MECS
Modern Energy Cooking Services

Electric Cooking Outreach (ECO) webinar series: research methods and tools

Webinar 4: Data analysis.

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This webinar covers

- Data analysis and the ECO research questions
- Representing data – general guidelines
- Data analysis of energy used to cook
  - All fuels
  - Electricity profiles
  - Off-grid electricity
  - Fuel stacking
- Data analysis of what menu items are cooked and how they are cooked
  - Type and frequency of dishes/meals cooked
  - User experiences and perceptions of electric cooking, including Taste, Affordability, Safety
- Useful resources

Data analysis and the ECO research questions

- The Cooking Diaries approach generates a large amount of data and there are a wide range of ways this data can be analysed and represented.
- This webinar provides examples of some of the key ways that data from a Cooking Diaries study can be analysed to address the two ECO research questions:
    1. *Does the use of efficient electrical cooking appliances fit the cultural processes of cooking for a given market?*
    2. *Can the electrical cooking appliances fit with the electricity delivery in the market space?*

- Compatibility can be assessed by making comparisons e.g. Phase 1 (baseline) and Phase 2 (transition), Phase 1 (baseline) and Phase 4 (endline)…
- Need to show that the cost of cooking with electricity is comparable with baseline costs.

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Representing data – general guidelines

- Actual numbers are key (e.g. number of households, number of meals/dishes cooked with each fuel, etc) – please do not provide just percentages
- Incorporate both quantitative (numerical or measurement data) and qualitative (e.g. perceptions, opinions, feelings) data analysis
- Data analysis should highlight the **before** and after picture – what were cultural cooking process like at the start of your project (i.e. the baseline) and what happened after efficient electric cooking appliances were introduced
- Explain the significance of data – e.g. what does it demonstrate, indicate, suggest? What are the implications of the data?

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Energy consumption

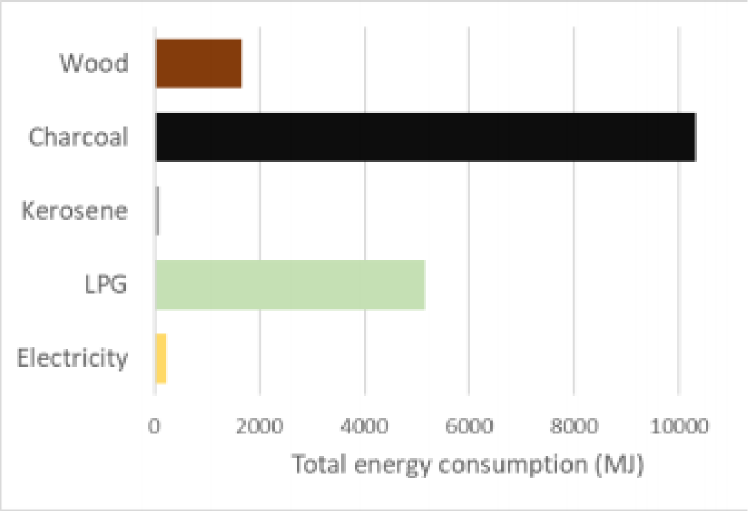

Figure 5 Energy content of fuels used in Phase 1

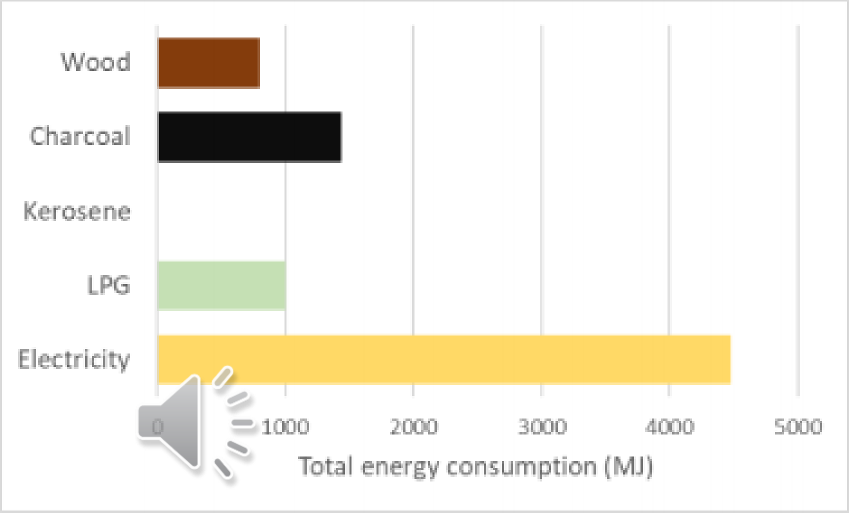

Figure 6 Energy content of fuels used in Phase 2

- The tables show energy consumption shifts from charcoal to electricity after electric appliances are introduced (as intended by the Cooking Diaries study).
- Even after electric appliances were introduced, there was still continued charcoal use. Participant interviews revealed this was often because of power cuts.
- Overall energy consumption drops as well as the conversion efficiency of charcoal is far less than that other fuels.
- Energy per capita drops significantly after electric appliances

Source: Leary et al. (2019)

Energy consumption – per capita

Table 1 Per capita energy consumption by heating event – Phase 2 Electricity only

Heating event	Frequency	Mean (MJ/pers/event)	Median (MJ/pers/event)	Std.dev.	25% Quartile	75% Quartile
Breakfast	33	0.76	0.59	0.52	0.39	1.12
Lunch	185	0.86	0.65	0.82	0.33	1.10
Dinner	319	1.12	0.81	1.11	0.48	1.30
Heating water	45	1.03	**1.12**	0.44	0.84	1.26
Snack	6	0.65	0.61	0.37	0.34	0.91
Food for baby	2	3.25	3.25	0.09	3.18	.

