PARTNERSHIP FOR CLEAN INDOOR AIR

Impacts of Household Fuel Consumption for Biomass Stove Programs in India, Nepal and Peru

Webinar: August 11, 2011

Michael Johnson, Berkeley Air Monitoring Group

Speakers

- Brenda Doroski, U.S. Environmental Protection Agency
- Michael Johnson, Berkeley Air Monitoring Group

Purpose of Webinar

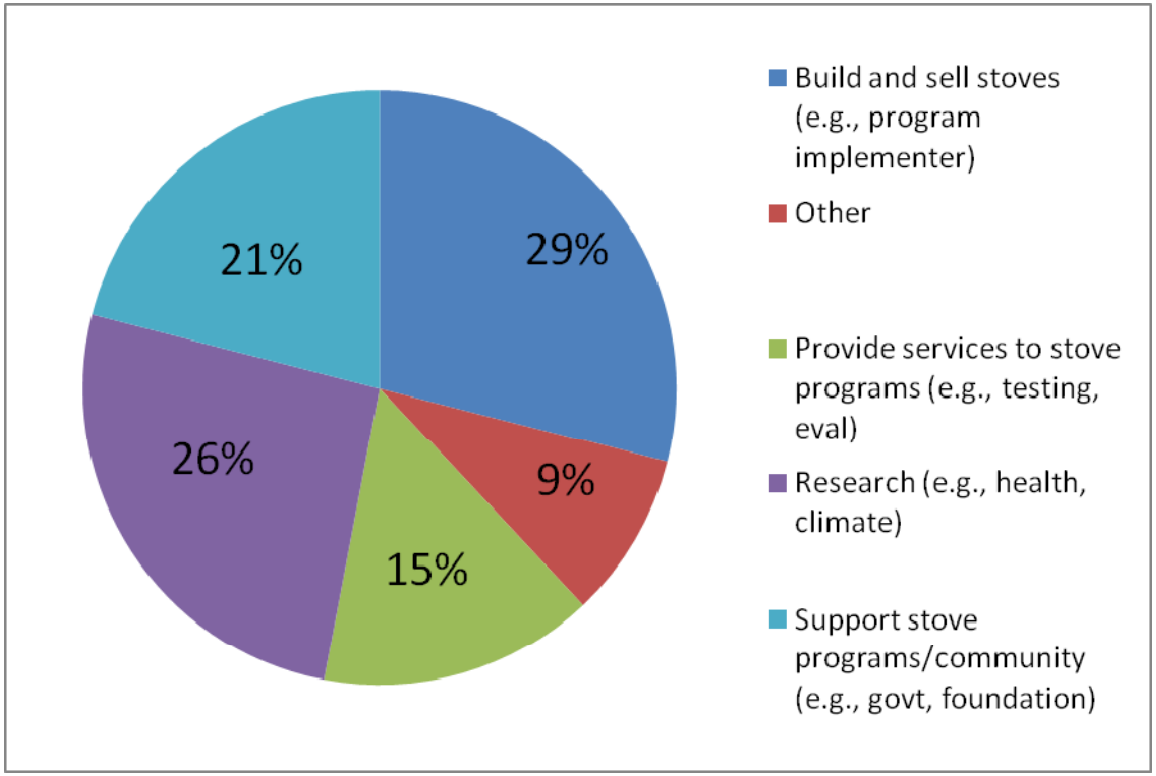
1. Share the methods used and results of the EPA-funded KPT training and technical assistance program supporting Partner organizations in India, Nepal and Peru.
2. Equip Partners with insights on the value of field testing to assess fuel consumption and potential fuel savings and how to apply these insights to their own program.
3. Discuss recommendations for increasing field assessments to better characterize 'real-world' stove performance across a range of technologies and fuels.
4. Motivate Partners to increase their stove testing capacity and to report testing results.

Agenda

- Audience Snapshot
- Project Introduction/Overview
- Kitchen Performance Test (KPT) Basics
- Training and Field Program Overview
  - Results and Impact
  - Using KPT Results
  - Important Project Takeaways
- Key Findings & Recommendations
- Questions & Answers
- Next Steps

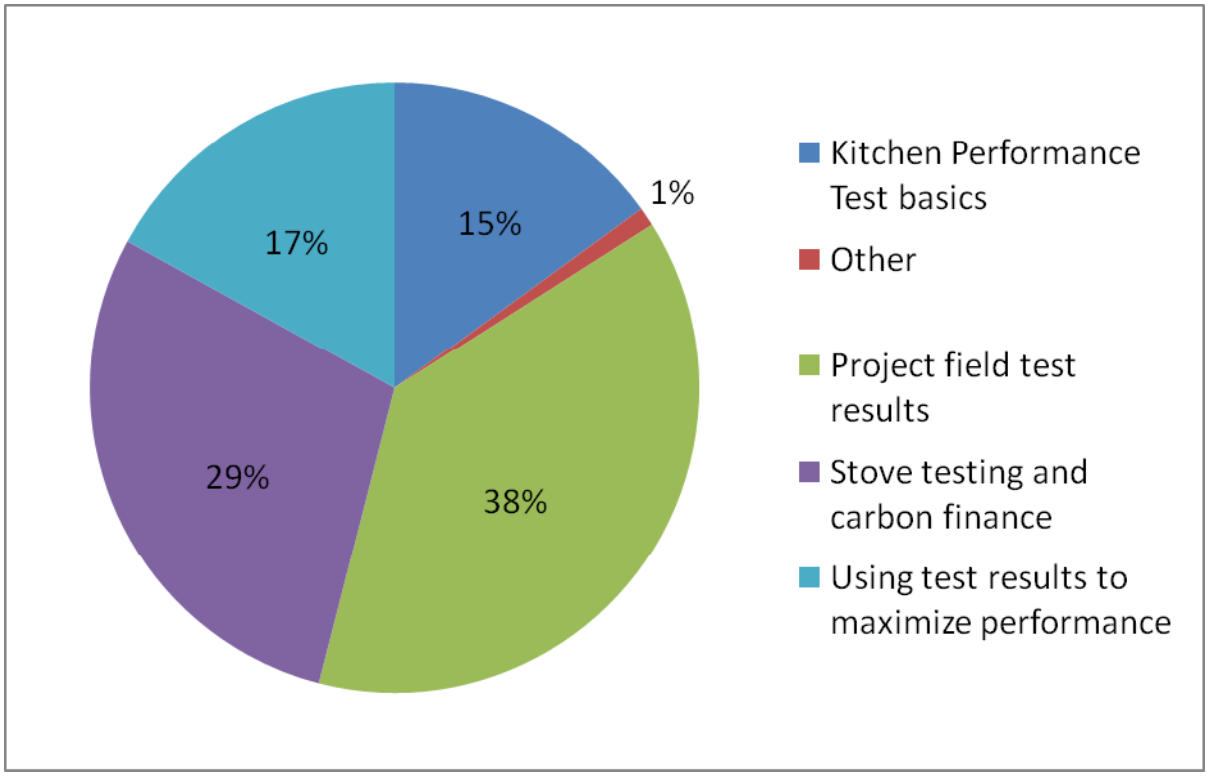
Audience Snapshot

Which best describes your organization ?



