Cooking with electricity

The emerging opportunities for micro-grids

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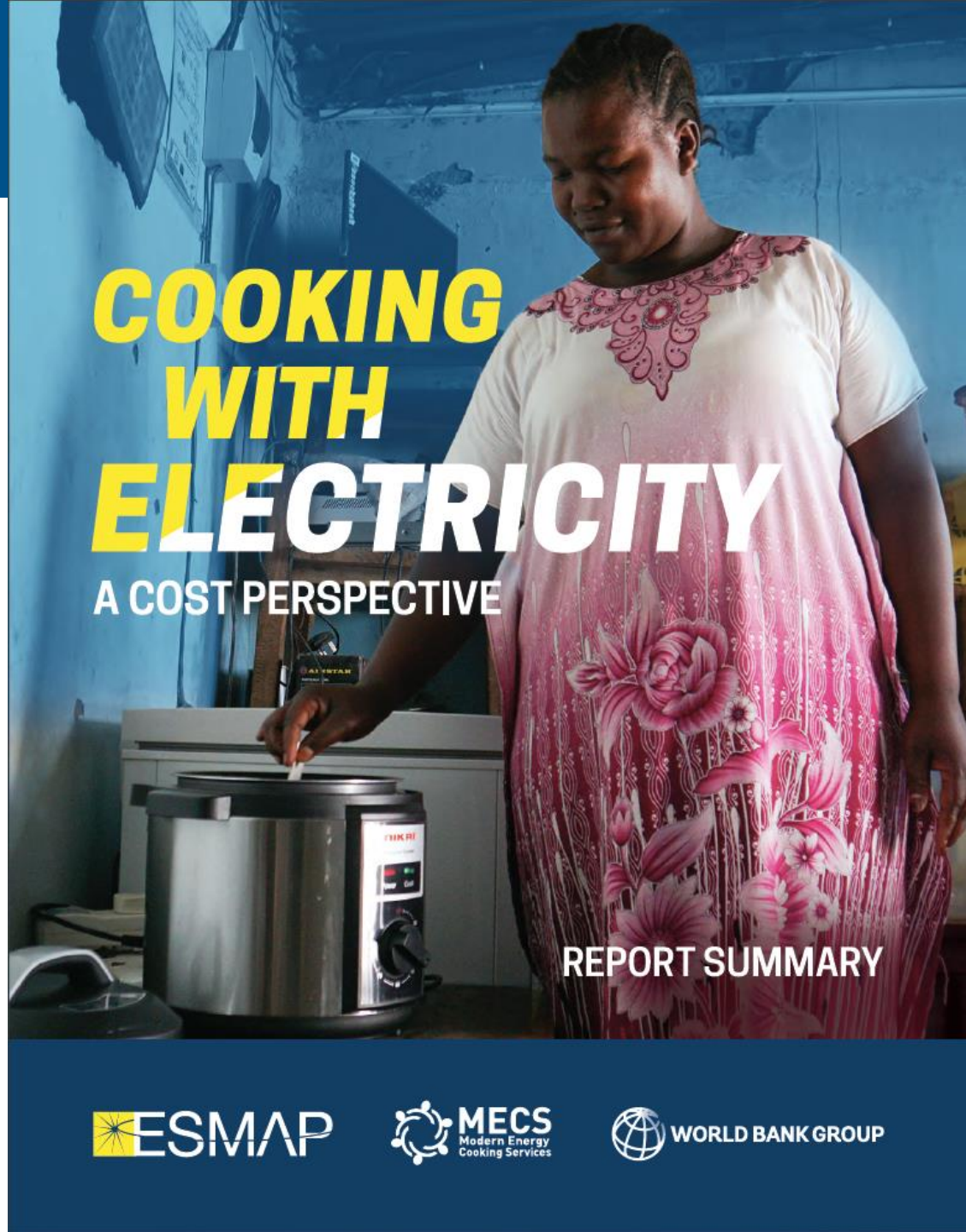
HOMER International MICROGRID Conference | 8th Annual | #HIMC2020

UKaid from the British people
Loughborough University
Gamos
ESMAP
MECS Modern Energy Cooking Services
WORLD BANK GROUP

Background

- 2.8 billion people still cook with biomass, yet just 789 million are now without access to electricity (IEA, IRENA, UNSD, World Bank & WHO, 2020)
- New opportunities opening up for eCooking
  - Falling costs of solar PV & battery storage
  - Energy-efficient appliances
    - Electric Pressure Cooker (EPC)