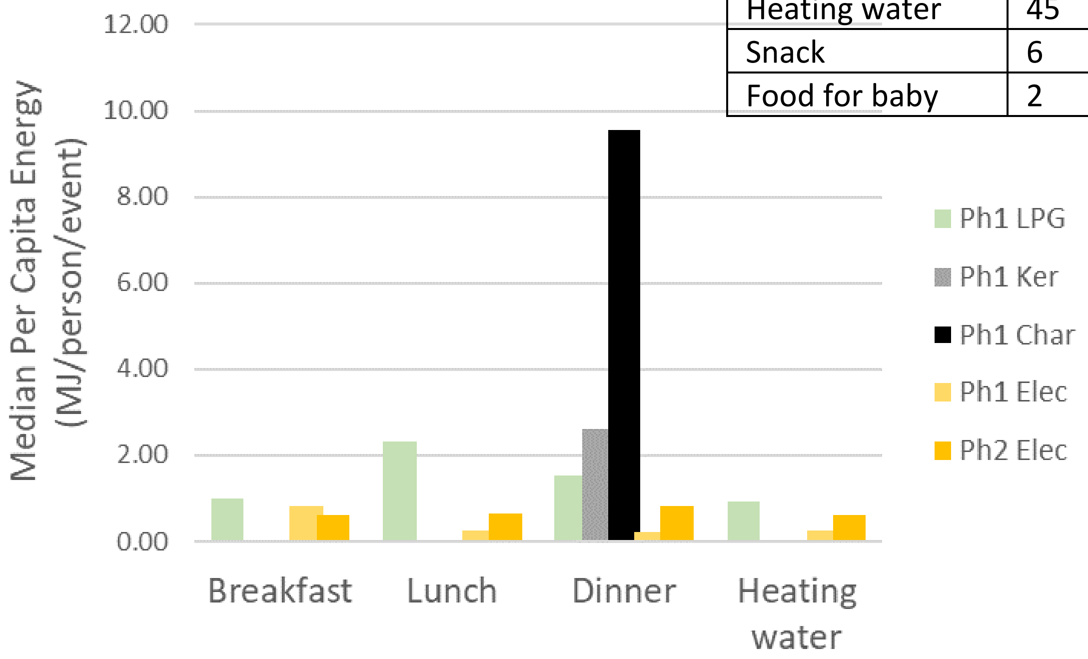

Figure 1 Per capita energy consumptions for different heating events

- Per capita energy consumption much lower with modern fuels
- Create tables showing per capita energy consumptions for different heating events using different fuels .

Source: Leary et al. (2019)

Energy consumption - daily

Table 15 Total daily energy consumption (MJ/household/day) – use of single fuel in a day

	Daily energy consumption (MJ/household/day)					Proportion of days with heating event				Household members (mean of means)
	n	Mean	Q1	Median	Q3	Breakfast	Lunch	Dinner	Water heating	
Charcoal (Phase 1)	3									
Kerosene (Phase 1)	17	16.5	6.3	10.0	21.4	82.4%	11.8%	94.1%	17.6%	4.0
LPG (Phase 1)	129	18.5	3.5	8.1	19.0	76.0%	37.2%	77.5%	20.9%	3.2
Electricity (Phase 2)	431	6.1	3.4	5.1	7.8	79.8%	42.9%	83.8%	13.5%	3.1

- Not all meals prepared every day – in Kenya, dinners are prepared most commonly (>80%), and lunches are most commonly skipped.
- Daily energy consumption useful for sizing systems and comparing costs.

Source: Leary et al. (2019)

