port Sudan before the end of 2014. These shipments will contain additional samples of the new BDS "cool mesh." The team is excited to experiment with pricing for this new design, and to gain feedback from current and potential customers. On her visit to El Fashir in July 2014, PE's Sudan Field Representative provided a training video to the assembly shop with instructions on assembling this new version of the stove.

Production

As noted in the summary above, since the last milestone report we've faced delays in manufacturing and at customs. In India, our manufacturer Shri Hari Industries has had challenges obtaining the Berkeley-Darfur Stove's inner grate made of cast-iron. To mitigate this challenge, PE is currently consulting with Shri Hari Industries to explore affordable alternatives to cast-iron that can still withstand high temperatures. In the short-term, PE placed the remaining orders for 2014 in July to enable Shri Hari to order the cast-iron grates in bulk. To further diversify risk, the team is currently exploring opportunities to contract other manufacturers to produce our stove flat-kits. Since our last Milestone Report, PE Consultant/Mechanical Engineering PhD Candidate at UC Berkeley, Daniel Wilson has been leading PE's efforts to receive quotes from manufacturers in India and China.

Assembly

Due to the delays in India, the first batch of 5,000 flat-kits for 2014 did not arrive in Sudan until August. This shipment has not yet been released from Port Sudan. With their port exemption due to expire in Spring 2014, our Sudanese partner, Sustainable Action Group submitted a renewal request to the Government of Sudan's Humanitarian Aid Commission (HAC). Following approval from HAC, SAG submitted an application to the Ministry of Finance. In mid-October, SAG received Ministry of Finance approval and is now finalizing details with

HAC to enable the transport of these 5,000 flat-kits from Port Sudan to El Fashir. We've been in close contact with the SAG team throughout this process.

Distribution

PE and SAG finalized the distribution plan for the current batches of stoves, with SAG selling 60% and donating the remaining 40% of stoves to the most vulnerable populations of IDPs. During her July visit to Sudan, PE's Field Representative discussed a plan to further increase the stove price and remove PE's subsidy. SAG has agreed to launch a "growth fund," where up to 40% (for the next 1-2 batches) of stove revenues will be deposited into a separate account that will serve to offset future order costs. The goal of this fund is to enable SAG to eventually "own" stove production and begin placing stove orders directly with Shri Hari Industries. PE will continue to provide technical support to SAG and its local partners and will cover the remaining costs until SAG has fully transitioned into this role.

In collaboration with SAG, PE has been working diligently to improve record-keeping of stove sales. In addition to reviewing and reorganizing all stove distribution-related paperwork, PE is creating a database that ensures accurate tracking of all sales and free distribution of stoves in Darfur. Upon completion of this project, PE will package a toolkit that will be shared with future partners.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

Our randomized control trial (RCT) is currently underway in Debre Zeit. The key theme of this RCT is to detect impact of Berkeley-Ethiopia Stove use and to determine which program interventions increase usage. Prior to the launch of the RCT, the PE team finalized the research plan, which explores the following questions:

1. What approaches can help potential customers understand the value of the stove and thus increase willingness to pay?
2. What approaches improve usage among stove owners?
3. What are the impacts from usage?
4. How do customer survey responses change depending on the data source, such as traditional "paper" surveys, temperature loggers and high-frequency mobile mini-surveys?

Willingness to Pay

Previous research in the cookstove sector has established that free trials are an effective means to increase stove usage and willingness to pay. For this RCT, we are exploring the influence of information and community, asking questions such as "Can households learn from their neighbors' free trials?" In collaboration with Ethiopian NGO, Ratson, approximately 100 groups (with 10-15 households per group) were recruited to participate. All groups have attended, or will attend stove demonstrations over the next few months, with some households randomly selected to participate in a free trial. Following the free trial, a bidding game is conducted in order to elicit willingness to pay, with the winning bidder offered the opportunity to purchase the stove. At the end of this process, PE will compare stove purchase rates and conduct a cost-benefit analysis according to: 1) participation in a free trial versus 2) knowing someone who participated in a free trial versus 3) no participation and/or knowledge of someone who participated in a free trial.

Stove Usage

Building on our work in Darfur, we are employing Stove Use Monitors (SUMs) in Ethiopia to learn more about stove usage rates as well as the effectiveness that various interactions and messaging can have on customer behavior. In this RCT, we are randomly varying the timing, frequency, content and mode of follow-up messaging

and activities (e.g. mobile phone versus in-person reminders) and will monitor for corresponding changes in stove usage.

Impacts from Usage

In an effort to determine the impact of the BES, the team is collecting baseline and follow-up data to gain insight about:

- Fuel usage and monetary savings
- Symptoms and unpleasantities associated with smoke exposure (cough, headache, irritated eyes, etc.)
- Reductions in burns and other cooking injuries

Improved Data Sources

The Stove Use Monitors employed in this study will enable the PE team to assess and overcome reporting bias regarding stove use by customers and provide fine-grain feedback on the timing of usage and impacts of follow-up activities. In addition to SUMs, using the mobile phone survey technology, VOTOMobile we will examine the effect that high-frequency phone surveys and reminders have on stove usage and impacts.

Procedure

Under the supervision of ERG, randomly selected individuals are invited to participate in a meeting where RATSON staff members explain that they are being invited to participate in a study about a new stove. If they agree to participate, individuals are then asked to:

- Complete a short survey (approximately 10 minutes) at the meeting
- Attend a stove demonstration as part of the meeting
- Complete a second short survey (approximately 10 minutes) at their home (or another private place) in approximately 2 weeks
- Some will be asked to complete a third survey (approximately 30 minutes) in a few months
- Some will be asked to answer questions occasionally by mobile phone

At the meeting, it is then explained to participants that as part of the study, some people may have the opportunity to try a new stove, and some may have the opportunity to buy a new stove, but this will be determined using a lottery. Following the meeting, over the course of two weeks, all participants will be visited to play a lottery-based game for a chance to purchase the new stove, enabling our team to learn more about perceived value and willingness to pay for the stove.

Purchase Price Lottery Game

In this activity, pieces of paper with different prices written on them are placed in a bag. Participants are then asked to state the maximum amount they are willing to pay, and then draw a piece of paper. Participants are encouraged to always bid the highest amount that they would be willing to pay because if they state an amount lower than their true willingness to pay, there is a risk that they cannot buy the stove. If the price drawn is higher than the amount stated, the participant is unable to purchase a stove. If the price drawn is lower than or equal to the amount stated, the participant can pay the price that was on the paper – not their stated willingness to pay amount – to receive a stove.

RCT Status

To date, four groups in Debre Zeit have attended meetings, participated in baseline surveys and were randomly selected for two-week free trials of the stove. Early next week, ERG and Ratson will conduct the first Price

Purchase Lottery Games. In preparation, PE created and shared a training manual for Ratson that includes instructions and paperwork for documenting stove sales.

7. Develop local manufacturing capacity (Ethiopia)

Assembly of the 600 “cool mesh” Berkeley-Ethiopia Stoves is nearly complete at the assembly shop in Addis Ababa. PE conducted several online trainings via Skype to ensure that the Stove Use Monitors (SUMs) were programmed and properly affixed to the stoves. Assembled stoves are being warehoused at a facility owned by one of the co-founders of PE’s Ethiopian partner, Ethio-Resource Group (ERG) until they are ready to be included in the sales trials in Debre Zeit.

As previously reported to USAID, based on our experience implementing this pilot project, we are increasingly concerned that 1) the costs associated with importing goods – even those that are unassembled, and 2) the overall cost of doing business in Ethiopia, may be prohibitively high to build a stove business at scale. We are actively in discussions with our partners to determine next steps based on the results of our sales trial and RCT.

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

Analysis of SUMs data for this study is nearly complete, and several themes of programmatic lessons-learned have emerged. Key themes arising from this study are:

- Baseline adoption of the Berkeley-Darfur Stove (BDS) is between 73% and 81%. In comparison to similar programs distributing free technologies in humanitarian settings, this adoption rate is high, but leaves room for improvement.
- Adoption of the BDS can be dramatically improved to above 90% with a single additional “soft” interaction, such as a survey or household follow-up visit made several weeks after participants take home their stove.
- Agile, fast, and responsive data analysis is necessary to make important decisions about how to implement cookstove distributions and research studies.

Although distributed for free, baseline adoption of the Berkeley-Darfur Stove (BDS) is between 73-81% of participants utilizing the cookstove for at least 10% of the days that they owned the stove. This level of adoption occurred after a single interaction with Sustainable Action Group, where women picked up their cookstoves from a community center and received a short training on how to use the stove. When the first SUMs data was transmitted to the Potential Energy team via our real-time data transfer and analysis system, we were curious as to why 19-27% of participants did not use the stove that they received. This early SUMs data did not imply that these women did not *like* the stove – we would expect that if women were unsatisfied with the product, the data would reveal early usage that then dropped off. In this case, the data revealed that these “non-users” had not attempted to use the stove since receiving it.

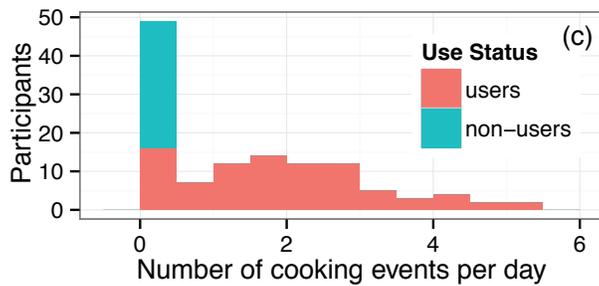


Figure 3: Histogram of baseline stove adoption (before follow-up survey) shows a clear bimodal distribution comprised of users and non-users. Non-users behave exceptionally differently from users in a way that indicates that they have a fundamentally different relationship with the stove, namely, that they have not tried it.

