

US EPA ARCHIVE DOCUMENT

Experimental Interventions to Facilitate Clean Cookstove Adoption, Promote Clean Indoor Air, and Mitigate Climate Change

USEPA Cookstove Research Meeting

Research Triangle Park, NC

Building C, Classroom C111

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From the RFP...

- How would **a feasible set of interventions** for residential cooking, heating, or lighting in a developing part of the world impact air quality and climate?
- What is **the realistic range and timeframe** of foreseeable benefits to air quality and climate of various interventions in cooking, heating, or lighting practices in a developing part of the world...

From: http://www.epa.gov/ncer/rfa/2012/2012_star_cook_heat_light.html

Past/current interventions...

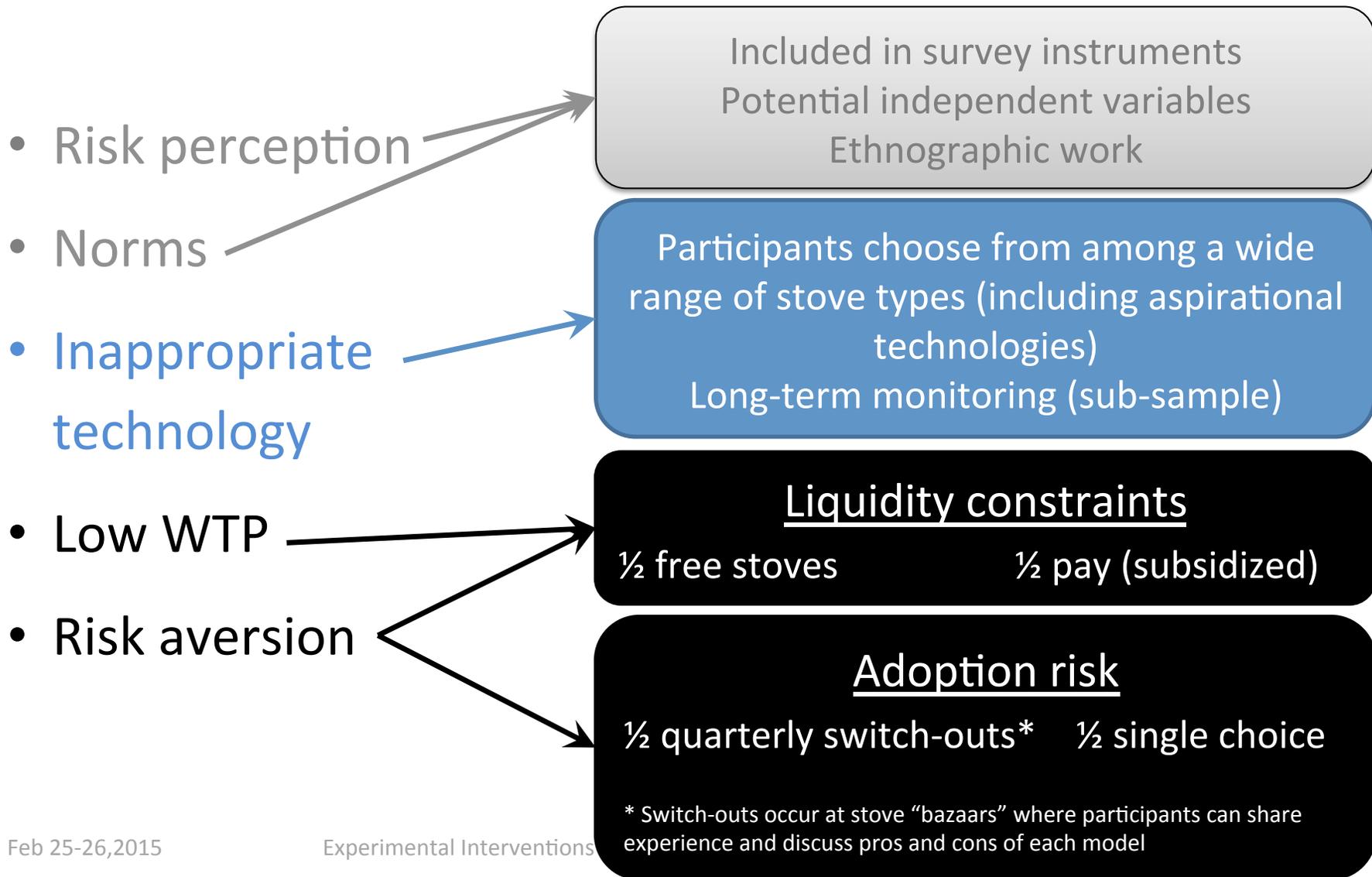
- Low adoption rates
- Lower than expected benefits



Why?