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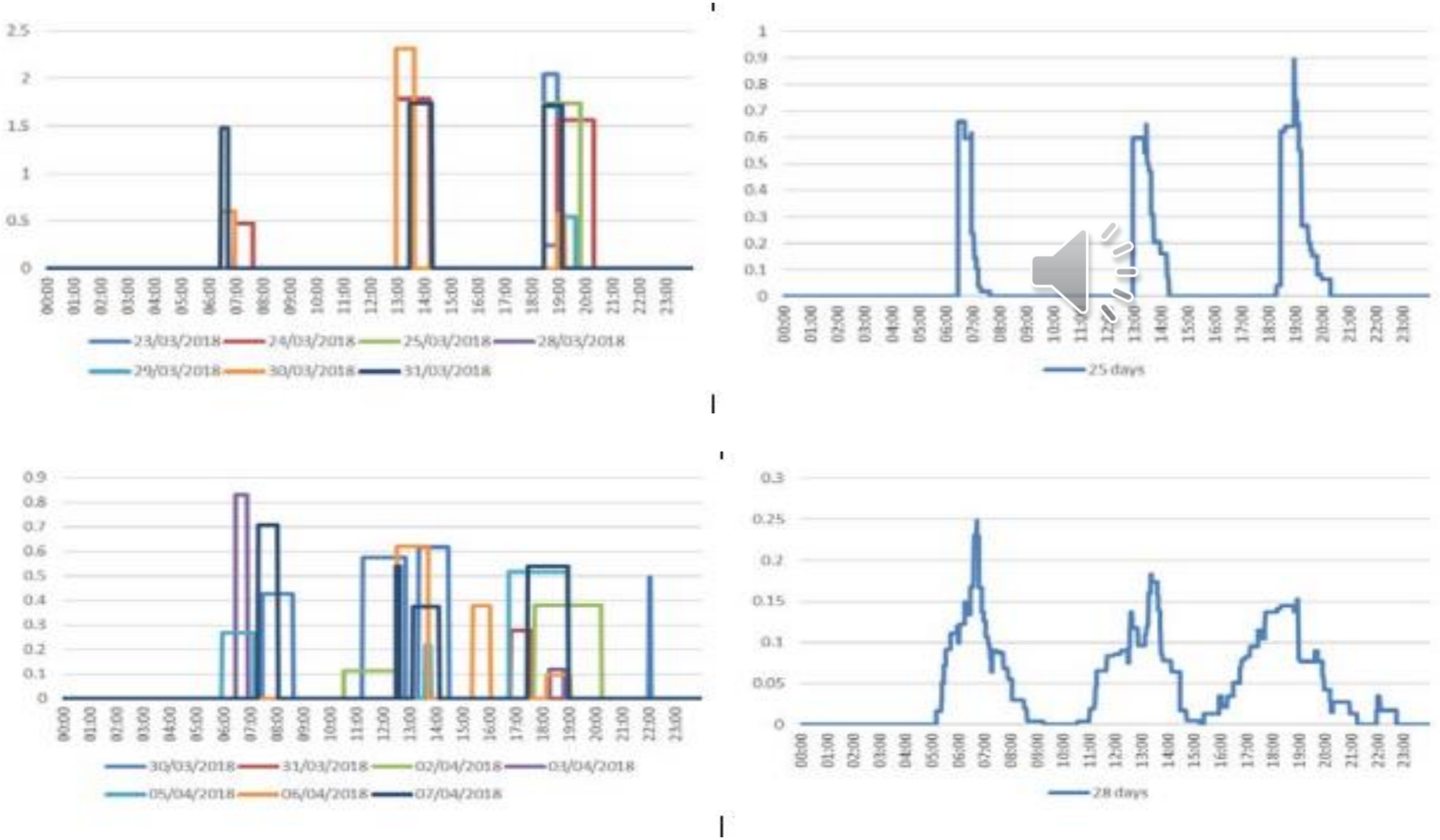
24 hour electricity load profile – by household



- Load profile patterns may vary considerably by household.
- Some households may follow a regular cooking routine while others regularly change.
- Implications: designing a battery supported system is easier for households with regular routines as it is easier to size a battery for a more predictable typical day (and therefore avoid the situation of the battery running out half way through a meal).
- Aggregating all the household load profiles shows a profile with three clear peaks.
- Daily load profiles are particularly relevant for understanding the impact of electric cooking on electricity supplies.

Source: Leary et al. (2019)

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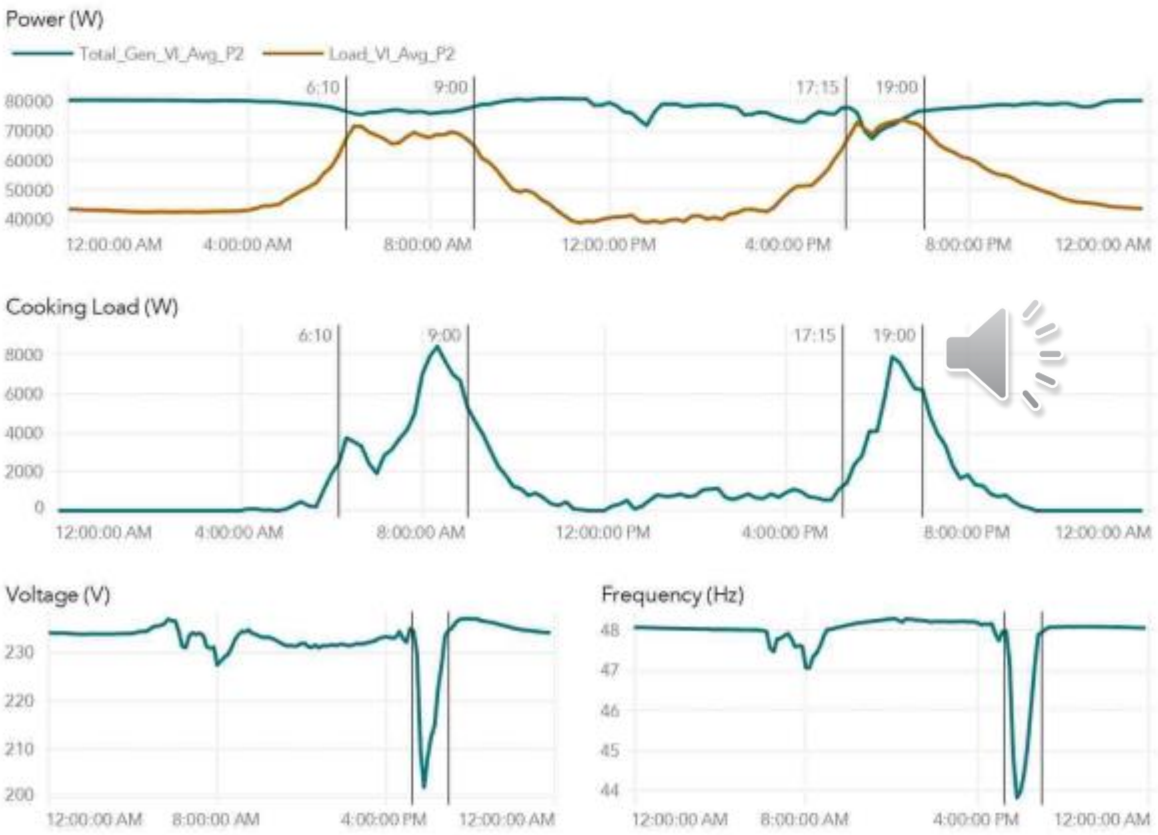
Off-grid electricity data analysis