Methodology

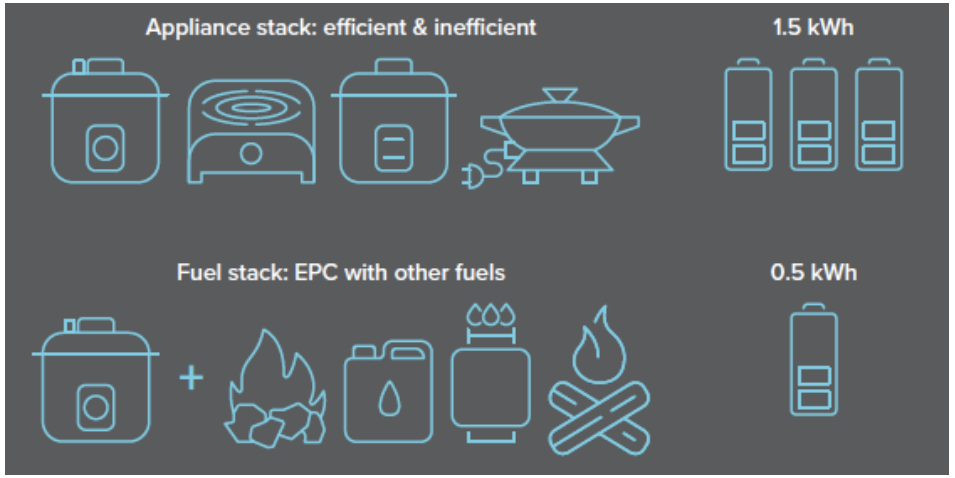
Compare the monthly cost of cooking with popular fuels and eCooking in 5 case studies

New empirical dataset on energy demand for cooking

- Cooking diaries
- Focus groups
- Household surveys
- Stakeholder workshops

Techno-economic modelling

- Cost trends for key components
  - 2020, 2025
- With & w/o household energy storage
- Inefficient & efficient appliances

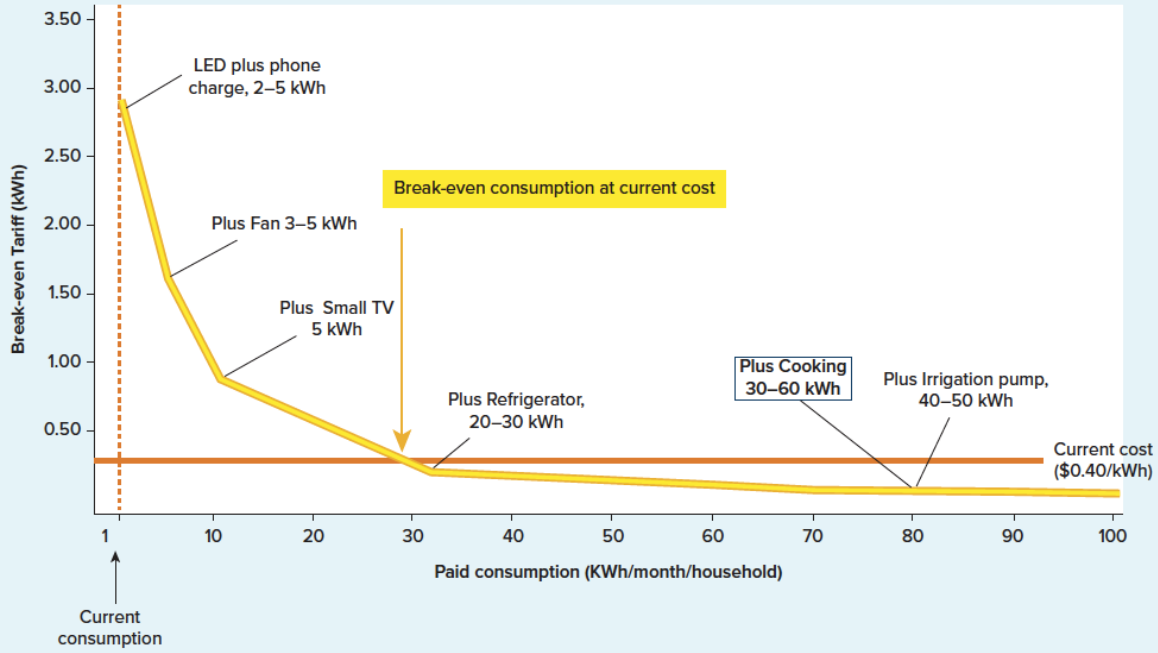


eCooking on mini-grids

Current perception: eCooking isn't viable on mini-grids

- Transforming 'high-grade' electricity into 'lower-grade' heat seen as wasteful
- Tariffs typically high
- Biomass fuels in rural areas cheap, or free
- Peak loading constraints

FIGURE 3.14 Break-even tariffs for typical solar hybrid mini grid in India at different levels of energy consumption