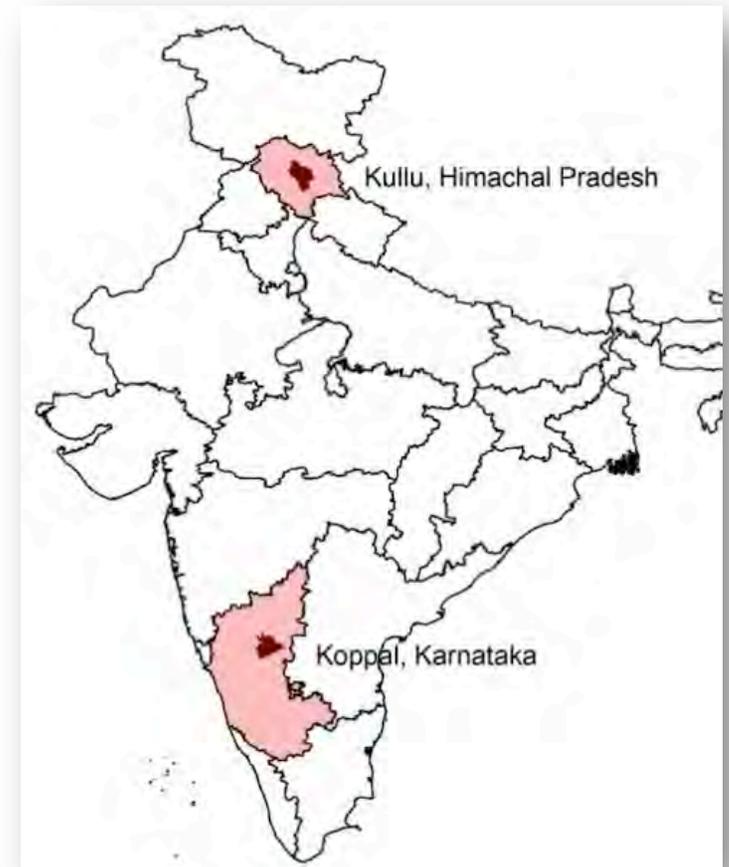
- Misperception of health risk?
- Low “willingness to pay” (WTP)?
- Risk aversion?
- Inappropriate/poorly designed stoves?
- Norms and preferences?

Study design



Study design

- RCT in 2 Indian States
 - with local NGO co-Pis
- 4 villages each
- 480 HHs total
 - Factorial design



Study design

(replicated in two states)



Data collection



Socioeconomics & social networks
(full sample)



KPTs
(20% sub-sample)



Emissions/SUMS
(10% sub-sample)



Exposures
(full sample)



Pre-treatment, after each bazaar, and post-treatment

Stoves

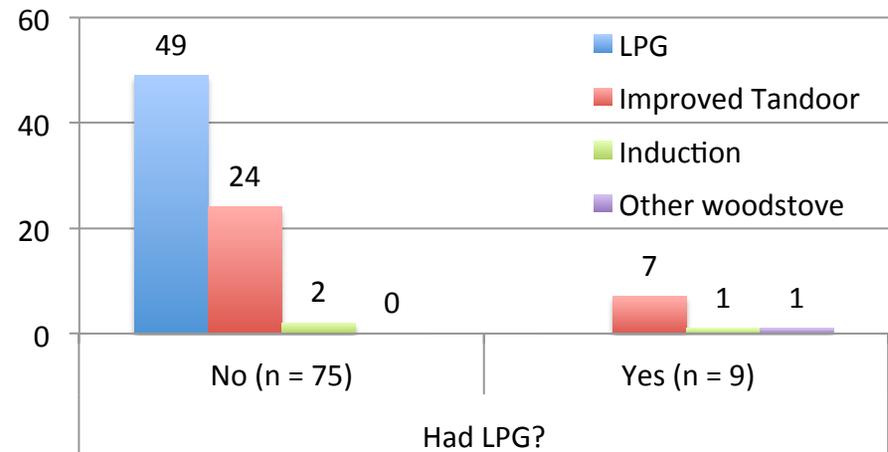
- 1-pot, no chimney (Envirofit, Chulika, Greenway, Samuchit)
- 2-pot, chimney (Prakti, TIDE, Envirofit)
- Forced draft: TERI, Eco-chulha
- TLUD (Serval)
- Improved tandoor (HP only)
- Induction
- LPG



Preliminary activities



- CCTs and trial sales events
 - 3 villages in HP (84 HHs)
 - Gauge response to unfamiliar stoves
 - Measure WTP





Tangent: LPG in India

- National subsidy scheme
 - HHs get up to nine 14.2 kg cylinders/yr
- Phasing in Aadhaar-based system linked to bank accounts
 - “world's largest direct benefit transfer scheme”

Gas Equation	
₹417 Price of subsidised LPG cylinder (Delhi)	₹694.82 Landed cost of imported LPG
₹789.76 Cost of cylinder after bottling, transport, margin	
₹393.77/cylinder Under-Recovery (Revenue Loss)	
₹26 Dealer's commission	₹18 Delivery charges
SUBSIDISED PRICE	
Delhi	417.00
Kolkata	419.00
Mumbai	452.00
Chennai	404.50
MARKET PRICE	
Delhi	865.00
Kolkata	905.00
Mumbai	887.00
Chennai	863.50





Socio- economics & social networks

(full sample)