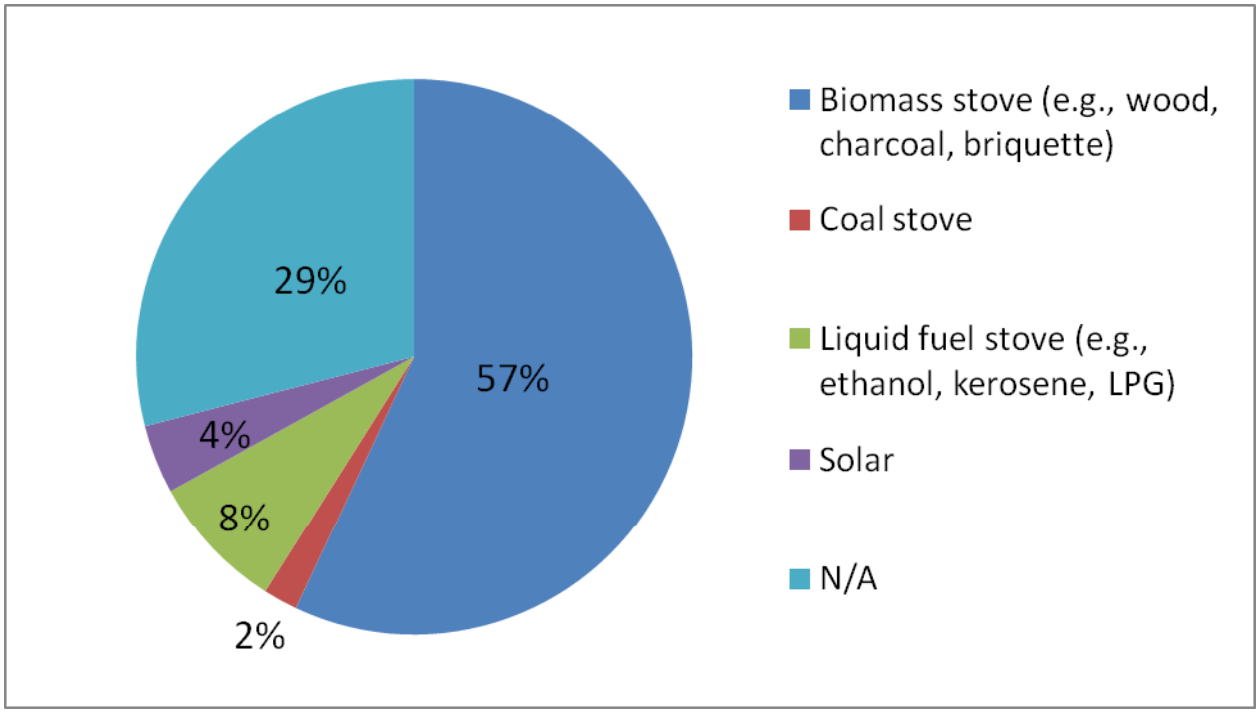
Audience Snapshot

What are you most interested in hearing about during this webinar?



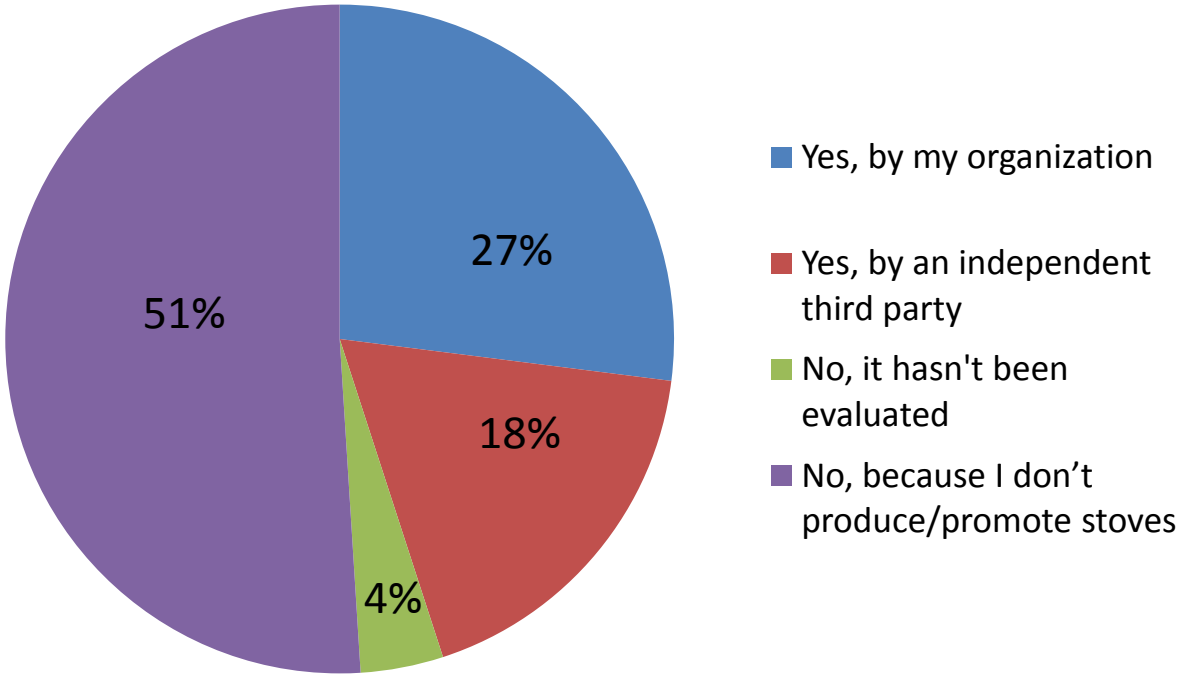
Audience Snapshot

If your organization promotes stoves, indicate which type of stove/fuel you promote.



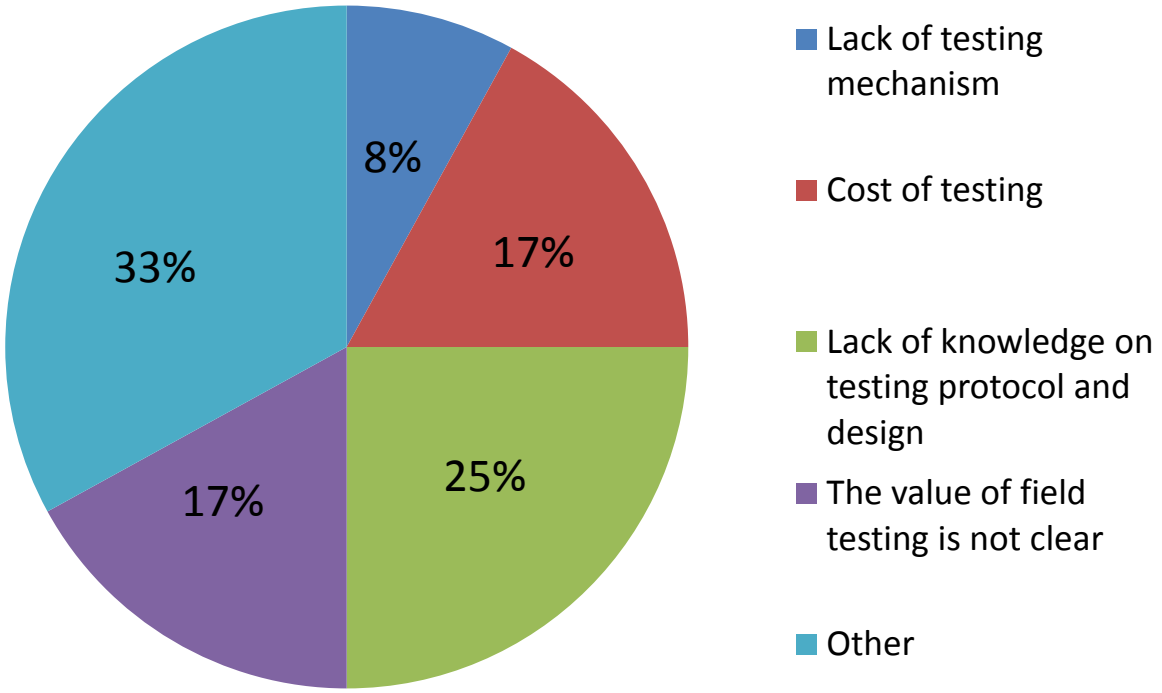
Polling Question

Has the performance of your stove(s) been evaluated?



Polling Question

If you produce/promote a stove **and** have **not** tested it, what is the main obstacle preventing you from evaluating the performance of your stove?



