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Cooking

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Our speakers

- **Jon Leary**
  - Researcher at Modern Energy Cooking Services (MECS)
  - Working to empower everyday cooks
  - Develops and trials innovative solutions

- **Leonard Shurg**
  - Head of Production Innovation at 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

- **Biraj Gautam**
  - CEO of People, Energy & Environment Development Association
  - Over 12 years experience as a management leader and an environmental professional
  - Specializes in coordinating a multi-sectoral team, resource mobilization, orientation, and supervision of project implementation
  - Holds an MSc. in Environmental Science from Tribhuvan University, Nepal.

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Cooking with Electricity

Jon Leary - MECS

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Cooking with electricity

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MECS
Modern Energy Cooking Services

Loughborough University

ESMAP
Energy Sector Management Assistance Program

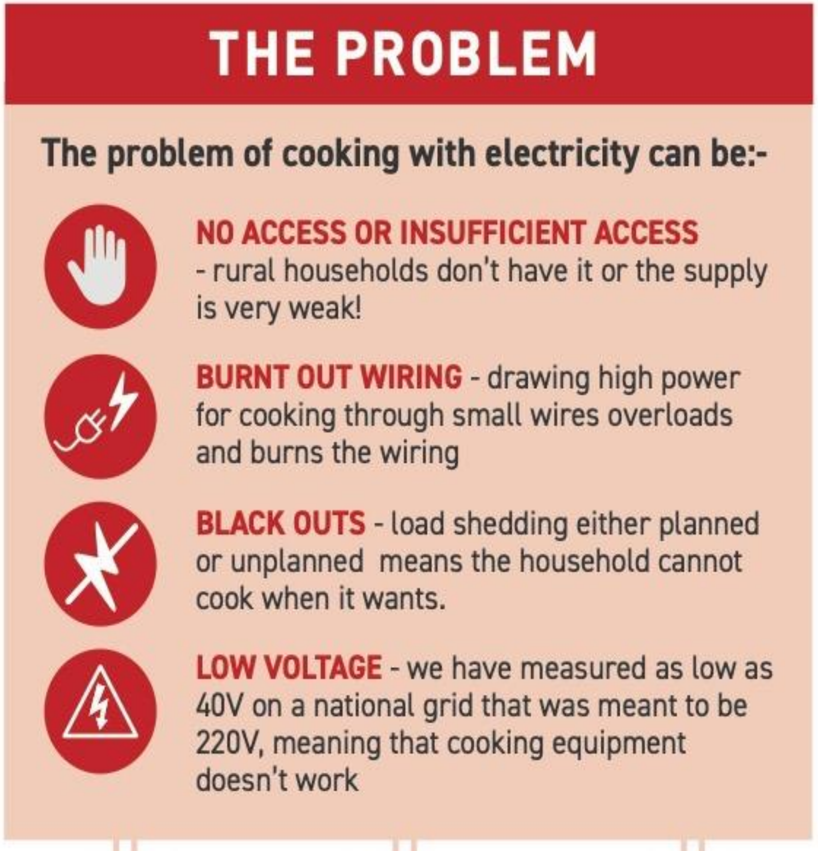
UKaid
from the British people

Outline

- What new opportunities are on the horizon for eCooking?
- Which eCooking appliances are most efficient & why?
- How can we make eCooking accessible, affordable & desirable?

The old narrative on eCooking

- 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
- Electric cooking historically ignored 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!

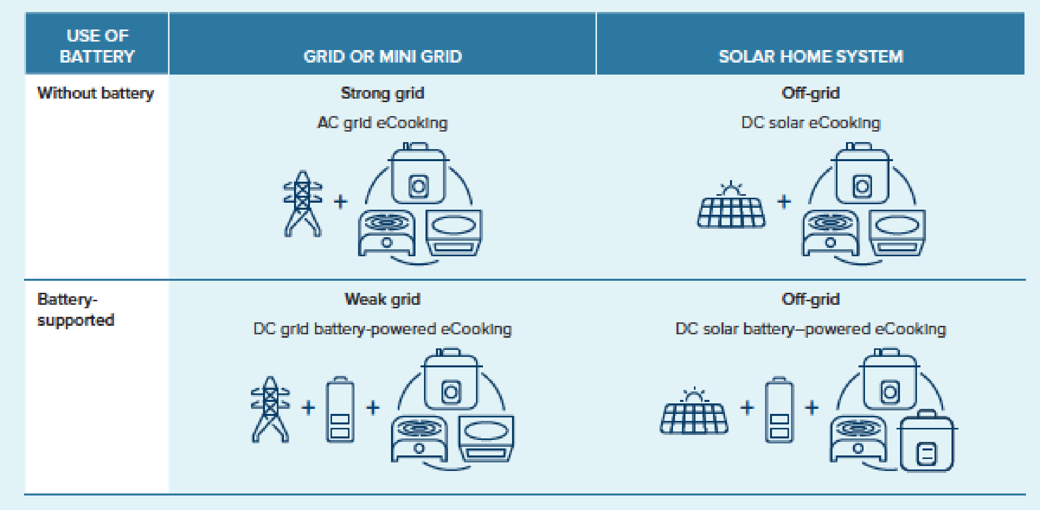
BURNT OUT WIRING - drawing high power for cooking through small wires overloads and burns the wiring

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

New opportunities opening up for eCooking

- Falling costs of solar PV & battery storage
  - Rising cost of biomass fuels
- Energy-efficient appliances
  - Induction, infra-red, rice cooker, Electric Pressure Cooker (EPC)…