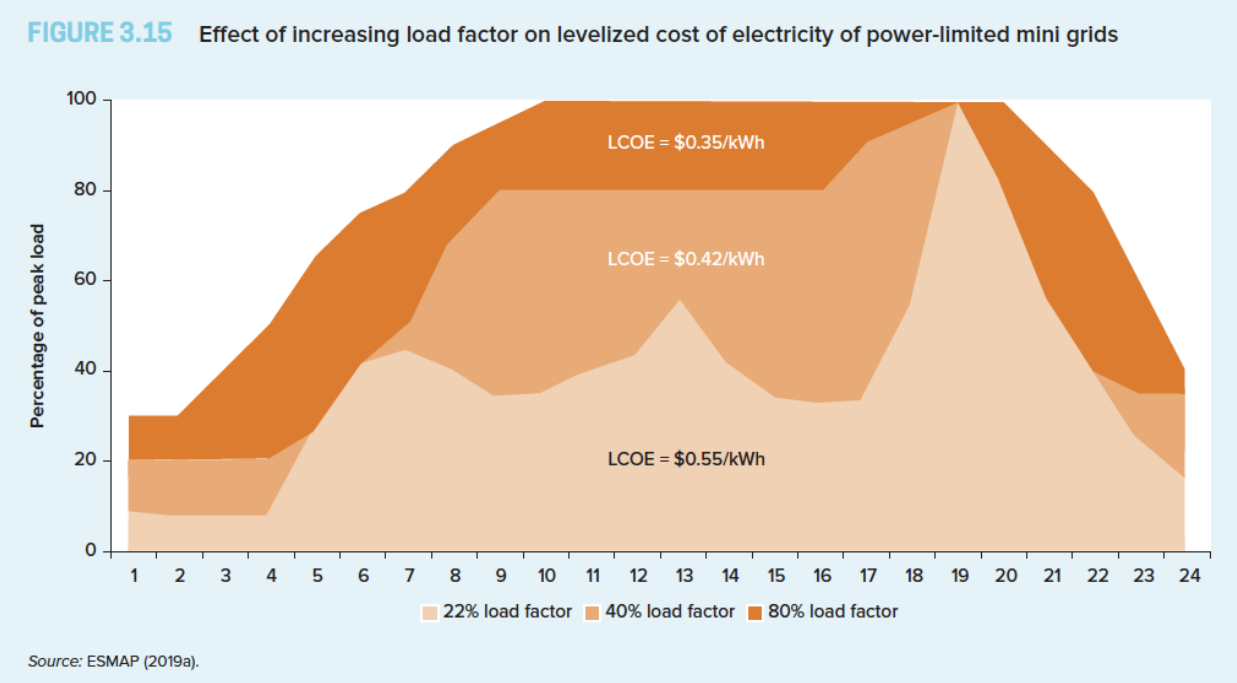


Source: Adapted from ITT (2016).

eCooking on mini-grids

The emerging opportunity:

- Many mini-grid developers actively stimulating demand
  - Load factor ↑ = tariff ↓
- Many developing regions are rapidly urbanizing
  - Biomass fuel prices ↑
- Expenditures on biomass fuels can be converted into revenue for mini-grid developers



