Welcome to Webinar 2!

Field Testing

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Aprovecho Research Center

OSPREY FOUNDATION

Agenda

1. Introduction
2. CCT
3. KPT
4. Other Methods
5. Comparision

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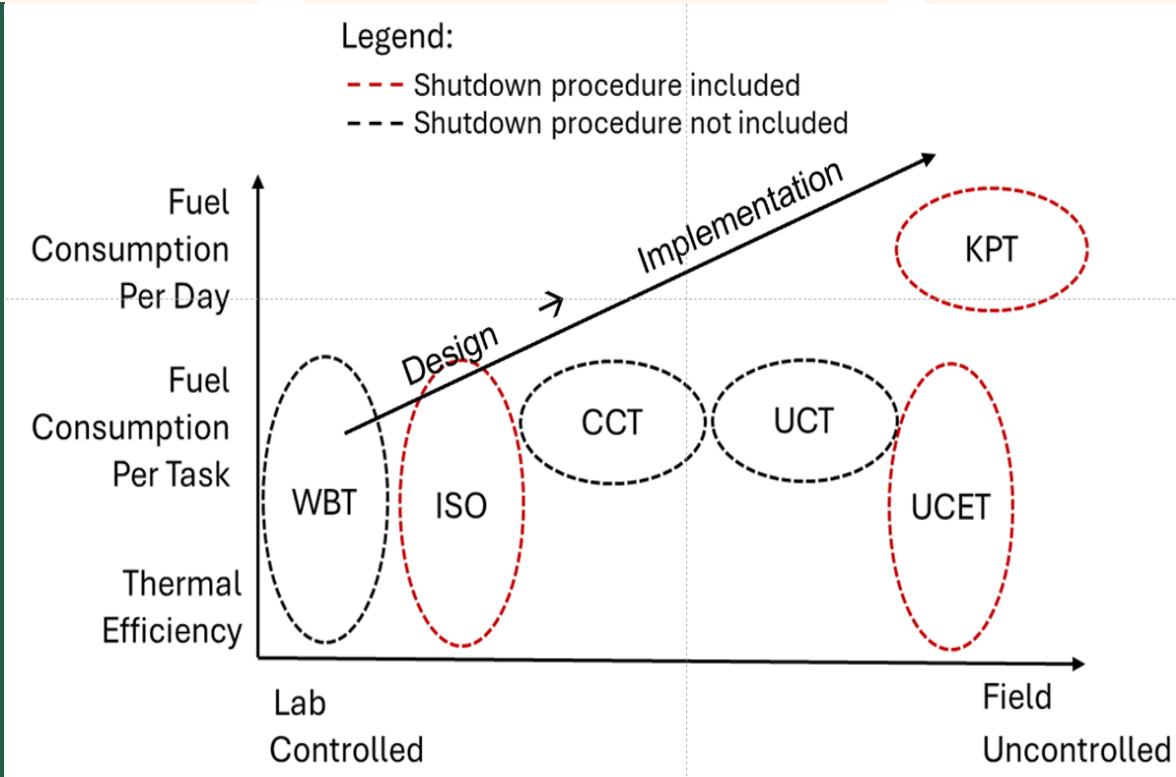
1 Introduction

- Lab tests are great: **repeatable**, **easy** to do whenever, **reliable**
- But they **don't reflect what people are doing**.
- Field testing takes **more repetitions** (cost) and **requires participants,** but gives a better idea of **how the stove cooks, how people like it, and if people are/will use the stove**
- Lab testing is valuable in **early design** to easily compare stoves and design changes. Field testing is valuable for **design validation**