Questions to Consider

- How satisfied are you with your organization's ability to field-test the performance of the stoves that you promote?
- What type of information and feedback would you like to get from end-users and about stove performance in homes?
- How can you use stove testing results to improve both stove performance and program implementation?

PCIA Field Testing Goals

- Help build capacity at Partner organization for conducting KPTs.
- Increase global knowledge of fuel-consumption and savings estimates.
- Continue refining and improving in-field study practices for stove evaluation.

Project Introduction/Overview

- Purpose: Increase Partner capacity for stove performance testing and quantify fuel savings
- Funding provided by USEPA
- Project Partners
  - Nepal: ESAP/AEPC and CRT/N
  - India: First Energy
  - Peru: SENCICO and GIZ-EnDev

Household Energy and Health
Stove Performance Testing Protocols

Where does the KPT fit into the testing spectrum?

- Water Boiling Test:

  Tests stove performance to boil and simmer water. Tool for evaluating stove design as well as comparing different stoves using a common protocol.

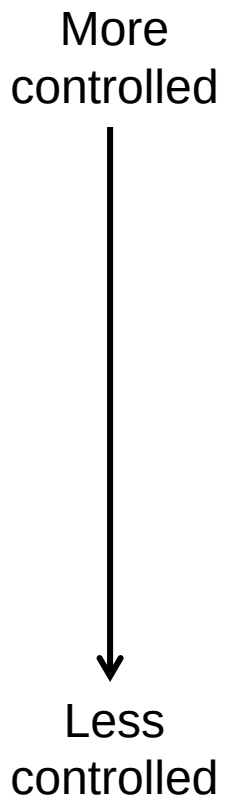
- Controlled Cooking Test:

  Tests stove performance preparing common foods cooked by local people in a controlled setting. Designed to assess the performance of the improved stove relative to what it is primarily meant to replace.

- **Kitchen Performance Test:**

  Tests stove performance in real-world settings. Directly measures daily household fuel consumption.

Protocols online at http://www.pciaonline.org/testing

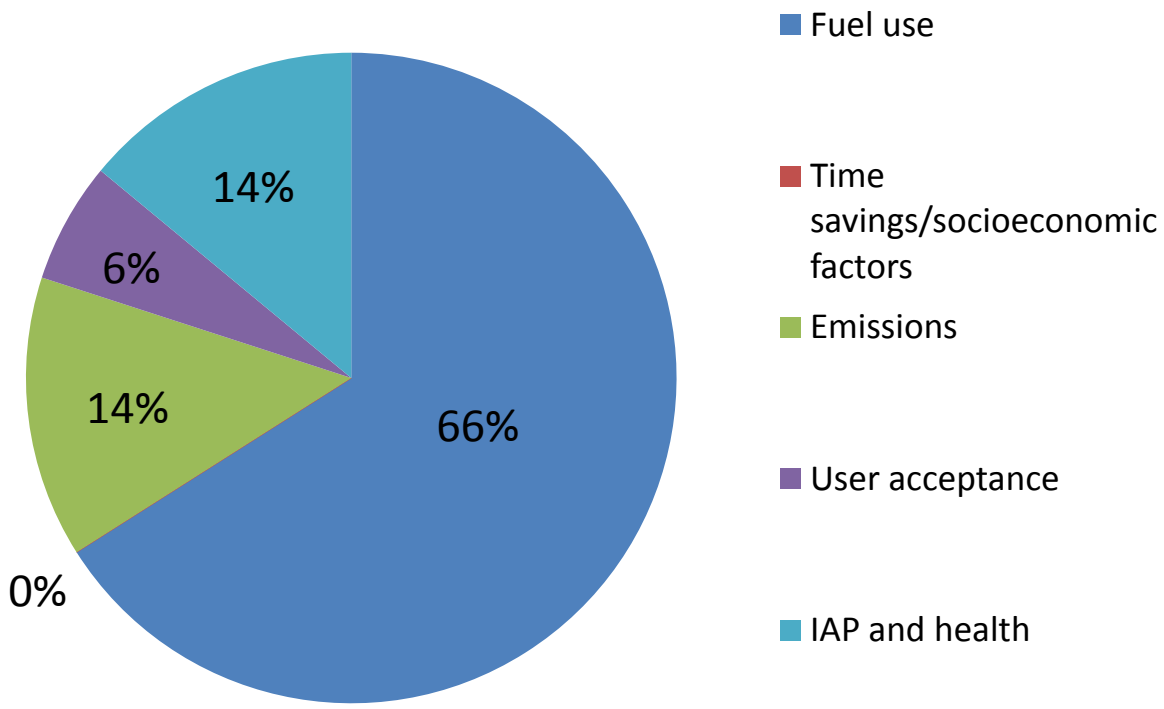


Kitchen Performance Test Basics

1. Measure fuel consumption in homes during normal daily stove use.
2. The two main goals of the KPT are:
    a. to evaluate the impact of improved stoves on fuel consumption in the kitchens of real households.
    b. to assess qualitative aspects of stove performance and usage through household surveys.
3. Output metrics
    a. Fuel consumption (e.g. kg/person/day).
    b. Qualitative information on stove and fuel usage.
4. Provides estimate of real household fuel consumption.
5. Often used as a program-level impact evaluation.

Polling Question

If you have conducted testing, what is the primary performance indicator you have evaluated?



Training and Field Program Overview

- Week-long technical KPT training workshop in Partner country.
  - Covered topics on study design, KPT protocols, equipment calibration, data analysis, and reporting.
  - Field visit to practice protocols.
- Field study followed the training workshop.
  1. 4 days of visits per home (3 days of data).
  2. Define fuel inventory areas.
  3. Weigh each fuel-type: unused stock and additions for next day.
  4. Take moisture content readings of wood.
  5. Brief questionnaire on stove use, fuel types and people present for meals.

Nepal Study

- Cross-sectional study in rural village outside Dhulikhel.
- Improved biomass chimney stoves are built in-place, constructed of mud bricks, clay and rice husks, and reinforced with iron support rods. One-pot and two-pot versions.

Traditional chulha

Improved biomass stove

India Study

- Cross-sectional study in peri-urban Kolhapur, Maharashtra.
- The Oorja stove is a mass-manufactured, portable, forced-air gasifier stove, optimized to use pellets made from compressed sugar cane residues.

Traditional chulha

Oorja

pellets

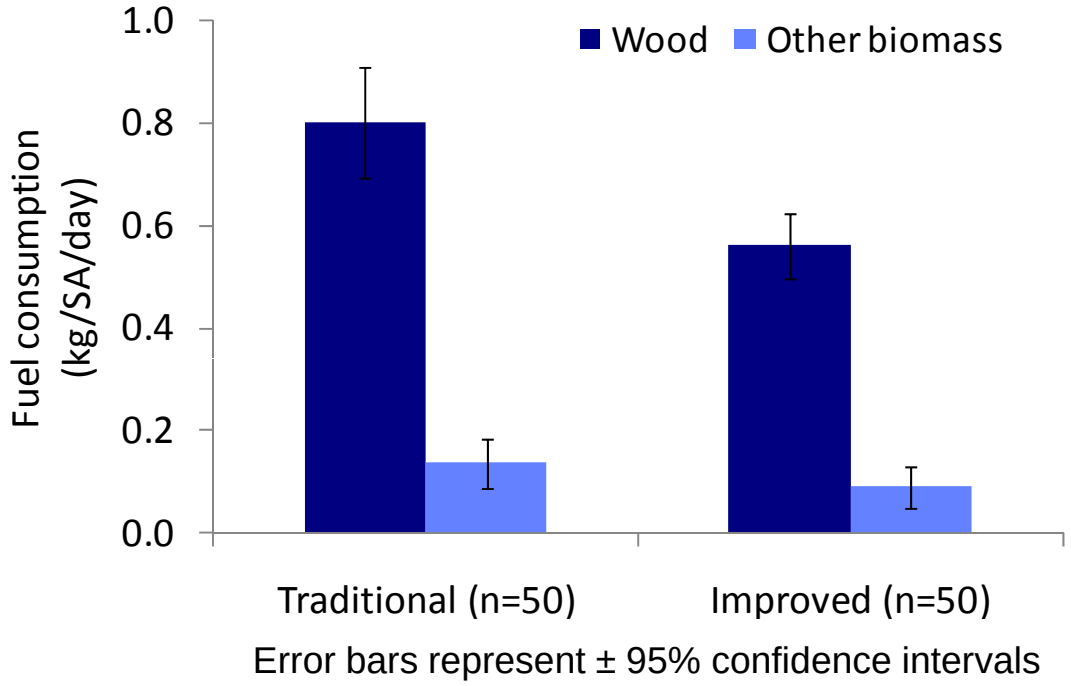
Peru Study

- Peru: cross-sectional and before/after in rural villages of Sanagoran and Santiago de Chuco, La Libertad. Three intervention phases in Sanagoran: no additional maintenance or training, maintenance but no training, with additional maintenance and training.
- Inkawasi chimney stove: Built in-place, has an adobe base and reinforced concrete top plate with two hot-rings for submersing pots into the combustion zone.

