

Dale Andreatta
SEA, Ltd.

Title: A Solar Heater/Drier for Low Temperature Household Energy Needs

Abstract: A significant fraction of household energy is needed at low temperatures for washing, bathing, space heating, and grain or wood drying. For low temperature applications such as these, it makes sense to use solar energy rather than burning fuel. In terms of fuel savings, these applications are often "low hanging fruit" that can be harvested easily.

Preliminary experiments were conducted with a general purpose solar heater/drier, and it works well for all of the above applications, plus pre-heating of water to be used for cooking, and water pasteurization. The solar heater/drier is very simple and inexpensive, and the user has many options for how to use it. Test results are given for a variety of tasks under a variety of weather conditions.

The solar heater/drier is very simple in design, rather like a tent with an insulated black floor and a clear top. Up to 90 degrees C has been achieved at the tent floor, enough to heat the inside objects to 50-70 degrees. While the efficiency is not high, the sheer magnitude of the solar energy collected makes it an effective heater and drier.

Learning Objectives: Attendees will learn:

- That a significant fraction of household energy needs are not related to cooking, and most of these are low temperature applications that could be fulfilled by solar energy.
- That the solar devices to fill these needs can be very simple and inexpensive. The devices are also versatile, meaning the user has many options for how to use them.
- That these devices work well.
- One or two good jokes.

Craig Attenweiler
University of Dayton

Title: Post Combustion Methods for Emission Reduction in Small Scale Combustion: A Literature Review

Abstract: Over the past few decades, it has been a global priority to improve indoor air quality and the environmental sustainability of cookstoves. This primarily has led to the efficient cook stove movement which aims to address both problems with a singular solution. While the environmental sustainability of biomass and wood based cookstoves continues to be an area of

development, the first of the two goals has a much simpler, much more obvious solution: a chimney. However, this simple solution also presents a problem, while it improves indoor air quality, the pollutants resultant from these stoves still remain and overall air quality still suffers. This review acts to analyze and postulate how post combustion methods of emission reduction could be used to treat the aforementioned issue, with specific emphasis on catalytic devices, fibrous filters, and electrostatic precipitators.

Learning objectives: To inform the cookstove community on what I have learned about post combustion methods of emission reduction.

- Understand the Basic Operation of Catalytic Devices, Fibrous Filters, and Electrostatic Precipitators
- Understand the implication such devices might have on efficient cookstoves

Norman Baker
Sierra Club

Title: Flame Cap TLUD?

Abstract: Our continued work on TLUD Design and function has allowed us to develop a simple TLUD that has the unique ability to not produce smoke. A pyrolysis event simply proceeds from start to finish without the ever present puff of pyrogas at the end of the burn. Testing scheduled soon after the ETHOS meeting will give us actual levels of emissions.

Learning objectives:

- TLUD or Top Lit Updraft Gasifier
- TLUD Design
- Emissions
- Secondary Combustion

Michael Barbour*
Intellectual Ventures Lab

Title: The Kuniokoa Turbo: a widely adopted, side-feed, biomass cookstove

Abstract: Multiple biomass cookstove projects have failed in the past due to poor field performance and/or low rates of user-adoption. The Global Good Fund and Burn Manufacturing are co-developing the Kuniokoa Turbo - a new forced-draft rocket stove that aims to overcome these obstacles and become the first widely adopted, tier 4, biomass cookstove. This open-innovation development effort leverages the expertise of the Aprovecho Research Center, BURN Design Lab, the Clean Cookstove Lab (University of Washington), and

Intellectual Ventures Lab. The research and development process, which utilizes “field condition” laboratory testing, computational modeling, and multiple rounds of user-feedback testing, is focused on creating a unique and exciting cooking experience for the user, while significantly reducing emissions both in the lab, and, where it counts, in the kitchen. By combining ideal emissions performance and multiple user value-adds into a cost-effective system, we aim to create a biomass cookstove capable of achieving meaningful health improvements. This talk will highlight the Kuniokoa Turbo development strategy and key learnings from our first two rounds of prototype development and user-evaluation testing.

Learning objectives:

- Provide a summary of the Kuniokoa Turbo development process and strategy
- Provide a high-level overview of prototype development progress
- Discuss key learnings from user-feedback testing (in Kenya) and integration of that feedback into the prototype development

**Presented by Paul Means and Van Dinh*

Sam Bentson

Aprovecho Research Center

Title: Descriptions of Thermoelectric Generation and Electrostatic Precipitation in a Rocket Stove

Abstract: Without water cooling, a 20 W TEG was successfully installed in a downdraft Integrated Rocket type stove that offers cooking, heating, and charging of a cell phone, plus lighting of the kitchen. The hot side of the TEG runs at around 290C while the cold side radiator lowers temperatures to 80C. An electrostatic precipitator from OekoTube removed up to 90% of the PM_{2.5} when tested at 29,000 volts and 25 watts.

Learning objectives:

- Teaching how to install a 20 watt TEG in a Rocket stove
- Describing how electrostatic precipitation functions with test results

Sam Bentson

Aprovecho Research Center

Title: The New ISO Compliant Laboratory Emissions Monitoring System (LEMS)

Abstract: The 2018 ISO Biomass Cooking Stove Standards includes needed upgrades to the LEMS. The changes in the LEMS are described and details of the improvements are summarized.

Modifications also include stricter laboratory procedures and the test itself now measures emissions and thermal efficiency at three power levels increasing the ability of the Water Boiling Test to predict real world performance.

Learning objectives:

- Teach how the LEMS has been changed
- Go over the new ISO protocols and test procedures.

Dana Charron
Berkeley Air Monitoring Group

Title: Green fuel comes to the big city: will ethanol displace kerosene and charcoal in urban homes?