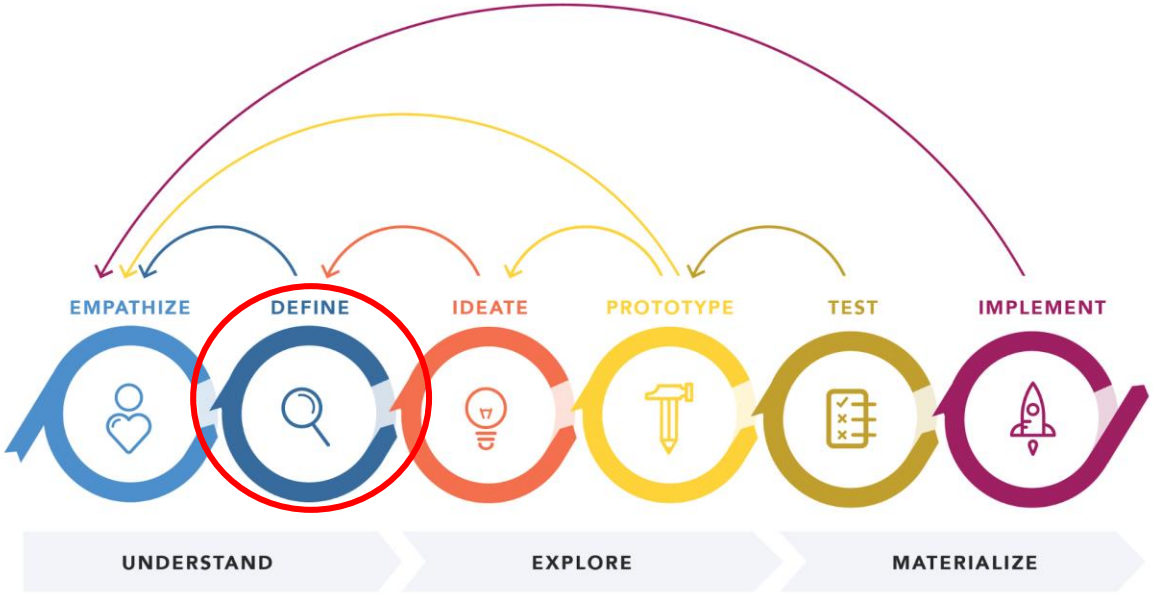


1 Introduction

WHEN TO DO FIELD TESTING

Field testing is useful when defining the scenario:

- What are people cooking?
- What firepower is used?
- What size of pot?
- How much fuel are they using?
- What types of fuel are they using?
- What difficulties are they facing?



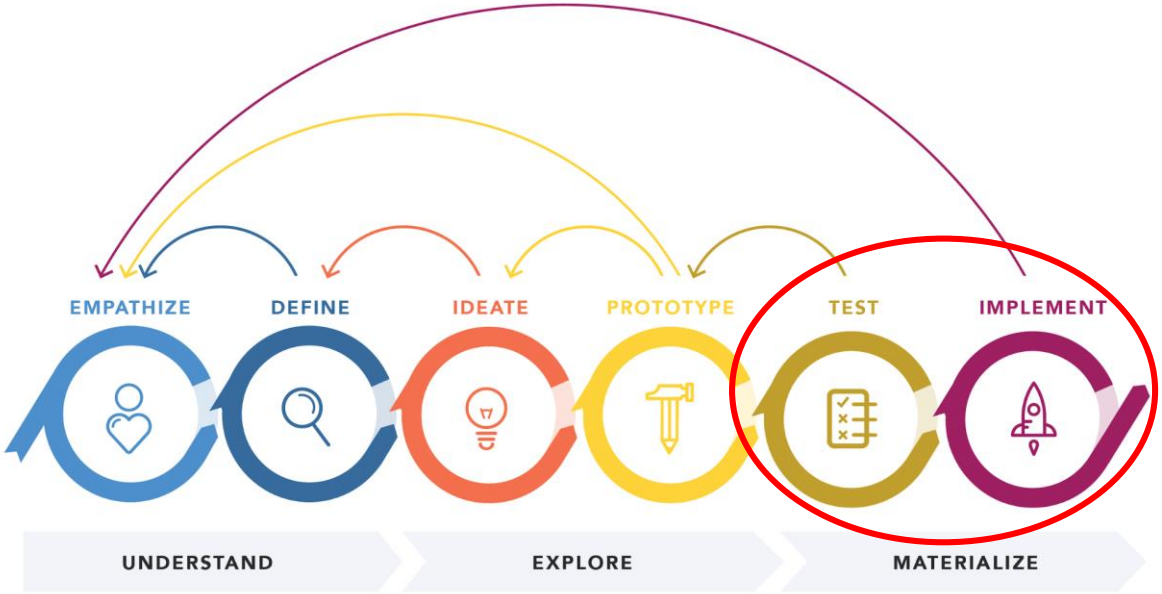
The Design Cycle

1 Introduction

WHEN TO DO FIELD TESTING

Field testing is useful when approaching implementation and during implementation:

- Do people like the stove?
- How well does it cook common food?
- How much fuel does it use?
- How often is it used?
- How does it perform over time?