Co-led by Bailis, Zerrefi, and Dwivedi

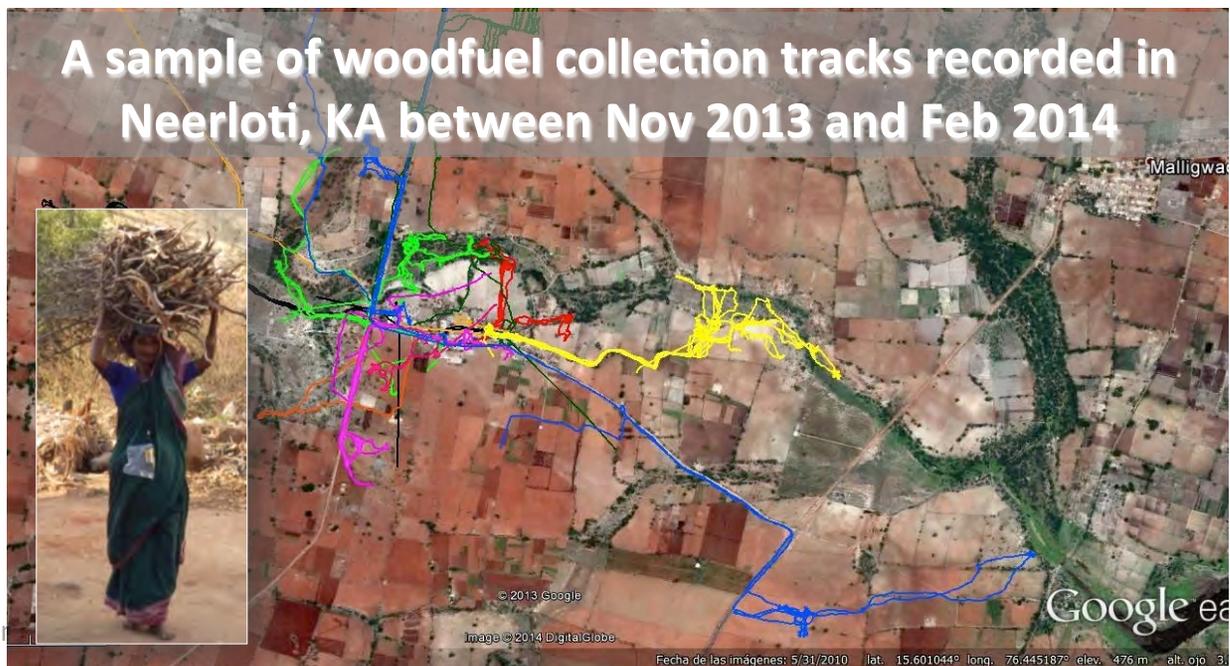
- Demographics
- Wealth
- Gender
- Energy use
- Soc. networks
 - Information sharing between HHs
 - Role in adoption/rejection



KPTs

(~20% sub-sample)

- Fuel consumption
- Species preference
- Extraction patterns



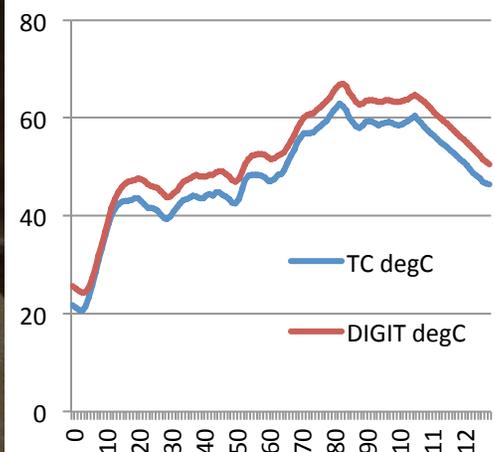


Emissions/ SUMS

(10% sub-sample)