Curious about the cause of this lack of use among stove recipients, our team conjectured that these women had just not overcome force of habit, and therefore they had never given the stove a chance. After receiving these first data points, we revised our research plan and decided to continue using SUMs to measure women’s use of the BDS after the follow-up survey. We also decided to measure the influence that “soft” social pressure (e.g. a brief follow-up) could have on stove adoption.

Analyzing adoption results after the follow up survey, we immediately observed a dramatic uptick in use among the non-user group and no meaningful behavior changes among the user group. In fact, after a single follow-up survey, behavior of the previous “non-users” was indistinguishable from “users” and the total population’s adoption increased to well over 90%⁴.

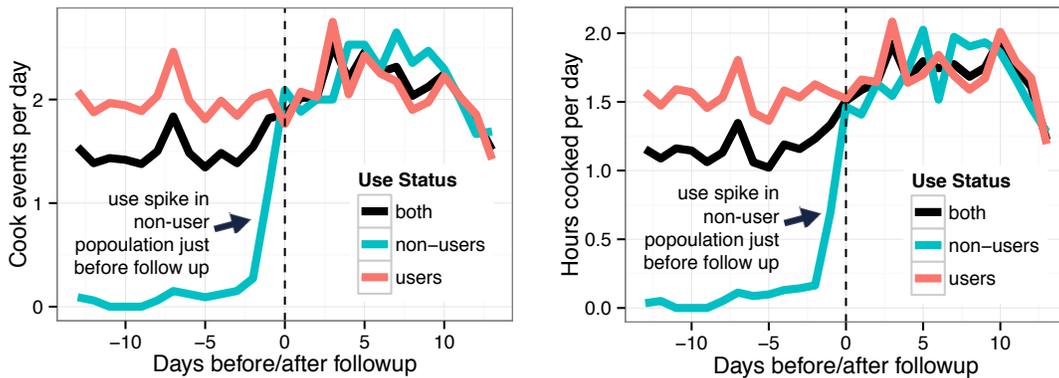


Figure 4: Events and hours of cooking per day in the two weeks preceding and following the follow-up. The average cooking time for the entire population is shown in black while non-users and users are shown in teal and red, respectively. The population of non-users begins to use their stove roughly two days before the first follow up, presumably as a “courtesy” to make the stove appear well-used or to become familiar with the stove prior to being interviewed in the follow-up.

⁴ Exact value pending analysis



Figure 5: A scene from a survey that indicates the possibility of social pressure.

When considering why such an interaction could lead to dramatic increases in adoption, our team speculates that the interaction amongst women when participating in the follow-up survey (women were interviewed at nearby community centers) influenced non-users to try their BDS for the first time.

		All Participants			Users			Non-Users		
		n	mean	sd	n	mean	Sd	n	mean	sd
Pre 1st follow up	Daily cooking hours	122	1.1	1.0	89	1.5	0.9	33	0.024	0.049
	Daily cooking events	122	1.4	1.4	89	2.0	1.3	33	0.033	0.058
Post 1st follow up	Daily cooking hours	61	1.6	1.3	44	1.6	1.3	17	1.7	1.3
	Daily cooking events	61	2.1	1.5	44	2.0	1.6	17	2.2	1.5

Table 4: Summary data for all participants, users, and non-users separated into pre and post follow up behavior.

Improvements to the algorithmic labeling of SUMs data are underway. Large SUMs data sets can be exceptionally onerous to analyze. For context, in this SUMs study, our team analyzed roughly 1.4 million individual cooking data samples. Because of the challenges faced writing *ad hoc* algorithms to analyze the data, our team members leading this aspect of our work are working to create a tool that will present users with graphical displays of cooking data, allowing the user to select a subset of cooking “events.” A computer algorithm utilizing machine learning can then “learn” what comprises a cooking event and automatically label the remainder of the data. We believe that tools like this are essential not only for Potential Energy’s work, but for others working in the sector. Without tools like this, it is difficult to make quick decisions and changes to research plans based on early monitoring results. This algorithm work was initially catalyzed by USAID funding, and is now being built upon using a small outside grant.

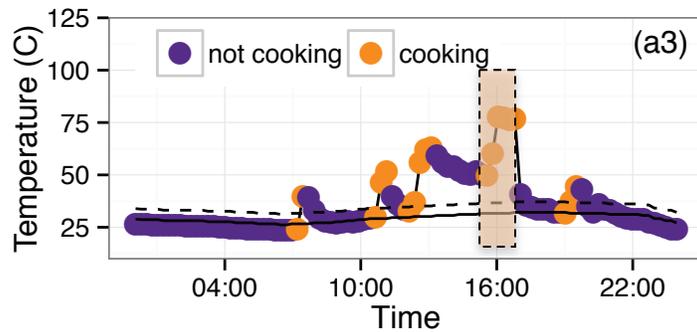


Figure 6: Graphical depiction of a user interface allowing a user to manually select a subset of cooking events (orange box). The algorithm slowly learns what cooking is and auto-labels remaining data.

9. Iterate on Stove Financing Structures

In order to make our stoves affordable in our target markets, PE is actively testing financing strategies in Darfur and Ethiopia and has added this new milestone to report on our progress in this area. In Sudan, we have been selling stoves on 3-month installment plans. Credit decisions are made on two levels; first, Potential Energy, in conjunction with our local partner Sustainable Action Group (SAG), allocates a certain number of stoves, on credit, to a Community Based Organization (CBO). The CBOs then offer the stoves on credit to customers. CBOs are responsible for collecting repayments as well as documenting stove user information, which is collected and returned to PE and SAG. In Ethiopia, we are working with our partner, Ethio-Resource Group (ERG) and the Ethiopian NGO, Ratson to test flexible financing structures and sales tactics, such as 6-month installment payment plans and free trial periods. As part of our RCT, we are conducting stove auctions to determine customer willingness to pay, which will inform our financing and sales strategy in Ethiopia.

10. Test Improved Exterior Stove Design for Customer Interest and Willingness to Pay

Because product design is such a critical piece of adoption, we have also included this new milestone to report on. As we work to increase the price of the Berkeley-Darfur Stove, we are experimenting with finding ways to improve the BDS design in order to increase the perception of the stove as an aspirational product (thus increasing willingness to pay). The “cool mesh” modification to the Berkeley-Darfur Stove was developed based on feedback from Darfuri customers regarding: 1) appearance of the stove after regular use and 2) concern about the outside of the stove causing burns if accidentally touched while in use. We are currently piloting this design in Ethiopia and at the end of 2014 we will introduce samples of this new design to the Darfuri market. In Darfur, we plan to offer “cool mesh” stoves at a higher price point than the previous version of the BDS, and will survey customers to gather feedback and iterate on the product design.

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #12 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development (USAID)
Development Innovation Ventures**

January 30, 2015



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
BDS	Berkeley-Darfur Stove
BES	Berkeley-Ethiopia Stove
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
HAC	Humanitarian Aid Commission of Sudan
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
MDPD	Malam Darfur Peace and Development
NIDAA	Sudanese Development Call Organization
OA	Oxfam America
PE	Potential Energy, Inc.
RCT	Randomized Control Trial
SAG	Sustainable Action Group
SUM	Stove Use Monitor
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard¹

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14	Apr-14	Jul-14	Oct-14	Jan-15
Milestone No.	1	2	3	4	5	6	7	8	9	10	11	12
Indicator												
Total population with access to FES in targeted communities in Darfur ²	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556	226,056	226,056	244,056	247,518
Total population with access to FES in targeted communities in Ethiopia ³	N/A	N/A	N/A	N/A	N/A	57	57	57	57	57	91	285
Geographical distribution of FES in Darfur	(see chart)											
Geographical distribution of FES in Ethiopia	(see chart)											
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926	37,676	37,676	40,676	41,253
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10	10	10	16	50
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

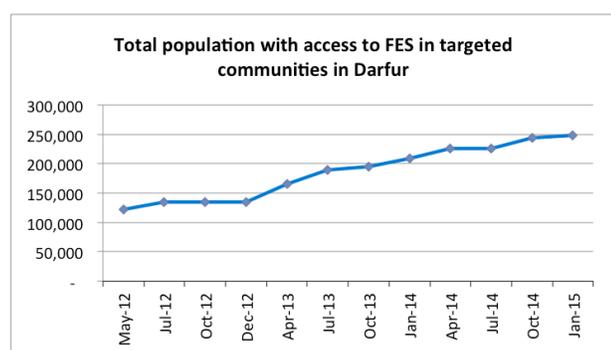
¹ In this Milestone report, we've opted to exclude the row that was previously included in our Indicator Dashboard in Milestone Reports 1-8: "CO2 Equivalent mitigated (tons) by using FES instead of traditional methods." The reason for this exclusion is that we are currently in the process of changing Project Developers for our Carbon Offset Programming as our previous developer, Impact Carbon, discontinued their services. We will re-evaluate these calculations with are new Project Developer to determine if these calculations are consistent with their methodology, and will re-incorporate reporting as appropriate.

² This number is calculated by multiplying the total number of stoves distributed in Darfur by an average household size of 6.

³ This number is calculated by multiplying the total number of stoves distributed in Ethiopia by an average household size of 5.7.

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14	Apr-14	Jul-14	Oct-14	Jan-15
Milestone No.	1	2	3	4	5	6	7	8	9	10	11	12
Indicator												
Objectively measured usage: Derived from Stove Use Monitor (SUMs) data analysis	N/A	73% ⁴	73% ⁵	73% ⁶	73% ⁷							
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Ethiopia ⁸	N/A	N/A	N/A	N/A								

Figure 1: Total population with access to FES in targeted communities in Darfur



⁴ 73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approximately 1.5 hours per day.