Overview of case studies

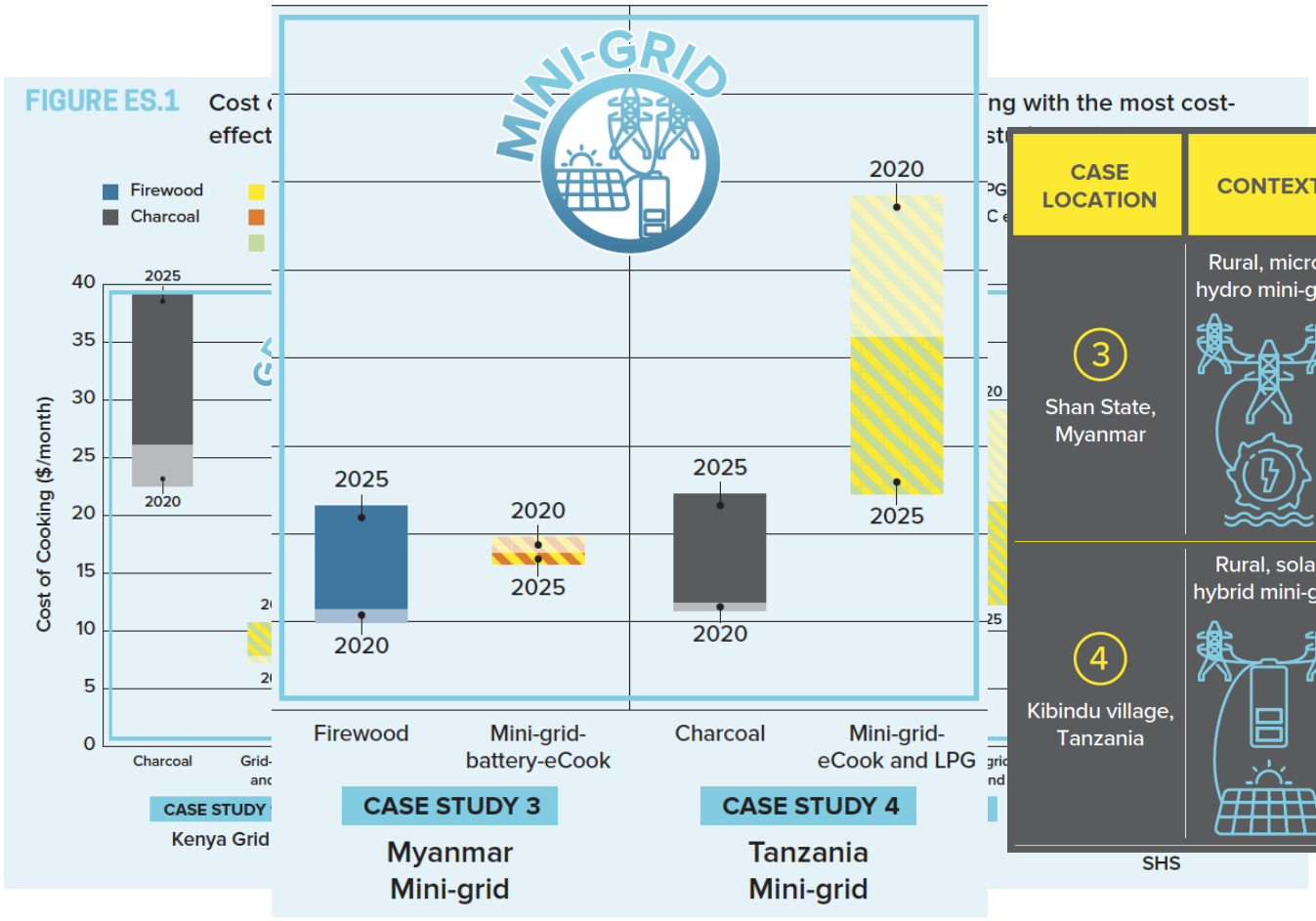


FIGURE ES.1 Cost … effect … ng with the most cost-…

TABLE ES.1 Comparison of the five case studies and rationale for selection

CASE LOCATION	CONTEXT	SUPPLY SIDE	DEMAND SIDE: BASELINE FUELS/ APPLIANCES	KEY OPPORTUNITY TO ENABLE 100% CLEAN COOKING	ENERGY STORAGE CONSIDERED
1 Nairobi, Kenya	Urban, national grid	Stimulate demand for surplus national grid electricity	LPG, charcoal and kerosene	Clean fuel stack: LPG and most efficient electric appliances (EPCs)	None
3 Shan State, Myanmar	Rural, micro-hydro mini-grid	Mitigate peak loading constraints on micro hydro mini-grids with energy storage	Firewood and efficient electric appliances (induction stove, rice cooker and insulated electric frying pan)	Only efficient electric appliances (induction stove, rice cooker and insulated electric frying pan)	Household battery
4 Kibindu village, Tanzania	Rural, solar hybrid mini-grid	Stimulate demand for electricity in rapidly growing solar-hybrid mini-grid sector	Charcoal and firewood	Clean fuel stack: LPG and most efficient electric appliances (EPCs)	Centralized battery bank
5 Echariria village, Kenya	Rural, off-grid	Enable electricity access and clean cooking with solar systems	Charcoal, kerosene LPG and firewood	Clean fuel stack: LPG and most efficient electric appliances (EPCs)	Household battery

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Case study: Myanmar MHP

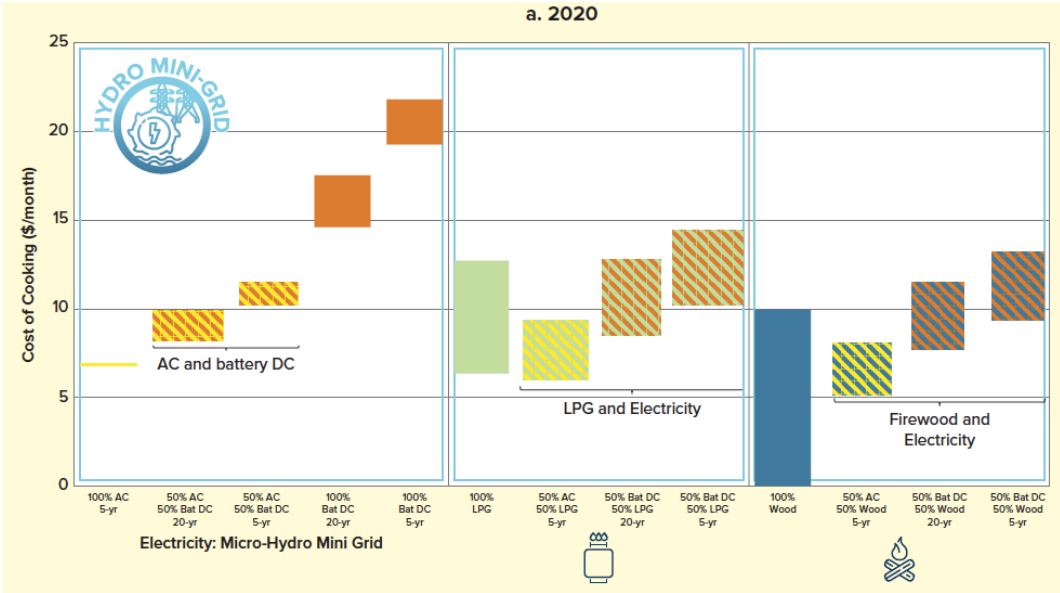
MHP tariffs often similar to national grids -> eCooking often already cost effective

- eCooking already a mainstream solution for MHP in SE Asia
  - Rice = major staple
  - Rice cookers affordable, user-friendly & energy-efficient
- Over 5,000 MHP systems in Shan State, Myanmar