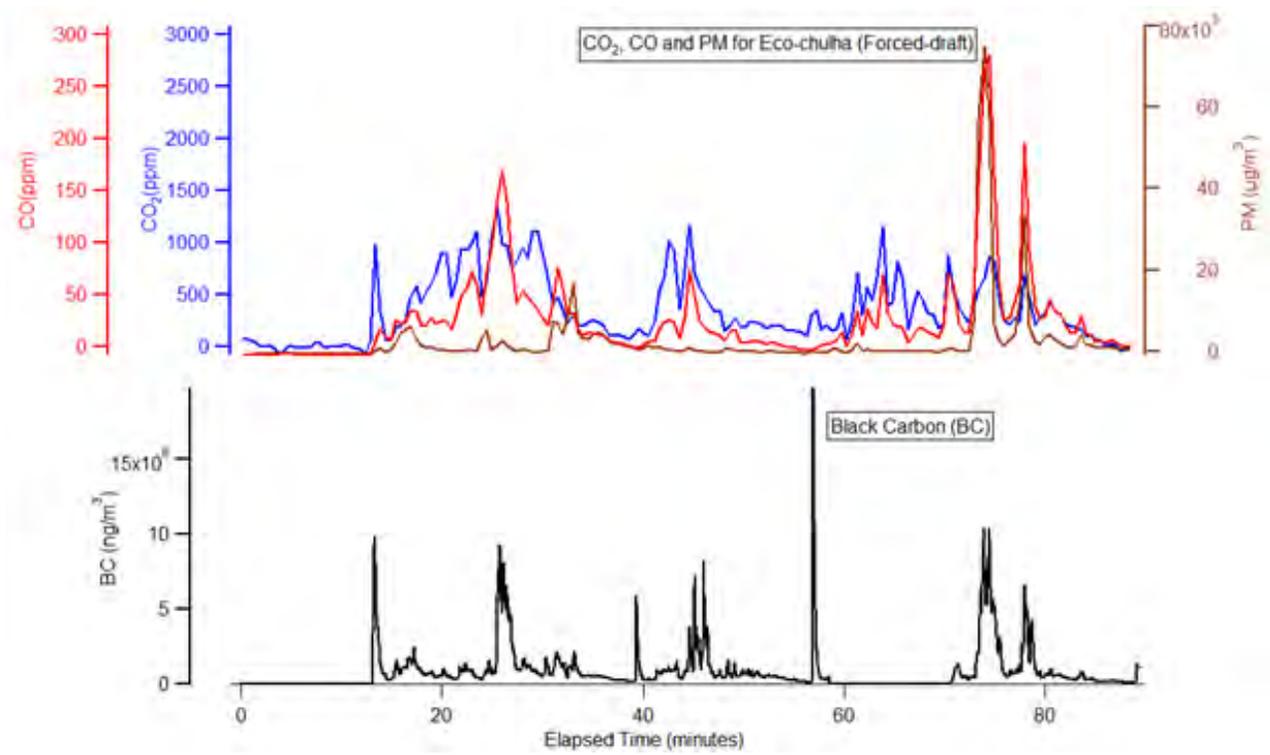
Led by Grieshop

- STEMS
 - Real time CO₂, CO, PM and BC
 - Gravimetric PM_{2.5}
- SUMS





Emissions/ SUMS (10% sub-sample)





Exposures (full sample)