Traditional stove

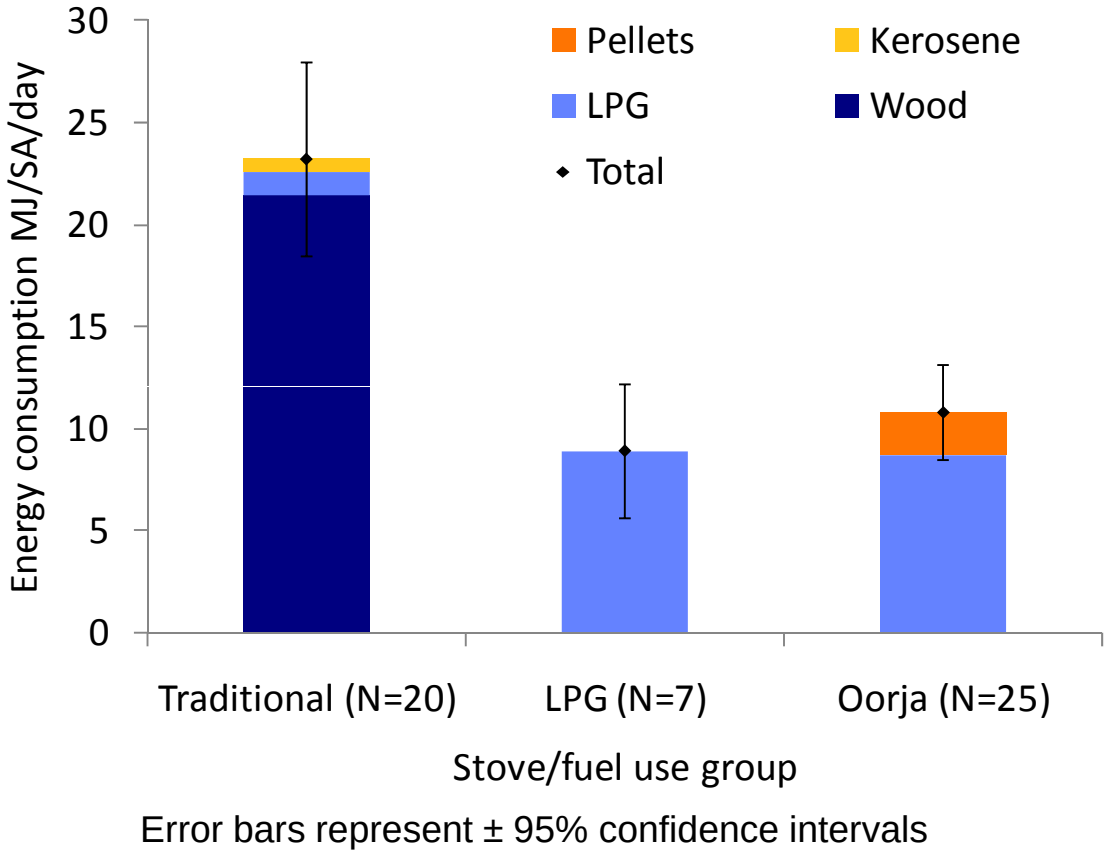
Inkawasi

Results and Impact: Nepal



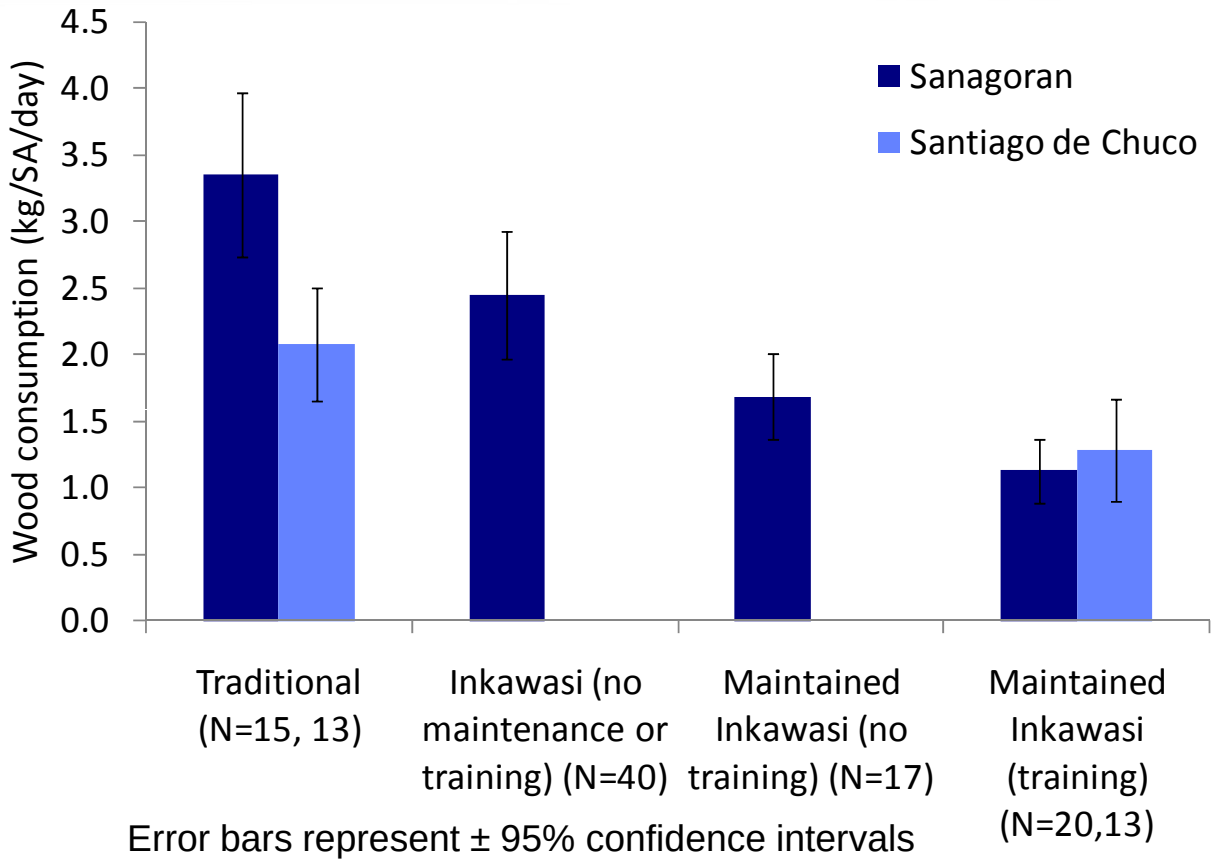
- 30% reduction in fuelwood consumption.
- Biogas also used, but not quantified (hard to weigh).
  - ~35% of users in each group.