Case study: Myanmar MHP

Major challenge: peak loading

- Potential solutions:
  - Increase generating capacity
  - Demand-side management
    - Energy-efficient cooking appliances
    - Time-shift cooking loads
      - Energy storage
        - Centralised/distributed
        - Water/battery
      - Off-peak cooking
        - Community agreements
        - Time of use tariffs



Case study: Tanzania solar-hybrid

Solar-hybrid mini-grids = most universally deployable mini-grid technology

Major challenge: high tariffs

- Tariffs typically several times higher than national grids
  - eCooking was prohibitively expensive
- Costs are declining rapidly
  - Load factor ↑, streamlined planning, component costs ↓ (ESMAP, 2019)
  - Tariffs ↓: new opportunities for cost-effective eCooking open up

Case study: Tanzania solar-hybrid

2020:

- Tariffs typically $0.55–$0.85/kWh (ESMAP 2019)
- Fuel stacking highly efficient electric appliances (EPCs) with charcoal is cheaper than cooking with charcoal alone for some peri-urban mini-grid customers
  - Cost–viability gap of up to $11 a month
- 100% eCooking not yet cost effective

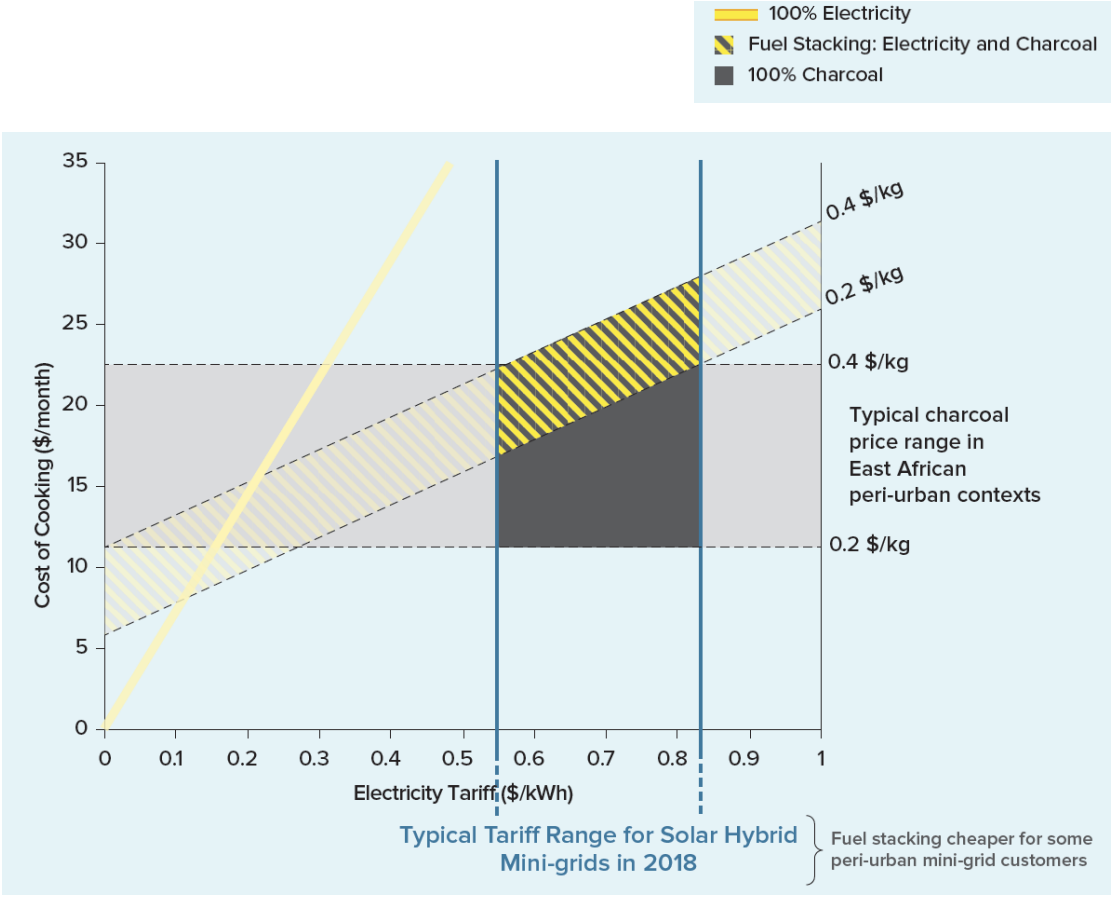
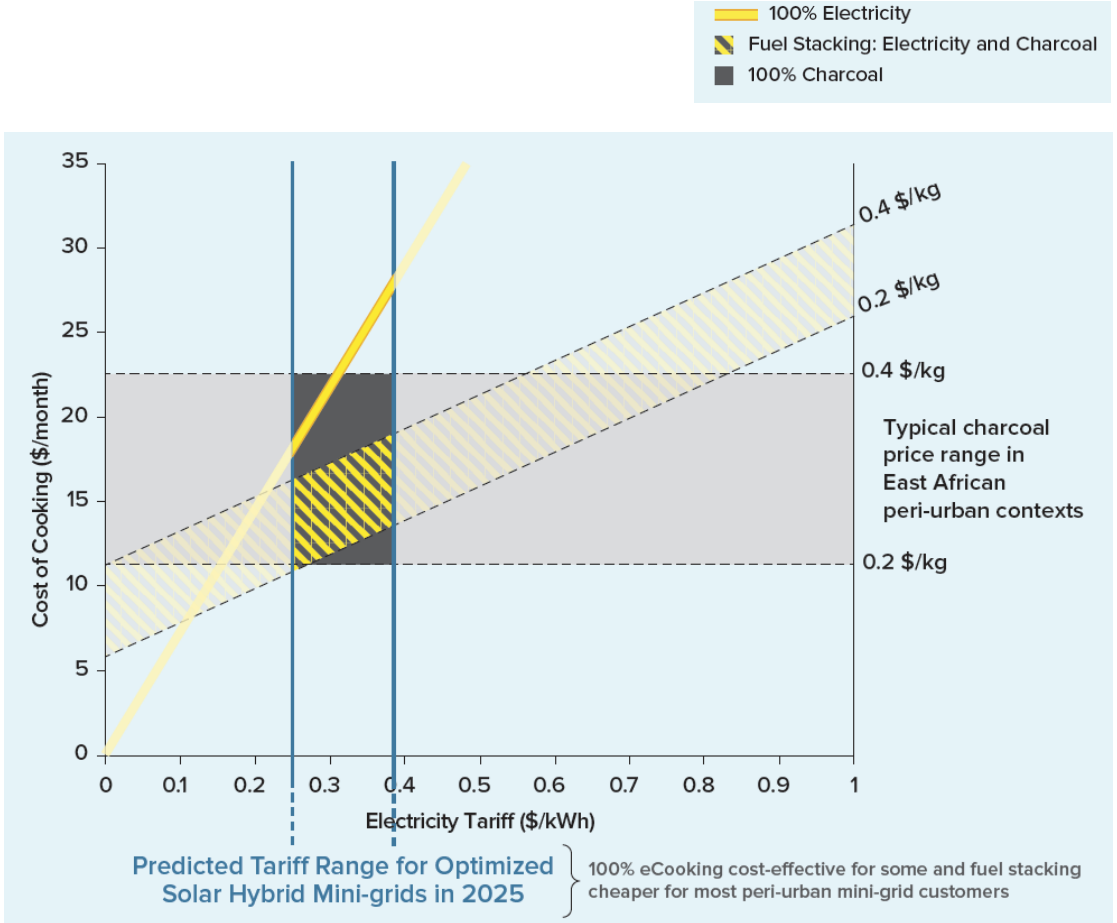