Abstract: This talk will report on a study done in 2017-18 in Lagos, Nigeria, in partnership with Project Gaia and funded by the African Development Bank. A commercial pilot is rolling out in Lagos to sell an initial 2,500 CleanCook stoves and 15,000 alcohol fuel canisters in selected neighborhoods. This early-stage observational study aimed to improve the potential for successful ethanol technology scale-up by collecting data on cooking patterns, customer perceptions, and willingness to pay. In-home field assessments were undertaken in an experimental sample of 30 households for up to 6 months. A combination of sensor-based stove-use measurements, canister refill monitoring, and household surveys were used to measure uptake, use, and acceptability of the CleanCook. The evaluation also included performance testing of both the CleanCook with the ethanol-methanol fuel and a local kerosene stove conducted at the National Center for Energy Research and Development (NCERD) laboratory at the University of Nigeria, Nsukka, to estimate emission factors/rates and fuel efficiency. We will present top-line results and conclusions of the field study and some preliminary estimates of the potential for ethanol to reduce climate-damaging pollution.

Learning objectives:

- To briefly introduce the Cleancook stove and fueling system and the parameters of the commercial pilot.
- To explore evaluation design, methods, and challenges from this study.
- To share top-line learnings on customer preferences related to ethanol as well as role of ethanol in reducing climate pollutants.

Dana Charron
Berkeley Air Monitoring Group

Title: Worth 1000 Words: Using Photo Elicitation to Understand Time-Use and Quality in Rural Kenyan Households

Abstract: Recent evidence has posited that lack of access in low and middle-income countries to clean, modern, efficient energy to meet household cooking, heating, and lighting demands may create an undue time burden, particularly for women. In 2018, with support from the Clean Cooking Alliance, Berkeley Air conducted a study in rural Kenya to identify and understand changes in time use patterns, quality of time, and perceived levels of drudgery, for members of households that had received an improved wood-burning stove. A mixed-method study design which included surveys, stove use monitoring and participatory research methods was implemented. Following the distribution of BURN wood-burning Kuniokoa stoves, a subset of homes participated in a photo elicitation exercise wherein they were asked to document any impacts the change in cooking technology had on the daily lives of all household members. This session aims to first explore the role of mixed methods study designs in better measuring and understanding time-use patterns, quality of time, and perceived levels of drudgery. We will then offer perspectives on what unique data photos have to offer through a discussion of methods and top-line results.

(Madeleine Rossanese, Kirstie Jagoe, Dana Charron (BAMG), colleagues at the CCA)

Learning objectives: Learning objectives for this topic include an overall illustration of the value of collecting both quantitative and qualitative information when trying to understand a multi-faceted topic like time use and quality - especially what is valuable about photographic data, and what we miss without it, and some insights into analyzing that photographic data. The talk will also touch on the differences between methods to gather this data, namely Photovoice and photo elicitation, and detail the methods used to produce our results.

Evan Coffey
CU Boulder

Title: Field findings from a low-cost PM sensor and comparisons to gravimetric sampling

Abstract: Impact evaluation efforts within the cookstove intervention realm depend on reliable exposure data. There has been an increasing demand for accurate, affordable exposure monitoring tools that offer high temporal data resolution, low power consumption and are easy (least inconvenient) to wear. Here we field test one candidate for PM monitoring: the HAPExNano is a small, lightweight, commercially available PM monitor under 120USD. A total of 37 paired HAPEx Nano and gravimetric filter samples were collected between 2017 and 2018 measuring kitchen area PM as part of the Prices, Peers and Perceptions study. Device

intervariability and comparisons to gravimetric values are discussed, including effects of environmental factors (e.g. temp, rh) and PM composition on readings.

Learning objectives: Performance of low cost PM sensor (the HAPEx Nano) in the field with gravimetric reference

Kathy Cox
City University of Seattle

Title: Guatemala store and alternative fuel

Abstract: The social enterprise Enactus team from City University of Seattle Green Energy Center (GEC) has spent the last three years applying our ideas and values to scale up our Green Energy Center (GEC) business model. We started with a field concept test in Gabon and Puerto Rico of a clean cookstove with an economic incentive of power generation. After meeting Richard Grinnell at ETHOS 2018 we are helping to accelerate the stove store in Guatemala. This year, a formal partnership was formed with an Enactus team who specializes in industrial engineering from Rafael Landívar University (Universidad Rafael Landívar) in Guatemala to research and develop fuel alternatives for clean cookstoves and help implement the store initiatives. At this ETHOS conference, Richard will give an update on the stores and we will discuss our activities to accelerate the stores with an overview of the sustainable fuel, Ecole, made from common materials of coconut shell, corn leaf and pepper leaf by that provides reoccurring revenue for the stores.

Learning objectives:

- Understand the distribution model in Guatemala
- Explain marketing methods to gain awareness
- Discuss alternative sustainable fuels.

Elisa Derby
Independent

Title: Recent Climate Change Reports Summarized

Abstract: Do you remember being vaguely aware of a major climate change report released Thanksgiving weekend? Do you not have time to read the 1,524-page report, or even the 196-page “Report in brief”? Wondering what climate change impacts are predicted for the US and what adaptations measures are already underway? Want to feel more informed about climate change in general, and especially as it relates to health? As a special bonus feature, indicator

summary tables of the Lancet Countdown report on health and climate change will be available, printed on paper that you can take home!

Learning objectives:

- Learn the major findings of this ground-breaking new climate change report
- Find out why it all matters so much
- Learn about mitigation options to reduce climate change impacts
- Hear specific examples of adaptation measures already underway, why they are insufficient, what more we can do

Alison Filler

International Lifeline Fund

Title: Market Development Findings from Ugandan Refugee Settlements

Abstract: As a result of renewed fighting, food scarcity, and economic deprivation throughout South Sudan, over 1.3 million refugees have fled to Uganda since July 2016.

In October 2018, International Lifeline Fund began a 6-month Safe Access to Fuel and Energy (SAFE) program in partnership with the United Nations World Food Program (WFP) in three refugee settlements and two rural communities across Uganda. Key objectives of this program are to nurture markets for affordable energy efficient technologies, enable opportunities for income generation among refugees and host community members, and develop community assets that can be leveraged for long-term economic growth.