Results and Impact: India



- ~50-60% less total energy consumption in homes using LPG and/or Oorja.
- Oorja used primarily as supplement to LPG in this study area.

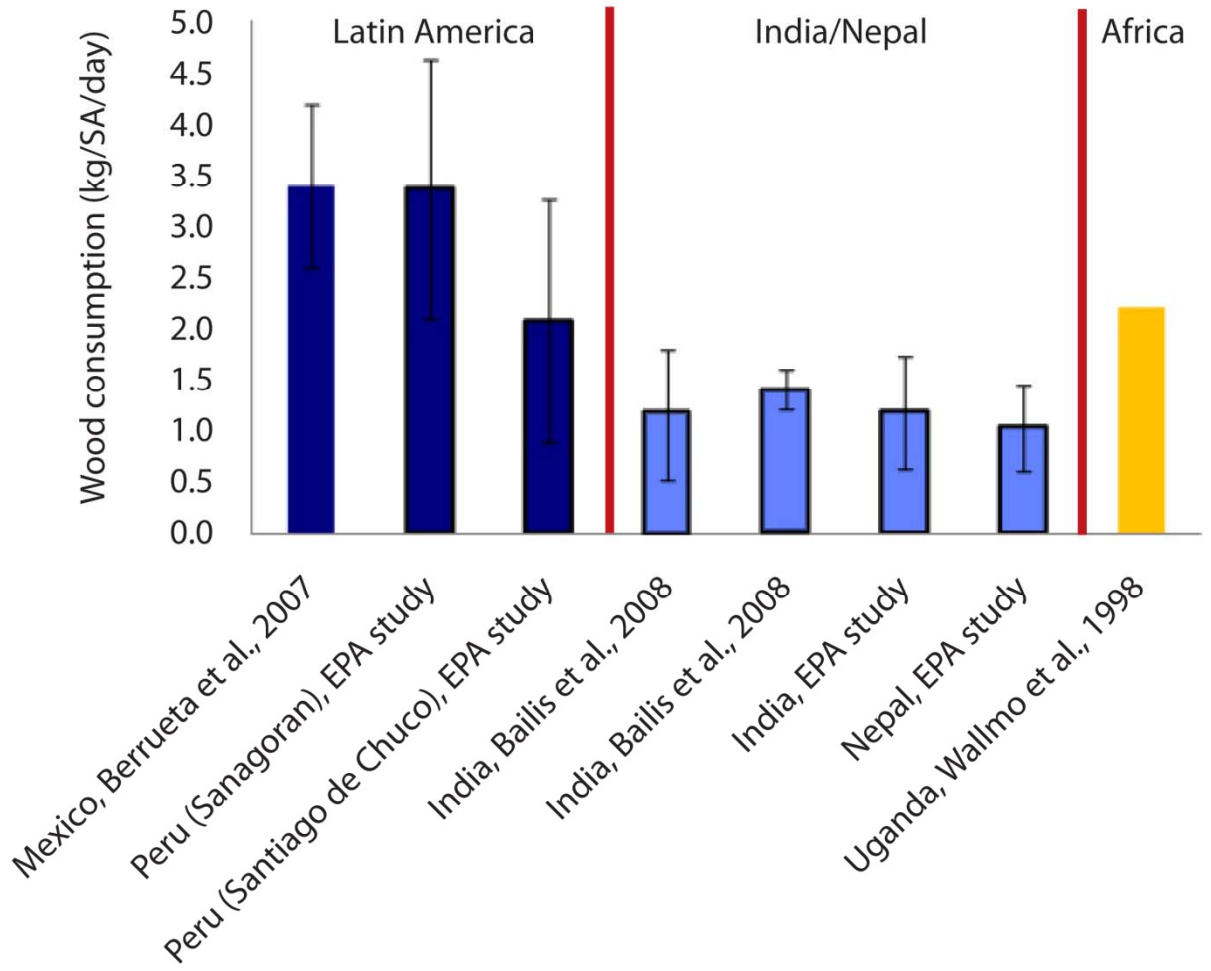
Results and Impact: Peru



- 27% reduction in fuelwood use with no additional maintenance or training.
- 54-66% reduction in fuelwood use with additional maintenance and training.
- Can be substantial differences in fuel consumption between villages.

Baseline Wood Consumption Comparison

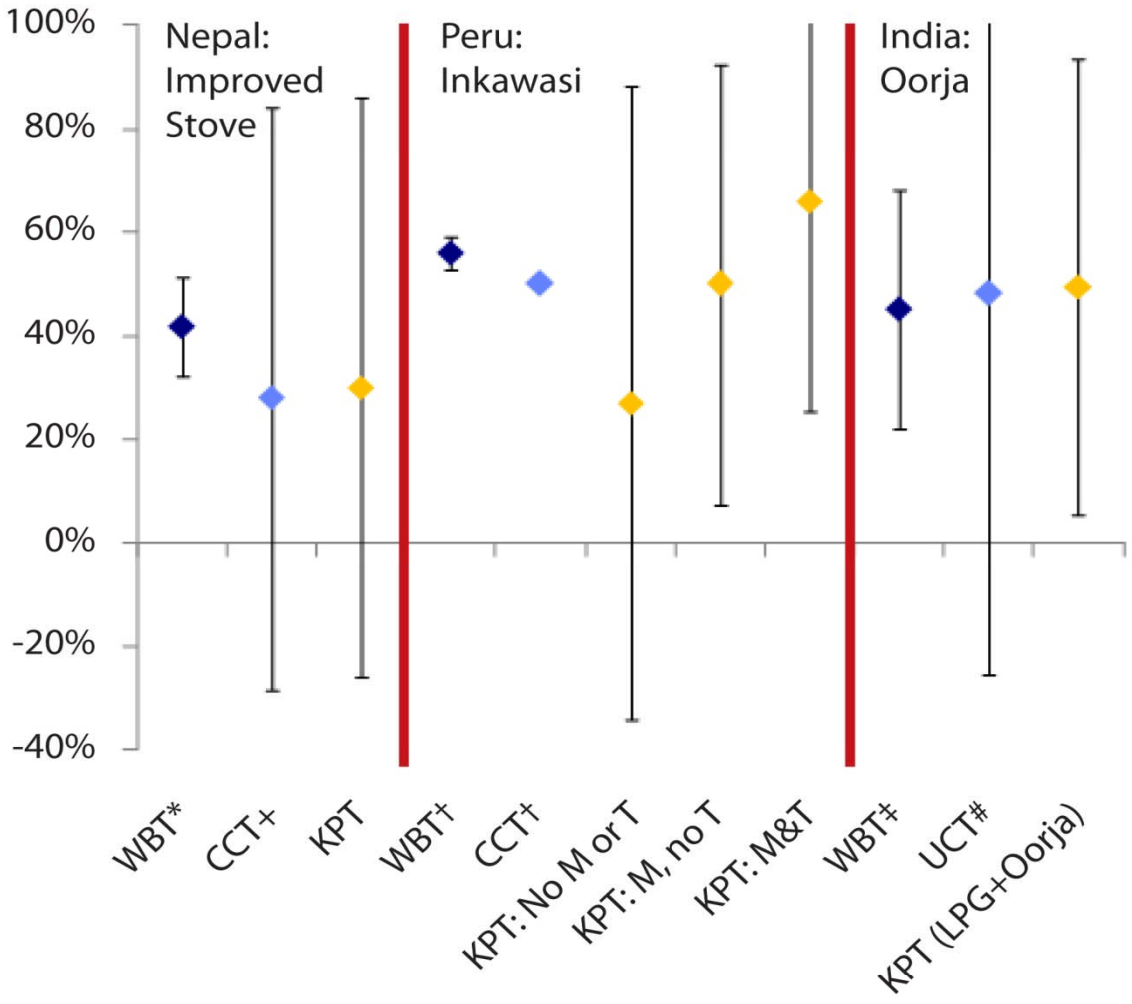
- Very little peer-reviewed KPT data available.
- Pattern of higher fuel consumption in Latin America compared to India/Nepal.
- Can also be large differences within regions due to weather, cooking practices, fuel availability, etc.
- Need more comprehensive understanding of daily household energy use patterns.