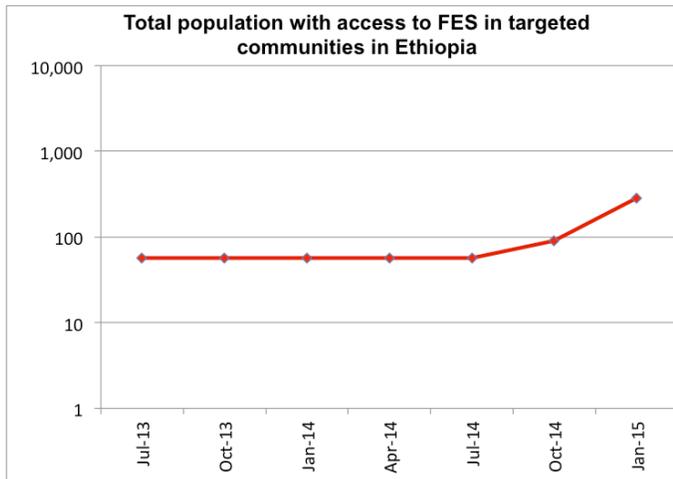
⁵ *Ibid.*

⁶ *Ibid.*

⁷ *Ibid.*

⁸ We plan to provide data following the analysis of data collected during our randomized control trial in Ethiopia. These findings will be presented in PE's final impact evaluation report to USAID DIV.

Figure 2: Total population with access to FES in targeted communities in Ethiopia

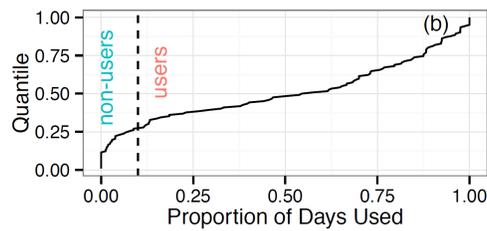


Notes on Indicator Dashboard

A) We report customer satisfaction levels in Darfur based on:

1. Data analysis from the Stove Use Monitors (SUMs) research supported by USAID DIV.
 - a. It should be noted that this SUMs research was conducted with recipients of free Berkeley-Darfur Stoves. In the future, we plan to conduct SUMs research in Darfur with stove purchasers to compare usage data.
 - b. *Objectively Measure Usage:* There is no industry standard on what defines a stove user. Our distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) (shown below) was created that ranks the 122 unique cooks by the proportion of days they used the stove. In order to account for “courtesy” uses immediately before a follow up, a two-day period preceding the first follow up survey was ignored. For the purposes of this analysis, **a demarcation between “user” and “non-user” was made at 10% of possible stove-use days during the observed period (i.e. if a participant used the stove less than 1 in 10 days, she is categorized as a “non-user”). This classification is arbitrary and used only as a metric by which to separate women who regularly use the stove and those who use it very little or not at all.** Using this classification, 73% (89 participants) are categorized as “users” and 27% (33) as “non-users.” To obtain an upper bound on the bias effect from higher SUMs failure rates with “user” cooks, we recalculate this percentage assuming that all the thermally-failed SUMs were with the “users” group. This leads to an upper bound estimate of 78% (118) users and 22% (33) non-users.

Cumulative Distribution Function



c. Between 73% and 81% of our participants use the stove on more than 10% of ownership days.

2. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
3. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the most of any stove, and all 50 said they would recommend a friend to purchase it. We are currently laying the groundwork to conduct follow-up customer satisfaction surveys.
4. The fact that no one has returned any of the stoves that have been distributed since receiving DIV funding, and those who purchased them continue to make payments.

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

Table 2: Geographic Distribution of FES in Darfur

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free

2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free
1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013 C	North	Rural El Fasher	2450	CBOs	14	2013	Revolving Loan Fund/installment payment plan
2013 C	North	Rural El Fasher	2750	CBOs	14	2014	Revolving Loan Fund/installment payment plan
2013 C	North	Kassab Camp (Kutum)	2000	CBOs	14	2014	Free
2013 C	South	Malam rural area	400	MDPD	14	2014	Free and installments
2013 C	South	Nyala (urban and rural)	300	MDPD	14	2014	Installments, Cash
2013 C	West	ElGinena (urban and rural)	300	Nidaa	14	2014	Cash
2014 A	North	Rural El Fasher	400	OA	14	2015	Free
2014 A	North	Maidoub Mountain area	59	Maidoub Mountain CBO	14	2015	Installments
2014 A	North	Kutum and surrounding regions	59	Ayadi Al Rahma CBO	14	2015	Installments
2014 A	North	Rural El Fashir	59	Om al Qora CBO	14	2015	Installments
		TOTAL	41,253				

Table 3: Geographic Distribution of FES in Ethiopia*

Batch	Region	Location	#
2013A	Oromia	Sebeta	5
2013A	Oromia	Meki	5
2014A	Oromia	Debre Zeit	40

**Assembly of 600 Berkeley-Ethiopia Stoves is nearly complete and stoves are slowly being introduced in Debre Zeit as part of our RCT*

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

Since our last report, Potential Energy (PE) has been working with our pilot partners in South and West Darfur to determine the next steps for building sustainable stove enterprise in both locations. The results of the sales trials conducted during the Summer - Fall 2014 were very promising and we're excited about the demand for the Berkeley-Darfur Stove (BDS) we continue to experience through our partners in the region.

Malam Darfur Peace and Development (MDPD) and Nidaa, the two organizations that participated in the trial, were successful in selling 300 stoves each. The majority of stoves that were sold during the trial were offered on a cash basis, at a price of 90 SDG. During the sales process, we worked closely with both partners to train them on stove usage, sales and marketing techniques, and to provide sales and follow-up documentation that will help lay the groundwork for effective tracking and monitoring efforts. After completing the sales trials, both organizations expressed a desire to collaborate to build stove enterprises within their organizations. We're delighted by this outcome and are now working with the leadership teams at both organizations to lay the groundwork for increased sales in 2015. While we anticipate some subsidy may be required at the early stages of setting up these partnerships, we are equipping them with business planning tools that enable them to understand the cash flows and pricing that will be required for sustainability and scale.

In North Darfur, we are working with Sustainable Action Group (SAG) to minimize and eventually eliminate the subsidies that are still present in their stove program. Currently, SAG covers all of the in-country costs associated with the sales efforts, including local transport, stove assembly, program management, warehousing, repairs and distribution. The costs that are still not borne by SAG (and are thus covered by PE, with support from USAID) include the cost of raw materials for the production of flat-kits in India and the shipping costs to transport flat-kits from India to the Port of Sudan. In order to find a way to sustainably cover these costs, PE has been working with SAG to establish a "growth fund," which is effectively a bank account where SAG is depositing stove revenue, with PE monitoring these deposits. Additional stove revenue has become available because of an increase in the retail price; whereas with previous batches we charged between 60 - 70 SDG, the latest batch of stoves is retailing at 100 SDG, allowing for 30- 40% of the revenue from stove sales to be deposited into a local bank account. The funds in this account will be used to offset the costs of raw materials in India and SAG will be responsible for directly wiring the manufacturers funds to pay for subsequent orders. Because of OFAC restrictions on the flows of funds between Sudan and the US, this arrangement is the only available option in terms of cost sharing because PE cannot bill SAG directly for materials costs. PE is providing technical support for this initiative with the goal of having SAG cover stove materials & shipping costs by the end of 2015.

Throughout 2014, Potential Energy invested heavily in improving our systems for tracking stove distribution and customer information. In close consultation with SAG, PE's Sudan Field Representative reviewed paperwork and re-organized our information database to make it more transparent, user-friendly, and complete. We are currently creating a toolkit for both new and existing partners on how to track client information, receipts and documentation in an organized fashion.

The project in Darfur experienced delays on the manufacturing side of our supply chain in India, as well as at the Port in Sudan. In India, our manufacturer had difficulty obtaining the cast-iron grates for the Berkeley-Darfur Stove at a reasonable cost. In the short-term, PE addressed this issue by placing a number of orders at once so that the grates can be made in bulk. As a long-term solution, PE is exploring other using materials for the stove grates; we are evaluating materials options in conjunction with Engineers at UC Berkeley. In Sudan, the Ministry of Finance audited all humanitarian organizations holding customs waivers. This auditing process lasted several months, and caused 5,000 flat-kits to be held at Port Sudan for that time period. The flat-kits were finally released from holding at Port Sudan on November 12, 2014 and assembly and distribution for these stoves is in process.

In Ethiopia, PE's Randomized Control Trial (RCT) is well underway. Since our last report, several responsibilities have successfully been transferred to our local partner, Ratson, including survey implementation, installation, data downloading from stove use monitors (SUMs), and stove demonstrations. This shift of operations to the project location in Debre Zeit increases the number of participants who can be enrolled in the project each day and will ensure that all necessary procedures are completed in time for the scheduled project end date. To date, 17 groups consisting of approximately 10 participants each have participated in a baseline survey, have attended a stove demonstration, and have been given the opportunity to purchase a stove through a sales auction. While the results are still very preliminary, on average we are seeing a willingness to pay of \$15-20 for the BES. While this is below the cost of import, assembly and distribution, we are experimenting with ways that we can inspire higher willingness to pay through free trials, network effects and increased exposure to the product.

Within Ethiopia, assembly of the 600 "cool mesh" Berkeley-Ethiopia Stoves is nearly complete and these stoves are gradually being incorporated into the sales trial. PE has prepared Ratson by providing a training manual and paperwork to track stove sales, incorporating lessons learned from Potential Energy's work in Darfur.