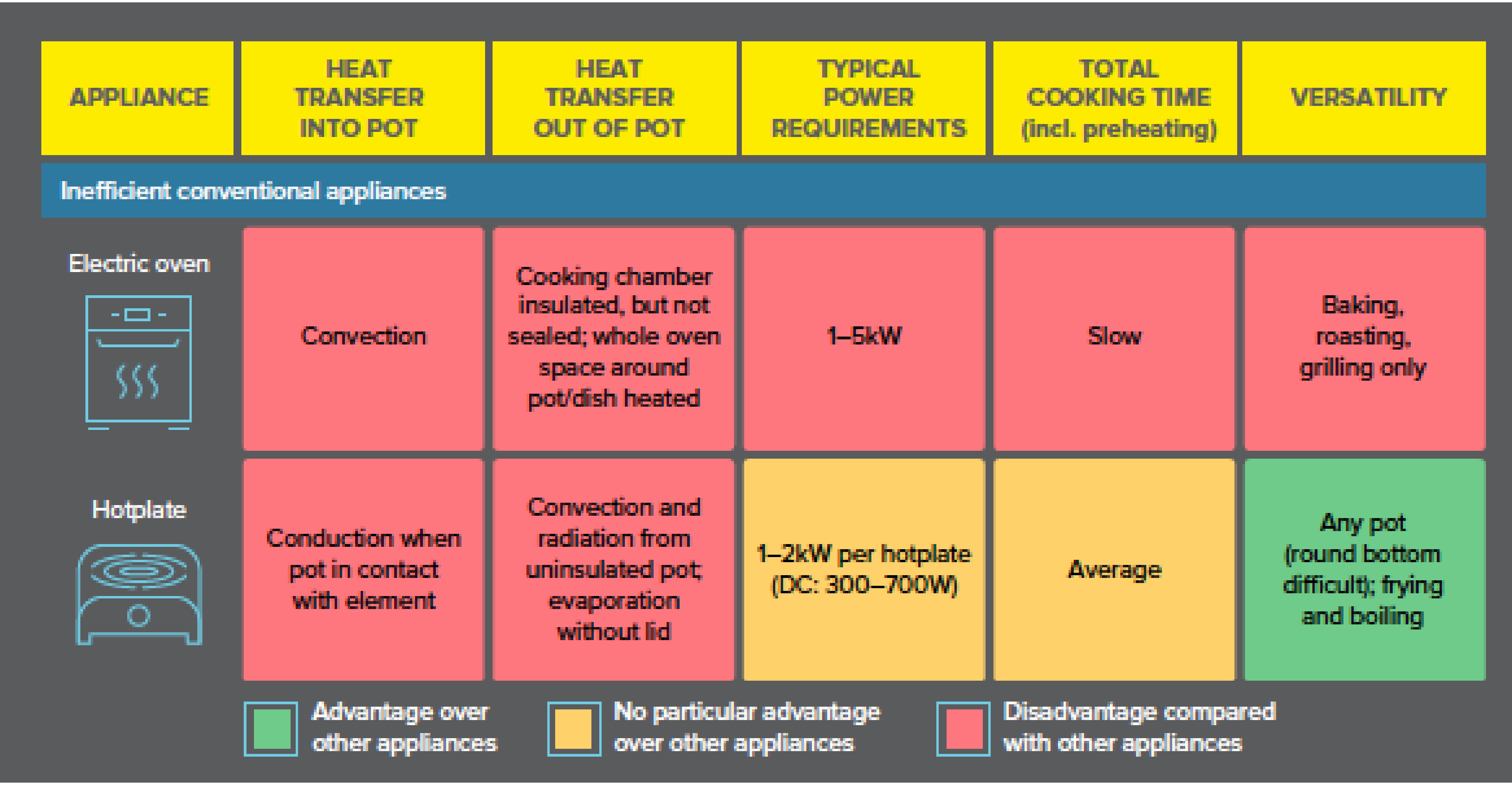
USE OF BATTERY	GRID OR MINI GRID	SOLAR HOME SYSTEM
Without battery	Strong grid AC grid eCooking	Off-grid DC solar eCooking
Battery-supported	Weak grid DC grid battery-powered eCooking	Off-grid DC solar battery–powered eCooking

ESMAP (2020)

What is the ‘*LED of battery-supported eCooking*’?

LED vs. incandescent
90% reduction

Typology of eCooking appliances



APPLIANCE	HEAT TRANSFER INTO POT	HEAT TRANSFER OUT OF POT	TYPICAL POWER REQUIREMENTS	TOTAL COOKING TIME (incl. preheating)	VERSATILITY
Inefficient conventional appliances					
Electric oven	🟥 Convection	🟥 Cooking chamber insulated, but not sealed; whole oven space around pot/dish heated	🟥 1–5kW	🟥 Slow	🟥 Baking, roasting, grilling only
Hotplate	🟥 Conduction when pot in contact with element	🟥 Convection and radiation from uninsulated pot; evaporation without lid	🟨 1–2kW per hotplate (DC: 300–700W)	🟨 Average	🟩 Any pot (round bottom difficult); frying and boiling

🟩 Advantage over other appliances

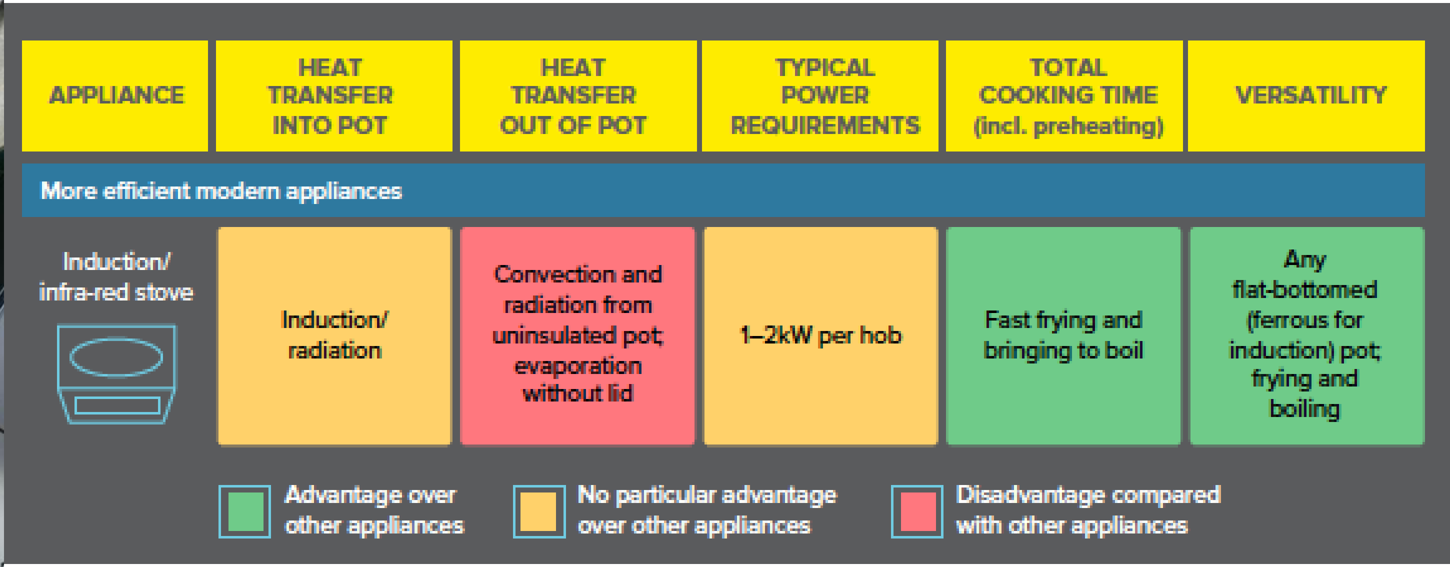
🟨 No particular advantage over other appliances

🟥 Disadvantage compared with other appliances

ESMAP (2020)

Typology of eCooking appliances

ESMAP (2020)