Error bars represent ± standard deviation

Comparison with WBTs and CCTs

- Percent fuel savings from controlled testing was generally similar to that found during KPTs.
- Promising for linking lab and field performance.
- Difficult to compare across all the Peru groups.
- Oorja group includes substantial LPG use so savings comparison is not direct.
- Need better understanding of why different testing approaches agree or do not agree.
- Far greater standard deviation in field testing than lab testing.



Error bars represent ± standard deviation

Interpreting KPT Data

- What are the most appropriate fuel consumption metrics?
  - Fuel consumption per home, per person, per standard-adult, per meal.
  - Energy basis or mass basis.
- Need to consider potential impacts from seasons, stove age, and adoption rates.
- Differences in user groups/communities (cooking practices, fuel types, income, and energy demands).
- Small changes in stove design can result in potentially large end-user impacts.
- More variability in KPT data than more controlled testing.
- Snapshot in time.

Using KPT Results

Ways to use KPT results to enhance stove and programmatic performance:

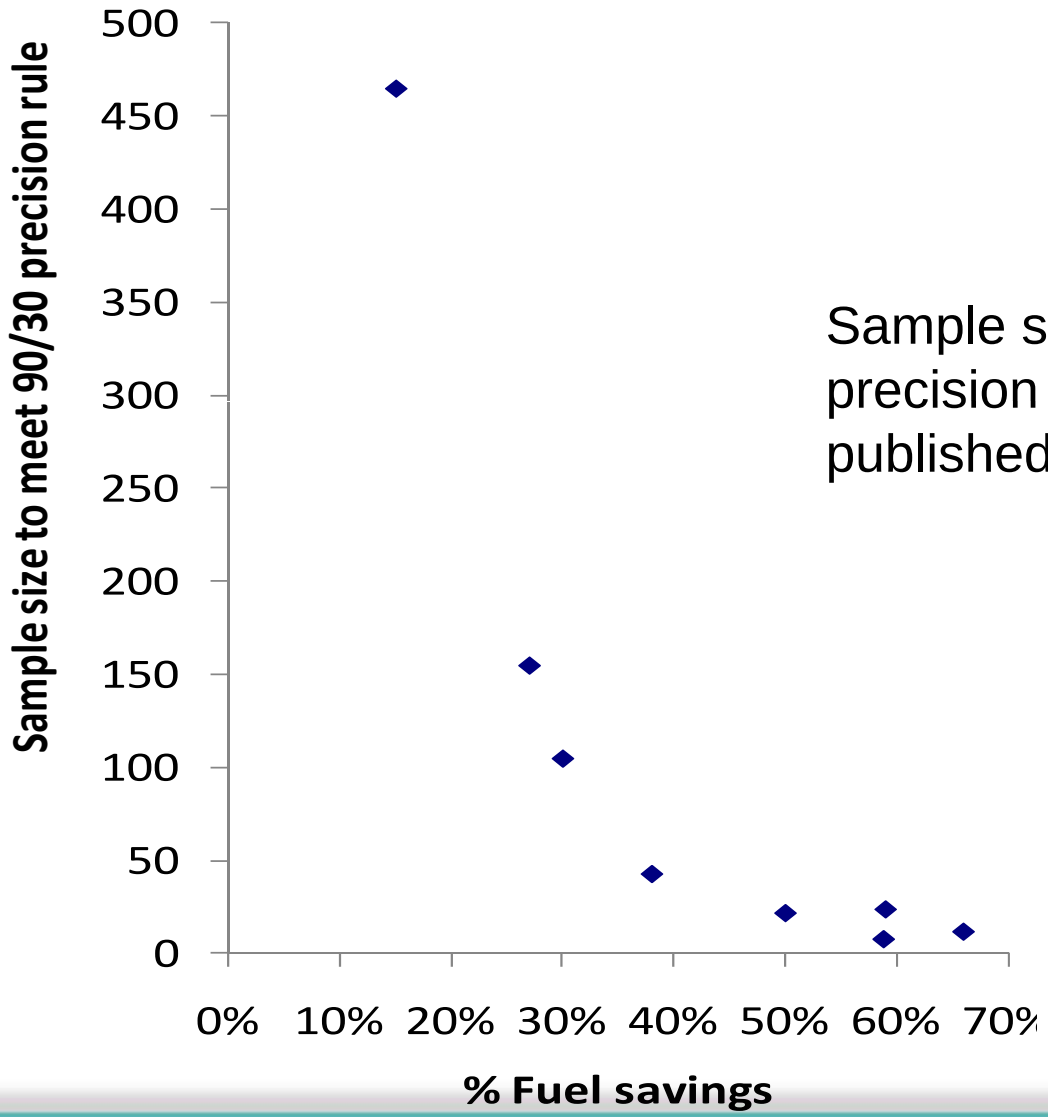
- Helps answer a primary question: Is the stove working in homes?
  - Quantitative reality-check on program effectiveness.
- Better understanding of fuel and stove use patterns in homes:
  - What is the stove being used for and not being used for?
  - Are the stoves being used as intended?
  - What is their condition?

  (Information that can be used for adapting stove design and optimizing implementation strategies).
- Estimates of in-home impacts and user feedback at earlier stages of a program can avoid stove design/selection problems and optimize implementation strategies.
- Demonstration of in-home impacts can be useful for potential funding sources.
- Component of carbon finance monitoring.

Using KPTs for Carbon Finance

- KPT is a cornerstone of the Gold Standard (GS) Method (voluntary market).
- KPT is an option for Clean Development Mechanism (CDM) Methods (compliance market).
- Both methods have recently been updated with new precision rules.
- Precision rules guide sample sizes for study design.
  - Given confidence interval (e.g., 90%) should be less than a percentage of the estimated mean (e.g., 10%).
  - When the precision rule is met, the project can use the mean estimate rather than a conservative confidence bound for offsets.
  - CDM: apply 90/10 or 95/5 to individual consumption estimates.
  - GS method: apply 90/30 precision rule to fuel savings.
    - Graph (on next slide) shows that you need very large sample sizes to meet the precision rule for fuel savings when savings are low.

GS Sample Size Requirements



Sample sizes to meet GS precision rules: based on published data

Important Project Takeaways

- KPTs require significant time and personnel resources for planning and conducting the study.
  - PCIA assistance was critical for Partners.
- International collaborations pose unique challenges.
  - Understanding of conditions in project area is critical for study design - can be difficult at a distance.
  - Coordinated data management and analysis requires extra effort.
  - Language barriers.
    - Need clear communications for technical training and with field team.
    - Careful translations of questionnaires/forms.
      - Dialects are important: e.g., “estufa” vs. “cocina.”

More Important Project Takeaways

Careful study design is critical for obtaining meaningful data.

- Cross-sectional studies need well-matched groups.
  - Location, fuel types, cooking practices, and demographics/socioeconomics.
- Gather key knowledge before study begins.
  - Visit homes and inspect kitchens and stoves.
  - Understand fuel/stove use patterns for project area.
- Stove performance is a function of more than stove design.
  - Factors such as training, maintenance and usage rates, amongst others, affect impacts.

Key Findings and Recommendations

What else is needed to strengthen stove performance monitoring?