MILESTONE UPDATES: JANUARY 30, 2015

1. Recruit and Train Local Sales Agents (Darfur)

Based on their repayment performance during the first round of our revolving loan fund program, 11 of the 17 Community Based Organizations (CBO) qualified to participate in additional end-consumer finance rounds. (Please see below; Milestone 9: "Iterate on Stove Financing Structures" for more information). The CBOs that did qualify demonstrated high repayment rates (90%+) and a willingness to collect payments and information from clients in a timely manner. The CBOs that did not qualify demonstrated poor repayment performance, and will not be eligible for further credit until they repay the funds that are still outstanding from previous rounds. Participating CBOs, as well as 1-2 new CBOS, will be re-trained on lending and collections practices during a planned visit to North Darfur by our Sudanese Country Manager in February 2015.

2. Expand sales based on findings from marketing trials (Darfur)

After conducting sales trials in West and South Darfur in September-October 2014, both partners (Nidaa in West Darfur and MDPD in South Darfur) expressed interest in establishing long-term partnerships with Potential Energy. PE has been in close contact with both organizations to formalize a strategy for establishing stove enterprises during 2015/2016. After assessing the organizational capacity and baseline survey results from each sales trial, PE will likely focus more time and energy supporting Nidaa, as our evaluation is that they are better equipped to scale-up operations at this time (given their staff size, organizational capacity, existing resources, connectivity, and ability to invest in sales and marketing). However, we've committed to support MDPD with basic training and capacity building needs.

Our baseline survey results have indicated that West Darfur, where Nidaa is located, is and has been experiencing considerably high fuel prices. The financial savings for a household cooking with a BDS in this region are substantial and this will be a critical selling point for new distributors / CBOs working with Nidaa.

Figure 3: Change in Wood Prices in West Darfur*

Fuel	Unit	Average price 12 months ago (SDG)	Average price 6 months ago (SDG)	Current average price (SDG)
Wood	kilo	9.5	15.6	18.2
Charcoal	Kilo	10.7	14.3	20.4
Gas	cylinder	66	90	118
% change			between 12 and 6 mo ago	between current and 12 mo ago
Wood		-	64%	92%
Charcoal		-	34%	91%
Gas		-	36%	79%

**Reported by approx. 180 survey respondents in late 2014*

3. Replicate assembly shop (West Darfur)

When we started this project, we had recently set up the assembly shop in North Darfur, and were still in the process of understanding the capacity for assembly. Since 2012, we have outfitted the shop with improved tools, and have enhanced our workflows and training. As a result, we have seen an increased capacity as well as ability to store and transport stoves throughout the region. Our current shop has the capacity to assemble 28,000+ stoves per year. With our current sales and distribution rates, we are only at 53% of capacity and do not yet see a need to replicate our assembly shop in the next 1-2 years.

4. Build distribution channels (West Darfur)

In 2014, PE invested in the early work required to build distribution channels in South and West Darfur. Through the identification of local partners, PE is working with Nidaa and MDPD on direct training, and also on helping them identify sub-distributors that can help ensure that stoves reach rural and marginalized areas throughout the region.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

Production: As discussed in previous reports, stove production experienced delays during 2014. PE’s manufacturing partner, Shri Hari Industries, has faced challenges obtaining the Berkeley-Darfur Stove’s inner grate made of cast iron. Additionally, PE’s second 2014 shipment of 5,000 stove flat-kits arrived at Port Sudan in late August and was held by port authorities until mid-November as the Ministry of Finance conducted an audit of all humanitarian organizations before renewing port tax exemptions. The stoves were eventually released but Potential Energy was required to pay fees to the Port Authority for the delays, despite having retained the customs exemption. The third and final batch of 5,000 flat-kits for 2014 is currently complete and will be shipped soon from Mumbai to Port Sudan.

Assembly: After the 5,000 flat-kits were released from Port Sudan in November 2014, they were transported to El Fashir, where SAG began assembly in early December. Included in this batch of stoves were 100 units of the

Berkeley-Darfur Stove with the “cool mesh” exterior; this is the first time the cool mesh version of the stove is being introduced in Darfur. There are currently 10 employees that are working near-full days at the assembly shop to complete the assembly of this batch of stoves.

Distribution: In collaboration with SAG, PE allocated 3000 stoves to be sold directly through Community-Based Organizations (CBOs) in the first quarter of 2015. PE and SAG have agreed to sell 60% of the stoves and reserve 40% to be donated to new arrivals in IDP camps and emergencies (flood, fire, etc.). At the time of this report, 577 of the total 5,000 stoves have been distributed, with 400 being used by Oxfam America for free distribution and 177 being sold at a price of 100 SDG by three CBOs in North Darfur. After discussions held between PE, SAG and participating CBOs in July 2014, a new sales price will be tested for the current model of the Berkeley-Darfur Stove as well as the new “cool mesh” stoves being introduced to the market.

In 2014, PE worked diligently to centralize the stove tracking system with SAG. This database is now complete, and PE is working on a toolkit to be shared with both new and existing partners in order to ensure that accurate stove distribution records are maintained.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

Since the last update, the team in Berkeley and in Ethiopia finalized preparations for stove distribution and data collection and began the first rounds of recruitment, stove promotion, and participant data collection.

Survey and survey software: The survey and the software (Open Data Kit 2.0) have undergone multiple revisions to improve data quality and to protect against data loss. Not only will these revisions improve the quality of PE’s market assessment and impact evaluation, but they have also contributed to broader adjustments in the development of the second major iteration of ODK, which has quickly gained acceptance as one of the most preferred data-collection platforms for international development research. Within the past several months, new partnerships have been established with USAID HESN (Higher Education Solutions Network) researchers at UC Berkeley with the goal of streamlining the data workflow used to gather, store, and process the survey data using Open Data Kit 2.0 tools. Additionally, prototype hardware is being developed to integrate SUMs sensor configuration, reading, and data management into the survey workflow with the intention of making scale-up of these interventions and reuse in similar studies available for others working in the sector.

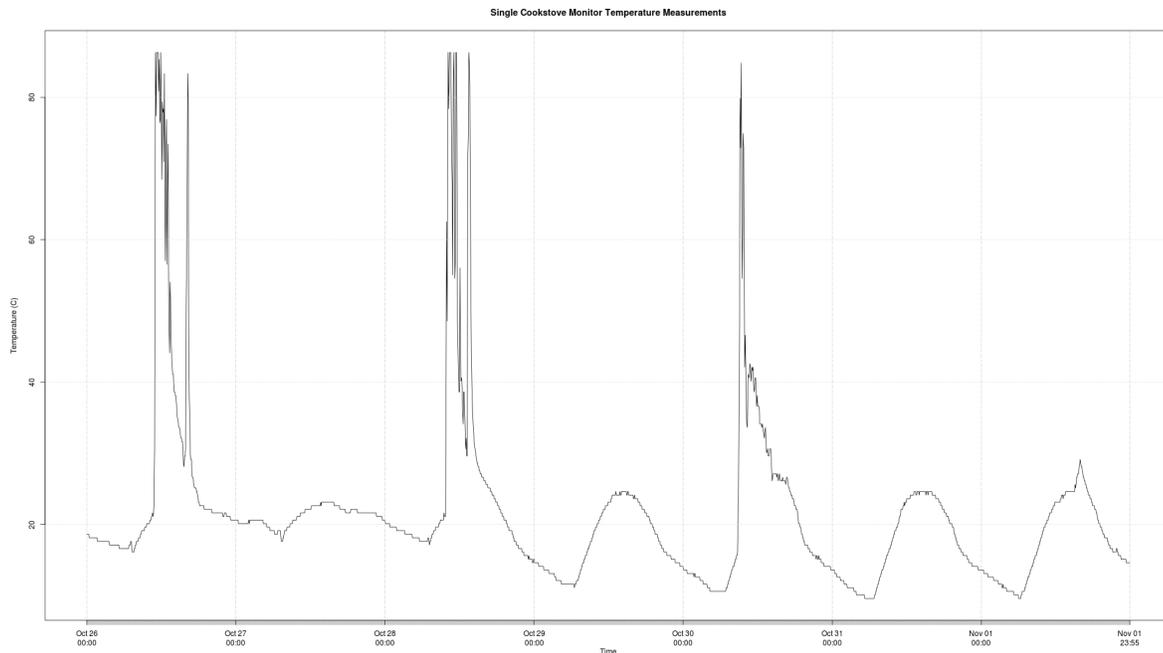
Survey implementation: In order to reduce data collection costs and allow for smoother operations, recruitment and data collection responsibilities have been shifted to PE’s Ethiopian NGO partner, Ratson (with supervision from ERG, PE’s Ethiopia Field Representative) because Ratson is already very familiar with the study communities. Training was reported to be successful, with 5-6 enumerators from Ratson currently trained in survey implementation and the use of the smart tablets and ODK tools. ERG’s assessment is that Ratson enumerators are collecting the data quickly and with high quality. This shift of the operating base from Addis Ababa (where ERG is based) to the project location in Debre Zeit increases the number of participants who can be enrolled each day and will ensure that all necessary procedures are completed in time for the scheduled project end date.

Free trial implementation: To date, at least two members of all enrolled groups have been assigned to receive free trials of the Berkeley-Ethiopia Stove in order to acquire early usage data and ensure the trial/retrieval process is operating well. Participants are reported to be very excited about the free trials, and group members have mentioned actively engaging the free trial recipients to be able to learn from them, which suggests that the most cost-effective density of free trials may be considerably lower than 100%. If this finding proves true in the larger sample, the implications for boosting uptake while reducing promotional costs are very positive. Going

forward, approximately 1/3 of the study groups will not receive free trials in order to provide a control group for those who are exposed to free trials.

Sensor implementation: In order to increase the efficiency of data collection, ERG has successfully trained a Ratson staff member to install and download data obtained using stove use monitors (SUMs). Early stove SUMs data appears to confirm the choice of sensor placement on the stove. Placement appears to render the sensors sufficiently sensitive, as cooking events successfully register at elevated temperatures that can be distinguished from variations in ambient temperature. At the same time, there are observed instances of sensor burnout that can occur when sensors overheat.

