



**EFFICIENCY
FOR
ACCESS**



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Efficiency for Access Design Challenge Technology Week: Webinar 4: Cooking



EFFICIENCY FOR ACCESS



Jessie Press-Williams, Design Engineer, BURN

- Working across engineering and sustainable development
- Scoped potential new fuels and cookstove products for East Africa
- Background in International Development research and data collection



Leonard Schurg, Head of Production Innovation, BURN

- Dedicated career to sustainable future and green energy
- Worked previously on product development, validation and production process
- Project Portfolio includes cookstoves, solar heat and electricity



Jon Leary, Researcher, Modern Energy Cooking Services (MECS)

- Mechanical Engineering Meng, and Engineering/Social Science PhD at University of Sheffield
- Working to empower everyday cooks
- Develops and trials innovative solutions



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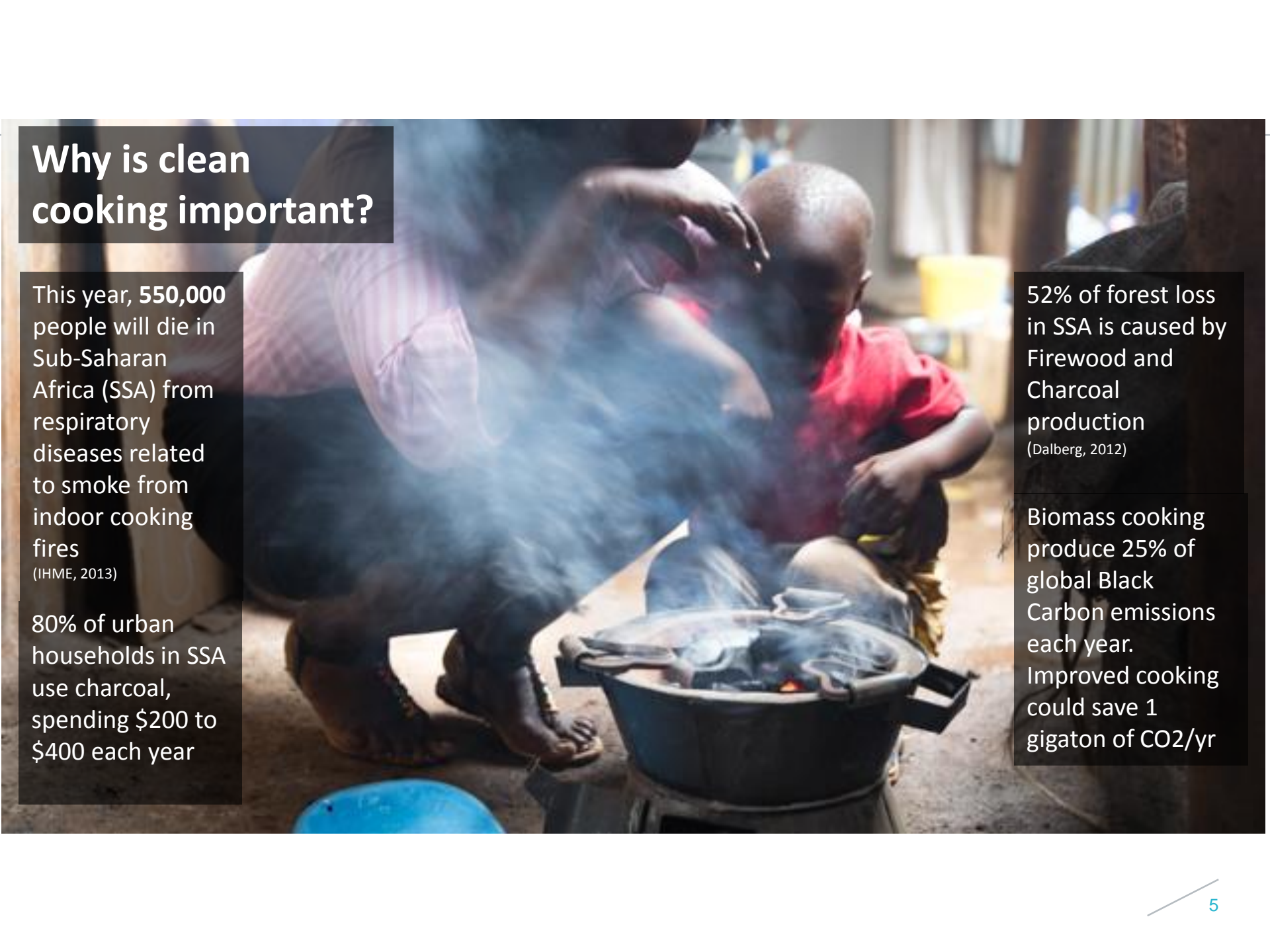
Jessie Press-Williams,
Design Engineer, BURN



Leonard Schurg,
Head of Production Innovation, BURN



Efficiency for Access Design Challenge
Cooking Webinar
17 October 2019

A photograph showing a woman and a young child in a kitchen setting. The woman is leaning over a charcoal stove, and the child is sitting next to it. A large pot is on the stove, and thick white smoke is rising from it. The background is slightly blurred, showing a typical indoor environment.

Why is clean cooking important?