Representatives from Lifeline will discuss project mid-point findings and plans going forward, including:

- Project implementation strategies and key success factors,
- Stove promotional activities and market teasers to generate demand in humanitarian and low cash contexts, and
- How the stove design process can impact livelihoods.

Learning objectives: Attendees will explore the following learning points:

- How do we stimulate market demand among populations with limited cash availability?
- In a humanitarian setting where free distribution is business as usual, how do we balance supply and demand in such a way that increases access to energy efficient technologies but does not oversaturate and undermine the value of the market?
- How do we effectively transfer this knowledge to the funder community to evolve business from the usual to the future?

Charity Garland*

Honorary Berkeley Air (Bay Area Air Quality Management District)

Title: An Alternative Technique for Determining Gravimetric Particle Mass Deposition on Filter Substrate: The Particle Extraction Method

Abstract: Airborne particulate matter (PM) filter sample processing is susceptible to error and can present issues associated with organizing samples, tracking data, and maintaining weighing conditions. While filter weighing facilities should implement robust quality assurance and control checks to ensure that data collection is accurate and filter storage is secure, mistakes and accidents can still occur that compromise valuable data. There is now a novel approach to PM filter sample processing that allows for data validation or data recovery while ensuring data integrity. The technique approximates the original, unused pre-sampling weight of polytetrafluoroethylene (PTFE) filters after PM collection to determine PM mass-deposition (MD). The method describes the extraction of PM loaded on PTFE filters via sonication in relatively non-toxic solvents, methanol and distilled water. The extraction method is compared to the standard gravimetric PM MD determination method for a set of 265 PTFE filters.

Learning objectives:

- The extraction method process
- Potential applications for the extraction method
- Limitations of the extraction method

**Presented by Madeleine Rossanese*

Grace Gius

Cal Poly Physics

Title: Insulated Solar Electric Cooking: Year IV, progress in California, Uganda, and Malawi

Abstract: A 100-Watt solar panel can cook a family's dinner in a well-insulated pot in a few hours, while charging a cell phone and lighting system. The cooking/charging/lighting system can be assembled for \$10 - \$20 in materials plus the cost of the solar panel. This is our fourth year presenting Insulated Solar Electric Cooking (ISEC), previously reporting* deployment of two ISECs in Uganda. Updates include making heating elements from a diode string rather than resistive wire, with two advantages: (1) Diodes draw power from solar panels more effectively under varying solar intensity, and (2) Diodes provide an inexpensive voltage controller, allowing the heating element to simultaneously function as a battery charger. We now partner with social enterprise, Kuyere (www.kuyere.com) for system design development and field testing in Malawi. We suggest that these systems provide a model for providing rural electrification with very low-cost solar electricity that can economically displace a considerable portion of biomass cooking.

* Insulated Solar Electric Cooking - Tomorrow's Healthy Affordable Stoves?, T. Watkins, et al, Development Engineering 2 (2017) 47-52. Associated video:
<https://www.youtube.com/watch?v=XTQhdjVd0Fk>

Presenters:

Grace Gius, Matt Walker, Pete Schwartz, and many other students, Cal Poly Physics

Peter Keller, Aid Africa

Robert Van Buskirk, Kuyere!

Learning objectives: Presently the world's poorest pay the highest price for electricity: small batteries cost more than 200 times what we pay for grid electricity per amount of electricity used! However, the price of solar panels continues to decrease, historically by ~ 50% every 5 years since 1970. While the retail price of solar panels in the US is about \$1/W, a shipping container of solar panels can be purchased at the factory door in China for less than \$0.30/W, resulting in a full system cost of potentially less than \$0.50/W. By maximally consuming the solar electricity for continuous charging and cooking, the cost of solar electricity in such a system is exceedingly small: well under \$0.10/kWh if amortized over five years or more: less than we pay for electricity in California!

Gerard "Kirk" Harris

Aprovecho Research Center

Title: Update on the Wonderwerk TLUD-ND Tier 4 cook stove

Abstract: The discussion will include improvements in the latest iteration of the Wonderwerk 316 TLUD-ND wood fired cook stove, the Wonderwerk 918 (working principles confirmed by testing at Aprovecho Research Center in September of 2018, 9-18). Included will be descriptions of new designs and principles for: primary-air/power-level control, clean-up of transition to coals, clean start-up technique, wood-gas/air mixing, additive burner arrangement, clean-up burner and its function, supplemental forced air, radiant heating attachment, and stove/cooking vessel interface.

Learning objectives: The presentation will cover the techniques used to:

- Produce a Tier 4 TLUD-ND stove with flat line particulates as tested at ARC.
- Make the stove easier and cheaper to manufacture than its predecessor and easier to repair in the field.

Jim Jetter

Title: New international ISO standard for lab testing of cookstoves now published!

Abstract: This talk will provide information on ISO (International Organization for Standardization) Standard 19867-1: Laboratory testing of cookstoves for emissions, efficiency, safety, and durability. The talk will include (1) a description of the background context, (2) explanation of the testing protocols, and (3) discussion of ongoing implementation efforts and next steps. ISO 19867-1 was just published in June 2018 after a 4-year process involving a diverse group of international experts and stakeholders. Countries and organizations may now adopt or adapt the standard to meet their needs.

Learning objectives:

- To briefly introduce the new international ISO standard for laboratory testing of cookstoves
 - To provide basic explanation of the testing protocols
 - To discuss ongoing international efforts to implement the standard
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Michael Johnson

Berkeley Air Monitoring Group

Title: Updates from the HAPIN Trial: Progress and pilot exposure results

Abstract: The Household Air Pollution Intervention Network (HAPIN) Trial is a multi-country effort to demonstrate the effects of a liquefied petroleum gas (LPG) stove and fuel distribution intervention on birthweight, child health, and adult chronic disease (www.hapintrial.org). This presentation will provide a high-level update of the HAPIN trial and summarize the pilot baseline and post-intervention PM_{2.5} exposure measurements from the four field sites. The pilot studies, which were conducted to determine the potential of detecting improvements in women and children's health, indicated that PM_{2.5} exposures fell on the steep sections of known exposure-response curves, implying potentially important health benefits with a gas intervention. The exposure reductions were relatively large compared to those reported for other household energy interventions, including for some associated with liquid or gas fuels. The results also suggest clean fuel interventions may lower exposures to near or below the WHO interim-1 target of 35 µg/m³. Finally, the range of exposures indicate promise for better characterizing the exposure-response functions for important health endpoints, which to date have very limited household energy-specific evidence.