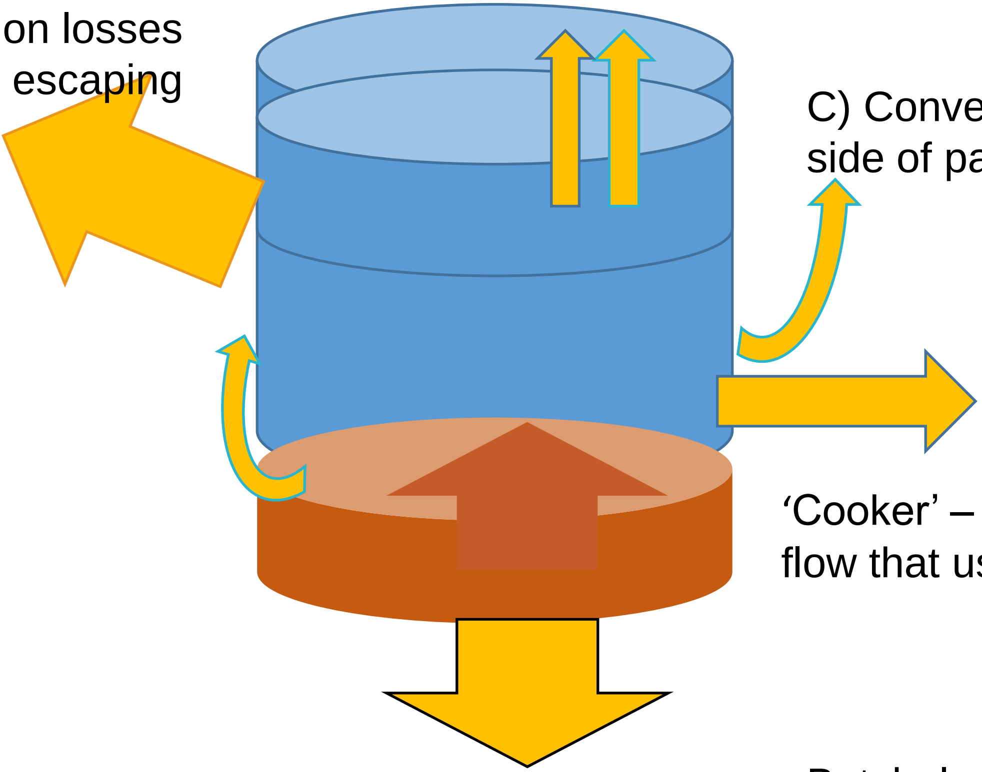
APPLIANCE	HEAT TRANSFER INTO POT	HEAT TRANSFER OUT OF POT	TYPICAL POWER REQUIREMENTS	TOTAL COOKING TIME (incl. preheating)	VERSATILITY
More efficient modern appliances					
Induction/ infra-red stove	🟨 Induction/ radiation	🟥 Convection and radiation from uninsulated pot; evaporation without lid	🟨 1–2kW per hob	🟩 Fast frying and bringing to boil	🟩 Any flat-bottomed (ferrous for induction) pot; frying and boiling

🟩 Advantage over other appliances

🟨 No particular advantage over other appliances

🟥 Disadvantage compared with other appliances

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



B) Convective & radiant losses from lid of pan

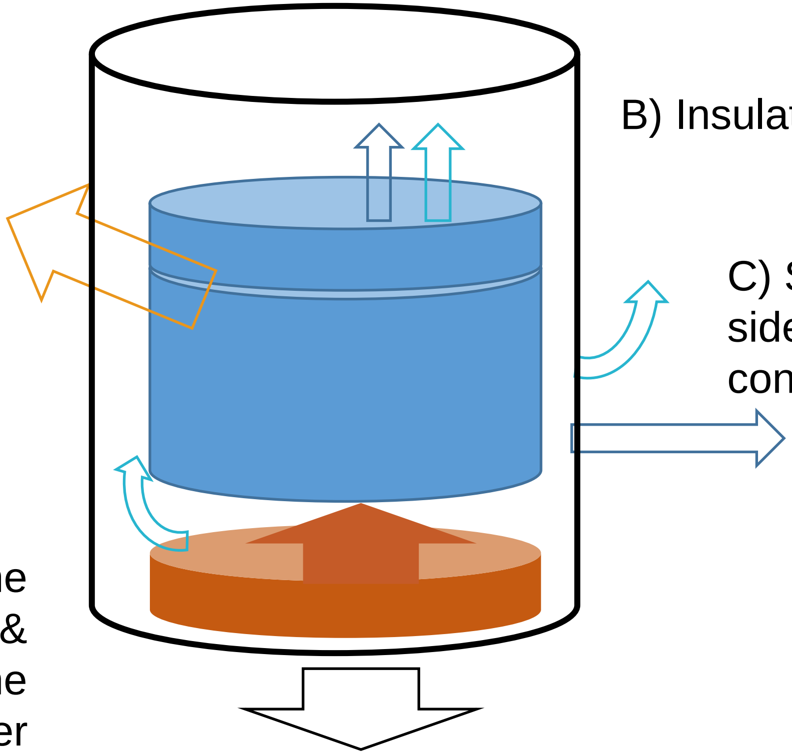
D) Evaporation losses
from steam escaping

C) Convective & radiant losses from side of pan

‘Cooker’ – a heating element or gas flow that uses energy to heat up the pot

Batchelor et al (2018)

Think INSIDE The box



D) Minimise evaporation losses by having a lid and a thermostat to stop excessive conversion of water to steam.

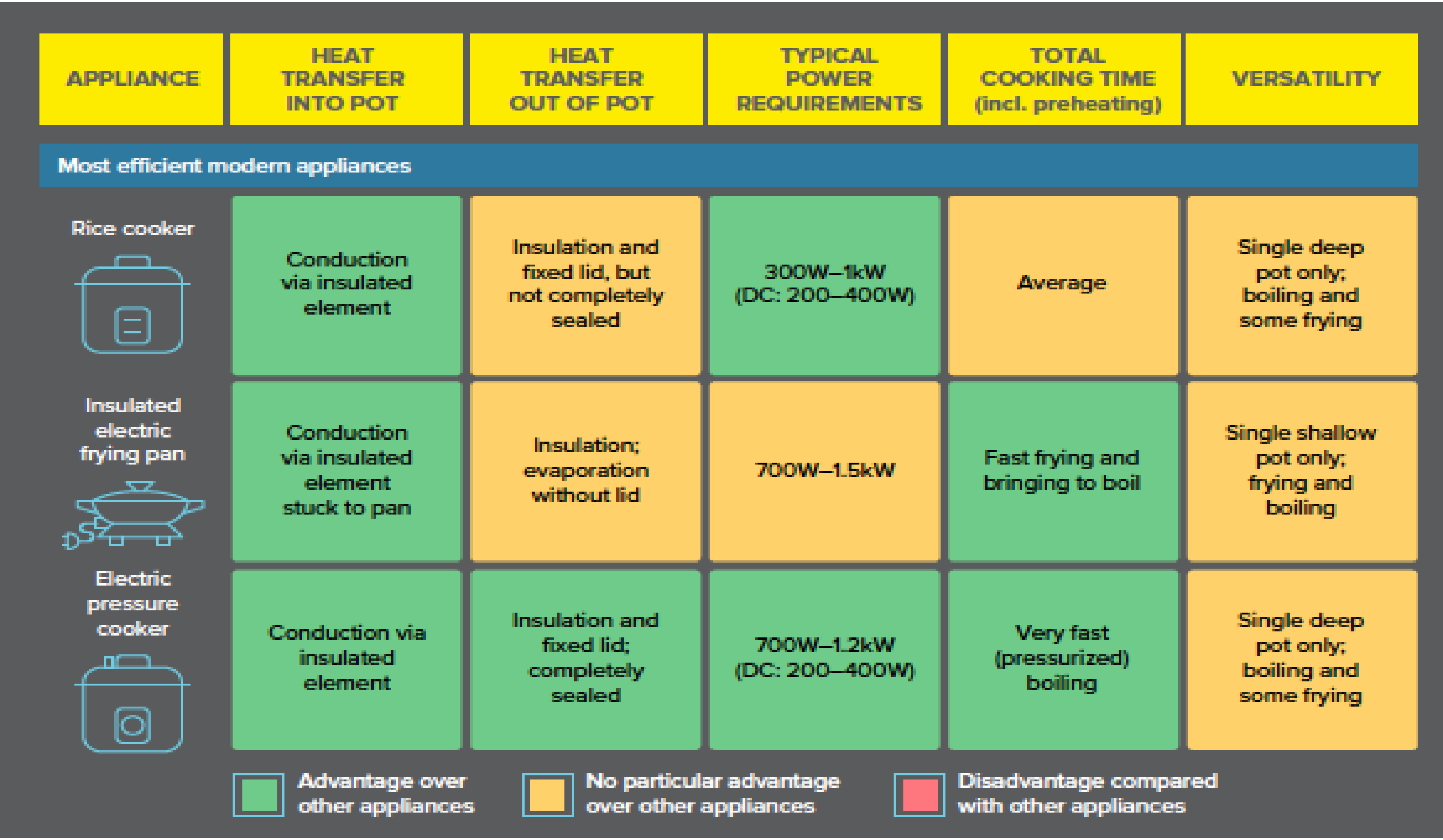
B) Insulate the lid too!