Figure 4: Sample SUMs readout showing the stove being used over a 1-week period



Mobile data collection: Pre-testing of high-frequency surveys using VotoMobile cell phone software showed that the sound quality of the recordings in Amharic were lower than the team thought would be acceptable. These are being recorded again in a studio with a professional voice actor to ensure voice appeal and sound quality and are expected to be complete by the end of January. Since only a subset of the full sample will participate in the mobile surveys, this has not caused any delays to the overall project.

Preliminary findings: Valuation data from the first 40 participants has offered a very preliminary preview of what may be observed in the broader sample. In particular, average willingness to pay (solicited through the Becker-DeGroot-Marschak mechanisms, which rewards honest valuations) was approximately 300 Birr (\$15 USD), with the highest bid seen at 700 Birr (\$35 USD). The lowest valuation also belonged to the same group but was a woman with access to electricity, whereas the high valuation was a wood user. This provides suggestive early evidence that among women who are not in extreme poverty, price may be an effective means of directing the Berkeley-Ethiopia Stove toward users who are likely to benefit the most. As new data continues to arrive, the team will be able to move from analysis of uptake and willingness to pay into actual usage and benefits.

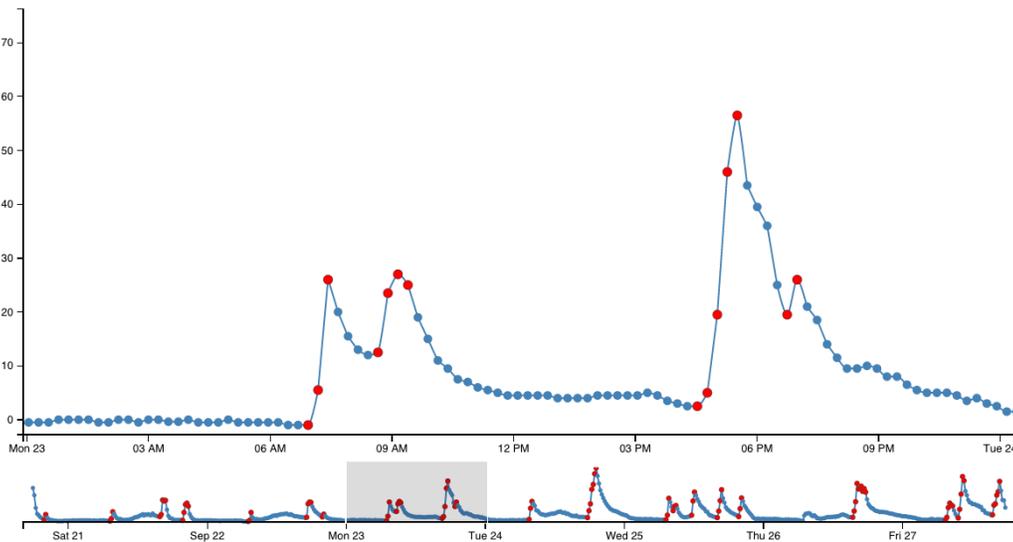
7. Develop local manufacturing capacity (Ethiopia)

Approximately 200 “cool mesh” Berkeley-Ethiopia Stoves have been assembled at the workshop in Addis Ababa. Due to a lack of storage space, assembly will ramp up once the first set of assembled stoves is transported to Ratson for sales in Debre Zeit. As previously reported to USAID, based on our experience implementing this pilot project, we are increasingly concerned that 1) the costs associated with importing goods – even those that are unassembled, and 2) the overall cost of doing business in Ethiopia, may be prohibitively high to build a stove business at scale. PE will revisit discussions with our partners to determine next steps based on the results of our sales trial and RCT.

8. Employ Stove Usage Monitors (SUMs) to measure effectiveness (Darfur)

The primary progress on Potential Energy’s stove use monitoring (SUM) work has been the initial development of a hand labeling and machine learning system. The development of this tool began with a graphical user interface (GUI) built in the D3 language. This GUI graphs the temperature of a cookstove versus time and allows the user to click, drag, and label instances when a woman is cooking. This GUI, which operates on the client side, is now being integrated with Django and MySQL into a full web-based labeling tool. By June 2015, this tool will evolve into a full-fledged event detection package that allows a user without knowledge of computer coding to label and analyze vast quantities of SUMs data. The software will accomplish this by “learning” what cooking is as the user trains the algorithm with a small set of hand labels. Over time the algorithm will become smarter and more sophisticated until it is able to automatically label the remaining data without any user input. The team is excited to implement this system in future stove projects as well as share this tool with others in the sector.

Figure 5: Screenshot of prototype graphical user interface (GUI)⁹



9. Iterate on Stove Financing Structures

In order to make our stoves affordable in our target markets, PE continues to test financing strategies in Darfur and Ethiopia. In Sudan, we continue to sell stoves on 3-month installment plans, with credit decisions made on two levels; first, Potential Energy, in conjunction with SAG, allocates a certain number of stoves on credit to a

⁹ Available at <http://50.116.4.99/D3test/index.html>

Community Based Organization (CBO). The CBOs then offer the stoves on credit to customers. CBOs are responsible for collecting repayments as well as documenting stove user information, which is collected and returned to PE and SAG. Below is a table describing the allocations of stoves by CBO, based on repayment performance and size. This table was recently updated based on feedback from the past round of stove financing:

Table 4: Stove Allocation by CBO

Type of CBO	Number of stoves that can be obtained for resale per “round” of revolving loan fund		
	Round 1	Round 2 <i>If 90%+ of funds are collected, can access Round 2 funding. Otherwise, excluded</i>	Round 3 <i>If 90%+ of funds are collected, can access Round 3 funding. Otherwise, excluded</i>
New CBO operating in closed or mostly closed area (irrespective of CBO size)	25		
Small CBO (1-10 employees)	50	75	100
Medium CBO (10-40 employees)	50	100	200
Large (>40 employees)	50	200	400

In Ethiopia, we are working with ERG and Ratson to test a 6-month repayment plan offered to clients who are interested in purchasing a stove after a free trial period (or after observing a neighbor/friend’s stove in use during a free trial). We’ve opted for 6-month repayment periods instead of 3-month periods (as in Sudan) because 1) the retail price of the stove is higher, and 2) a 6-month period matches common installment plans found in and around Debre Zeit. As part of our RCT, auctions are being used to determine customers’ willingness to pay, which will inform our financing and sales strategy in Ethiopia. Stove sales are launching this week (as we submit this report).

10. Test Improved Exterior Stove Design for Customer Interest and Willingness to Pay

As we work to increase the price of the Berkeley-Darfur Stove, we are experimenting with finding ways to improve the BDS design in order to increase the perception of the stove as an aspirational product (thus increasing willingness to pay). The “cool mesh” modification to the Berkeley-Darfur Stove was developed based on feedback from Darfuri customers regarding: 1) appearance of the stove after regular use and 2) concern about the outside of the stove causing burns if accidentally touched while in use. In Darfur, SAG has assembled 100 units of the new cool mesh stove. We’ve agreed on attempting to sell these stoves at an income-generating price of 140 SDG. At this price, 50 SDG will go to SAG to cover transport, assembly and coordination, 15 SDG will go to CBOs for distribution, and 75 SDG will be invested in the growth fund to help support the sustainability of the program.

Testing and Developing a Sustainable Model for Cookstoves in Darfur and Ethiopia

Milestone #13 Report

USAID Grant No. AID-OAA-G-12-00012

**Submitted by Potential Energy, Inc. to
The United States Agency for International Development (USAID)
Development Innovation Ventures**

April 13, 2015



USAID
FROM THE AMERICAN PEOPLE



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ACRONYMS

ACF	Action Contre la Faim
ACSMCC	African Charitable Society for Mothers and Child Care
AIDCD	Hands of Mercy Community Development
BDS	Berkeley-Darfur Stove
BES	Berkeley-Ethiopia Stove
CBO	Community Based Organization
DARA	Darfur Development and Reconstruction Agency
DDA	Dar Es Salaam Development Association
FRDN	Fasher Rural Development Network
ELF	El Fasher, North Darfur, Sudan
ERG	Ethio-Resource Group
HAC	Humanitarian Aid Commission of Sudan
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Person
KSCS	Kebkabiya Smallholder Charitable Society
KWDA	Kebkabiya Women's Development Association
LBNL	Lawrence Berkeley National Laboratory
MDPD	Malam Darfur Peace and Development
NIDAA	Sudanese Development Call Organization
OA	Oxfam America
PE	Potential Energy, Inc.
RCT	Randomized Control Trial
SAG	Sustainable Action Group
SUM	Stove Use Monitor
UMCOR	United Methodist Committee on Relief
RVNHD	Rural Voluntary Network for Helping and Development
WDAD	Women's Development Association of Dar Es Salam

INDICATOR DASHBOARD

Table 1: Indicator Dashboard¹

Date	May-12	Jul-12	Oct-12	Dec-12	Apr-13	Jul-13	Oct-13	Jan-14	Apr-14	Jul-14	Oct-14	Jan-15	April-15
Milestone No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Indicator													
Total population with access to FES in targeted communities in Darfur ²	121,656	134,856	134,856	134,856	164,856	188,856	194,856	209,556	226,056	226,056	244,056	247,518	251,238
Total population with access to FES in targeted communities in Ethiopia ³	N/A	N/A	N/A	N/A	N/A	57	57	57	57	57	91	285	752
Geographic dist. FES in Darfur	(see chart)	(see chart)	(see chart)	(see chart)	(see chart)								
Geographic dist. of FES in Ethiopia	(see chart)	(see chart)	(see chart)	(see chart)	(see chart)								
Number of women with access to FES in Darfur	20,276	22,476	22,476	22,476	27,476	31,476	32,476	34,926	37,676	37,676	40,676	41,253	41,873
Number of women with access to FES in Ethiopia	N/A	N/A	N/A	N/A	N/A	10	10	10	10	10	16	50	132
Proportion of women who report cost savings from using FES instead of traditional methods in Darfur	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Objectively measured usage: Derived from Stove Use Monitor (SUMs) data analysis	N/A	73% ⁴	73% ⁵	73% ⁶	73% ⁷	73% ⁸							

¹ In this Milestone report, we've opted to exclude the row that was previously included in our Indicator Dashboard in Milestone Reports 1-8: "CO2 Equivalent mitigated (tons) by using FES instead of traditional methods." The reason for this exclusion is that we are currently in the process of changing Project Developers for our Carbon Offset Programming as our previous developer, Impact Carbon, discontinued their services. We will re-evaluate these calculations with are new Project Developer to determine if these calculations are consistent with their methodology, and will re-incorporate reporting as appropriate.