Learning objectives: This presentation will aim to provide the audience with a current understanding of the rationale and progress of the HAPIN trial. The results of the exposure pilots will be highlighted to illustrate how the expected exposure contrasts relate to potential health outcomes. Finally, the relationships between exposure and health being evaluated for the HAPIN trial will be explained in terms of their broader potential application for policy,

including how they relate to improving the health-based evidence for all household energy interventions.

Olivier Lefebvre
Climate Solutions Consulting

Title: Enabling Regional Stove Testing Centers to do Personal Exposure Measurement: combining gravimetric measurements with real time filter reflectance and pressure drop measurements

Abstract: A network of 30+ RTKC has been established across the world. They can provide lab-based testing services but real-world personal exposure assessment remains out of reach due to the need for very accurate micro balance. In this presentation we show how a set of new tools and methods enable accurate gravimetric based PM2.5 exposure measurement with the semi-micro balances that are already available in every Regional Stove Testing Center.

The proposed method combines traditional integrated gravimetric measurements across several households (to measure the mean exposure of a group) with real time sensor-based measurements of IR/UV reflectance and pressure drop directly across the filter (to measure the inter and intra household variability).

In addition to leveraging existing equipment available in country and reducing the number of filters needed, this new method does not require filter change in the field which is often a source of contamination and require lengthy training of enumerators.

Learning objectives:

- Source of uncertainties in gravimetric measurement
 - We analyze the different sources of error in gravimetric measurement and compare them to the new proposed method.
 - Relationship between filter mass loading, IR/UV reflectance and pressure drop
 - We show that real time mass loading on a filter can be estimated quite accurately by measuring the change in reflectance at different wavelength and the change in pressure drop across the filter.
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Dave Lello

Ekasi Energy

Title: Distributed Pellet Fuel Manufacture from Alien Trees

Abstract: The majority of Africa is still dependent on biomass derived fuels for cooking. Pellets have been tested and proved to be an effective fuel for gasifier stoves and could be a gamechanger to charcoal challenges if they can be made widely available at an affordable price.

Despite dramatic worldwide pellet production growth over the last 15 years, Africa is has no significant pellet capacity in any country, except Ghana. One of the major reasons is infra-structure in the form of logistics and grid infra-structure.

In rural Africa, the cost benefits of large centralised pellets plants are outweighed by the cost of getting raw material to the plant and distributing it to users again.

A small containerised turnkey pellet plant can be deployed and moved to wherever waste biomass resource is available. This assists with factors like seasonality and smaller pockets of resource.

We have piloted such a plant in South Africa, using material from the clearing of AIPs (Alien Invasive Plants) in water sensitive areas, where the aliens are threatening water supply and biodiversity.

We will share our experiences on making pellets in a containerised plant from different biomass sources and the applicability in the rest of Africa.

Learning objectives: Great stove technologies have developed over the last 20 years and higher efficiency rates have dropped per capita fuel use. Once these gains have been realised, how do we improve resource use further.

Not enough focus has been given to the local supply chains for cooking fuel. These supply chains turn various raw products in to usable fuel.

Daily precious forest is being destroyed, but at the same time many other available raw materials are being discarded or burned.

This session will focus on fuel production strategies for Africa.

- What fuels can be classified as sustainable and green?
- What is the affordability of such fuel?
- What economic activity / wealth creation does it offer?

Elliott Levine

Energy and Environmental Strategies

Title: The Alliance for Green Heat--Comparison of Cookstoves and Woodstove technologies.

Abstract: About 10% of all homes In the United States are heated fully or partially with wood or pellets. Despite these woodstoves being common throughout the northern US, Canada and Europe no one has yet developed a solution to prevent them from emitting excessive smoke in the hands of operators. Further, the technology boom of the past few decades has largely missed the wood stove industry, yet innovation still holds great promise.

The Alliance for Green Heat recently concluded a Woodstove Design Challenge to demonstrate that (1) improved designs including sensors and computer controls can make wood stoves cleaner and more efficient, and that (2) the integration of thermal electric generators producing heat from the burning wood could be utilized - in this case by the partial charging of a Tesla vehicle.

This design challenge culminated in a competition where the woodstoves were judged by their emission reductions, their electrical wattage production and other factors using protocols that were developed for this purpose.

The event was held over 5 days on the Washington, DC Mall.

This presentation will describe the event structure, The technologies introduced, similarities and differences between cookstoves and wood heating stoves and a description of the participating stoves.

Note: The Aprovecho stove was one of the participants and will be described in a talk following this presentation.

Learning objectives:

- Comparison of woodstove and cookstove technologies
- Description of the recently concluded Alliance for Green Heat Design Expo hosted on the DC Mall.

Nordica MacCarty

Oregon State University

Title: A modular system of wireless sensors for integrated assessment of cookstove usage, stacking, fuel consumption, air quality, and personal exposure

Abstract: A variety of measurements are needed to fully report the impact of a clean fuel or cookstove program, and each require measurements of different parameters from sensors or

field tests, making data acquisition and analysis cumbersome and costly. To address this need, a team of researchers at CSC and OSU have developed an integrated modular system of affordable sensors that can comprehensively monitor even the most complex cooking system where stacking of multiple stoves and fuels type are present. With this system, up to 20 sensors can be deployed simultaneously in a household, and data are downloaded into a single file with a common time series. Available sensors currently include 1) infrared stove usage monitors (EXACT), 2) small particulate matter sensors (HAPEx) that can be worn for personal exposure assessment or placed anywhere for air quality assessment, and 3) a novel fuel consumption sensor (FUEL) that monitors the fuel consumption by logging the weight of fuel supply, providing data over a longer time period with finer granularity than the KPT. The system and various sensors have been used and validated in 14 countries by 12 partner organizations with excellent performance to date.