FIGURE ES.2 Comparison of cost of cooking with charcoal, fuel stacking charcoal and electricity, and cooking solely with electricity for peri-urban mini-grid customers in Tanzania, 2018 (panel A) and 2025 (panel B)
0.2–0.4 $/kg = Typical charcoal price range in East African peri-urban contexts

Case study: Tanzania solar-hybrid

2025:

- Tariffs typically $0.25–$0.38/kWh (ESMAP, 2019)
- 100% eCooking cost-effective for some peri-urban MG customers
- Fuel stacking EPC/charcoal cheaper for most peri-urban MG customers



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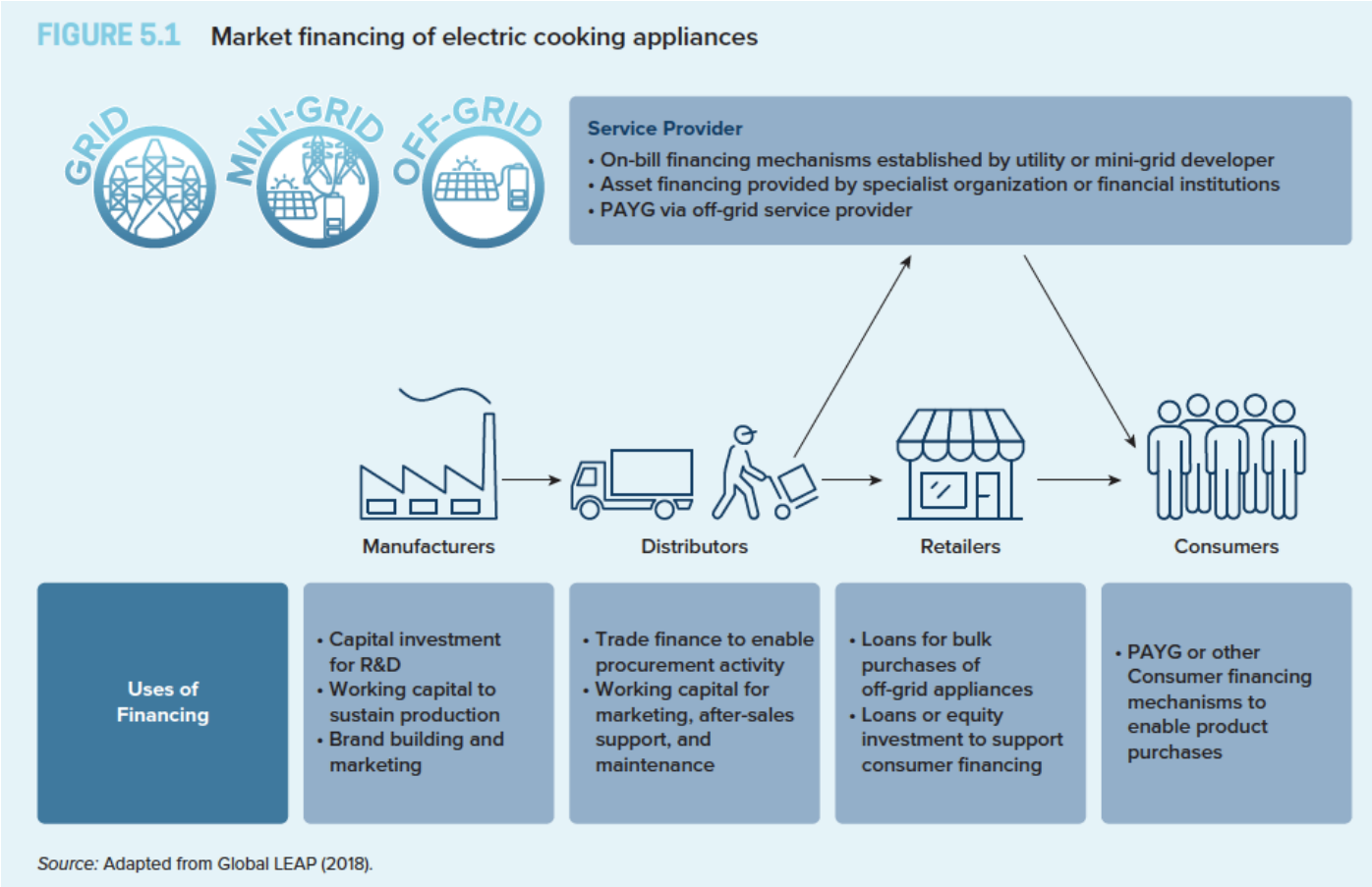
Delivery models & financing

Challenges:

- eCooking is CAPEX heavy
- Behavioural change

Innovative financing & delivery models, e.g.

- On-bill financing
- Electricity price signaling
  - Off-peak tariffs
- Peer-to-peer women-led distribution models