- Power generation vs power demand from cooking key to seeing whether electric cooking can fit an off-grid electricity supply
- In this example from Nepal – power generated is sufficient for the cooking load except during the evening peak (voltage and frequency drop)
- This suggests battery support is likely to be required for the evening peak

Source: PEEDA (2020)

Foods cooked

Table 1 Number of meals containing food types (Breakfast, lunch and dinner heating events only)

	Phase 1 N = 559		Phase 2 N = 913	
	Frequency	Percent	Frequency	Percent
Eggs	60	10.7%	96	10.5%
Meat	105	18.8%	193	21.1%
Ugali	140	25.0%	231	25.3%
Fish	24	4.3%	45	4.9%
Chapati/pancake	53	9.5%	68	7.4%
Githeri/mokimo	47	8.4%	62	6.8%
Pasta/noodles	30	5.4%	62	6.8%
Mandazi	1	0.2%	10	1.1%
Porridge	41	7.3%	61	6.7%
Pilau	10	1.8%	15	1.6%
Chips	14	2.5%	12	1.3%
Rice	156	27.9%	257	28.1%
Sausages	9	1.6%	14	1.5%
Matumbo	12	2.1%	12	1.3%
Matoke	7	1.3%	26	2.8%
Chicken	20	3.6%	32	3.5%
Leafy veg	162	29.0%	229	25.1%
Beans/peas	160	28.6%	247	27.1%
Potatoes/pumpkin	55	9.8%	100	11.0%
Other	25	4.5%	49	5.4%

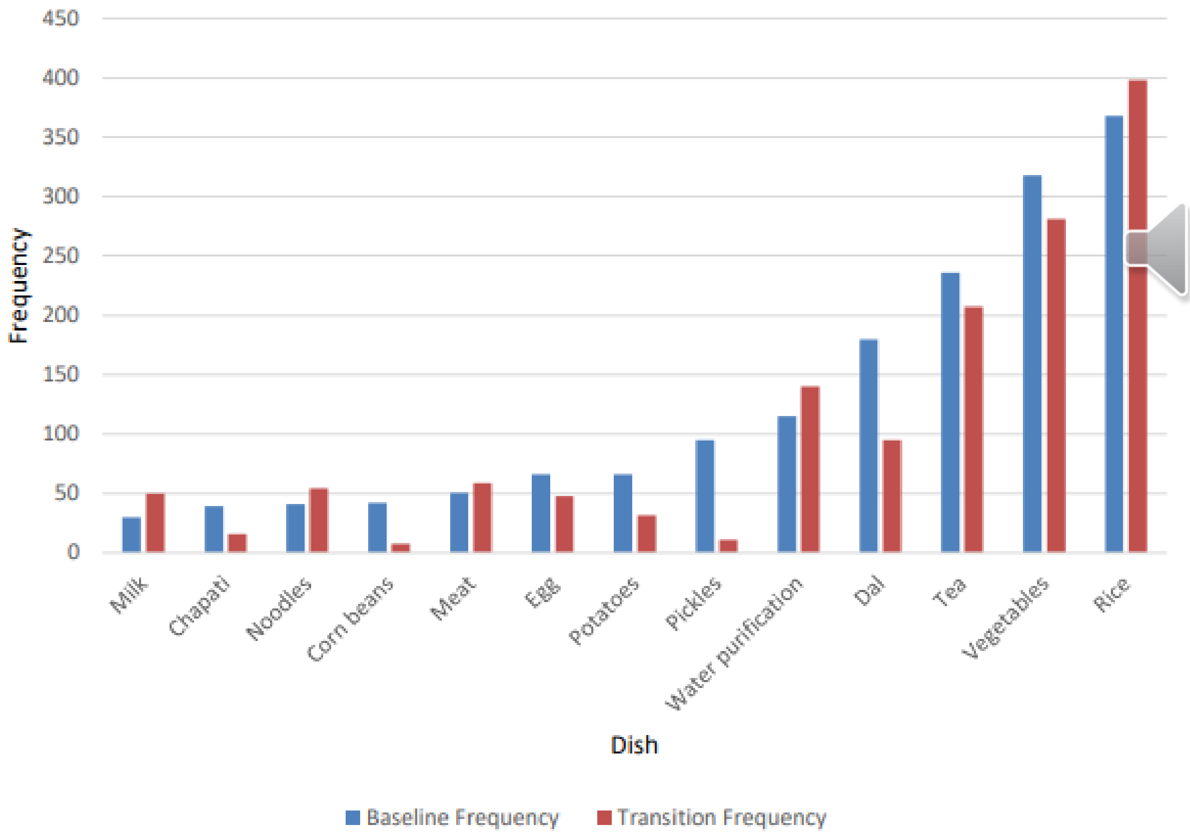
- Separating out foods cooked in all meals events provides a comparison of menus cooked in 2 phases. In this example (Kenya), there was a high degree of consistence between Phase 1 and Phase 2 i.e. cooking with electricity was compatible with their menus. Exception is chapatis.
- Number of foods in a meal were also similar across phases, indicating people were just as able to prepare complex meals when cooking with electricity