This year, **550,000** people will die in Sub-Saharan Africa (SSA) from respiratory diseases related to smoke from indoor cooking fires

(IHME, 2013)

80% of urban households in SSA use charcoal, spending \$200 to \$400 each year

52% of forest loss in SSA is caused by Firewood and Charcoal production

(Dalberg, 2012)

Biomass cooking produce 25% of global Black Carbon emissions each year. Improved cooking could save 1 gigaton of CO₂/yr

BURN is the first company to address this challenge with a scalable commercial solution

Since 2013, BURN has sold **600,000** best-in-class modern biomass cookstoves in East Africa. These stoves have transformed the lives of **3 million people**, helping reduce:

- fuel consumption by 56%
- household fuel expenditures by \$150-\$200/yr
- total fuel costs by US\$130 million
- wood consumption by 2.4 million tons
- carbon emissions by 2.5 million tCO₂e
- PM_{2.5} and CO₂ emissions by 65-81%*

*The Jikokoa™ meets ISO/IWA Tier '4' ratings - the highest possible rating for performance and health impact - in 6 out of 9 categories, including PM_{2.5}



Poll Question:
What fuel do you typically cook with in
your home?

1. Electricity
2. Gas
3. Charcoal
4. Wood



Kenya Ceramic
Jiko (KCJ)

The BURN Family of Products



3-Stone Fire



Prototyping for cookstove development

- Market research collects rapid user feedback.
- New product development team uses product parameters and design requirements to design and prototype.
- Prototypes are tested.
- Final designs are adjusted for manufacturing and integrated into production lines.

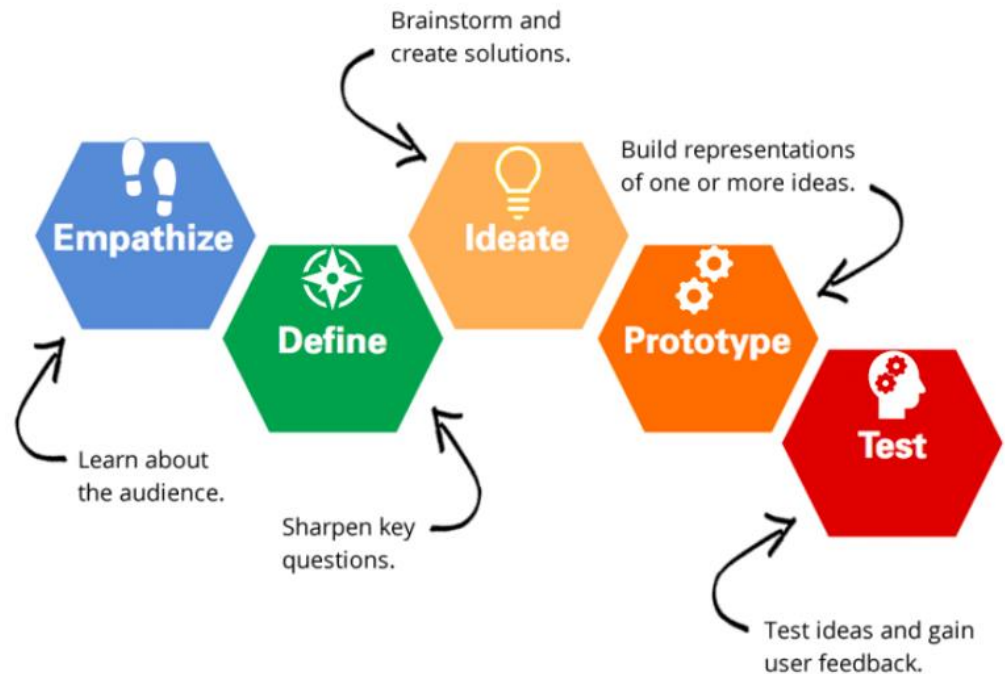


Image <https://blog.movingworlds.org/human-centered-design-vs-design-thinking-how-theyre-different-and-how-to-use-them-together-to-create-lasting-change/>