Learning objectives:

A novel method to assess household fuel consumption:

- The audience will learn about the sensor-based method developed by CSC and OSU to monitor fuel consumption in real time.
- Integrating stove usage, fuel consumption and exposure measurement to get insights into complex cooking system:
- The audience will how data from different sensor types can be combined to get information that would not be available from each sensor separately.

Omar Masera
UNAM

Title: Health, Energy and Greenhouse Gas Emissions Implications of Fuel-Device Stacking

Abstract: I will talk about the importance of understanding the rationale and implications of stacking between traditional and clean stoves. In particular, I will show results from an ongoing project in Mexico where we are exploring the implications of different types of stacking patterns on health, climate, and energy use.

Learning objectives:

- Understanding actual cooking energy systems
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Molly Mazzucco

Burn Design Lab

Title: Walk Away Testing

Abstract: Traditional testing methodologies fail to provide a means of quantifying the cookstove's impact on usability, for an example; an extended period of time which the user can walk away from the stove and come back to a profitable fire. This is a feature prioritized by the consumer that has not reached the market. A test protocol, "The Walk Away Test" aims to quantify the period of time which the user can walk away from the stove, as well as what can have an impact on the length of time which a person could walk away.

Learning objectives:

- To understand "The Walk Away Test" procedure.
- To understand the data collected.
- To understand what future testing looks like.

Paul Means

Burn Design Lab

Title: Shea Roasting: A Tough Nut to Crack

Abstract: Burn Design Lab and Burro have been collaborating to develop an improved shea nut roaster. Ghana is a major producer of shea butter, which is a key ingredient in many cosmetic applications, including soaps and creams, and is also used for cooking and local consumption in Ghana. Shea kernels are roasted throughout northern Ghana by women using open fires and large drums. Burro and BDL have made significant improvements in the design of an improved roasting device. The presentation will provide details of the development process including the concept selection and the laboratory-based prototype development of an improved combustion chamber / rotating drum concept. Progress made through January 2019 will be shared.

Learning objectives:

- To understand current roasting methods and their deficiencies.
- To understand BDL and Burro's approach to prioritizing design features and prototyping.
- To understand the development process associated with a new combustion chamber and roaster design.

John Mitchell

USEPA

Title: The Contribution of Household Energy Emissions to Ambient Air Pollution

Abstract: This presentation will focus on the impact of household energy emissions beyond the household/immediate community, that is, the contribution of household energy emissions to regional ambient air pollution. Recent studies from China and India indicate that between 10 and 40% of regional ambient air pollution comes from household energy (cooking, heating, and lighting) sources, depending on the season. It is estimated that approximately 25% of the estimated four million premature deaths from household energy emissions are from the household energy contribution to ambient air pollution.

Learning objectives:

- To learn about the latest studies showing the significant contribution of household energy emissions to regional ambient air pollution.
- To understand that policy makers will not achieve their ambient air quality objectives without addressing household energy emissions as part of their air quality management planning and reduction initiatives.

John Mitchell

USEPA

Title: Utilizing Implementation Science to Evaluate Household Energy Programs

Abstract: The US National Institutes of Health (NIH), in partnership with USAID, the CDC, the EPA and the Global Alliance for Clean Cookstoves (GACC), launched a Clean Cooking Implementation Science Network (ISN) to advance the science of uptake and scale-up of clean cooking technology in the developing world. Hosted by the Center for Global Health Studies (CGHS) at Fogarty, and supported by the NIH Common Fund, the Network aims to advance collaborative efforts and understanding among researchers and implementers to accelerate successful adoption and use of clean cooking technologies with an eye to scaling up appropriate use. For more information on the Clean Cooking ISN, see <https://www.fic.nih.gov/About/Staff/Policy-Planning-Evaluation/Pages/clean-cooking-implementation-science-network.aspx>

This talk will introduce Clean Cooking ISN and their recent activities supporting the development of 11 case studies of large-scale clean fuel programs in regions across Africa, Latin America and Asia. They were published in Scaling up Clean Fuel Cooking Programs, an open access special issue of Energy for Sustainable Development (October 2018).

Learning objectives:

- To introduce ETHOS to the Clean Cooking Implementation Science Network;
- To briefly review the 11 case studies of large-scale clean fuel programs; and
- To present the Clean Cooking ISN's next initiatives.

Mohammad Pakravan
Oregon State University

Title: Integration of user behavior into cookstove design through utility functions and the Theory of Planned Behavior

Abstract: Adoption of clean cookstoves plays a critical role in the successful design and implementation of clean cookstove projects. The decision process for cookstove adoption involves users' attitudes toward the technology, social norms, and perceived behavioral control. Therefore, a mixed method approach is needed that systematically integrates households' decision-making behavior based on personal attributes with conventional design criterion. This study develops a decision-based design framework based on the Theory of Planned Behavior. Using data collected in a rural community in Northern Uganda, utility functions for three different cooking devices in households are estimated with a framework developed to incorporate demographic, behavioral, and technological attributes. Results indicate that including TPB attributes in the decision-based design process improves prediction of consumers' choices based on their beliefs.

Learning objectives:

- Learning about application of agent based modeling in adoption studies.
- Learning about behavior based attributes that shape households' decision whether to adopt a clean cookstove or not.
- Introducing a new methodology to evaluate clean cookstove design and implementation strategies.

Erin Peiffer
Oregon State University

Title: Improved Technologies for Processing Handcrafted Shea Butter in Northern Ghana: Research, Design, and Repercussions

Abstract: The shea tree provides a primary source of income throughout the Shea Belt that runs across West Africa's savanna lands, from Senegal all the way to Sudan. Through extensive processing, the shea nut from these trees can be turned into handcrafted shea butter which can then be used locally or exported to the global market. The roasting of shea nuts is a crucial step of the process, although an unpleasant one by traditional means, requiring mass amounts

of fuel and intense manual labor, while exposing the women roasters to smoke and heat. To address these issues, Burro, a Ghana-based company, is developing a commercially-viable, improved shea nut roaster with support from a USAID grant won in partnership with Burn Design Lab. This talk details the process followed in designing an improved roaster for women in northern Ghana with a focus on end user feedback. Special attention is given to the sometimes-unexpected consequences of improved technology in the hand crafted shea butter industry.