Table 1 Number of foods included in a heating event (Breakfast, lunch and dinner heating events only)

Number of food types in meal	Phase 1		Phase 2		Total
	Frequency	Percent	Frequency	Percent	
1	160	29%	272	30%	432
2	231	41%	381	42%	612
3	163	29%	254	28%	417
4	5	1%	5	1%	10
5	0	0%	1	0%	1

Frequency and number of dishes cooked

Figure 11: Frequency of dishes in each phase



Source: PEEDA (2020)

- These graphs from Nepal indicate that the menu and cooking practices have changed since the introduction of electric appliances
- The first graph shows the menu narrows after electric cooking is introduced – the research suggests this was likely due to households growing accustomed to the new induction stoves and rice cookers
- Be aware of transient effects, for example:
  - certain vegetables being in season may be the key factor in menu choice
  - the afternoon meal may be prepared less often during school holidays.

Reheating foods

Table 1 Food types most commonly reheated (individual dishes, cooked as part of meals)

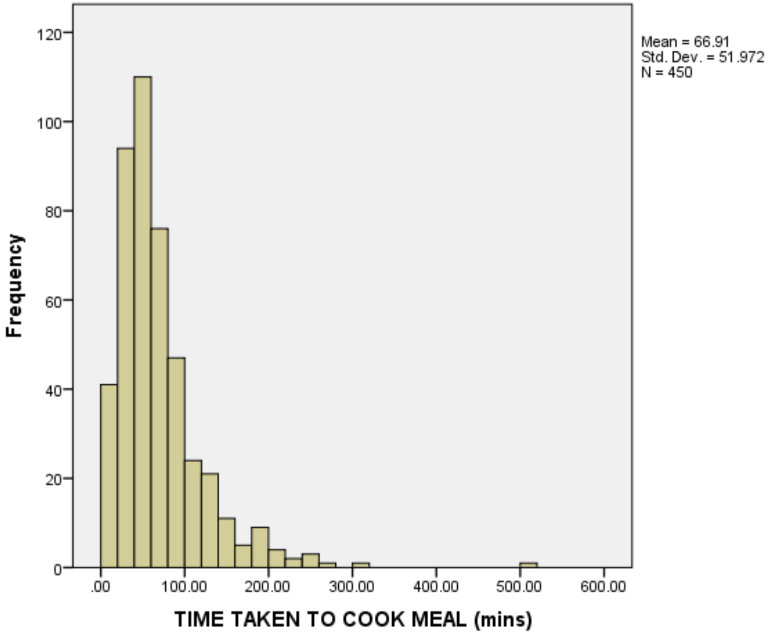
	Fresh	Reheated	Total
Eggs	156 (96%)	7 (4%)	163
Meat	209 (70%)	89 (30%)	298
Ugali	340 (90%)	36 (10%)	376
Fish	35 (58%)	25 (42%)	60
Chapati/pancake	83 (68%)	39 (32%)	122
Githeri/mokimo	59 (60%)	40 (40%)	99
Pasta/noodles	70 (75%)	23 (25%)	93
Mandazi	7 (64%)	4 (36%)	11
Porridge	74 (63%)	44 (37%)	118
Pilau	12 (48%)	13 (52%)	25
Chips	20 (69%)	9 (31%)	29
Rice	263 (62%)	161 (38%)	424
Sausages	25 (100%)		25
Matumbo	24 (96%)	1 (4%)	25
Matoke	29 (81%)	7 (19%)	36
Chicken	39 (70%)	17 (30%)	56
Leafy veg	310 (79%)	83 (21%)	393
Beans/peas	236 (60%)	160 (40%)	396
Potatoes/pumpkin	123 (73%)	46 (27%)	169
Other	75 (84%)	14 (16%)	89