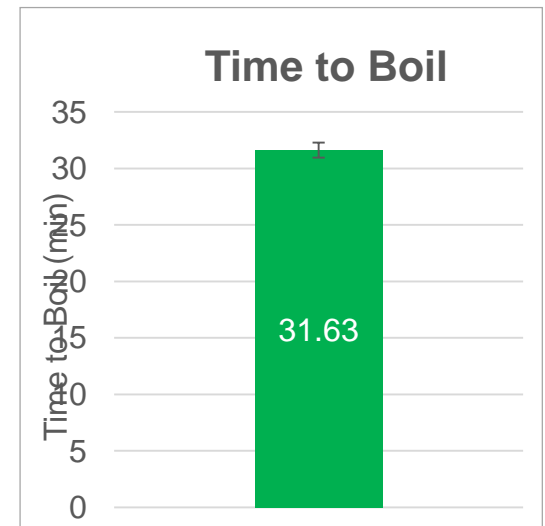
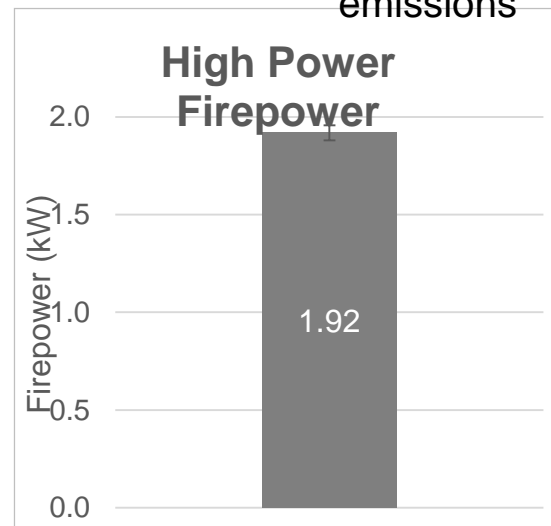
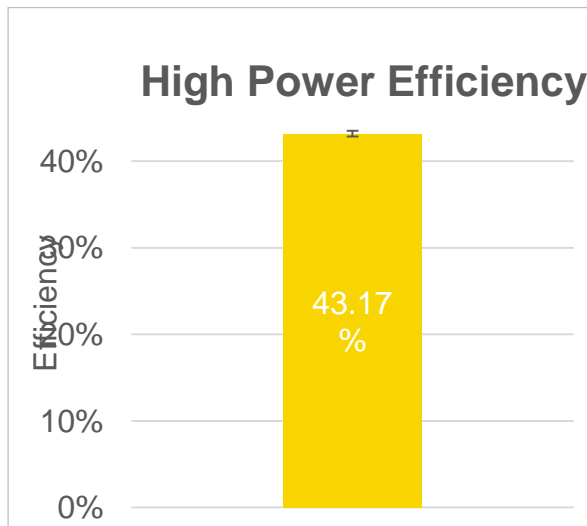
Performance testing for cookstove development

Tests:

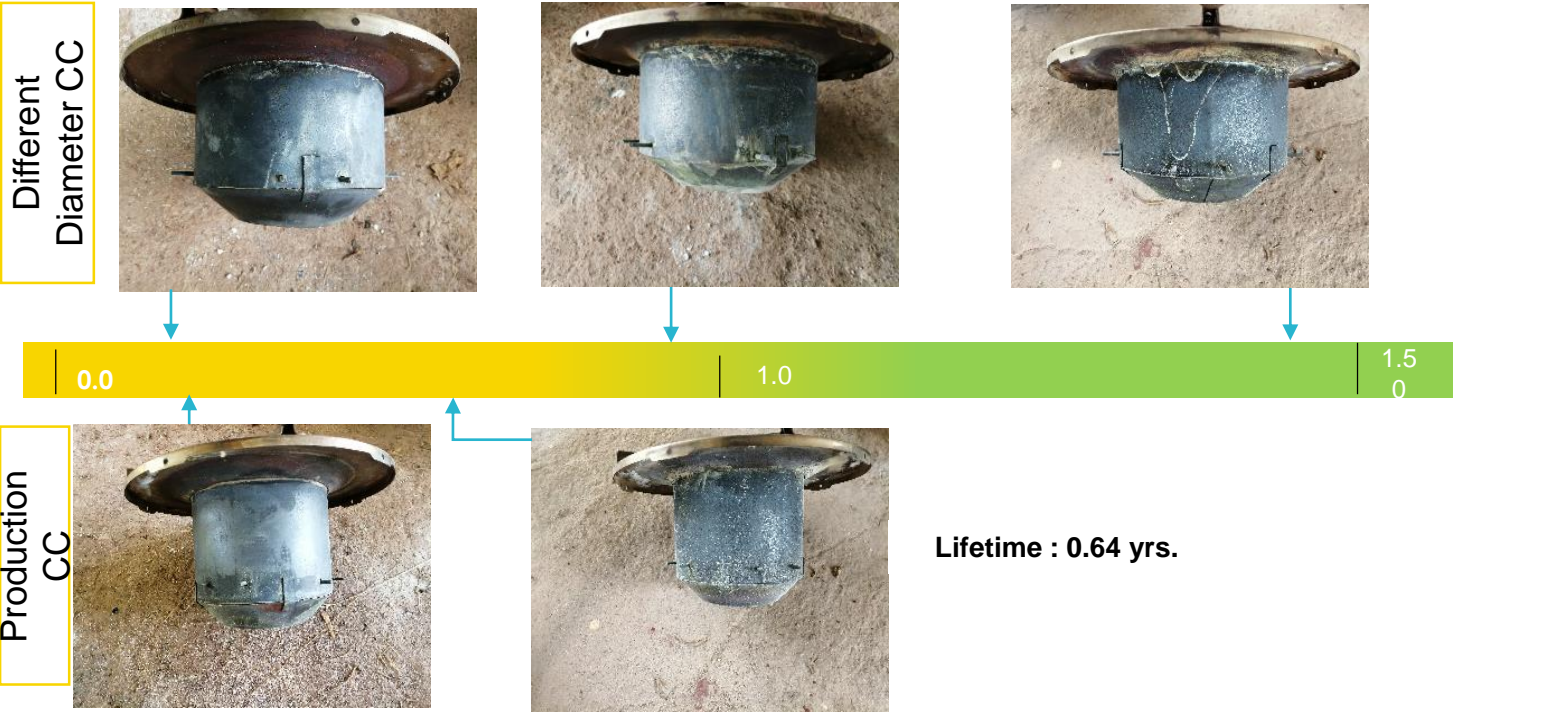
- Water boiling tests (WBTs)
- Temperature testing
- Emissions testing