² This number is calculated by multiplying the total number of stoves distributed in Darfur by an average household size of 6.

³ This number is calculated by multiplying the total number of stoves distributed in Ethiopia by an average household size of 5.7.

⁴ 73% of study participants use the BDS on more than 10% of ownership days; of this group average daily usage is approximately 1.5 hours per day.

⁵ *Ibid.*

⁶ *Ibid.*

⁷ *Ibid.*

⁸ *Ibid.*

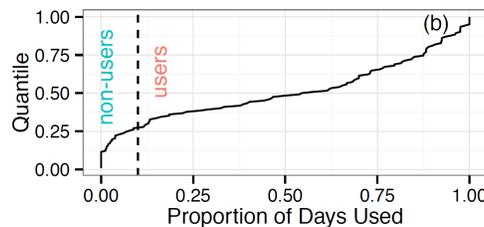
Proportion of targeted population who report satisfaction from using FES instead of traditional methods in Darfur	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
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Notes on Indicator Dashboard

A) We report customer satisfaction levels in Darfur based on:

1. Data analysis from the Stove Use Monitors (SUMs) research supported by USAID DIV.
 - a. It should be noted that this SUMs research was conducted with recipients of free Berkeley-Darfur Stoves. In the future, we plan to conduct SUMs research in Darfur with stove purchasers to compare usage data.
 - b. *Objectively Measure Usage:* There is no industry standard on what defines a stove user. Our distinction between a “user” and “non-user” was determined by the proportion of days that the stove was used. A cumulative distribution function (CDF) (shown below) was created that ranks the 122 unique cooks by the proportion of days they used the stove. In order to account for “courtesy” uses immediately before a follow up, a two-day period preceding the first follow up survey was ignored. For the purposes of this analysis, **a demarcation between “user” and “non-user” was made at 10% of possible stove-use days during the observed period (i.e. if a participant used the stove less than 1 in 10 days, she is categorized as a “non-user”). This classification is arbitrary and used only as a metric by which to separate women who regularly use the stove and those who use it very little or not at all.** Using this classification, 73% (89 participants) are categorized as “users” and 27% (33) as “non-users.” To obtain an upper bound on the bias effect from higher SUMs failure rates with “user” cooks, we recalculate this percentage assuming that all the thermally-failed SUMs were with the “users” group. This leads to an upper bound estimate of 78% (118) users and 22% (33) non-users.

Cumulative Distribution Function



- c. Between 73% and 81% of our participants use the stove on more than 10% of ownership days.
2. The survey we conducted in 2010-2011 with 180 stove users, which showed that all were still using their stove eight months after receiving it.
3. A customer satisfaction survey we conducted during our marketing trial in 2011-2012. We surveyed 50 of the 640 women who participated in the marketing trial (25 in urban areas and 25 in rural areas) and asked if they have complaints about the stove. All said no. All 50 said they use their Berkeley-Darfur Stove the

most of any stove, and all 50 said they would recommend a friend to purchase it. We are currently conducting follow-up customer satisfaction surveys.

4. The fact that no one has returned any of the stoves that have been distributed since receiving DIV funding, and those who purchased them continue to make payments.

B) Average household sizes:

1. Darfur = 6
2. Ethiopia = 5.7

Table 2: Geographic Distribution of FES in Darfur

Batch	Region	Location	#	Distributed by	Version	Year	Payment Method
CHF	South	Otash	206	CHF	5	2007-9	Free
CHF	South	Kalma	55	CHF	5	2007-9	Free
CHF	South	Dereig	95	CHF	5	2007-9	Free
CHF	South	Yara	46	CHF	5	2007-9	Free
CHF	South	Gussa	10	CHF	5	2007-9	Free
CHF	South	Kass	136	CHF	5	2007-9	Free
CHF	North	El Fasher	100	CHF	5	2007-9	Free
CHF	North	Al Salaam	14	CHF	5	2007-9	Free
CHF	South	Gereida	4720	ICRC	5	2007-9	Free
CHF	North	Al Salaam	797	ACF	5	2007-9	Free
CHF	South	Otash	109	ACF	5	2007-9	Free
CHF	South	Al Sereif	113	ACF	5	2007-9	Free
CHF	South	Ed Daein	225	UMCOR	5	2007-9	Free
2900	North	ZamZam	573	OA	14	2009-10	Free
2900	North	El Fasher rural areas	250	OA	14	2009-10	Free
2900	North	El Fasher town	350	OA	14	2009-10	Free
2900	North	Abasi IDP camp (Mellit)	450	OA	14	2009-10	Free
2900	North	Mellit Rural Areas	1009	OA	14	2009-10	Free
2900	North	Umasir	250	OA	14	2009-10	Free
2900	North	Promotional Purposes (ELF)	18	OA	14	2009-10	Free
4650	North	ZamZam	700	OA	14	2010	Free
4650	North	Rural El Fasher	750	OA	14	2010	Free
4650	North	El Fasher Town	1125	OA	14	2010	Free
4650	North	Abasi & Goz	615	OA	14	2010	Free
4650	North	Mellit Town	840	OA	14	2010	Free
4650	North	Mellit Rural	695	OA	14	2010	Free
4650	North	Control Group	25	OA	14	2010	Free
4500	North	ZamZam Extension	1000	OA	14	2011	Free
4500	North	Zam Zam Extension	500	OA	14	2011	Free
4500	North	Abu Shouk	1000	OA	14	2011	Free
4500	North	Marketing Trial (ELF town, rural & Kebkabiya)	640	OA	14	2011	Installments, Cash
4500	North	Emergency	360	OA	14	2011	Free
4500	North	Al Salaam	1000	OA	14	2011	Free

1500	North	ZamZam	1500	Plan	14	2011	Free
2200	North	ZamZam	2200	Plan	14	2012	Free
2013 A	North	Kebkabiya	2850	KSCS	14	2013	Installments
2013 A	North	Dar es Salam	300	DDA	14	2013	Installments
2013 A	North	El Kuma, El Fasher, Mellit	825	DARA	14	2013	Cash
2013 A	North	Kutum	120	AIDCD	14	2013	Cash
2013 A	North	El Fasher, Dar es Salam, El Kuma, Kilimando	300	RVNHD	14	2013	Installments
2013 A	North	El Fasher	155	SAG	14	2013	Cash
2013 A	North	El Fasher	258	SAG	14	2013	Free
2013 A	West	El Geneina	300	DARA	14	2013	Cash
2013 B	North	Rural Mellit (Wama & Sayah villages),	186	SAG	14	2013	Free
2013 B	North	Kalimando (Om Betein village)	201	SAG	14	2013	Free
2013 B	North	El Salam camp	200	SAG	14	2013	Free
2013 B	North	Zam Zam camp	80	SAG	14	2013	Free
2013 B	North	Rural El Fasher	4225	SAG	14	2013	Free
2013 C	North	Rural El Fasher	2450	CBOs	14	2013	Revolving Loan Fund/installment payment plan
2013 C	North	Rural El Fasher	2750	CBOs	14	2014	Revolving Loan Fund/installment payment plan
2013 C	North	Kassab Camp (Kutum)	2000	CBOs	14	2014	Free
2013 C	South	Malam rural area	400	MDPD	14	2014	Free and installments
2013 C	South	Nyala (urban and rural)	300	MDPD	14	2014	Installments, Cash
2013 C	West	ElGinena (urban and rural)	300	Nidaa	14	2014	Cash
2014 A	North	Rural El Fasher	400	OA	14	2015	Free
2014 A	North	Maidoub Mountain area	59	Maidoub Mountain CBO	14	2015	Installments
2014 A	North	Kutum and surrounding regions	59	Ayadi Al Rahma CBO	14	2015	Installments
2014 A	North	Rural El Fashir	59	Om al Qora CBO	14	2015	Installments
2014 A	North	Ba Shagra camp	25	WDA	14	2015	Installments
2014 A	North	Rural El Fashir	20	Baraka	14	2015	Installments
2014 A	North	Rural El Fashir	225	NFC	14	2015	Installments
2014 A	North	Rural El Fashir	25	Wara	14	2015	Installments
2014 A	North	Rural El Fashir	25	Koroa	14	2015	Installments
2014 B	South	Nyala	300	SAG: Direct sales to Nyala distributor	14	2015	Installments
		TOTAL	41,873				

Table 3: Geographic Distribution of FES in Ethiopia*

Batch	Region	Location	#
2013A	Oromia	Sebeta	5
2013A	Oromia	Meki	5
2014A	Oromia	Debre Zeit	40
2014A	Oromia	Debre Zeit	82
Total			132