The Design Cycle

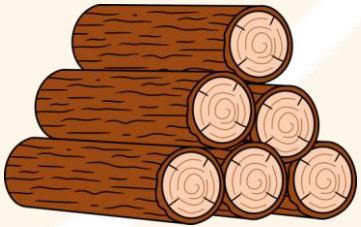
2 The Controlled Cooking Test

Can be done in the lab (emissions and firepower) or in the field

Measures fuel consumption per task - amount of fuel required to cook a specific amount of food

Compares fuel consumption per task of baseline stove to improved stove

Allows for observation: How is the cook using the stove? Is there enough power to cook the food? Is there too much power? Is the stove stable? etc.



Fuel Consumption per Task

CCT: Basic Steps

1

Identify a cooking task: A common meal prepared in the region the stoves will be used.

For best results, repeat CCT with other common meals.

2

Identify cooks: Local people that know how to cook the identified meal and are familiar cooking with the fuel

For best results, repeat CCT with multiple people

3

Prepare for the test: weigh the ingredients and fuel, record fuel moisture content and species, record the dry weight of each pot. Explain the test to the cook.

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CCT: Basic Steps

4

Start the test: Record time fire was lit. Let cook prepare the meal. Make observations. Record the cooking process.

5

Finish the test: Record end time, weight of food and pot, remaining fuel, and remaining charcoal.

Enter measurements and calculate results

CCT-1 for the

Shaded cells require user input; unshaded cells automatically display c

To be filled in after cooking task is complete (as defined by the directions or

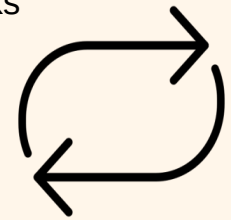
MEASUREMENTS	Units	Initial measurements data	Initial measurements label	Final measurements data	Final measurements label
Weight of wood used for cooking	g		f_i		f_f
Weight of charcoal+container	g				c_o
Weight of Pot # 1 with cooked food	g				$P1_f$
Weight of Pot # 2 with cooked food	g				$P2_f$
Weight of Pot # 3 with cooked food	g				$P3_f$
Weight of Pot # 4 with cooked food	g				$P4_f$
Time	min		t_i		t_f

6

Repeat: Repeat test (number depends on what the data is used for).

Basic ballpark: 9 reps (3 cooks 3 tests each) per stove

Results are more certain with more repetitions, more cooks, and more tasks



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CCT: What's Calculated

$$specifc\ fuel\ consumption(g/kg) = \frac{dry\ fuel\ consumed}{weight\ of\ food\ cooked}$$

Specific Fuel Consumption per Task

$$specifc\ energy\ consumption(g/kg) = \frac{dry\ fuel\ consumed * fuel\ lower\ heating\ value}{weight\ of\ food\ cooked}$$

Specific Energy Consumption per Task

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CCT: Tips and Tricks

Describe what you are measuring and what to expect before the cook starts the test to make it easier to get required measurements

Keep track of pots, containers, and lids – Be on top of weighing things

Don’t control how cooks light or use the stove – just make observations

For new/improved stoves, make sure cooks understand how to use the stove and that they’re comfortable with it

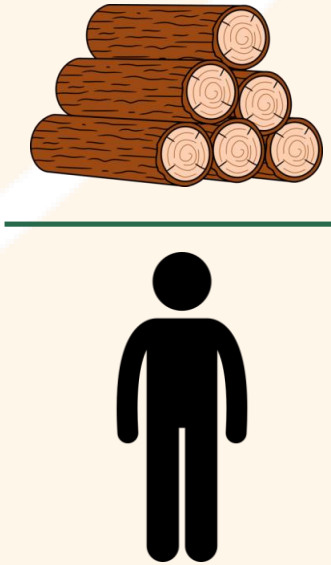
Cook the same *quantity* of food each time – same weight of ingredients each time
- Example: The same weight of water and beans is used for every test.

Write a detailed description of the cooking process with visual ques to understand potential outliers
- Example: Instead of “they took the food off the stove when it was ready” a better description would be “they took the food off the stove when it reached a boil”
- Example: The rice had excess liquid at the end of cooking

Bring the specific ingredients for the cooks to use and either bring fuel or compensate cooks for their fuel

3 The Kitchen Performance Test

- Can only be done in the field
- Measures fuel consumption per person per day
- Compares fuel consumption per day of baseline stove to improved stove
- Allows cooks to do whatever they want with the stove or multiple stoves
- Does not allow for observation but is minimally invasive (lower Hawthorne effect)
- Measures stove use and stove stacking



Fuel Consumption per Day per Person

What is Stove Stacking?

When a household uses multiple stoves during a day

Why does this matter?

- If stove stacking is not measured then we just assume that someone is only using the measured stove type
- This is inaccurate – over credits stove use/ carbon savings
- This is a good observation – why do people need multiple stoves? Can the design be changed to address this?