Key Parameters:

- Efficiency
- Firepower
- Time to boil
- CO & particulate matter emissions



Stove durability program



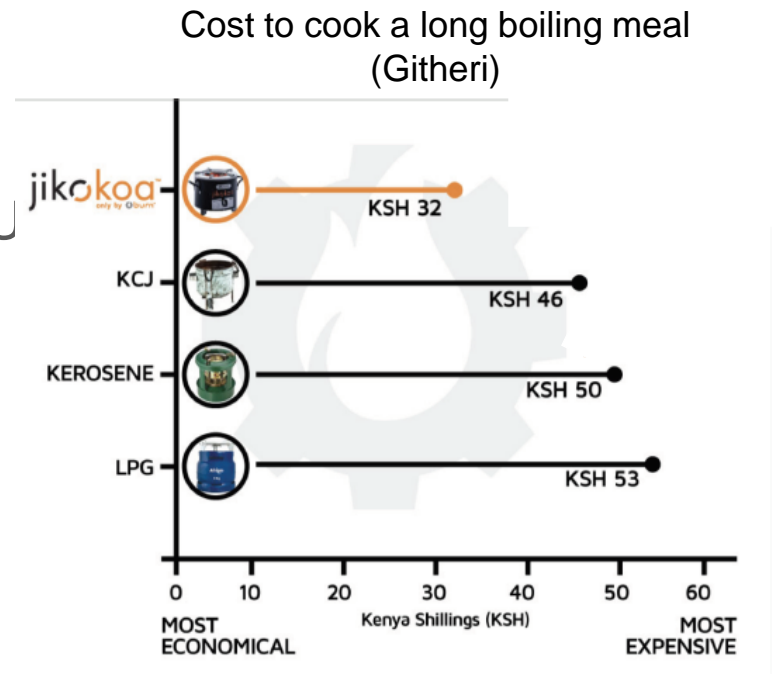
User testing for cookstove development

Tests:

- Focus groups
- Controlled Cooking Tests (CCTs)
- Home placements
- Stove Use Monitoring Systems (SUMS)

Key parameters:

- Cost to cook
- User preferences
- Challenge points
- Usage



Poll Question: How many different types of cooking appliances do you have in your home?

1. 1
2. 2
3. 3
4. 4 or more

Market Research for cookstove development



BORA UHAI

- Extremely cost constrained.



INNOVATO RS

- Motivated to show off new, exciting purchases.



FAMILIES

- Want the best for their families.



MODERN FUELS

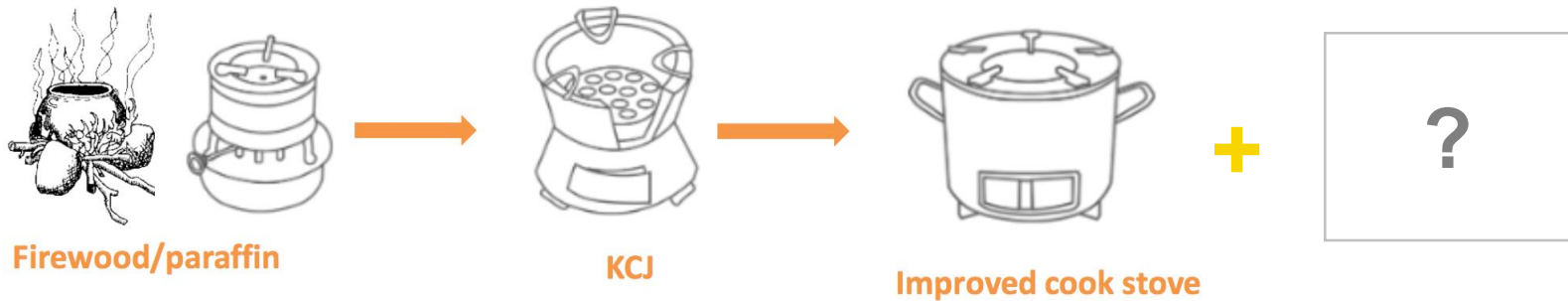
- Know the benefits of using modern fuels.



COST FOCUSED

- Optimize their purchases to save the most in the long run.

Example customer journey



- ▶ Customers purchase additional products over their lifetimes.
- ▶ Cooking decisions are made for many different reasons.
- ▶ Almost all customers participate in “fuel stacking,” meaning cooking stories are not always linear.

Conclusion

- Cooking technologies affect families around the world every day.
- There are many areas of innovation in this space:
 - Technology
 - Financial innovation
 - Traditional fuels
 - Clean fuels

More info: <https://burnstoves.com/>

Contact: kenya@burnmfg.com or recruitment.kenya@burnmfg.com





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Any questions?