Led by Julian Marshall

- 24-hour HAP concentrations
- Using μ PEM
- Real-time & gravimetric $PM_{2.5}$



Progress to date

Summer-Fall 2014

- Community selections
- Equipment trials
- Pilot surveys/sales events

Winter 2014/15 - HP

- Baseline surveys HAP and emissions
- Bazaars
- Stoves given to HHs

Spring 2015 - shift to Karnataka



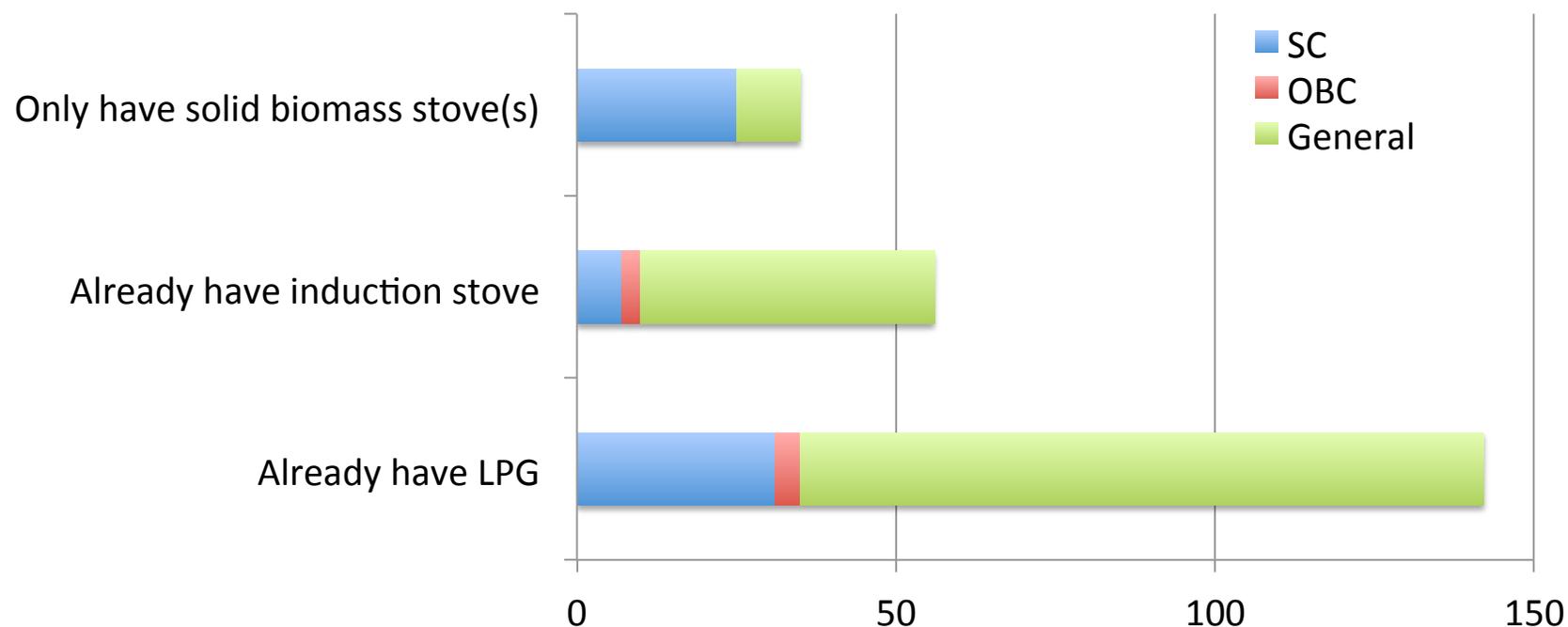
Insights from equipment trials

- “Improved” stoves not suitable for staple dishes
- In HP, a tandoor is essential
 - 1-pot “rocket” not popular
- In KA, 1-pot models were popular
- Forced-draft stoves got mixed reviews



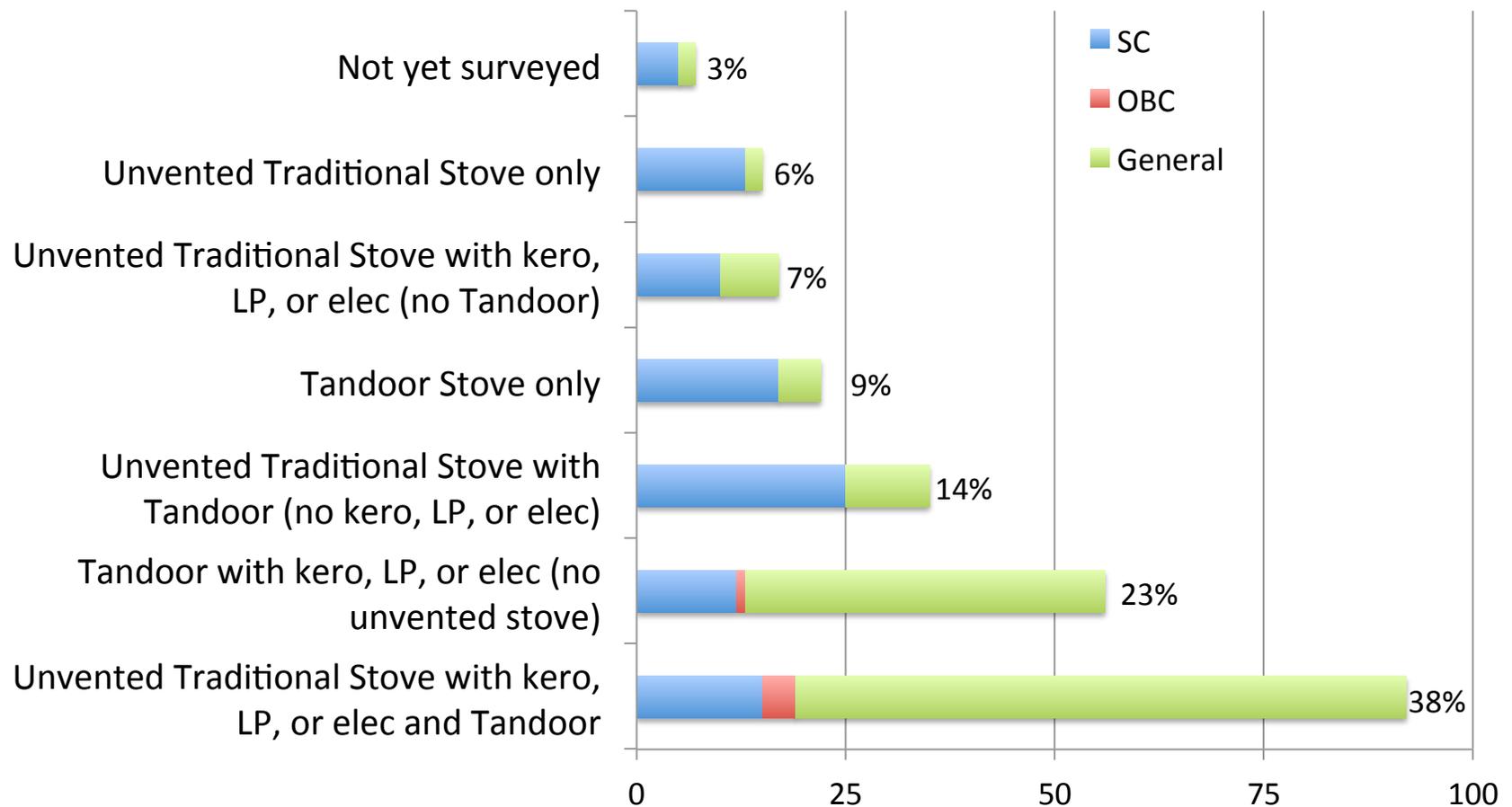
Insights from baseline surveys

- 60% of HHs already have LPG
- 23% have an induction stove



Insights from baseline surveys

- A lot of stacking



Insights from stove bazaars

- Participants understood:
 - Randomization
 - Treatment vs. control
 - Switch-out vs. 1-time selection

डबल-पाँट चिमनी स्टोव
साम्प्रदायिक चूल्हे की तुलना में:

लकड़ी की बचत
खाना तेजी से पके एक समय में दो चीजें पके
धुआँदान / चिमनी की सुविधा
कम धुआँ

4 **Prakti Wood Stove / प्रकृति वुड स्टोव**

40% लकड़ी की बचत
80% कम धुआँ
Rs. 2350/- Rs. 590/-

5 **Envirofit Double-Pot / एन्वैरोफिट डबल-पाँट**

50% कम समय
40% लकड़ी की बचत
80% कम धुआँ
Rs. 3700/- Rs. 925/-

6 **TIDE Pyro Mini / टाइड पैरो-मिनी**

30 - 40% लकड़ी की बचत
Rs. 2800/- Rs. 700/-

7 **TERI Forced-Draft Stove**

साम्प्रदायिक चूल्हे की तुलना में:

बर्तन पर तुरंत ताप, खाना तेजी से पके ताप पर बेहतर नियंत्रण
लकड़ी की जरूरत नहीं
बिलकुल धुआँ नहीं

70% कम धुआँ

8 **Himanshu Tandoor / हिमांशु तंदूर**

साम्प्रदायिक तंदूर की तुलना में:

50% लकड़ी की बचत
राख निकालने में आसानी
कम धुआँ
एक समय में कई चीजें पके
कमरा ज्यादा समय तक गरम रखे
मजबूत और टिकाऊ (20 से अधिक साल)

Rs. 5000/- Rs. 1250/-
Rs. 5500/- Rs. 1375/-

9 **Induction Stove / इंडक्शन स्टोव**

साम्प्रदायिक चूल्हे की तुलना में:

बर्तन पर तुरंत ताप ताप पर बेहतर नियंत्रण
बिजली का उपयोग करे लकड़ी की जरूरत नहीं
बिलकुल धुआँ नहीं

Rs. 4000/- Rs. 1000/-

10 **LPG Stove / गैस स्टोव और कनेक्शन**

साम्प्रदायिक चूल्हे की तुलना में:

बर्तन पर तुरंत ताप, खाना तेजी से पके ताप पर बेहतर नियंत्रण
लकड़ी की जरूरत नहीं
बिलकुल धुआँ नहीं

Rs. 4100/- Rs. 1025/-

JAGRITI
Village: Badha, Post Office: Mohal, District: Kullu-175126, HP.
Tel/Fax: 91 1902 224309. Website: www.iagritikullu.org

स्टोव अध्ययन: विशेष 75% छूट
इस पत्र में सभी जानकारी निर्माताओं का दावा हैं वास्तविक परिणाम भिन्न हो सकते हैं

रॉकेट स्टोव
साम्प्रदायिक चूल्हे की तुलना में:

लकड़ी की बचत
खाना तेजी से पके
हलका और वहनीय
कम धुआँ

1 **EnviroFit PCS-1 / एन्वैरोफिट पि.सि.एस-1**

50% कम समय
60% लकड़ी की बचत
80% कम धुआँ
Rs. 2000/- Rs. 500/-

2 **Chulika चुलिका**

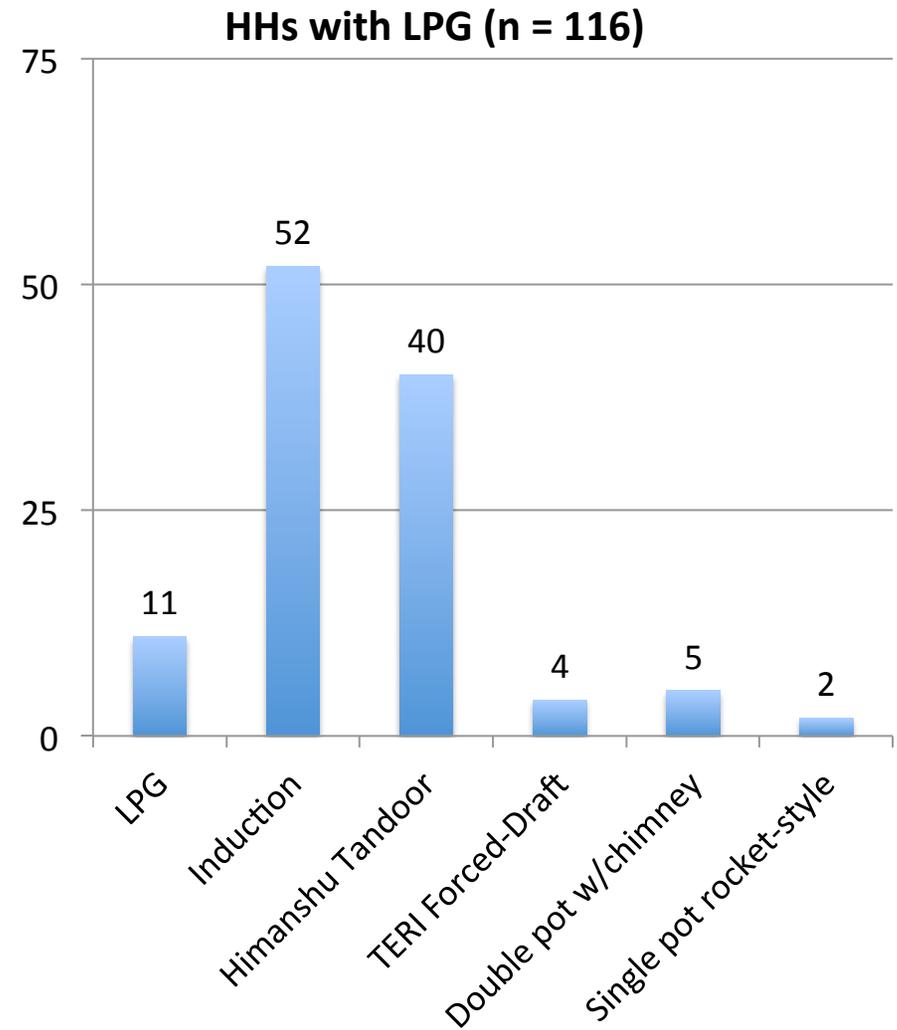
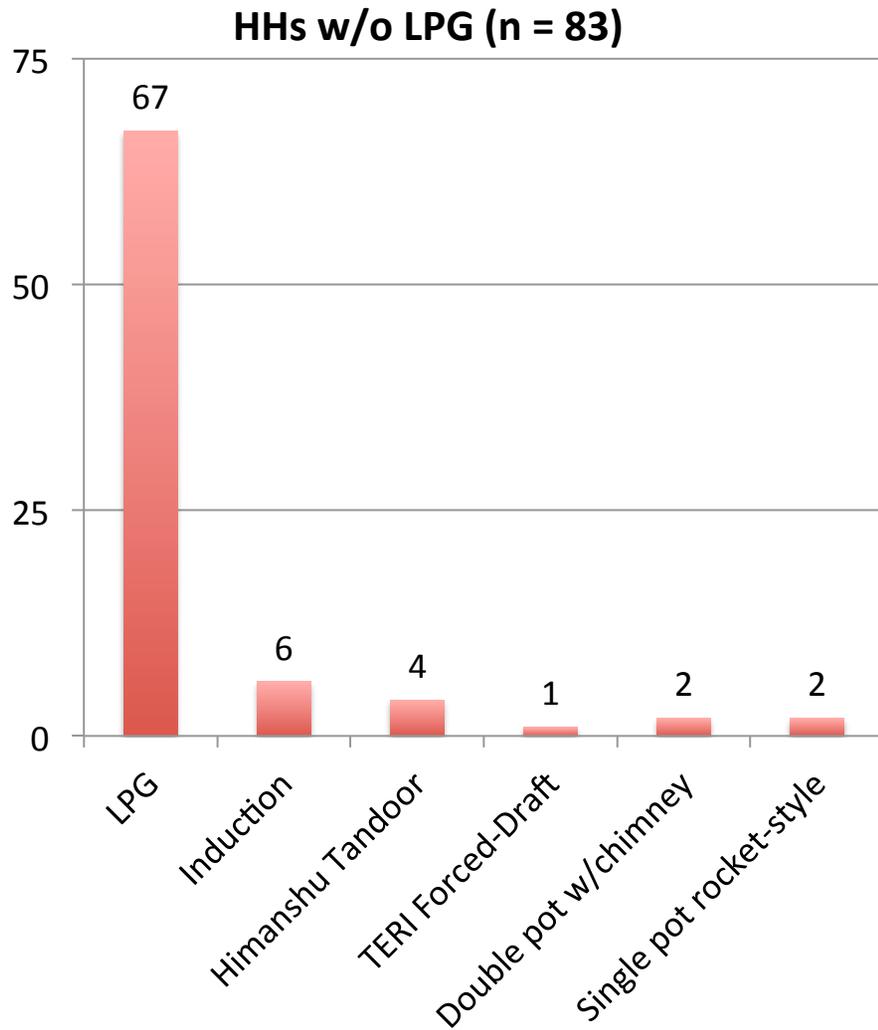
67.5% लकड़ी की बचत
80% कम धुआँ
Rs. 1800/- Rs. 450/-