KPT: Basic Steps

1

Identify households in the community: Households should be willing to participate and should be randomly chosen for represenative sample

2

Measure all fuel piles in the household: instruct household to only use measured fuel (have more than they'll need for the day)

3

Record: household demographics - number and age of people, fuel moisture content, type, calorific value

Ex) Household with 1 2-year-old, 1 16 year-old girl,1 38 year-old woman and 1 40 year-old man = 1 * 0.5 + 2 * 0.8 + 1 = 3.1 standard adults

Gender and age	Fraction of standard adult
Child: 0-14 years	0.5
Female: over 14 years	0.8
Male: 15-59 years	1.0
Male: over 59 years	0.8

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KPT: Basic Steps

4

Return next next day to measure fuel pile(s) again.
Ask about any demographic changes.
Make new fuel measurements.

5

Repeat: Repeat test (number depends on what the data is used for) usually 3 times per house

Numer of Households depends on community size and what results are used for (usually minimum 100)

6

Repeat: Repeat with baseline and improved stoves
Improved stove metrics may have to be repeated every year

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Digital KPT

Allows for multiple days of KPT measurement without returning to household

Better data quality – can verify that fuel from measured pile is used in stove and seeing what stove is used when

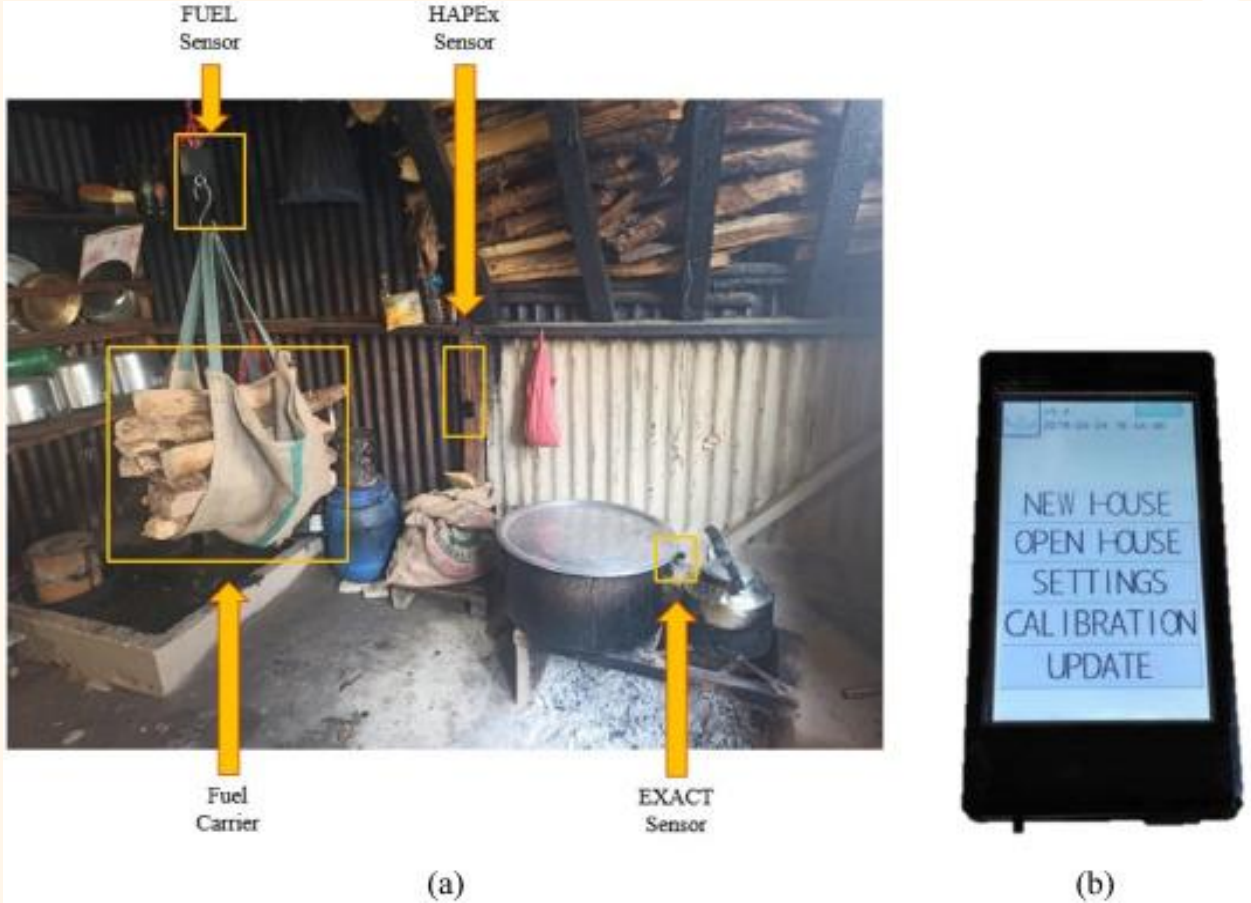
More finite observations

Measured Hawthorne effect

FUEL Sensor

EXACT Sensor

Digital KPT



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What is the Hawthorne Effect?