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**Jon Leary, Researcher,
Modern Energy Cooking Services (MECS)**



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Cooking with electricity

Dr Jon Leary
MECS Research Associate
j.leary@lboro.ac.uk



Jon Leary

- ▶ University of Sheffield
 - Mechanical Engineering MEng
 - Engineering/Social Science PhD
 - Engineers Without Borders
- ▶ Loughborough University
 - LCEDN
 - eCooking
 - MECS



Outline

- Modern Energy Cooking Services
- Understanding the cook
 - Cooking diaries & eCookBook
 - What's on the menu in urban Kenya?
- Battery-supported eCooking
- The Electric Pressure Cooker (EPC)
 - Opportunities to increase its potential impact







The 2 sides of energy access

- ▶ SDG 7 – access to reliable, sustainable, affordable & modern energy for all
 - Electricity
 - Rapid progress
 - Clean cooking
 - Slow (& in some contexts negative) progress in clean cooking
 - Focus on improving the efficiency of biomass cooking

- ▶ Electricity traditionally discounted by the clean cooking industry

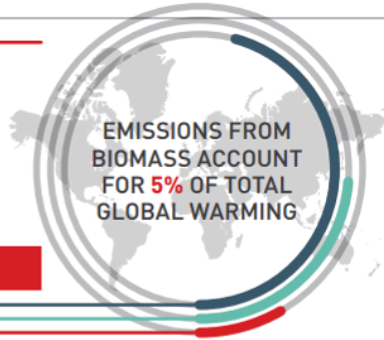
THE PROBLEM

The problem of cooking with electricity can be:-

-  **NO ACCESS OR INSUFFICIENT ACCESS** - rural households don't have it or the supply is very weak!
-  **BURNT OUT WIRING** - drawing high power for cooking through small wires overloads and burns the wiring
-  **BLACK OUTS** - load shedding either planned or unplanned means the household cannot cook when it wants.
-  **LOW VOLTAGE** - we have measured as low as 40V on a national grid that was meant to be 220V, meaning that cooking equipment doesn't work

An emerging opportunity

COOKING WITH ELECTRICITY IN AFRICA & ASIA



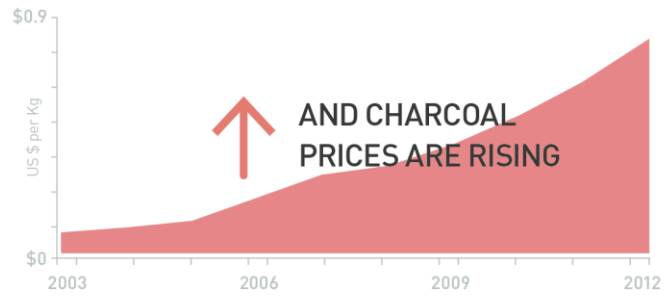
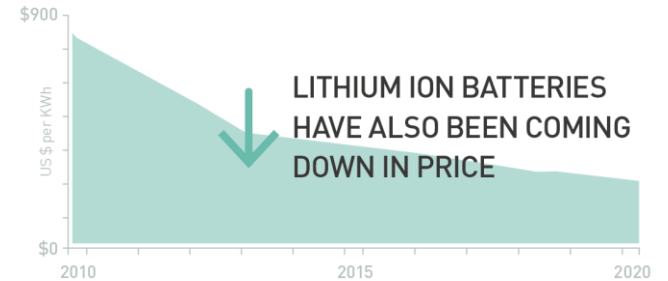
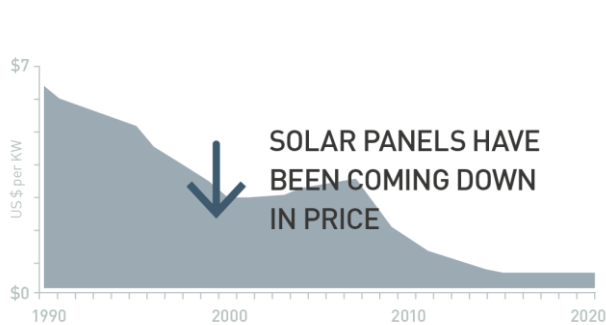
Batchelor (2013, 2015a)

COOKING WITH ELECTRICITY WILL SOON BE A COST EFFECTIVE OPTION FOR THE POOR.

3 BILLION
COOK WITH BIOMASS
WORLDWIDE

1.5 BILLION
PAY MORE THAN \$10 PER
MONTH TO COOK WITH BIOMASS

4 MILLION
PREMATURE DEATHS PER
YEAR FROM ACUTE
RESPIRATORY INFECTION AS
A RESULT OF COOKING OVER
WOOD AND BIOMASS



Battery-supported eCooking

THE SOLUTION

Solve these problems by trickle charging a battery, cook when you want, charge whenever power is available

TRICKLE CHARGE the battery from Solar PV during the day when the sun shines

OR

TRICKLE CHARGE from national grid during the night when there is spare capacity

OR

TRICKLE CHARGE from other sources during the day & night

Hydro grids
surplus energy particularly at night

Wind Power
energy available when the wind blows

Any micro or mini grid

For utilities and IPPs, this can mean more revenue and a more effectively used power system.



Battery-supported eCooking

- Shift towards service delivery business models
- Reducing the cost of the most expensive component key to achieving affordability
- Battery size can be significantly reduced by optimizing energy demand
- New ultra-efficient eCooking appliances now available



What is the '*LED of battery-supported eCooking*'?