C) Significant insulation on the side to stop radiant & convection losses

A) Encase the heater in the box to stop conduction & convection losses from the heater

Batchelor et al (2018)

Typology of eCooking appliances



APPLIANCE	HEAT TRANSFER INTO POT	HEAT TRANSFER OUT OF POT	TYPICAL POWER REQUIREMENTS	TOTAL COOKING TIME (incl. preheating)	VERSATILITY
Most efficient modern appliances					
Rice cooker	🟩 Conduction via insulated element	🟨 Insulation and fixed lid, but not completely sealed	🟩 300W–1kW (DC: 200–400W)	🟨 Average	🟨 Single deep pot only; boiling and some frying
Insulated electric frying pan	🟩 Conduction via insulated element stuck to pan	🟨 Insulation; evaporation without lid	🟨 700W–1.5kW	🟩 Fast frying and bringing to boil	🟨 Single shallow pot only; frying and boiling
Electric pressure cooker	🟩 Conduction via insulated element	🟩 Insulation and fixed lid; completely sealed	🟩 700W–1.2kW (DC: 200–400W)	🟩 Very fast (pressurized) boiling	🟨 Single deep pot only; boiling and some frying

🟩 Advantage over other appliances

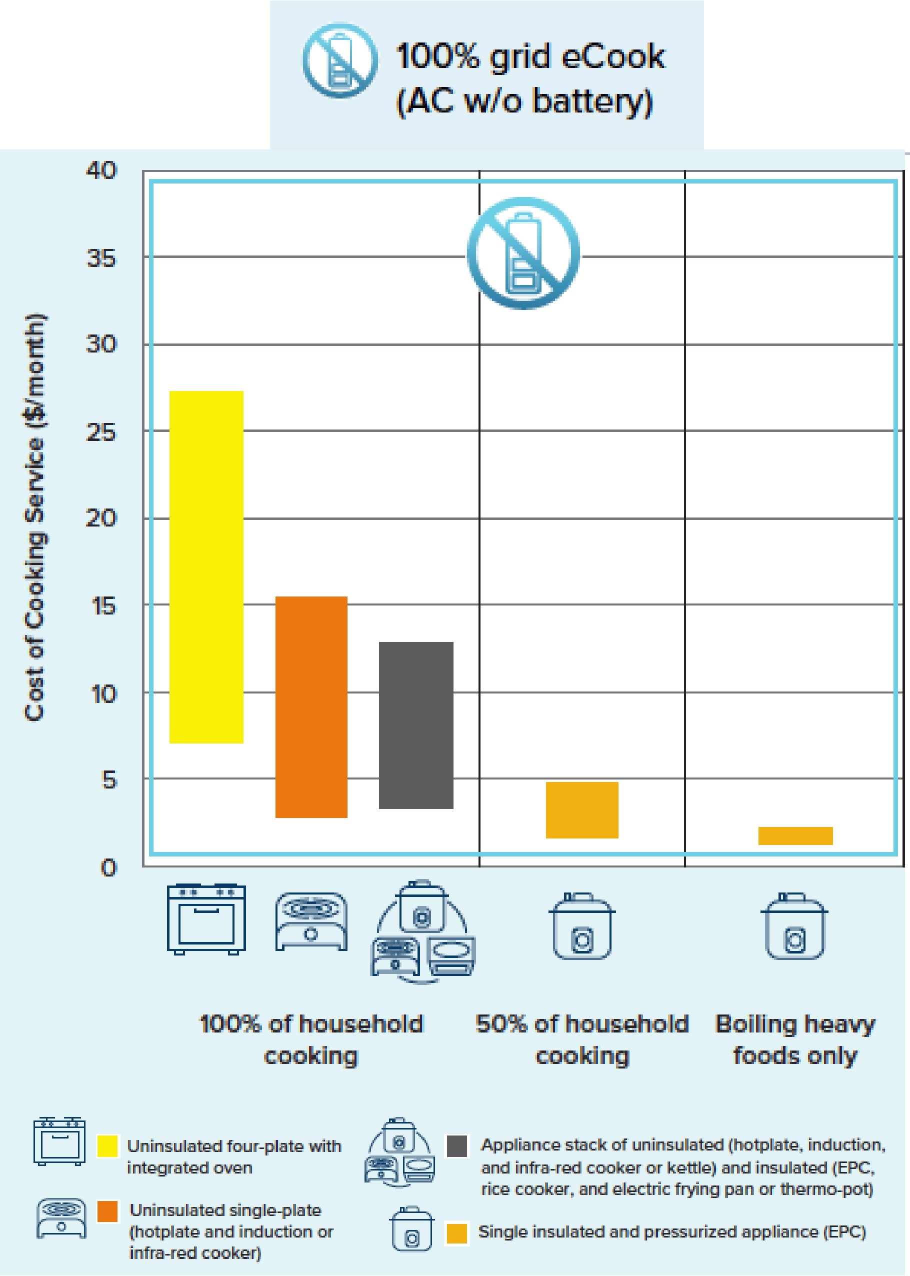
🟨 No particular advantage over other appliances

🟥 Disadvantage compared with other appliances

ESMAP (2020)