*Assembly of 600 Berkeley-Ethiopia Stoves is complete

SUMMARY OF ACHIEVEMENTS SINCE LAST REPORT

The last few months have been busy at Potential Energy. In Darfur, we've doubled-down on our sustainability strategy, increasing the price of the BDS stoves and enforcing strict guidelines on CBOs that wish to sell stoves on installment plans. We're evaluating the feasibility of local manufacturing in order to find a way to avoid the long and frequent delays we've been experiencing at the Port of Sudan with imported flatkits. We've finalized a contract with a new carbon offset project manager that will assist us in getting existing stoves' credits registered with Gold Standard, and we're in the midst of conducting mobile impact surveys with 200 randomly selected Darfur stove users. In Ethiopia we've deepened our data collection efforts and have collected baseline survey information on over 500 households. We've also begun to sell stoves after free trial periods are complete, and we're seeing a great deal of interest in the product. In new markets, we've launched trials of advanced stoves in Uganda, and are seeing promising early traction there in conjunction with our local partner, Eco Group Ltd, and technology partner African Clean Energy. Here is a summary of some of our key activities, by area:

Darfur Distribution Partnerships: Since our last report, 3,000 stoves have been assembled, with 620 new stoves sold in installments at a higher price than has previously been offered in North Darfur (85 SDG). In addition to the 11 CBOs already working on the project, 4 new CBOs and an independent distributor joined the program. By enforcing quota limitations for each CBO (i.e., limiting the number of stoves each distributor can access until repayments are successfully collected), we are increasing our repayment rates for stoves offered under the Revolving Loan Fund. Discussions have continued with PE's West and South Darfur pilot partners Nidaa and Mala Darfur Peace and Development regarding marketing strategies, with both organizations showing interest in scaling up their activities. Nidaa sought to establish an assembly shop in West Darfur, but was prevented from doing so by local authorities; discussions continue and we hope to see changes in the local government's perspective in the coming months.

Re-evaluating Local Manufacturing: In 2014, PE faced multiple challenges associated with getting stoves from our manufacturing hub in Mumbai to the assembly shop in Darfur. The Indian manufacturer experienced multiple delays, while PE and its local Sudanese partner faced added delays and accumulated fees at the Port of Sudan due to revocations of the port customs exemption permit. To address this direct sustainability risk, PE hired a consultant to study local manufacturing options; this study is currently being conducted, building on findings from 2010 when we last examined this question.

Impact Survey in Darfur: In February 2015, PE and SAG launched an impact survey to understand the economic impact of our stoves via voice-recorded questions transmitted directly to stove users via their mobile phones. The survey was designed in collaboration with VOTO mobile, with whom PE has also partnered in Ethiopia. The survey seeks to collect information from up to 300 stove users across North Darfur to investigate their fuel and cooking spending habits (time and money) before and after receiving the BDS. In March, the survey was launched with a courtesy call to 100 participants, explaining the survey objectives, mechanisms of participation and monetary incentive upon completion. Despite some technical issues, the data collection is off to a good start and we are excited about the ease of pushing surveys out. In addition to the goal of 300 women, we will survey 100 non-BDS users as a control group to compare fuel expenditures of both groups.

Stove maintenance in Darfur: In February 2015, PE and SAG performed a maintenance campaign in El Fashir. More than 100 users were invited, out of which 40 users from 2009, 2010 and 2011 brought their stoves for repair. Only four stoves were completely damaged and needed full replacement. A budget was drawn for the maintenance campaign, covering assembly workers wages, tools needed for repair (mostly rods that fall off main body and need reattaching) and transportation. PE and SAG have agreed on performing maintenance

campaigns for larger number of stove users on a quarterly basis, rotating areas and camps where many beneficiaries reside.

Monitoring in Ethiopia: A randomized control trial (RCT) is currently in progress in Ethiopia. While the evaluation has experienced a number of delays, the pace has now quickened; Electronic data collection has been especially helpful for the surveying, and we are using Open Data Kit 2.0, which is allowing the survey team to identify issues with the data collection early on and fix problems quickly. Through the Becker-DeGroot-Marshack “bidding game,” the research team has been able to gather data on what prices customers are willing to pay for the Berkeley Ethiopia stove. Most bids fell in the \$15-20, higher than the average stove price the market (between \$2.50 and \$10). Stove Usage Monitors (SUMs) have been collecting data on customers’ stove usage for all freely distributed and purchased stoves. To analyze Berkeley Ethiopia Stove usage, the research team is adjusting the algorithm used to analyze SUMs used for the Berkeley Darfur Stoves. The research team has also partnered with Voto Mobile to implement mobile surveys to customers.

New innovations in Uganda: Trial operations were also launched in Uganda. There are currently 20 stoves on the ground and PE is testing a leasing model that combines advanced biomass gasifying stoves with the sale of pelletized fuel. The stoves we are utilizing for the trial are produced in Lesotho, and the pellets were procured from a company in Rwanda. Future pellets will be procured locally in Uganda, and a few producers have already been identified. The stove system includes a USB port for the charging of lights and mobile phones, providing additional energy sources for our customers. The stoves are being leased along with a fuel package, which includes weekly fuel deliveries of locally sourced fuel pellets.

MILESTONE UPDATES

1. Recruit and Train Local Sales Agents (Darfur)

Since January, a total of 620 new stoves were distributed through international organizations, Community Based Organizations (CBOs) and independent distributors. PE and SAG continued to support and train new and existing CBOs to properly demonstrate stove use, market, sell, and document stove and users data and repay loans in a timely manner. Overall stove distribution numbers were low during this reporting period because 1) we have held off on free distributions temporarily in order to re-define what events / characteristics of the target populations qualify for free distribution, and 2) sales have been slow as we’ve increase the sale price in an effort to bolster the sustainability of the project (see “Iterate on Stove Financing structures,” below, for more information).

2. Expand sales based on findings from marketing trials (Darfur)

Since our last report, PE’s Sudan Field Representative permanently relocated to Khartoum, where she coordinated multiple meetings and phone conversations with our 2014 West and South Darfur expansion pilot partners, Nidaa and Malam Darfur Peace and Development. The partners had previously expressed their interest in scaling up operations in both West and South Darfur. As outlined in our previous report, PE’s evaluation of each partner led to developing different customized mechanisms to achieve scale based on the market needs of each state and the organizations’ performance, current resources and infrastructure.

Recent discussions have centered on current challenges and opportunities. Nidaa expressed interest in establishing an assembly shop in West Darfur. The organization sought a port exemption permit with the relevant authorities in Khartoum, but was informed that all permits, new and old, are on hold. As we reported

previously, our current partner SAG has been reapplying for a port exemption permit renewal for 10 months and was informed about the same challenges. PE and Nidaa agreed on waiting for the local manufacture study results before looking at other import options and stove enterprise set-ups.

PE and Malam have been discussing stove sales and marketing strategies, in anticipation of a visit by the organization's president in April. Malam revisited their pilot project marketing strategy and made amendments based on feedback from PE. PE and Malam will continue to work closely to finalize marketing plans before new stove sales take place in mid-April, May and June. Malam is keen on establishing strong market positioning in South Darfur, as well as improving sales and documentation mechanisms before scaling operations to more than a few hundred stoves per year.

3. Replicate assembly shop (West Darfur)

When we started this project, we had recently set up the assembly shop in North Darfur, and were still in the process of understanding the capacity for assembly. Since 2012, we have outfitted the shop with improved tools, and have enhanced our workflows and training. As a result, we have seen an increased capacity as well as ability to store and transport stoves throughout the region. Our current shop has the capacity to assemble 28,000+ stoves per year. With our current sales and distribution rates, we are only at 53% of capacity and do not yet see a need to replicate our assembly shop in the next 1-2 years.

4. Build distribution channels (West Darfur)

As noted in the above sections, we continue to actively expanding our distribution channels. We are working to identify partners that are able to market and sell the stoves at the higher prices that are required in order to get to sustainability.

5. Coordinate Stove Production, Assembly and Distribution (Darfur)

Production: In previous reports we have discussed our joint efforts with SAG to minimize and eventually eliminate stove subsidies. SAG continues to cover their local costs for transportation, assembly, storage, maintenance and overall management of the stove enterprise in North Darfur. Until this point, PE continues to cover the cost of raw materials, manufacture and transport of flat-kits from the port of India to Sudan.

Assembly: The current stove batch was assembled in December and distribution began while assembly continued until mid-January. SAG assembled 3000 stoves in anticipation of slow sales due to the higher retail price. Additionally, SAG sought to reduce storage costs and minimize theft risk from storage facilities. Currently, all assembled undistributed stoves are housed within SAG facilities with a 24-hour/7-day guard protecting the property.

Distribution: PE and SAG have agreed upon a stove allocation plan for the current batch, where at least 3000 stoves will be sold at an increased price, and 2000 stoves are available for free distribution as needs arise from the ongoing crisis. SAG will begin free distribution of this batch of stove to newly displaced communities in April.

6. Conduct randomized control trial evaluating marketing mix (Ethiopia)

The RCT in Ethiopia has been progressing well; Ethio Resource Group continues to manage data collection and cookstove distribution, which is being implemented by the local NGO Ratson in Debre Zeit. The research team from UC Berkeley has been providing ongoing oversight from California. Because operations have been behind schedule, measures have been taken to quicken the pace of study enrollment and data collection. As of mid-March 2015, Javier Rosa of the UC Berkeley team is spending 4 weeks with the implementation teams in Ethiopia to facilitate the work and resolve bottlenecks in the process.

Enumerator training and data collection: Initially, the primary enumeration team comprised six members of partner NGO RATSON who were trained by Mr. Hilawe Lakew of Ethio Resource Group. To increase the pace of data collection, three new enumerators are currently shadowing the experienced enumerators and will begin surveying independently this week. One of the original enumerators has also been removed after failing to reach survey targets. To date 520 baseline surveys have been completed, and 490 participants have taken part in cookstove demonstrations. Bids and first follow-up surveys continue on pace, with participants completing the follow-up visit (in which participants complete an additional survey and state their bid/willingness to pay for a Berkeley Ethiopia Stove) approximately two weeks after the baseline survey and cookstove demonstration.