- Consumer lending institutions



Recommendations

Find out whether eCooking makes sense on your mini-grid

- How much are your customers paying for cooking fuels?
- What are your customers cooking?
  - Identify culturally-appropriate energy-efficient eCooking appliances
    - Procure quality-assured models
- Model the implications of encouraging eCooking
  - Plan appropriate load management strategies

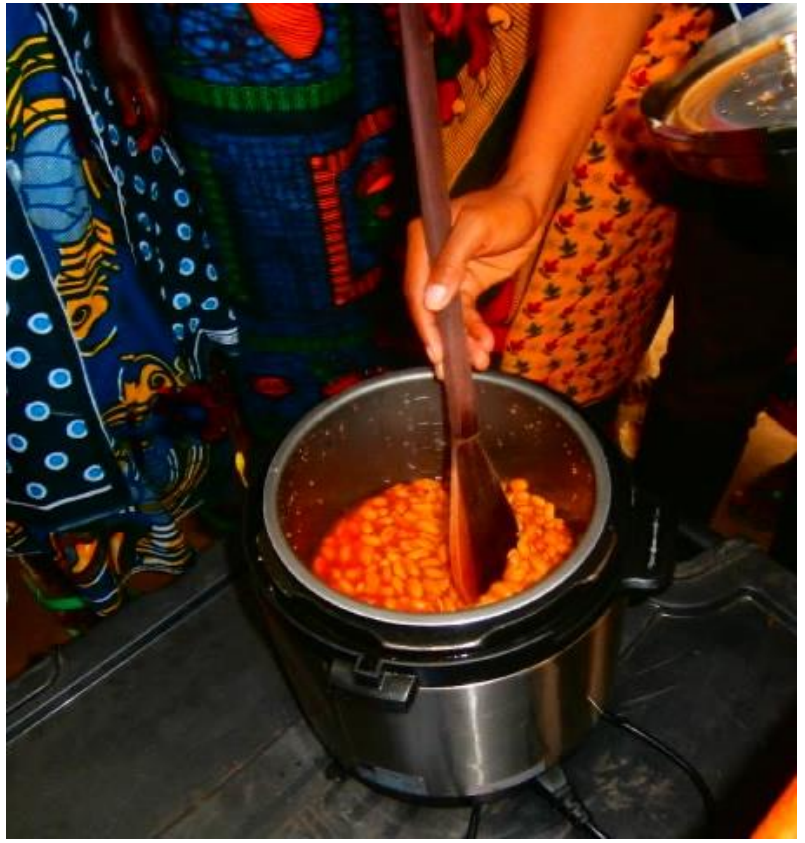
The Global LEAP Awards

NOMINATE A BEST-IN-CLASS ELECTRIC PRESSURE COOKER

Recommendations

Tackle behavioural change barriers

- Empower women entrepreneurs to market eCooking to their peers
- Develop on-bill financing mechanisms for eCooking appliances
- Carry out live eCooking demonstrations
  - Emphasise cost & time savings of energy-efficient appliances
  - Show that food cooked with electricity can be just as delicious