LED vs. incandescent
90% reduction





**Poll: How many people regularly
cook at home?**

Key behavioural change barriers

Slow



Single pot only



Many complicated buttons

Restricted access to pot whilst cooking



Flat bottomed pots only



Steel pots only

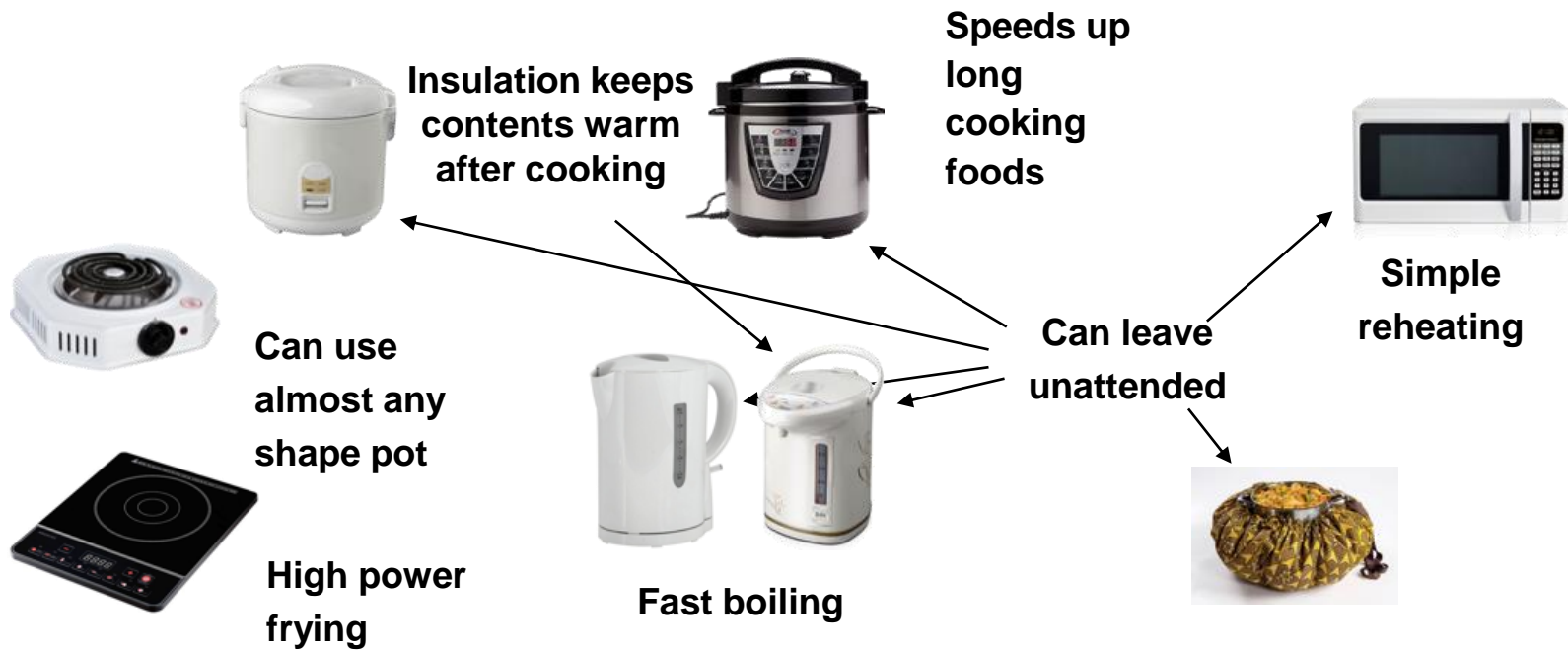


Water boiling only

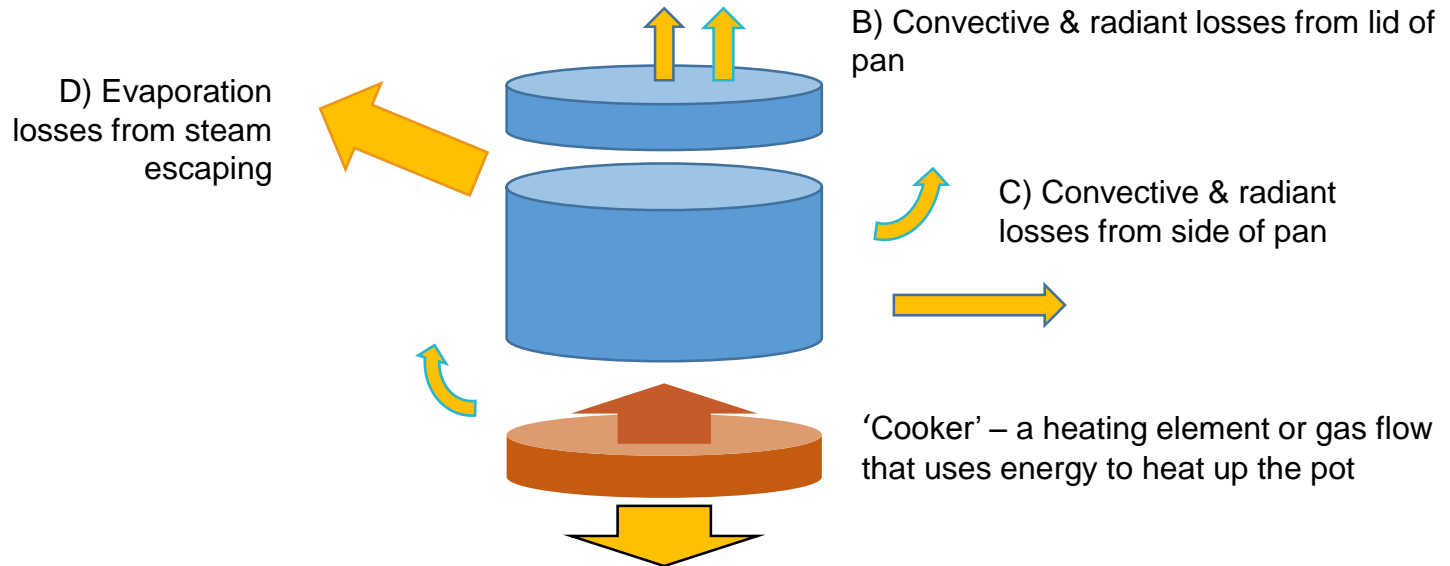
Requires other stove for initial heating