Cost-effective eCooking

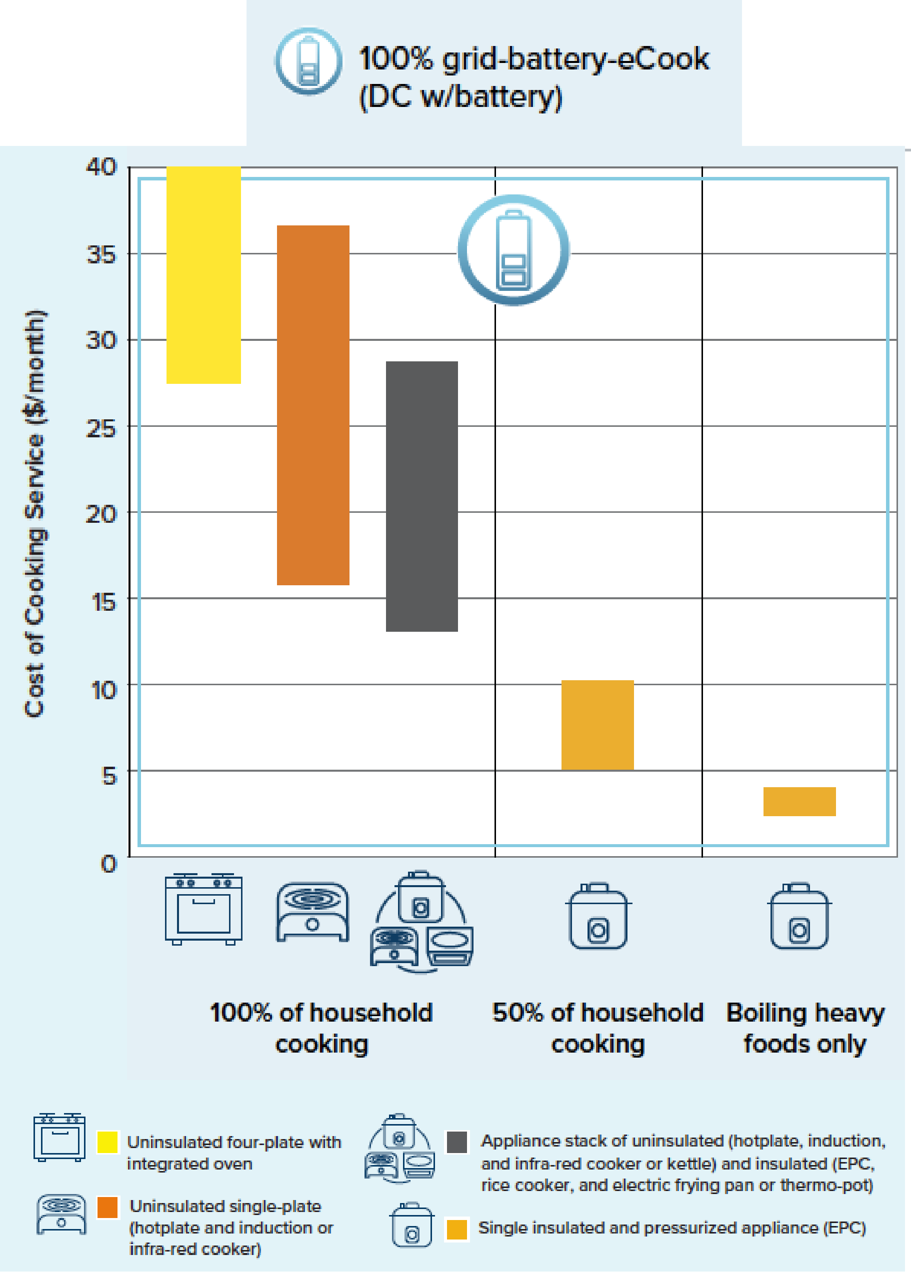
- Culturally-appropriate energy-efficient appliances can:
  - Reduce costs by optimizing energy demand
  - Be highly desirable to consumers by making cooking easier
- However, the most efficient appliances cannot cook all foods
  - Important to select appliances that match with local cuisine & plan for fuel/appliance stacking



ESMAP (2020)

Cost-effective eCooking

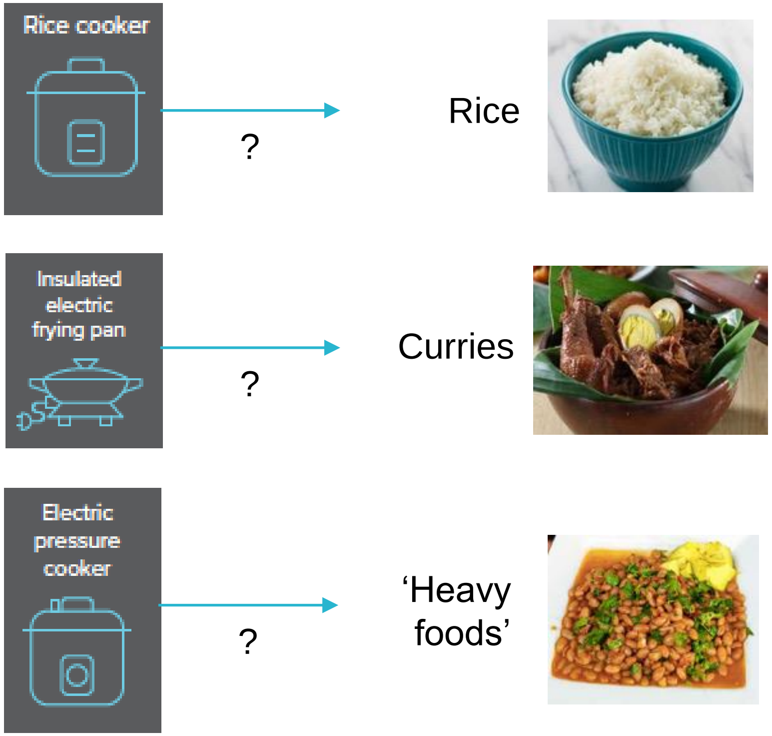
- Upfront costs typically high
  - Service delivery business models (e.g. PAYG, utility) can make eCooking affordable
- Battery-supported eCooking
  - Reducing the cost of the most expensive component key to achieving affordability
  - Battery size can be significantly reduced by optimizing energy demand



ESMAP (2020)

Identify culturally-appropriate energy-efficient appliances

- Establish which energy-efficient appliances fit best with local cuisine
  - Categorise the menu by understanding how popular dishes are prepared
  - Match popular dish types with appropriate appliances
  - Engage with real cooks



Rice cooker → ? → Rice

Insulated electric frying pan → ? → Curries

Electric pressure cooker → ? → ‘Heavy foods’

Conclusion

- Energy-efficient eCooking appliances have huge potential for tackling global health, environmental & gender equity challenges of cooking with biomass
- Design challenges to increase the impact of energy-efficient eCooking appliances:
  - Enable access for consumers in weak-grid and off-grid regions
  - Break down the high upfront cost
  - Identify & optimise culturally-appropriate appliances that can cook popular local foods efficiently

Thanks for listening!

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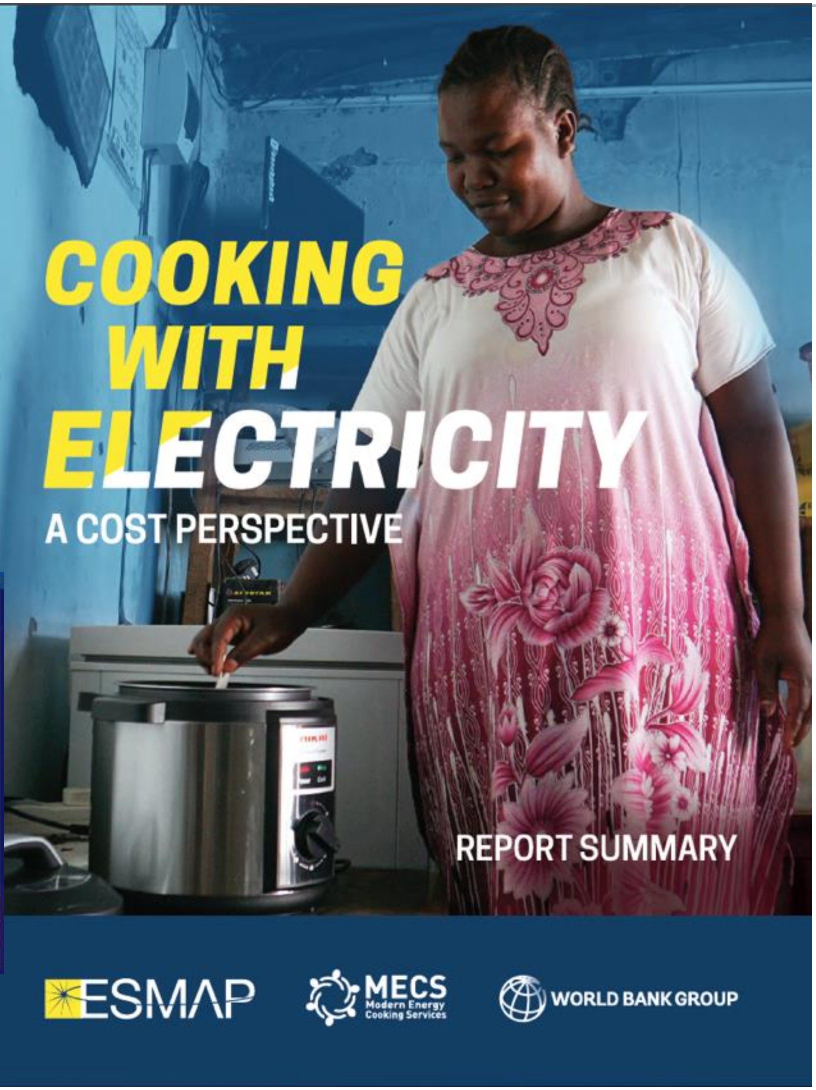

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- ESMAP. 2020. Cooking with Electricity: A Cost Perspective. Washington, DC: World Bank.