3 **Greenway Smart Stove ग्रीनवे स्मार्ट स्टोव**

65% लकड़ी की बचत
70% कम धुआँ
Rs. 1400/- Rs. 350/-

- Few had trouble paying
- “Aspirational” stoves were most popular

HH choices at initial stove bazaars



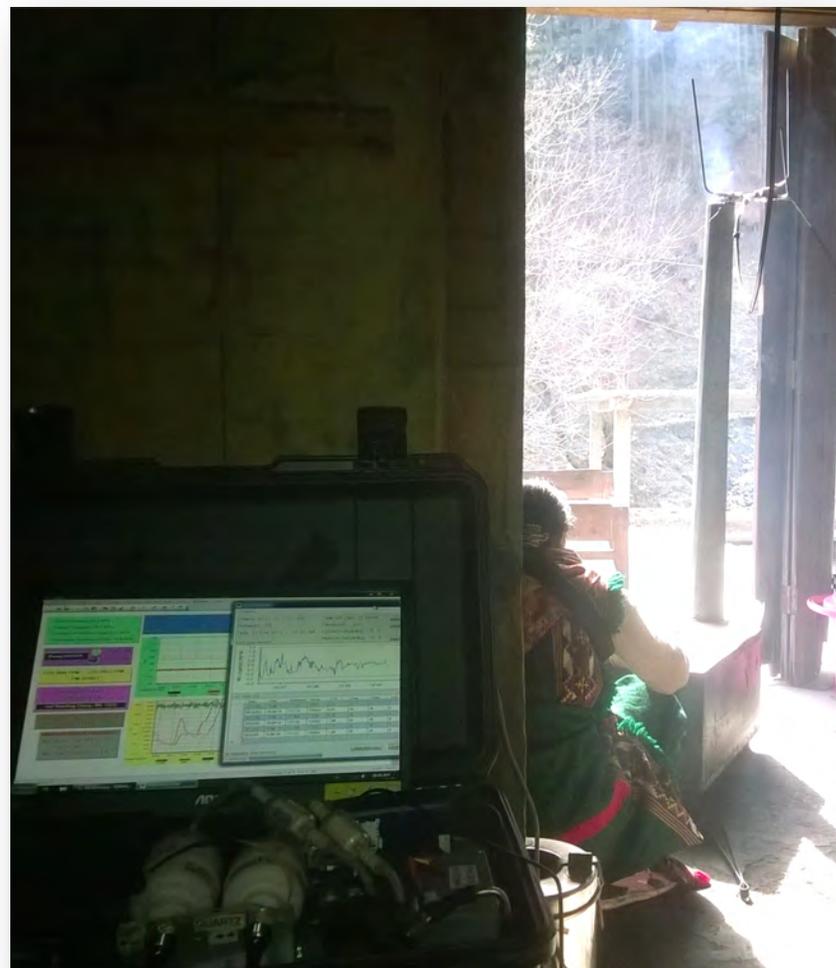
Next steps

Wrap up phase-1 in HP:

- Baseline emissions and exposure measurements
- SUMS and KPTs
- Stove handouts

Shift to Karnataka and repeat...

Start climate modeling (Unger)

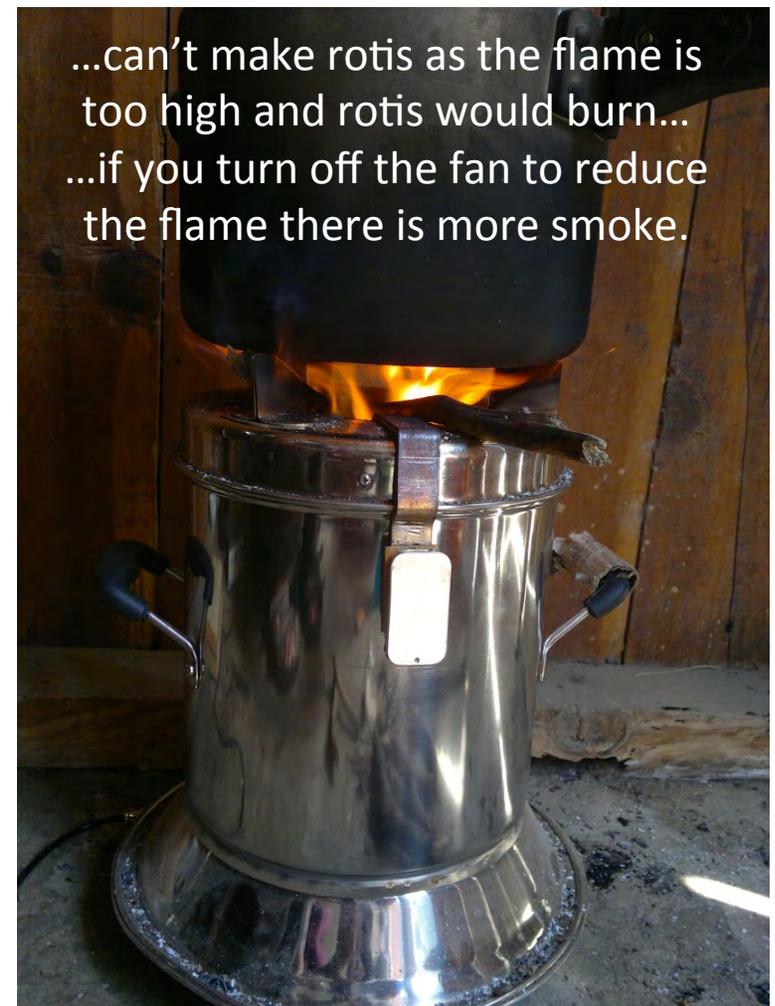


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- RAs: Adam Walters and Ryan Repoff (NCSU); Carlos Gould (Yale)



Insights from equipment trials





This was not posed!! I'm fixing TERI's forced-draft stove. At \$80, the stove is the most expensive model in our trial. It arrived at our test center with no fuse and 3 separate wiring faults.