Learning objectives: I'm hoping that attendees will learn more about the whole shea butter industry and come to understand the role technology has had in shaping the process today. I also would like attendees to reflect on the impact that technology can have, both good and bad, when implemented in a foreign cultural setting. Both of these will be framed around the design of an improved shea nut roaster.

Neeraja Penumetcha and Katie Gross
Clean Cooking Alliance/Independent

Title: Clean Cooking Standards Implementation Workshops

Abstract: WHO, EPA and the Clean Cooking Alliance are organizing a series of regional workshops to inform key stakeholders (from Ministries of Energy, Environment, Health, and Standards, testing centers, manufacturers, and others) about standards for testing clean cookstoves and clean cooking solutions. The goal of the workshops is to encourage the development of national standards and testing mechanisms. The first in the series, held last month in Nepal, gathered over 70 stakeholders from 9 countries towards this purpose.

David Pfotenhauer
University of Colorado Boulder

Title: Updated emission factors from diffuse combustion sources in sub-Saharan Africa and their effect on regional emission estimates

Abstract: Diffuse emission sources outside of kitchen areas are poorly understood and measurements of their emission factors (EFs) are sparse for regions of sub-Saharan Africa. Thirty-six in-field emission measurements were taken in northern Ghana from combustion sources common to rural regions worldwide. Sources sampled included commercial cooking, trash burning, kerosene lanterns, and diesel generators. EFs were calculated for carbon monoxide (CO), carbon dioxide (CO₂), as well as carbonaceous particulate matter, specifically elemental carbon (EC) and organic carbon (OC). Elevated EC and OC emissions were measured from kerosene lighting events (EF_{EC} = 27.8 g/kg-fuel SD = 28.7, EF_{OC} = 10.4 g/kg-fuel SD =

11.3). OC emissions from trash burning events were also large and highly variable (EFOC = 43.3g/kg-fuel SD = 37.1). Combining our results with other recent in-field emission factors for rural Ghana, we explored updated emissions estimates for Ghana using a region specific emissions inventory. Large differences are calculated for all updated source emissions, showing a 97.3% increase in OC and 79% decrease in EC compared to prior estimates for Ghana's emissions. Differences for carbon monoxide were small when averaged across all updated source types (1.3%), though the household wood use and trash burning categories individually show large differences.

Learning objectives: The research described in the above abstract highlights other potential sources of personal exposure in rural areas of Sub-Saharan Africa. Residential cooking activity continues to present a serious problem in regards to health related effects from exposure to combustion by-products, but other sources of particulate matter and hazardous pollutants should be investigated to better understand the broad picture of daily personal exposure in rural regions of the developing world.

My topic will explore non-residential pollution sources that we identified in the rural northern region of Ghana. Attendees will learn about 1) Sources of ambient pollution outside of residential settings in northern Ghana and 2) how their emission factors (gram of polluting species per kilogram of fuel burned) compare to cooking events and other well studied combustion events.

Ricardo Piedrahita

Berkeley Air Monitoring Group

Title: Bluetooth Beacon proximity sensing for personal exposure monitoring and behavior assessment in household air pollution studies

Abstract: Measurement of personal air pollution exposure is often an expensive and logistically challenging endeavor for research studies. Advancements in Bluetooth Beacon technology have allowed the development of location tracking systems that may be used in various household energy applications, including time spent in different cooking areas, exposure level in different cooking areas and away from home, and indirect modeling of personal exposure. In this presentation, we will discuss the system components, and possible use cases. Various works have shown that objective location monitoring can provide a reasonable means to estimate personal exposures when combined with area pollutant measures, as well as provide insight in to the contributions of exposures to different microenvironments. The sensor-based measures also do not rely on participant recall, which is generally not a precise nor accurate means of estimating location. Finally, Bluetooth signals provide highly detailed data on indoor location (not possible with GPS), which can be very important for applications such as in household energy contexts where exposures vary dramatically between and even within rooms.

Learning objectives: We will discuss the inner workings of the Beacon proximity monitoring system, and go through the benefits and drawbacks of the technology and its applications. Beacon technology is being used in the Household Air Pollution Intervention Network (HAPIN) trial, which is assessing the health impacts of LPG interventions in India, Guatemala, Peru, and Rwanda, for modeling personal exposure from indirect area measurements. Another previous study in Ghana focused on exposures as a function of Beacon-derived distances to various cookstove types, and exposure at home vs. away from home. We will provide instruction on both of these analysis approaches, and suggest potential applications for future projects.

Tara Ramanathan
Nexleaf Analytics

Title: Reevaluating Clean Cooking: An evaluation process that has yielded long-term sustained adoption*

Abstract: We will present Nexleaf's latest stove evaluation process which has helped us and our partner in India identify a stove that women love and has led to 90% sustained adoption over the past 2 years. We will walk everyone through the 3 step process we went through to achieve this result, so others can replicate in their own programs. Following lab testing and extensive field evaluation, we identified key steps to take to evaluate clean cooking solutions that helped us iterate on our programs and ensure households receive solutions they love to use.

After discussing our methodology, we will share real sensor data from our study and showcase results from our data-driven report "Beyond Monitoring and Evaluation" and highlight the ways stakeholders can learn from this process.

Learning objectives: Attendees will learn the following: 1) how to systematize their evaluations of clean cooking solutions when working to select which option their end users will love the most; 2) the importance of slowly rolling out clean cooking solutions while evaluating them instead of starting at large-scale.

We are presenting this topic because without sustained adoption, we won't see air quality improvements.