Photo credits

- Jacob Fodio Todd @ MECS (slide 14)
- Google images (slide 5)
- Jon Leary @ MECS (all other slides)

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Leonard Shurg, BURN

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Efficiency for Access
Design Challenge
Webinar: Cooking appliances
27-10-2020

Saving lives and forests through
the design, manufacture and
distribution of best-in-class,
clean cookstoves

Annually more than **500,000** people die in Sub-Saharan Africa from respiratory diseases related to smoke from indoor cooking fires

(IHME, 2013)

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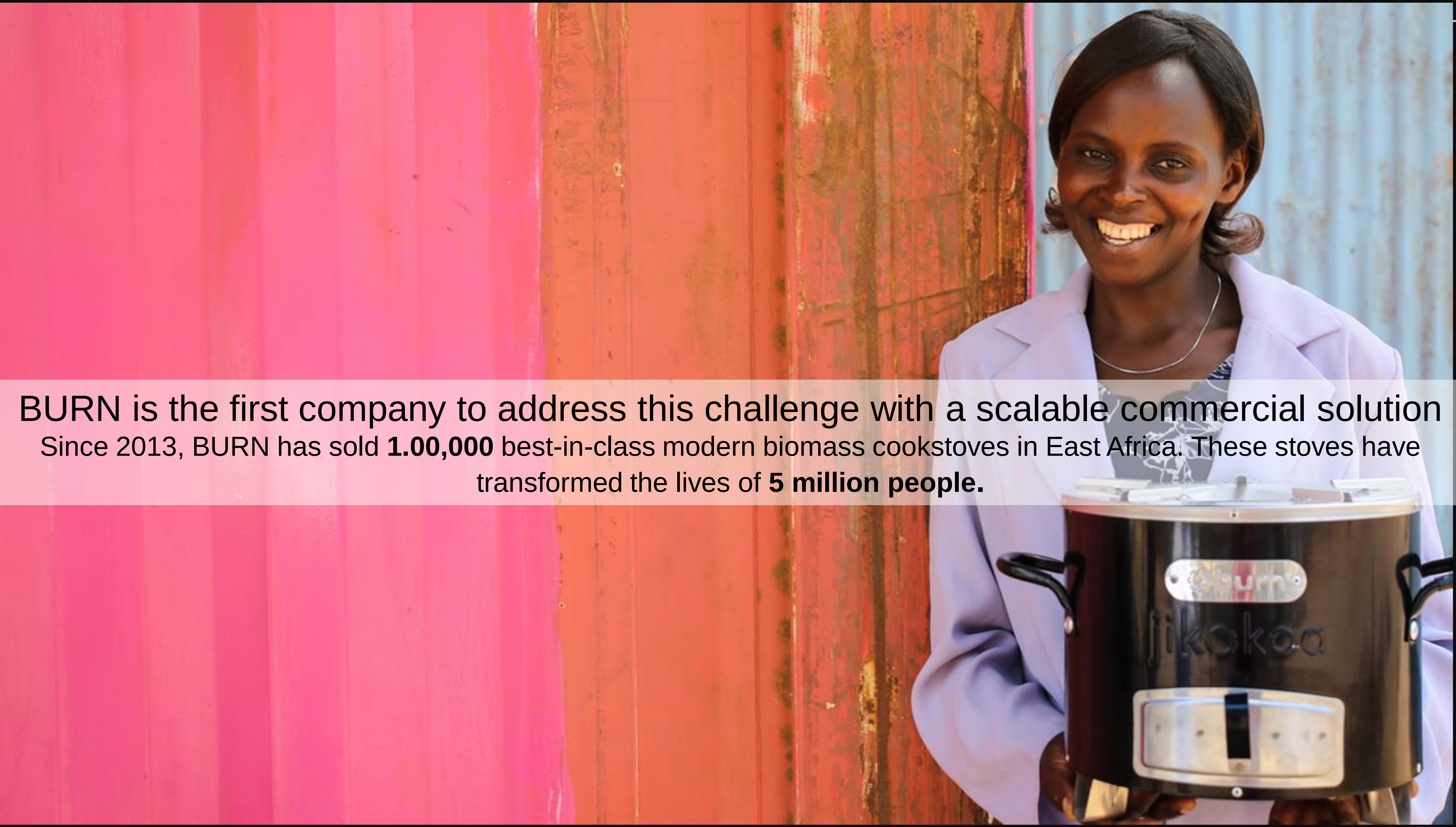
52% of forest loss in SSA is caused by Firewood and charcoal production

(Dalberg, 2012)

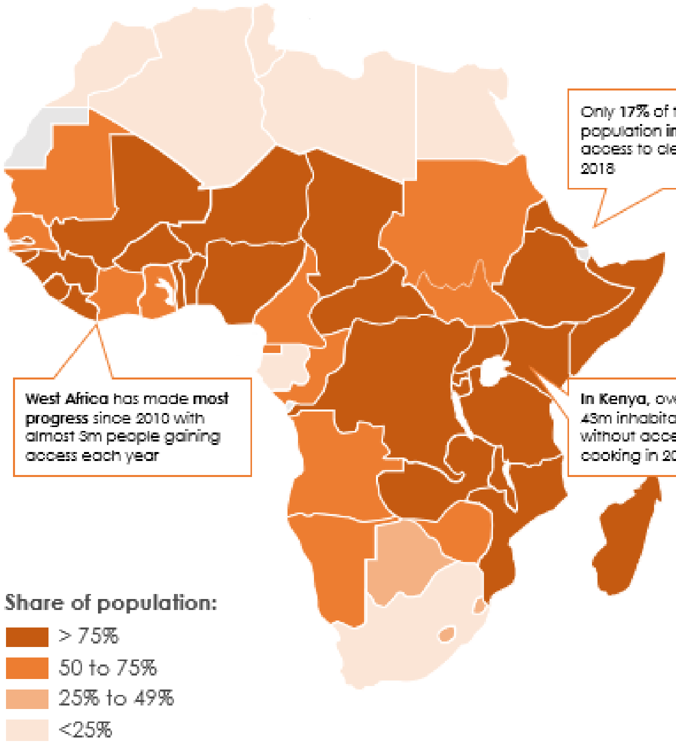


BURN is the first company to address this challenge with a scalable commercial solution

Since 2013, BURN has sold **1.00,000** best-in-class modern biomass cookstoves in East Africa. These stoves have transformed the lives of **5 million people.**

SSA progress on access to clean cooking is slow and heavily dependent on government's policy priorities

Share of population without access to clean cooking
(Africa, 2018)