- Food is tagged as either fresh or reheated.
- Most commonly reheated (% times cooked) – pilau, fish, beans, githeri
- Reheated most often (absolute) – rice and beans
- Calculate per capita energy to cook meals from fresh and using reheated foods
- Reheating lunches and dinners uses half the energy (LPG Ph1 and electricity Ph2)

Timing

Table 1 Time of day to start preparing meal –Phase 2 (electricity only)

Heating event	N	Mean	Median	Std.dev.	25% Quartile	75% Quartile
Breakfast	427	7.13	7.00	2.08	6.00	8.15
Lunch	217	13.12	13.00	1.27	12.30	13.36
Dinner	449	18.37	18.50	2.01	18.00	20.00



Time taken to cook dinner

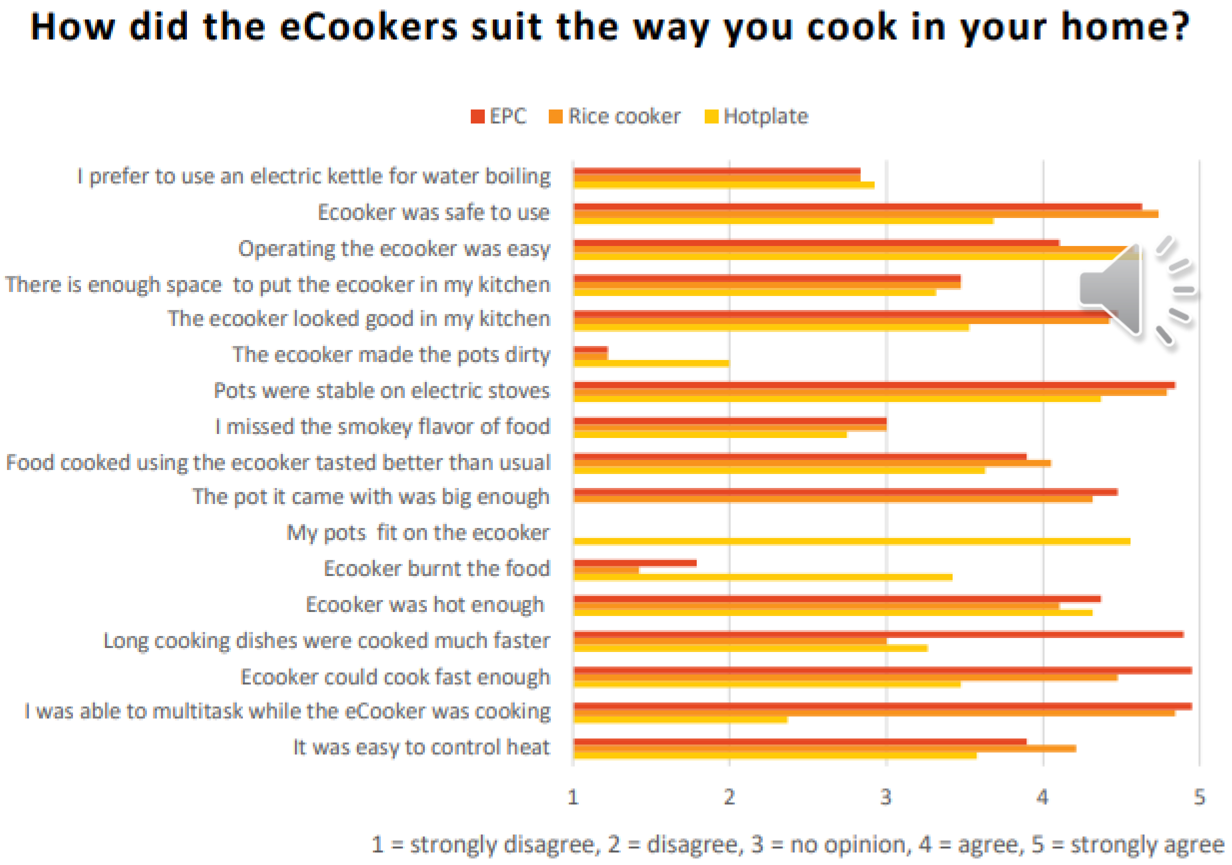
- Timing and duration of cooking has implications on availability of energy (e.g. PV systems)
- Variability impacts reliability – there will be occasions on which insufficient energy available to cook

Data analysis of data from exit surveys/focus groups/qualitative feedback

- Exit surveys usually provide mostly qualitative feedback from participants on their perceptions and preferences of electric cooking appliances such as:
  - User experience
  - Taste of food
  - Safety
  - Affordability

- This kind of data is not restricted to only being gathered during the exit surveys. For example, it could also be gathered mid-project through:
  - Comments from participant in their notepad forms
  - Focus group discussions
  - Feedback during training interventions

Overall user experience of electric cooking



- In this Kenyan study, there are high scores for looking good in participants' kitchens (4.5/5), food tasting better than usual (4/5) & the ability to cook faster (4.5/5) & multi-task (5/5).

- This suggests that electric cooking – and particularly the higher scoring EPC & rice cooker – are likely to be aspirational appliances.