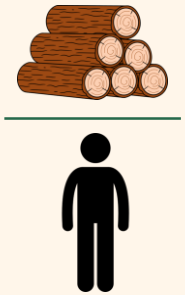
People may modify their behavior because they're aware they're being observed – especially when the stove is gifted to them

- People may use the stove more
- People may cook more impressive food
- People may give more positive feedback

Adding the EXACT sensor to the stove for 30 days can show usage patterns without people being aware. Then we can see if usage patterns change during the KPT

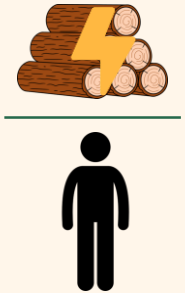
KPT: What's Calculated

$$specific\ fuel\ consumption(kg/person) = \frac{dry\ fuel\ consumed}{number\ of\ standard\ adults}$$



Fuel Consumption per Day per Person

$$specific\ energy\ consumption(kg/person) = \frac{dry\ fuel\ consumed * fuel\ lower\ heating\ value}{number\ of\ standard\ adults}$$



Fuel Consumption per Day per Person

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KPT: Tips and Tricks

Pay attention to your sampling method – it may be easier to sample households near the main road but this is not representative of the community

Fuel usage patterns may change depending on season, holidays, school schedules, etc. Baseline and improved tests should be done at similar times in the year

Make sure households understand to only use the measured fuel piles

Don’t bring too many people to a house

Find a local person to lead you around the community – have community leaders sign off on/promote the testing

Find a way to compensate households

4 Other Methods

THE UNCONTROLLED COOKING TEST

- Similar to the CCT but without assigning a cooking task
- Lower risk of changing cooking behavior
- Good for testing stoves across a variety of tasks
- Requires a lot of repetitions due to variability

THE UNCONTROLLED COOKING EFFICIENCY TEST

- Measures fuel per task but also thermal efficiency
- Requires measurement of temperature of each ingredient
- Lower risk of changing cooking behavior
- Good for testing stoves across a variety of tasks
- Requires a lot of repetitions due to variability

4 Other Methods

Field testing is meant to meet YOUR needs. Sometimes that's used for carbon credits/certification but other methods can also be useful

- **Surveys – demographics, fuel use, cooking methods, what do people want**
- **Focus groups – group feedback on stove, group design**
- **Field observations – sometimes what people say and what they do are different**
- **Low repetition iterative tests – try cooking actual food during the design phase as a reality check**

5 Comparison

CONTROLLED COOKING TEST

- Can be used in the lab (emissions testing, real-time firepower) and in the field
- Measures fuel use per task
- Great for observing how people cook common foods and if the stove design works for those cooking methods
- Requires fewer test replicates
- Does not measure stove stacking or adoption rates
- Has risk for higher Hawthorne effect
- Best for: initial design objective and near the end of the design for verification

KITCHEN PERFORMANCE TEST

- Can only be done in the field
- Measures fuel use per day
- Fuel per household (overall fuel consumption of the project)
- Less time spent per test (especially if using digital sensors)
- Requires more test replicates
- Measures stove stacking and use rates/adoption rates
- Can measure Hawthorne effect
- Doesn’t allow for observations during cooking
- Best for: final implementation/impact studies

6 Sources

Clean cook alliance has most protocols listed: https://cleancooking.org/protocols/

CCT: https://cleancooking.org/wp-content/uploads/2026/01/CCT-protocol-v3-Nov2025.pdf

UCT: https://cleancooking.org/binary-data/DOCUMENT/file/000/000/82-1.pdf

UCET: https://aprovecho.org/wp-content/uploads/2025/01/UCET-Protocol.pdf

KPT: https://cleancooking.org/binary-data/DOCUMENT/file/000/000/604-1.pdf

7 More Information

If you’d like me to go into more detail over a specific protocol then

email me:

jaden @aprovecho.org