Only 17% of the population **in SSA** had access to clean cooking in 2018

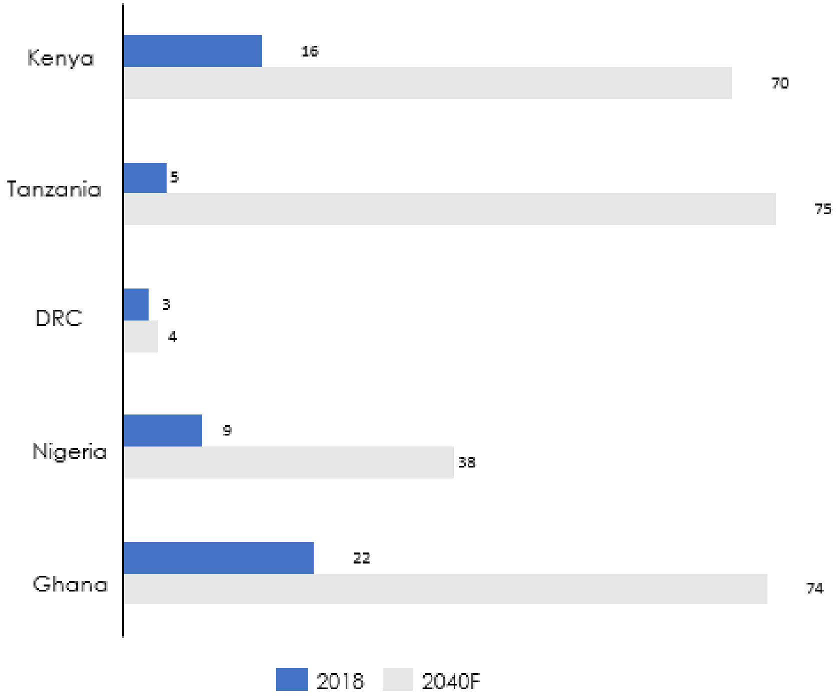
West Africa has made **most progress** since 2010 with almost 3m people gaining access each year

In Kenya, over 75% of the 43m inhabitants were still without access to clean cooking in 2018

Share of population:
- 🟫 > 75%
- 🟧 50 to 75%
- ▨ 25% to 49%
- ☐ <25%

Source: International Energy Association, 2019

Access to clean cooking,
Selected markets (%)



Journey to clean cooking

3-Stone Fire

Kenya Ceramic Jiko

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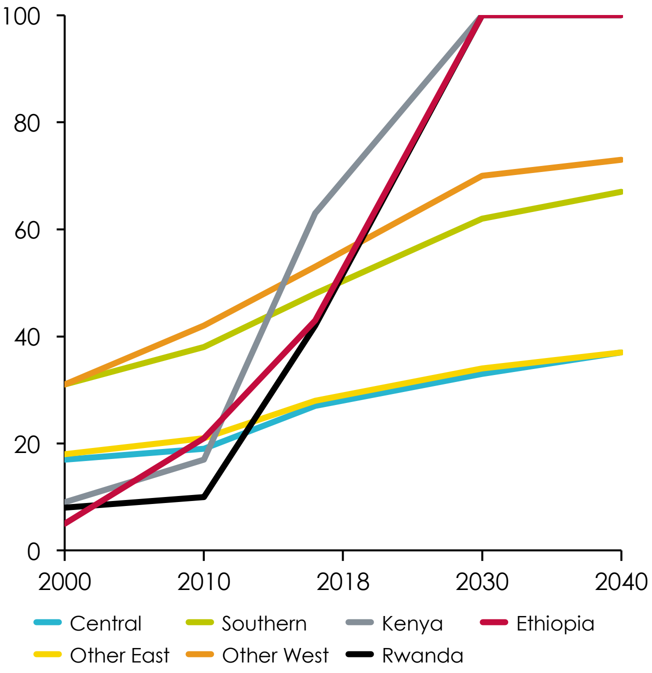
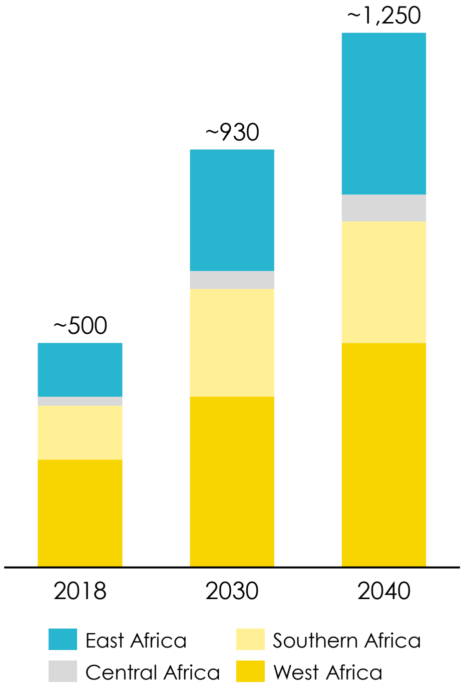
PHILIPS
Sunny day in a good mood

Electrification is forecast to increase across SSA reaching ~1.25 bn individuals with access to electricity by 2040

Access rate to electricity – selected markets (in %)



Population with access to electricity
(in m#)



- Access to electricity in SSA is forecast to continue to increase through 2040 with major governments having committed to ambitious policies targeting increased access to electricity in their countries
    - Kenya has released a National Electrification Strategy in 2018 with large investments into electrical grids
- Most rapid progress is expected in East Africa, the regional access rate to electricity is forecast to reach 70% by 2030
- Countries like Kenya and Tanzania are expected to make most progress with access to electricity:
    - Kenya reaching full electrification by 2030
    - Tanzania's electrification rate climbing from <40% in 2018 to 70% by 2030

Source: International Energy Association, 2019

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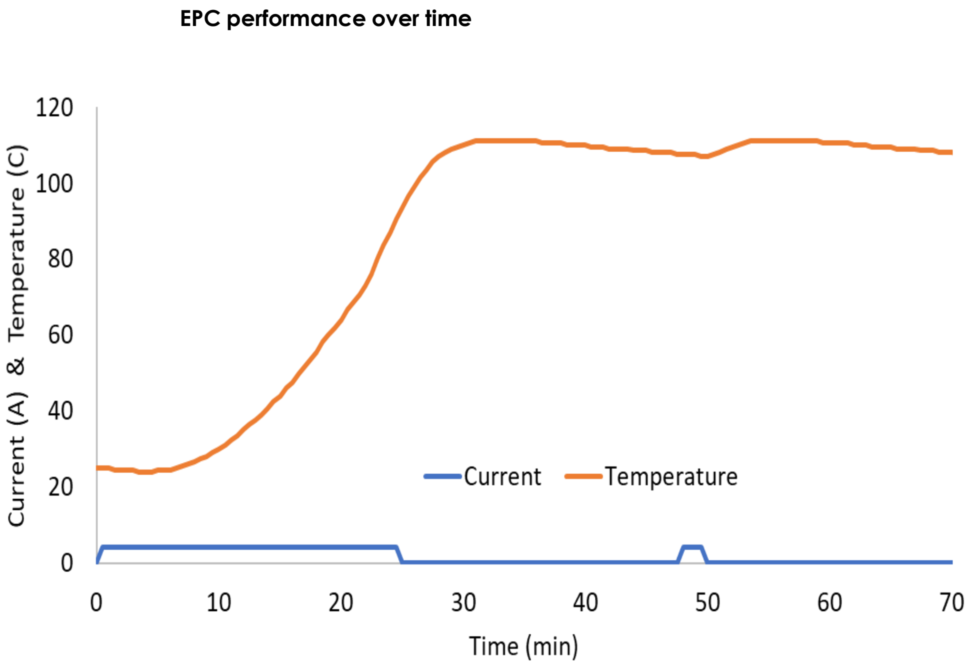
EPCs show high energy efficiency for long cooking foods