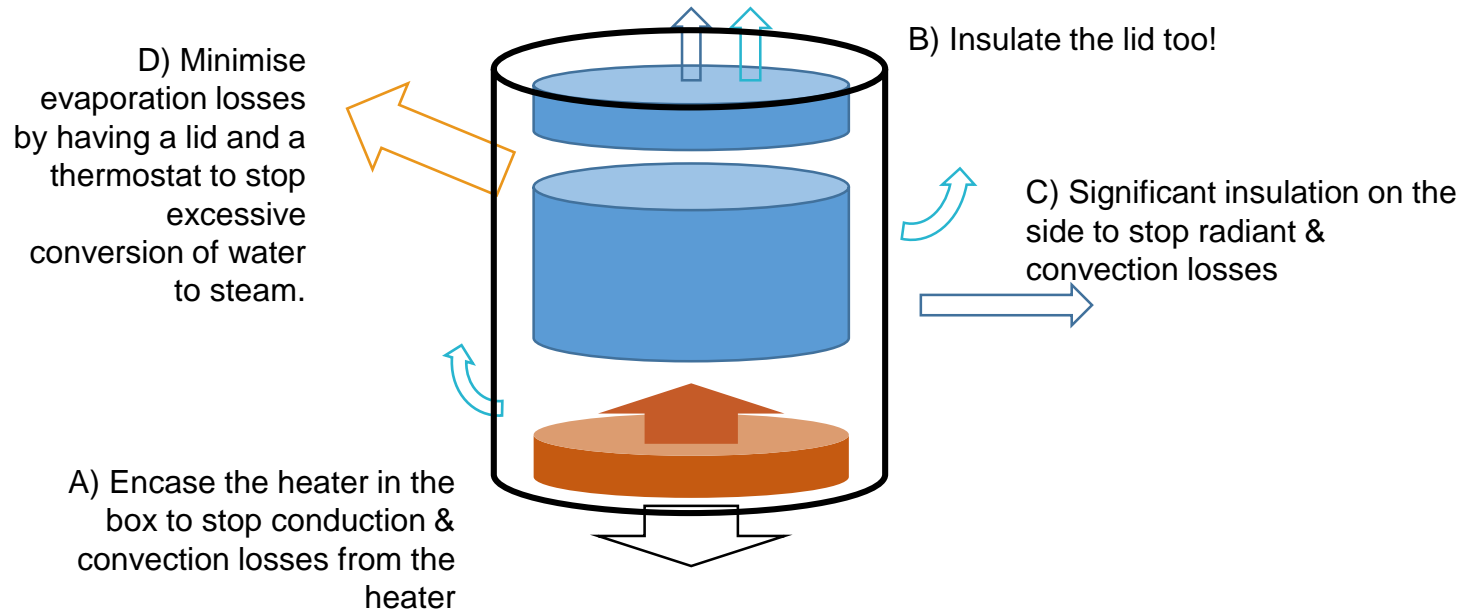
Key drivers for sustained adoption



Heat transfer OUT of the pot is as important as heat transfer into it!



Think INSIDE The box



The Electric Pressure Cooker (EPC)



WHAT IS IT?

The electric pressure cooker (or multicooker) is an appliance that is a combination of familiar things (an electric hotplate, a pressure cooker and an insulated hotbox) - with a fully automated control system.

*electric
pressure
cooker [EPC]*

=



insulation

+



electric hotplate

+



pressure cooker



**Poll: How many people have used
an Electric Pressure Cooker
(EPC) before?**

Cooking diaries study

- ▶ 80 households in 4 different countries
 - Kenya, Tanzania, Zambia, Myanmar
- ▶ Recording what they cook, how & how much energy they use
- ▶ 6 weeks – 2 weeks baseline, 4 weeks eCooking
- ▶ Range of appliances, including EPC



EPCs and charcoal are both favored for 'heavy foods'

"I used to cook beans on charcoal because I thought it was the cheapest option. I was so surprised to find out that cooking beans on the electric pressure cooker was faster and cheaper!"

- Damaris

where is the money going?