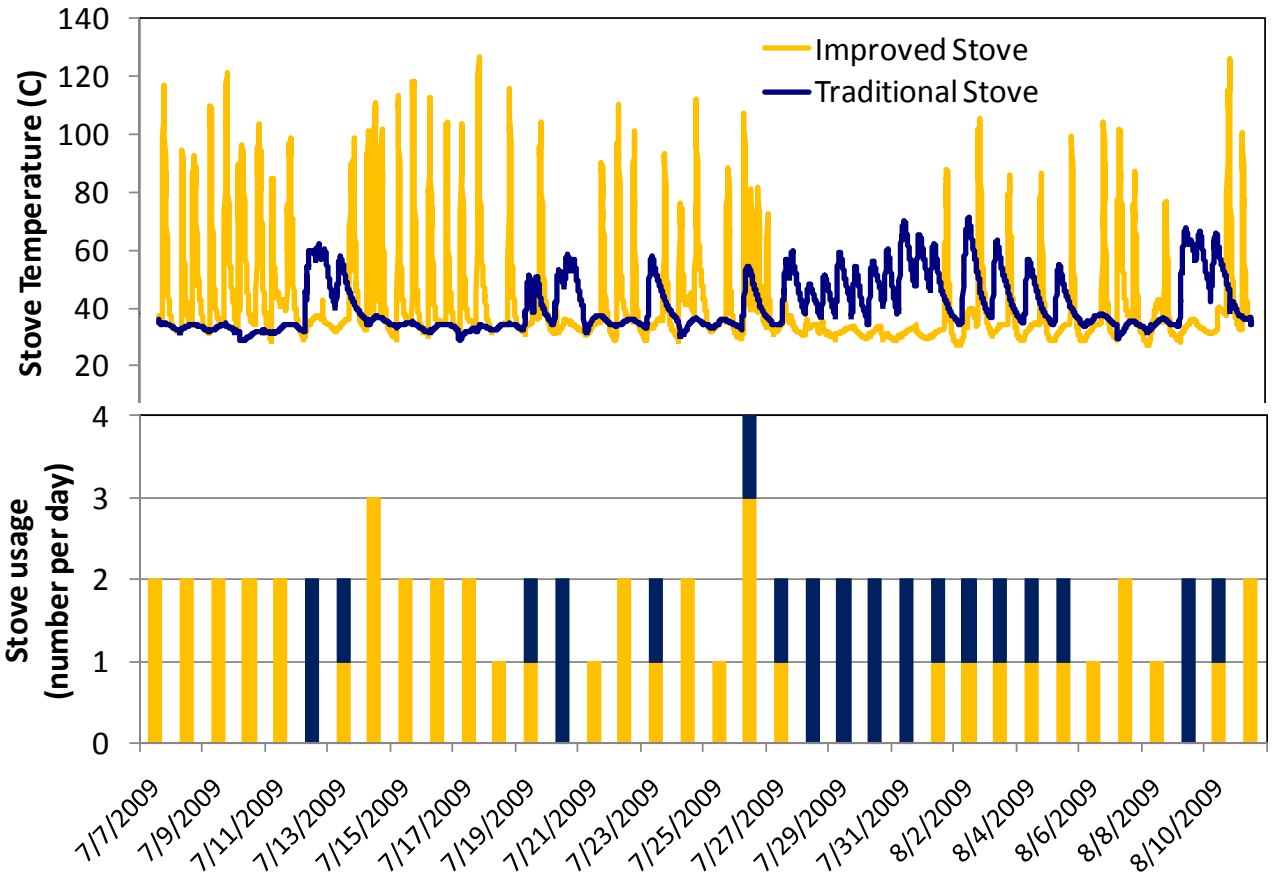
- Broad assessments of in-home fuel consumption across a range of geographies, technologies and fuels.
  - Evaluate what is working, what is not and why.
  - Field evaluation of potential game changers – advanced stove/fuel technologies.
  - More comprehensive fuel use inventories.
  - Tracking stove usage (e.g., SUMS).
- More program evaluation to asses and identify critical factors impacting fuel savings.
  - E.g., training/maintenance, durability, compatibility, etc…
- Link performance metrics derived during laboratory/controlled testing with in-home performance.
  - Coordinated WBT/CCT/KPT efforts.
  - Identify key factors responsible for differences in performance.

Follow Up Actions to Advance Field Testing

- Addressing the snapshot limitation: Stove temperature loggers (e.g., SUMS), surveys, cell phones/wireless/network platforms.
  - Linking usage with fuel consumption.

SEE: Ruiz-Mercado I, Masera O, Zamora H, Smith KR. Adoption and sustained use of improved cookstoves. Energy Policy. 2011; In Press, Corrected Proof.

Example SUMS Output



Follow Up Actions to Advance Field Testing

- Integrating emissions, indoor air pollution, and other forms of assessment.
- Linking stove performance with IAP and personal exposure.
- Refining current and developing new testing protocols.
- Continued efforts by PCIA, Global Alliance and others to increase testing and capacity.

Big thanks to GIZ-EnDev Peru, SENCICO, AEPC/ESAP, CRT/N, First Energy, the families which participated in the studies, USEPA, and Brenda Doroski and John Mitchell.

Contact information:

Michael Johnson

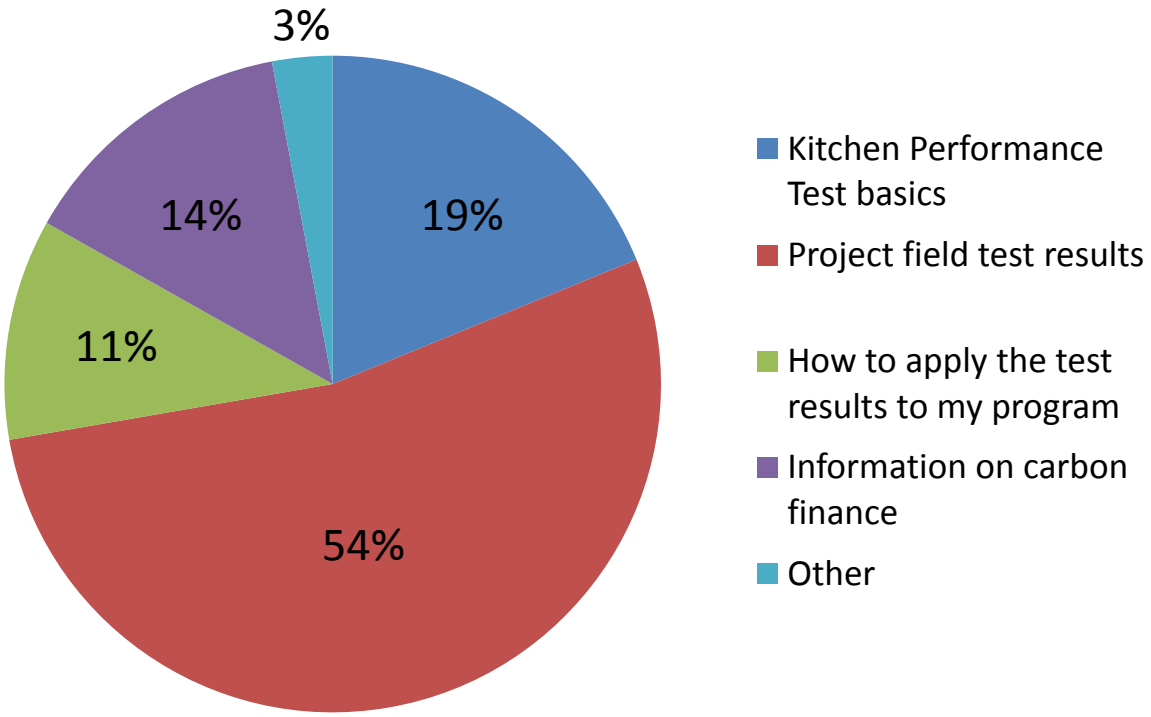
mjohnson@berkeleyair.com

Questions and Answers

- Please type your questions into the Question/Chat Pane.
- We will answer as many as we can, time permitting.
- Every question submitted will be answered and posted to the Proceedings page on www.PCIAonline.org in a few weeks.