**Presented in plenary only*

Vi Rapp

Lawrence Berkeley

Title: Laboratory commissioning, testing, and measurement validation training in Uganda

Abstract: To elevate experimental research capabilities and promote robust data collection in cookstove research and testing centers around the world, Berkeley Lab offered a 1-week training course at CREEC in Kampala, Uganda. The training course provided further details on topics covered in LBNL's free training video series for building, calibrating, and validating a cookstove testing facility and reviewed testing procedures published in the ISO/TC 285 Harmonized Laboratory Testing standard. During this presentation, an overview of the training program will be discussed. Specifically, the presentation will cover how we prepared for the training program, how we evaluated the staff's ability to accurately and reliably collect and analyze cookstove performance data, the onsite training materials provided, metrics used of measuring success of the training, how we addressed specific needs of the staff, and lessons learned.

Learning objectives: By attending this session, participants will learn:

- How we prepared for, organized, and evaluated the success of the training program
- Topics we covered during the 1-week course
- What worked well and what fell apart (i.e. lessons learned)

Madeleine Rossanese

Berkeley Air Monitoring Group

Title: Thermocouple Placement and Temperature Traces in Stove-Use Monitoring

Abstract: Berkeley Air Monitoring Group has collected usage data for traditional open fires using stove use monitors as part of numerous field studies. This stove-use monitoring occurs through the use of both iButton temperature sensors and thermocouple loggers to determine the number and duration of cooking events on household stoves. Through our process of collection and analysis of traditional stove use in rural Kenya, we noticed disparate characteristics in the thermocouple traces. This talk presents the results of an analysis on temperature traces in four different placements on open fires in four different homes, each completing the same cooking event with thorough field worker observations, to show how thermocouple probe placement and ash interference may affect stove usage results.

(Madeleine Rossanese, Kirstie Jagoe, Ricardo Piedrahita (BAMG))

Learning objectives: This small sub-study will include the different placements of the thermocouples and the patterns observed in the resulting temperature traces, to help inform placement decisions and monitoring techniques in future studies.

Ricardo Romero-Perezgrovas
Sustainable Harvest International

Title: Culinary traditions and long-term adoption of improved stove models

Abstract: Considering local cooking and culinary traditions in the design of improved stoves is one of the most important steps. Nonetheless, designers, extension agencies and in general the improved stoves community have tended to overlook this and give more importance to the “engineering” part of the design more than the final users' needs. We will show how three different models of locally improved stoves have been adopted in the long-term due to their low emissions and lower wood consumption, and demonstrate how these models are adapted to three different culinary traditions with different staple foods and needs. The examples come from the Cocolé province in Panama, where rice is the staple food and kitchens are outside the houses; from the Comayagua department in Honduras, where tortillas and beans are the staple, and kitchens are inside the main living facilities; and finally from Corozal and Orange Walk departments in Belize, where a combination of rice, beans and tortillas make up the staple diet, and kitchens are in a separate, closed space from the main living facilities.

Learning objectives:

- The importance of considering culinary traditions in the design of improved stoves
- Successful examples of long-term adoption of locally developed improved stoves

Victor Ruiz
National Autonomous University of Mexico (UNAM)

Title: Health implications of chimney-stoves in Mexico and Central America

Abstract: Plancha-type stoves have been widely disseminated in Mexico and Central America, but the contribution of fugitive emissions from these stoves to indoor air concentrations has been poorly quantified. In this study, fugitive emissions were measured for four plancha-type cookstoves most disseminated in Mexico (Patsari, ONIL, Ecostufa, and Mera-Mera). In controlled testing, fugitive emissions from plancha-type chimney stoves ($n = 15$ for each stove) were on average $5 \pm 3\%$ for PM_{2.5} and $1 \pm 1\%$ for CO, much lower than defaults in WHO Guidelines ($25 \pm 10\%$). Using a Monte Carlo single zone model with locally measured parameters, average kitchen concentrations resulting from fugitive emissions were $15 \pm 9 \mu\text{g}/\text{m}^3$ for PM_{2.5} and $0.06 \pm 0.04 \text{ mg}/\text{m}^3$ for CO. On the basis of these models, plancha-type stoves meet benchmarks for WHO Air Quality Guidelines (AQG) Interim Target I for PM_{2.5} and the 24 h AQG for CO, respectively, with on average 97% of homes meeting the guideline for

PM2.5. Similarly, all four plancha-type stoves were ISO IWA Tier 4 for indoor emissions of CO and Tier 3 for indoor emissions of PM2.5.

Learning objectives: Objectives

- Measurements show that fugitive emissions from well- functioning chimney stoves are a smaller fraction of total emissions than estimated for the WHO defaults of fraction of emissions entering the kitchen
- Plancha-type chimney stoves vent on average $95 \pm 3\%$ and $99 \pm 1\%$ of total PM2.5 and CO emissions out of the kitchen, respectively.

This topic shows the real development of an improved cookstoves use in Mexico and Central America and the health implications. These kind of devices could be a good option for people that don't have access to other kinds of fuels.

Montserrat Serrano

Universidad Nacional Autonoma de Mexico

Title: A geospatial web-based tool to evaluate woodfuel environmental impacts

Abstract The share that traditional woodfuel demand has on deforestation or forest degradation is tough to quantify because both processes are driven by many causes simultaneously. Evidence from the past decades indicates that woodfuel demand alone rarely drives deforestation, although it may serve a facilitating role in conjunction with other processes. For example, agricultural expansion is often the root cause of deforestation, while woodfuel demand does, in some circumstances, contribute to forest degradation. To produce realistic estimates of woodfuel-driven degradation within landscapes also experiencing deforestation, can be quite complex from an analytical perspective. Some corners should not be cut, and many project developers or practitioners often rely on third party consultancies to produce the needed information and usable results. In trying to jump the gap between needed results and spatial analysis skills to produce them, we developed MoFuSS (Modeling Fuelwood Savings Scenarios), a dynamic model that simulates the spatiotemporal effect of woodfuel harvesting on aboveground biomass, which also accounts for land use changes driven by other causes (e.g. land cleared for farming). We will show usage examples of MoFuSS over selected case studies in Honduras, Haiti, and India, including an ongoing validation effort using field data and satellite imagery in Mexico.