11.5 KSh
2hrs 5mins
0.51 units

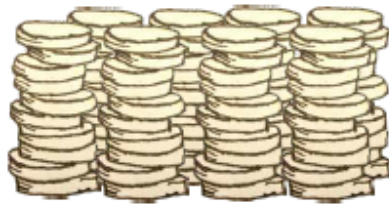


Damaris used roughly the same amount of energy pressure cooking for 10 mins, for 30, and for 100 mins. Each time the lid is opened on an EPC it adds at least 5 mins to the cooking time, and can increase the total cost by upto 50%.

when using charcoal...



80 KSh
3+ hrs
1 tin of charcoal



But what about the rest of the menu?

Food category	Typical dishes	Frequency on urban Kenyan menu
'Heavy foods'	Beans, matumbo, meat stews	32%
Staples	Ugali, rice	39%
Quick fry	Sukuma wiki, eggs	20%
Deep fry	Mandazi, fried chicken, chips	2%
Long fry	Chapati	4%

But what about the rest of the menu?

Food category	Compatibility with EPCs	Energy savings with EPCs	Enablers
'Heavy foods'	Users instinctively use EPCs	High	Cooking times & water quantities for popular local foods
Staples	Users use EPCs if encouraged	Moderate	Demonstrations, extra EPC
Quick fry	Users use EPCs if encouraged	Low	Demonstrations, manual heat control, extra EPC, shallow pan
Deep fry	Users cannot currently use EPCs	Low	Manual heat control or deep fry settings (160-180C)
Long fry	Users cannot currently use EPCs	Low	Manual heat control & shallow pan

Energy saving potential



Conclusion

- ▶ EPCs have a huge potential for tackling global health, environmental & gender equity challenges of cooking with biomass
- ▶ Design challenges to increase the impact of EPCs:
 - Enabling access for consumers in weak-grid and off-grid regions
 - Lowering behavioural change barriers & amplifying drivers
 - Cooking a broader range of foods



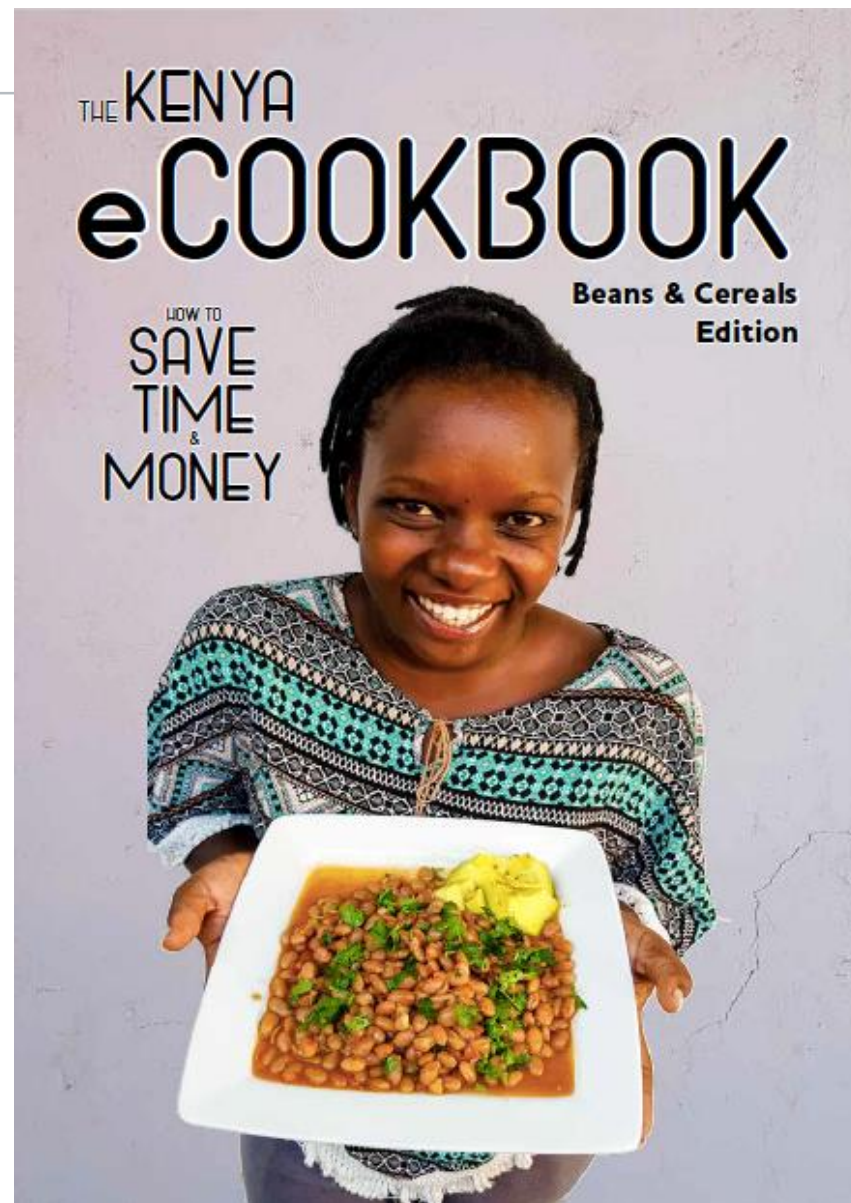
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