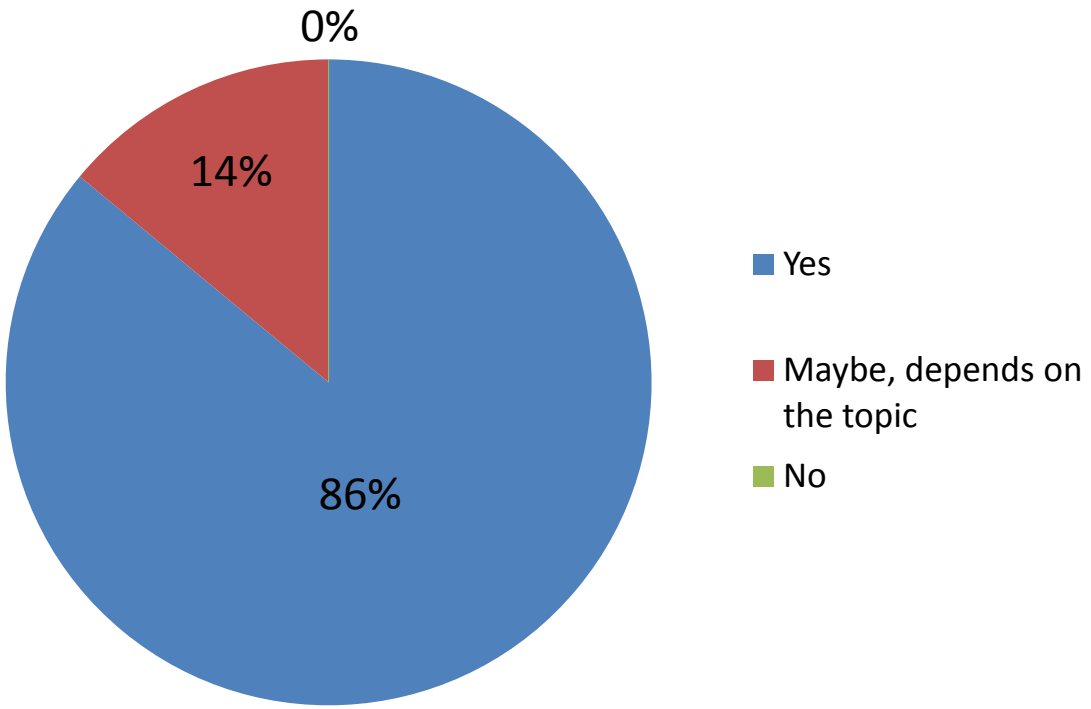
Polling Question

What information presented during this webinar did you find most useful?



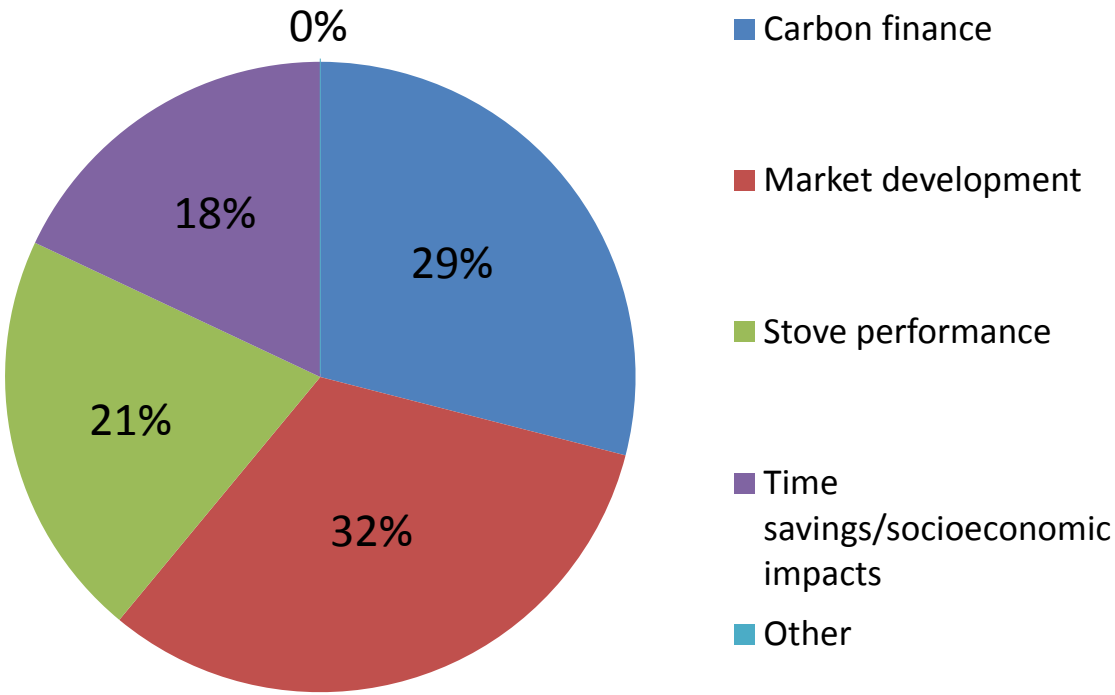
Polling Question

Would you be interested in participating in future PCIA webinars?



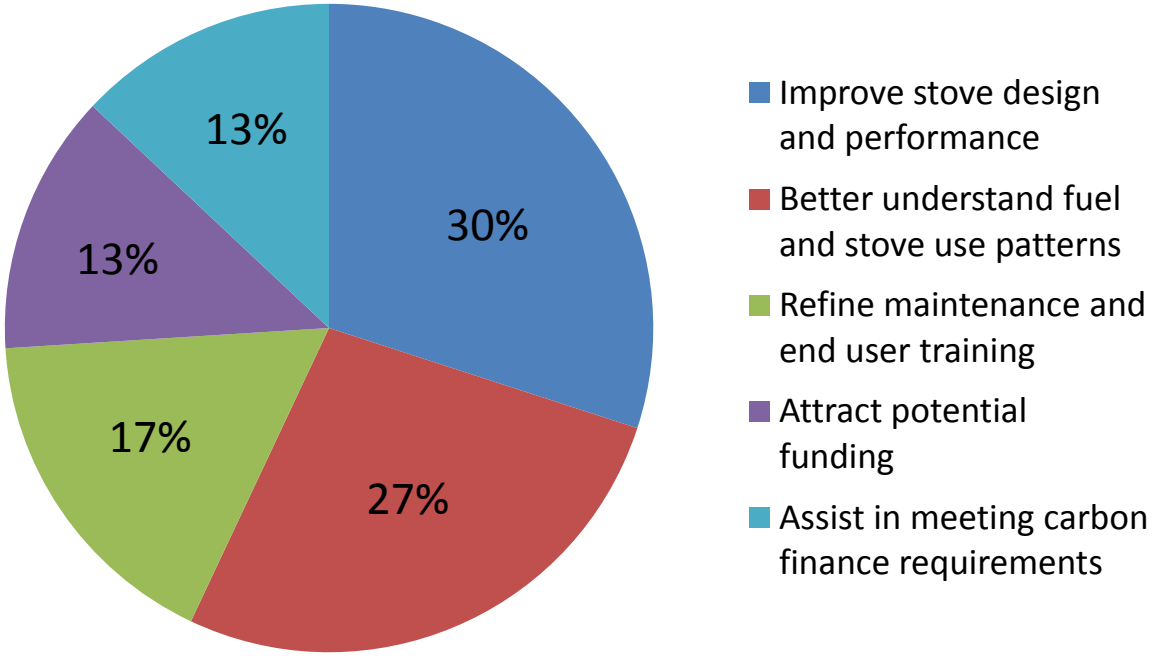
Polling Question

What other webinar topics would you be interested in?



Polling Question

What is the primary way you could use stove testing results to enhance your program?



Next Steps

- The presentation and answers to your questions from today will be posted to http://www.pciaonline.org.
- USEPA will continue to support field testing. Look for upcoming email announcements.
- Share your lab and field testing results with PCIA.
- Participate in upcoming PCIA stove performance testing webinars.
- Respond to the SurveyMonkey email you receive later today: help us help you!

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Thank You For Participating!

We Look Forward to Your Feedback