Electronic data and data processing. The research team has begun processing the electronic data that has been collected. Since all surveys are being collected concurrently (meaning that some participants complete follow-up surveys before other participants have even been enrolled in the study, as opposed to all baseline surveys being completed before moving on to the next stage of data collection), analysis to date has primarily been used: 1) for quality control, to ensure that enumerators have been well trained and are implementing both enrollment and data collection correctly, and 2) to prepare the analysis code to be ready for implementation very quickly upon receipt of the fuller dataset.

On this note, the team cannot emphasize enough how beneficial it has been to use electronic data collection, specifically with the Open Data Kit 2.0 software for this study. Though electronic data collection tools and implementation bring their own challenges, the ability to have centralized oversight of quality control provides the opportunity to catch challenges and problems early on and provide solutions before data collection is complete and it is too late. Since every study with large-scale data collection inevitably faces some set of unpredictable challenges, electronic data collection with active ongoing review offers the opportunity to increase studies' quality and usefulness greatly.

As examples, review and some basic analysis of the data for the first groups enrolled in the Ethiopia study revealed two challenges. First, it appeared that the recruiters were not targeting precisely the target demographic group that the research team envisioned for the study sample. Specifically, there was too high a proportion of households that cooked primarily with electricity or charcoal – households that were unlikely to benefit from or desire to purchase and improved wood cookstove. Because this enrollment pattern was detected early, the recruiters could be guided to communities with higher proportions of wood users while most of the sample was still yet to be recruited. Second, early review of the purchase bidding data showed that the lottery for participants' price assignment (the randomly-assigned price that a participant would pay for the stove, if it was lower than their stated bid) was not being implemented correctly by the enumerators in the field. Left undetected, this problem would have threatened the comparability of the "treatment" and "control" groups for the impact evaluation. However, because it was detected quickly, the problem was resolved by incorporating the random price draw directly into the survey software, eliminating the possibility of enumerator or participant error.

Cookstove, trials, bids, and purchases. To date, 61 study participants have completed or are currently completing a free trial (not all participants are selected for a free trial), and bidding data have been collected from 310 study participants. There have been 122 stoves sold through the Becker-DeGroot-Marshack “bidding game,” in which the participant states the highest price that she would be willing to accept for a Berkeley Ethiopia Stove; then if and only if the random price draw she is assigned is less than or equal to her stated acceptable price, she is allowed to purchase the stove. This design encourages truth-telling about willingness to pay and also allows for the generation of comparable treatment and control groups, where participants who have the same willingness to pay may be shuffled into the treatment group (purchases a stove) or control group (not able to purchase a stove) by the randomized price draw/lottery.

Note that a typical stove in the market sells for between \$2.50 and \$10 USD. While some of the study bids fall into that range, many are in the \$15-25 range, with a maximum bid so far of \$40. There is reason to believe that the bids for the remainder of the sample are likely to be somewhat higher than the initial bids: the early part of the sample actually contained a number of households who were cooking with electricity. Not surprisingly, these households were less interested in purchasing a wood-burning stove (and Potential Energy does not want to convert households who cook with electricity over to wood use). Because electronic data allowed the research team to detect these patterns early on, the enumerators were redirected to recruit in neighborhoods with lower electricity access and higher wood use, increasing the chance of identifying the target market for the Berkeley Ethiopia Stove.

Stove Usage Monitors. Temperature-logging sensors (Stove Usage Monitors) are collecting data from all free trial stoves and all purchased stoves to date (the sensors will be rotated among stoves once the number of stoves in circulation exceeds the total number of sensors). Using the free trial data from the first groups who were enrolled to the study, the research team is adapting the algorithms developed to analyze sensor data from the partner study of the Berkeley Darfur Stove. Because every location has different cooking patterns (including types of foods, cooking styles, and variations in wood type) as well as ambient temperature patterns, the algorithm must be adjusted to any new context.

The set of algorithms under development will not only enable the current study to convert temperature measurement samples into statistics such as the number of times and number of hours that the cookstove is used, but these algorithms will contribute to a larger “machine learning” product that will enable a typical “non-expert” practitioner to “train” the algorithm to work for other cookstoves in other contexts. During Javier Rosa’s current trip to Ethiopia, he will also be collecting a series of direct cooking observations and interacting with cookstove users for whom there is sensor data to discuss their cooking patterns, to validate and improve the algorithms under development. A series of discussions with cookstove-measurement experts has provided the team with useful insight in the types of validation that might be useful and convincing.

Automated mobile surveys. One planned component of the survey process has been to incorporate automated phone surveys to ask a series of follow-up questions (in automated surveys, a voice recording gives the question, and respondents respond using the numbers on their keypad). The implementation partner for this service to date is Voto Mobile, which conducts successful operations in a number of African countries, including Ghana where it is based. However, the transition to Ethiopia and operability with the single mobile service provider has presented a number of technical challenges around call quality and call completion. The UC Berkeley team is working with Voto Mobile to resolve remaining difficulties but may choose to change providers if the situation is not fully resolved soon.

7. Develop local manufacturing capacity (Ethiopia)

All of the Berkeley-Ethiopia Stoves allocated for the initial sales trials have been assembled at the workshop in Addis Ababa. As previously reported to USAID, based on our experience implementing this pilot project, we are increasingly concerned that 1) the costs associated with importing goods – even those that are unassembled, and 2) the overall cost of doing business in Ethiopia, may be prohibitively high to build a stove business at scale. PE will revisit discussions with our partners to determine next steps based on the results of our sales trial and RCT.

8. Iterate on Stove Financing Structures

CBOs involved in the first round of our revolving loan fund continued repaying their loans throughout the first quarter of 2015, and we're now seeing an overall repayment rate of over 80% overall, with 9 CBOs having no delinquency or defaults. 11 CBOs that had at least a 90%+ repayment rate were invited to participate in additional end-consumer finance rounds. Additionally, four new CBOs and an independent distributor from South Darfur joined the program in 2015. New CBOs were allocated 25 stoves to test selling in their home communities; they will be provided with more stoves when they repay their outstanding loans and submit the required stove tracking documents. We are actively seeking new CBOs and distribution partners in North Darfur and other Darfuri states where possible.

PE and SAG have seen some early success with the new rules on stove allocations based on CBO size and previous repayment rates. One of these rules is that all new CBOs start small, with just 25 stoves. This gives new CBOs a chance to test out sales as well as gain expertise in promotion and marketing before they make the decision to purchasing more stoves on credit. Old CBOs were encouraged to pay outstanding loans in a timely manner to qualify for additional up-front financing. PE and SAG are currently selling stoves at 85 SDG. There was some resistance from the CBOs about the increase in retail price; PE held a steering committee meeting with SAG and local CBO partners in February, and 12 existing CBOs and 4 CBOs that are new to the program attended. The meeting explained the need to push the project toward increasing sustainability; CBOs were supportive of this, however, they favored taking smaller samples of the stoves to test the new price in their communities.

9. Test Improved Exterior Stove Design for Customer Interest and Willingness to Pay

As we work to increase the price of the Berkeley-Darfur Stove, we are experimenting with finding ways to improve the BDS design in order to increase the perception of the stove as an aspirational product (thus increasing willingness to pay). The "cool mesh" modification to the Berkeley-Darfur Stove was developed based on feedback from Darfuri customers regarding: 1) appearance of the stove after regular use and 2) concern about the outside of the stove causing burns if accidentally touched while in use. In Darfur, SAG has assembled 100 units of the new cool mesh stove. We've agreed on attempting to sell these stoves at an income-generating price of 140 SDG. At this price, 50 SDG will go to SAG to cover transport, assembly and coordination, 15 SDG will go to CBOs for distribution, and 75 SDG will be invested in the growth fund to help support the sustainability of the program.

10. Trial Advanced Stoves Paired with Pelletized Biomass Fuel in new markets to gather customer feedback (Uganda)

After a number of months of research and planning, we have launched our trial operations in Uganda. We are experimenting with a new impact model that enables access to best-in-class cooking technologies combined with fuel alternatives that our customers can use to power their stoves. We have begun the distribution of advanced biomass stoves, which use forced air injection and gasification to achieve a clean, near smoke-free burn. The gasification technology built into the stove allows women to prepare meals by burning biomass—a practice they have done for generations—without the smoke.

The new stoves are significantly more complex than our Sudanese ones, built with batteries, fans, and lights. For this reason, these stoves are significantly more expensive (at around \$100) than the Berkeley-Darfur stoves (priced at \$20). The benefits of the stoves are significant; women who use the stove experience a smoke-free kitchen, and the ability to plug in a light and charge their phones.

Our challenge in Uganda is to make this advanced stove accessible and affordable for women in Africa. Our partners at Berkeley Lab are working on designing a more affordable advanced stove, but until then, we have decided to focus on innovating around the business model as a solution to the affordability challenge. We are now leasing stoves to customers instead of selling them; a lease enables women to try the product without the financial risk. As a part of the model, customers who lease the stoves are asked to purchase sustainably and locally sourced fuel pellets as biomass for their stove. This new fuel, which we are co-branding with our in-country partners as Eco Fuel, is made of compressed organic refuse and formed into small pellets. There are many benefits to this new model—the women’s expenditures don’t increase, the fuels are sustainable, the stoves are best-in-class, and the customers receive access to lighting and phone charging. We currently have 20 stoves and 2 tons of fuel deployed in Uganda. We are collaborating with our local partners to adjust the implementation model as the pilot continues, making adjustments with pricing, logistics, and operations to lead to the greatest impact.