Source: Leary et al. (2019)

Taste

- In this Kenyan study, food cooked on electricity was rated as the tastiest, just ahead of LPG & charcoal. Wood & kerosene lag far behind.
- Word frequency graphs are another means to represent data. The one above shows that while most respondents missed the smoky flavour in certain foods, a large number did not miss it at all.
- This suggests taste barriers to electric cooking may not be as significant as often assumed in this cultural context.

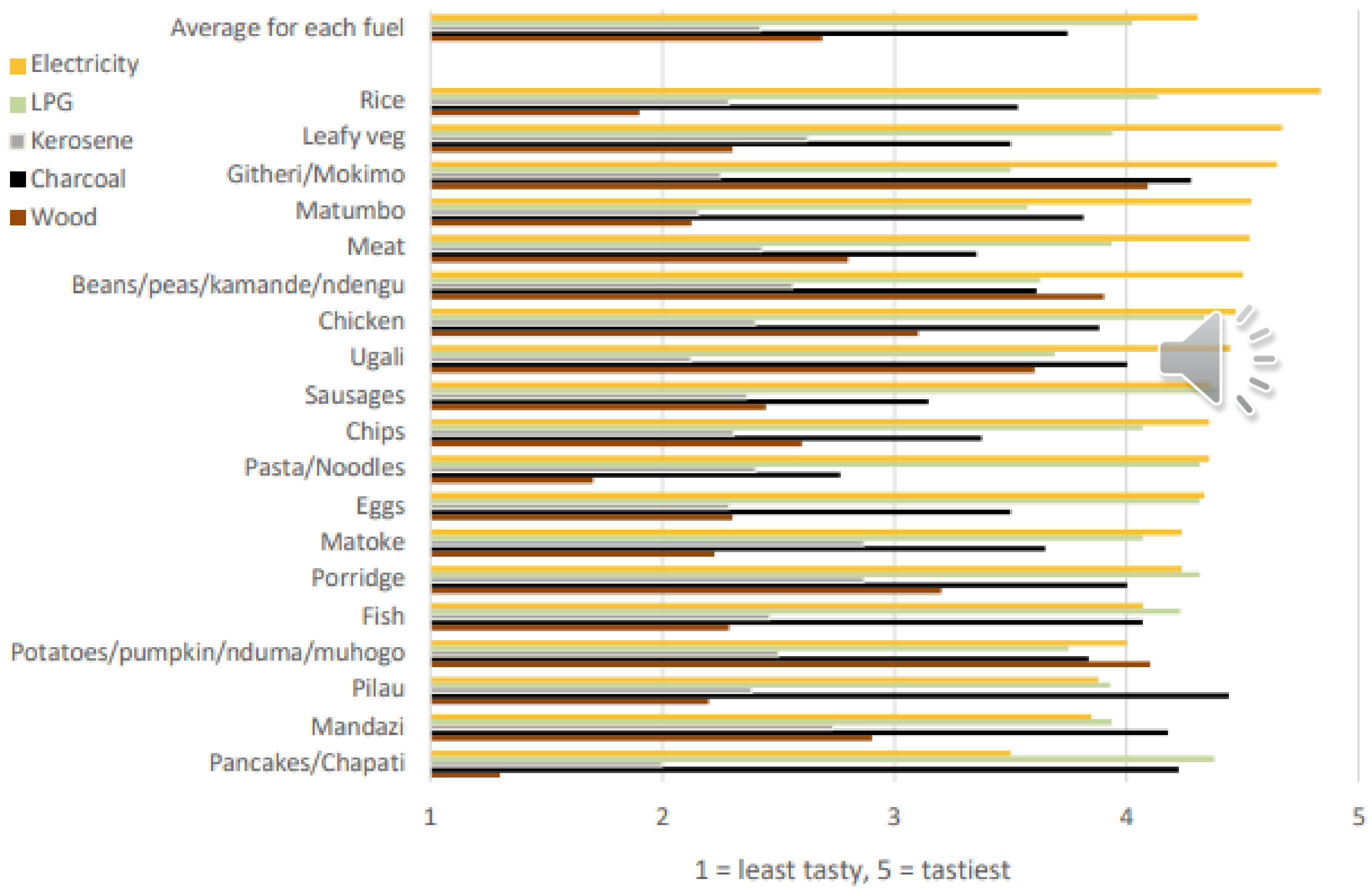
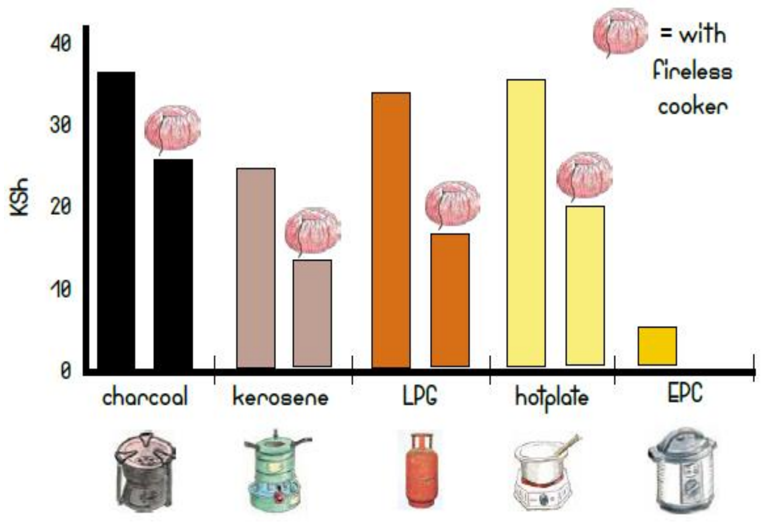