EPC performance over time

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Widespread e-cooking adoption in SSA will require electric safety upgrades – low-income households' grid connections may not be reliable enough for high wattage appliances

Required electric safety upgrades

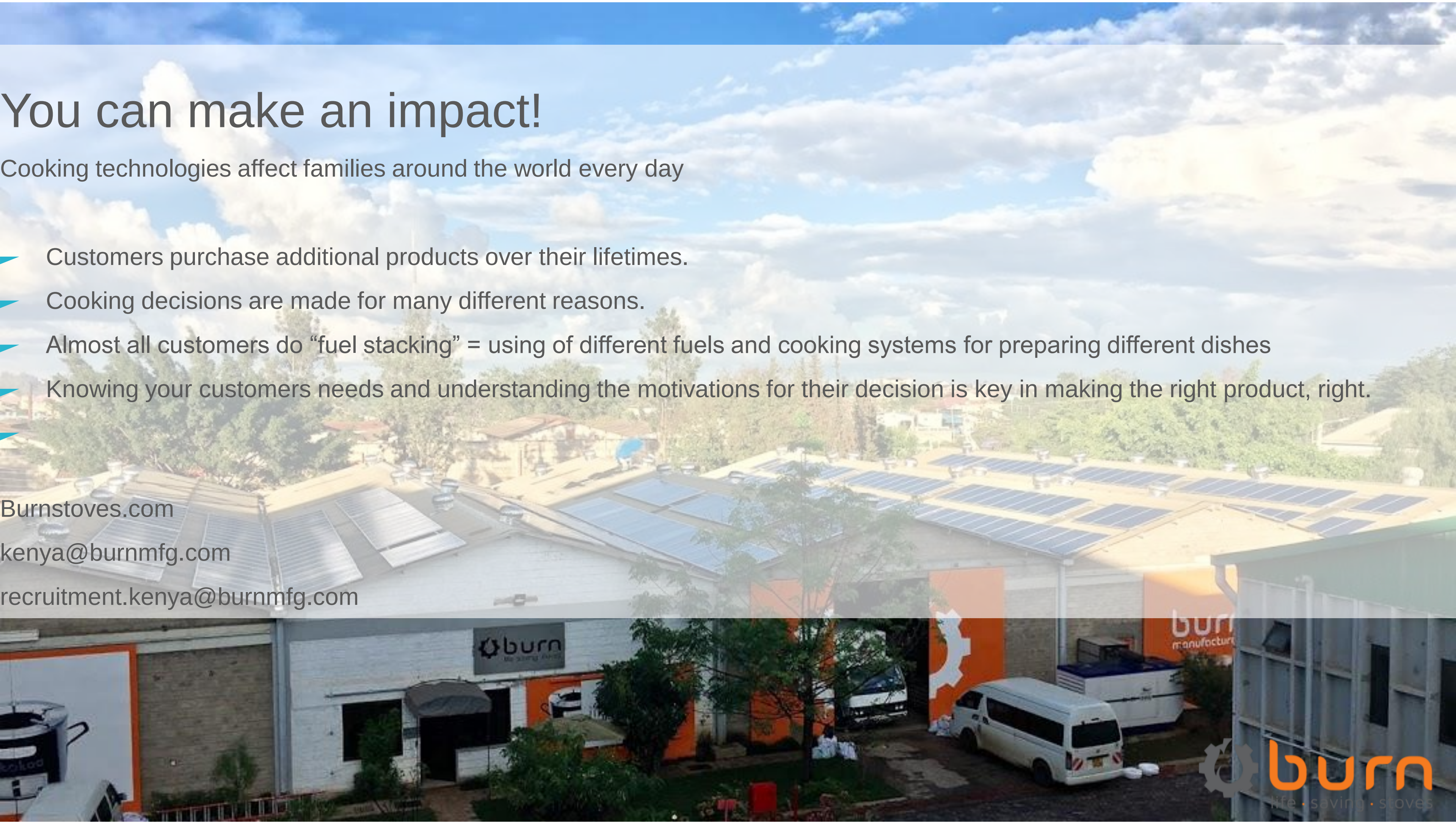
Target customers for electric cooking may not have the required grid infrastructure to support a high-wattage cooking appliance. Upgrades required may include:

- Electric socket replacement
- Circuit breaker installation
- New, safe wiring with new insulation
- Based on BURN's pilot data, upgrades could cost €14 / household.

Source: Pictures from BURN's pilot in Nairobi.

Evidence from BURN's research

- Over half of households showed evidence of unsafe electric safety practices, socket connections, and circuit breakers.
- Unsafe wiring, lack of earthing, or poor electrical safety practices (such as overloading extension cables and sockets) could cause safety issues if not addressed.



You can make an impact!

Cooking technologies affect families around the world every day

- Customers purchase additional products over their lifetimes.
- Cooking decisions are made for many different reasons.
- Almost all customers do “fuel stacking” = using of different fuels and cooking systems for preparing different dishes
- Knowing your customers needs and understanding the motivations for their decision is key in making the right product, right.

Burnstoves.com

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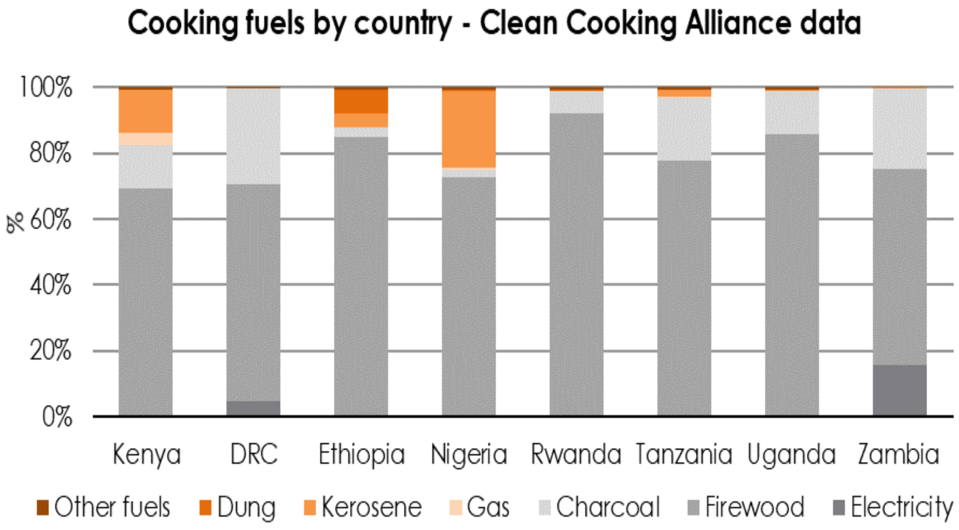
Cooking fuels SSA



Source: International Energy Association, 2019

- ~900m people in SSA still lack access to clean cooking
- Inefficient and polluting cooking stoves have been directly linked to ~500,000 deaths in SSA
- Access to clean cooking is particularly important to women's and children's health and empowerment, as they are worst affected by premature deaths related to air pollution
- Firewood and charcoal are the main fuel sources for cooking across all target countries (80%+)
- Improved cookstoves and alternative fuels are needed to support SDG

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Biraj Gautam, PEEDA

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A Video from Biraj Gautam, CEO of PEEDA

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Q&A

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