Learning objectives:

- Environmental impact assessments of traditional woodfuel harvesting and use can now be conducted by non-specialized personnel, avoiding costly and timely consultancies by third party agencies.

- We coded a free online tool to help project developers and practitioners to develop their own estimates of environmental impacts of fuelwood extraction and charcoal production under traditional or low-tech patterns.

Dean Still

Aprovecho

Title: Comparing Combustion Techniques in Heating and Cooking Stoves

Abstract: The Green Heat Alliance competition on The Mall in Washington, DC was a great opportunity to observe clean burning biomass heating stoves and to reflect on differences between clean burning cook stoves and heating stoves. Cook stoves usually burn sticks of wood, but heating stoves often burn split logs. Using long sticks doesn't allow for a closed door so the amount of primary air is much higher in cook stoves. Limiting the primary air, hotter temperatures and longer residence times were evident in modern heating stoves. Cook stoves seem to be more dependent on turbulence/mixing to achieve lowered emissions with "too much" primary air and lower temperatures.

Learning objectives:

- Differences in clean combustion techniques
- Combining techniques

Ryan Thompson

Mountain Air Engineering

Title: biogas

Abstract: household biogas system description. biogas stove emissions. climate impact. system performance. benefits. limitations. biogas monitoring instruments. biogas jokes.

Learning objectives: I am presenting this topic to share information about biogas. Attendees will learn how biogas will solve their problems.

Marco Tulio Maldonado

Hands for Peacemaking Foundation

Title: History of the production of the Aler stoves in Guatemala

Abstract: This talk will cover why Hands for Peacemaking Foundation decided to install wood saving stoves in the remote area of Barillas, Huehuetenango, Guatemala, in Central America.

It will also cover the type of stoves used to satisfy the needs for stoves in the area and its challenges. Because of the challenges we decided to build our own stoves.

Hands for Peacemaking has built stoves for 13 years. I will share what we have learned from our own production, challenges and long-term goals and dreams.

I will also cover the partnership with Burn Design Lab

Last, I will talk about the challenges with our government and the lack of interest to implement sustainable stove programs to make a difference in the lives of the Guatemalans.

Learning objectives:

- When identified a need make plans to satisfy it.
- Keep the satisfaction of the needs with a follow up plan and a continued quality control program.
- A dream without a plan is just a wish.
- Partnership helps to lower the weight of a dream.

Devin Udesen

University of Washington

Title: Using over-fire air-injection as a means to control emissions behavior in a side-feed wood-burning cookstove

Abstract: Poor field-performance and poor user-adoption of natural-draft side-feed wood-burning cookstoves are two of the key challenges preventing the successful transition to clean-cooking technology of millions of households around the globe who are reliant on wood as a household-fuel. We present an overview of the role of over-fire air-injection in reducing emissions of natural-draft side-feed wood-burning cookstoves, including topics such as the relationship between fan-performance, jet-characteristics, and emissions behavior.

Learning objectives:

- Fan performance curves; the relationship between pressure and flow.

- System impedance and how to optimize for optimum jet-velocities, flow-rates, and pressure-drop.
- Impact of over-fire air-injection on CO and PM emissions behavior throughout a wide-range of operating characteristics.

Jennifer Ventrella
Oregon State University

Title: Design and field testing of an integrated sensor system to measure cookstove fuel consumption and usage

Abstract: To help meet the needs for accurate and long-term measurement of fuel consumption and adoption of a variety of cookstoves and fuels, researchers at OSU have designed the Fuel, Usage and Emissions Logger (FUEL) to quantify program impacts in terms of time, fuel, and carbon/health emissions. Manufactured by partners Waltech Systems and Climate Solutions Consulting, FUEL is an autonomous, low power sensor platform that logs the weight of fuel supply in a household and pairs integrated measurements with cookstove temperature as a proxy for usage. The feasibility of the FUEL system was evaluated using ethnographic methods in Guatemala, Honduras, and Uganda. Results indicated that many users viewed storing fuel in the elevated holder as a benefit, and that in a study of 70 sensors, FUEL was used correctly on 85% of monitoring days with minimal user training. Preliminary calculations based on fuel consumption suggest that stove stacking households using an improved and traditional stove will produce up to 58% more carbon emissions compared to households of the same size who use only an improved stove. This study demonstrates the FUEL system's ability to provide long-term, quantitative data on cookstove adoption, fuel consumption, and emissions.

Learning objectives:

- Reports preliminary results on fuel consumption, usability, firepower, and global warming commitment for traditional and improved stove designs in Apac, Uganda
- Describes the methods for using an ethnographically-informed design process to develop and test products that integrate user context

Danny Wilson
Geocene Inc.

Title: How to Monitor Thousands of Cookstoves: Geocene's SUMS Platform for HAPIN

Abstract: Stove Use Monitoring Systems (SUMS) are used to track adoption of cookstoves. The Household Air Pollution Intervention Network (HAPIN) is running a randomized control trial in

thousands of households in Guatemala, India, Peru, and Rwanda. This trial seeks to "assess the impact of a liquefied petroleum gas (LPG) cooking stove and fuel intervention on health." Stove use is a critical link between exposure to household air pollution and health effects. In order to ensure use of the LPG intervention and discontinuation of the traditional stove - and thus hopefully maximize exposure reductions - HAPIN has employed over three thousand SUMS.

Geocene supplied these SUMS and the software to collect and analyze cookstove adoption data, with an explicit goal of providing near real-time feedback on stove use patterns. In this talk, we will discuss the challenges and best practices we established to manufacture, deliver, deploy, collect, and analyze data from thousands of SUMS and hundreds of millions of data points across multiple continents and contexts. We will discuss the entire SUMS process: from manufacturing, to development of the mobile application, algorithm refinement, and the collaborative and iterative design of an administrative dashboard.

Learning objectives: Attendees of this talk will learn how to:

- Scale a sensor hardware manufacturing operation
- Manage the deployment of large fleets of sensors
- Present massive quantities of sensor data for administrative review