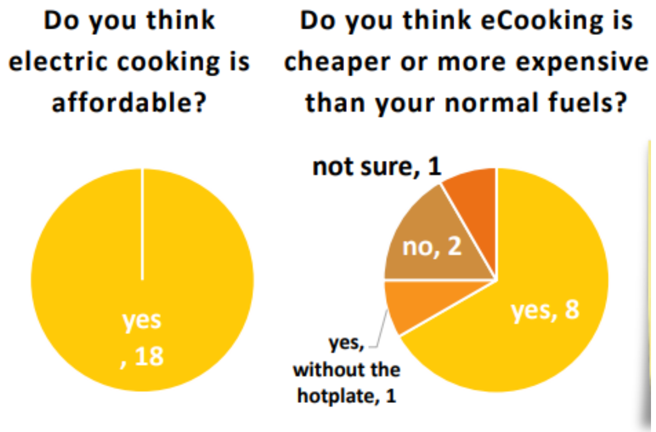
Figure 28: User perceptions of taste across different fuels.

Source: Leary et al. (2019)

Changing perceptions



Cost in Kenyan shillings (Ksh) of cooking beans with different fuels and appliances



Exit survey perceptions of the affordability of electric cooking

- In Kenya, energy measurement data demonstrated that cooking beans on an EPC was far cheaper compared to other fuels
- Exit survey data showed participant perceptions of cooking with electricity had changed, as they now all thought it was affordable, with 2/3 reporting it was cheaper than the fuels they used before.
- The quote shows how participant interviews can help clarify and further support quantitative data.

"I was so shocked! I couldn't believe how much money I had saved! I always thought charcoal would be cheapest for 'heavy foods' like beans"
(Damaris, Kenyan participant).

Source: [The Kenya eCookBook: Beans & Cereals Edition, 2019]

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Data analysis - further opportunities

This webinar has highlighted a selection of key examples of how you might analyse data to address the ECO research questions. But data analysis could also be varied by:

- Different data resolutions could be used: continuous, sub-dish, dish, meal, daily, weekly, monthly
- Applying different statistical analyses: e.g. standard deviation, regression analysis

Other important areas of data include:

- Marketing: e.g. willingness to pay, promotional activities/messaging
- Political factors – what data and data analyses would be most convincing in encouraging government/policy makers to promote pro-electric cooking policies.
  - Political factors will be an area of ongoing study by MECS and we encourage you to reach out and coordinate with the MECS in-country partner organisation on this issue.

Vendor	Male	Female
Charcoal	36	56
Wood	3	6
Gas	9	4
Electricity	2	0

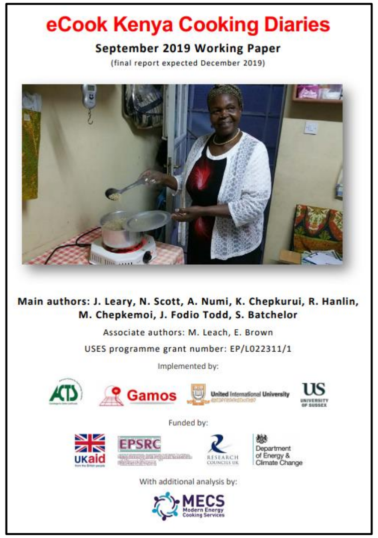
Cooking fuel choice of street vendors by gender in Mwanza, Tanzania (Perrett, 2020)

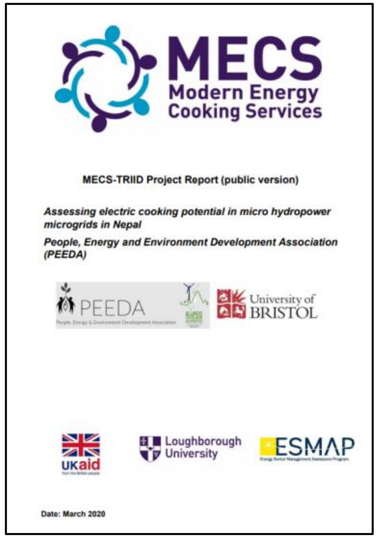
Useful resources

- 4 working papers from previous MECS Cooking Diaries studies in Kenya, Myanmar, Tanzania, and Zambia.
  - The Kenya working paper has an extensive section on qualitative data analysis and exit survey data analysis
- PEEDA (2020) Assessing electric cooking potential in micro hydropower microgrids in Nepal.
  - Uses the cooking diaries approach and has very clear data analysis, some of which has been included in this webinar.
  - Focuses on cooking on off-grid electricity (with induction hobs and rice cookers) and includes analysis of battery eCook
- eCookbooks

  eCookBooks on Kenya and Tanzania highlight energy and cost saving capabilities of electric cooking

All available to access on ECO Awardee shared folder – see direct links above





Example eCookbooks