Conclusion

New opportunities are opening up for eCooking on mini-grids

- Energy-efficient appliances key for cost-effective eCooking
- eCooking already widely adopted on MHP in SE Asia
  - Energy storage can mitigate peak-loading constraints
- Cost reductions in solar hybrid MG sector
  - By 2025, eCooking likely to be cost-comparable with biomass
- eCooking can stimulate demand & increasing MG impact

Find out more

Thanks for listening!

Visit MECS.org.uk to read:

- The report summary
- The full technical report

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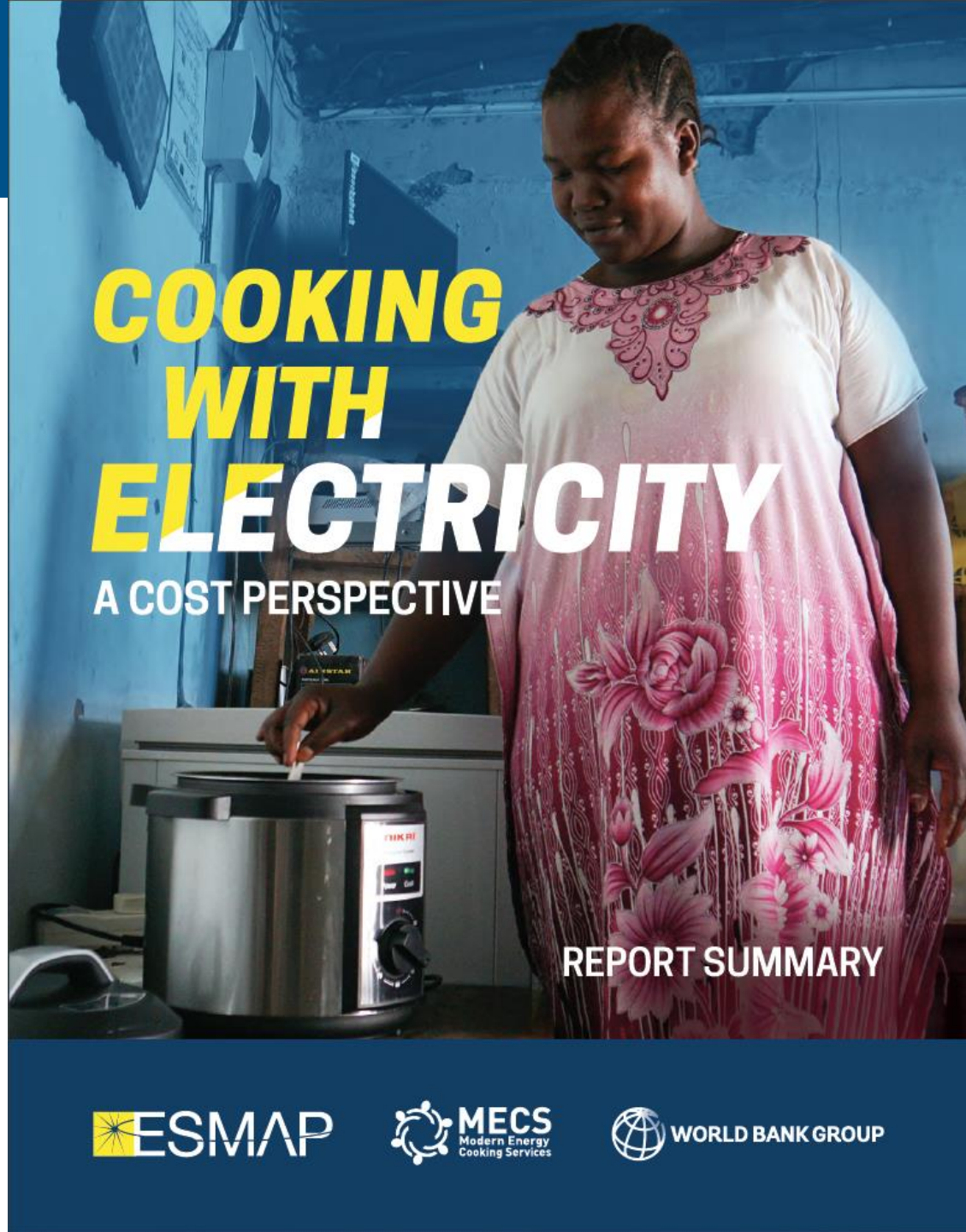

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- IEA, IRENA, UNSD, World Bank, WHO. 2020. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC.

Photo credits

- Hannah Blair @ CLASP (slides 1,2,7,11,16)
- Jon Leary @ MECS (slides 8, 15)
- Jacob Fodio Todd @ MECS (slide 17)
- TaTEDO (slides 3, 14)
- REAM/YiMon (Slide 7)