Bangladesh

eCooking Market Assessment

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Lead author: Melinda Barnard-Tallier

With contributions from:

MECS Bangladesh Team: Rezwhan Khan (UIU) / Uttam Kumar Saha & Sabbir Ahmed (Practical Action)
EnDev/GIZ Bangladesh Team: Henrik Personn, Zunayed Ahmed, Sen Sajib
MECS Workstream Leads: Jon Leary, Matt Leach, Simon Batchelor
EnDev eCooking Team: Gregor Brömling, Simone Fehrenbach, Verena Brinkmann

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The MECS/EnDev eCooking Market Assessments

This study is one of a series of publications produced jointly by Energising Development (EnDev) and the Modern Energy Cooking Services (MECS) Programme. This series of market assessments offer strategic insight on the current state of electricity access and clean cooking in eight countries across sub-Saharan Africa and South Asia. These studies identify the key opportunities and challenges to the scale up of electric cooking in the coming decade and conclude with a series of recommendations for targeted interventions that could support the development of emerging eCooking sectors. The market assessments are structured according to the MECS transition theory of change (TToC), which consists of three interrelated dimensions: the enabling environment, consumer demand and the supply chain.

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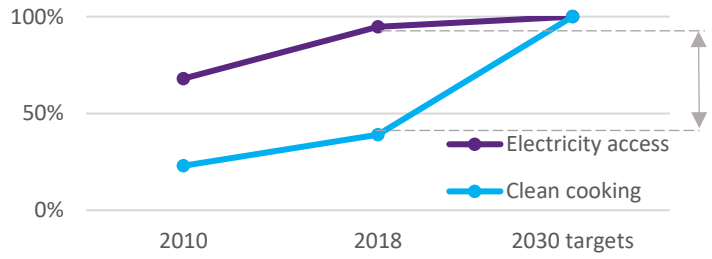
Executive Summary

One of the most densely populated countries in the world, with over 160 million people (64% living in rural areas), Bangladesh became a lower-middle-income country in 2015. The country has made rapid progress towards universal electrification with around 99% of the population having access to electricity, although the grid is plagued by issues of unreliability and is only 2% renewable. In spite of economic growth and urbanisation, firewood remains the dominant fuel choice of rural Bangladeshi households[1] and there is relatively little use of clean cooking fuels (electricity primary fuel 0%; gas primary fuel 22%). In the past, Bangladeshi people have been hesitant to make the shift due to socio-cultural perceptions, lack of awareness and concerns around affordability. Policy makers had previously not prioritised clean cooking and, indeed, expressed concern that eCooking would add pressure to the grid. However, the Government of Bangladesh (GoB) are putting together a National Country Action Plan for clean cooking and are aiming for 100% clean cooking by 2030. Additionally, local companies are committed to addressing perceptions by reducing prices of appliances and making them more accessible over the last few years.

Bangladesh data snapshot from MECS eCooking Global Market Assessment:

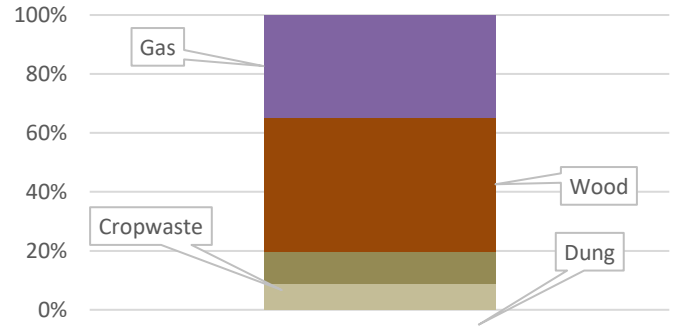


77% now connected to electricity, but still primarily cooking with polluting fuels

Cooking energy

Primary fuel use:

0% cook primarily with electricity

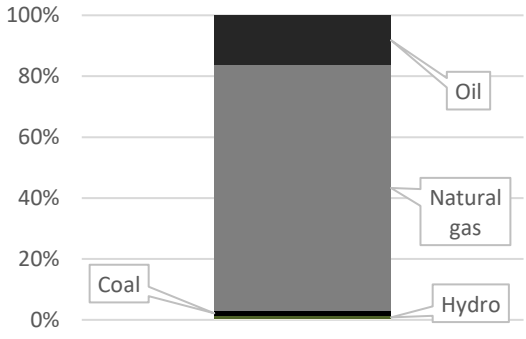


0% cook primarily with commercialized polluting fuels

Electricity generation

On-grid:

1.5% renewable



40-45% surplus power generation

Variable reliability: load shedding between 1-8 hrs/day across 17 districts.

[1] ESMAP (2015) "Beyond Connections: Energy Access Redefined"

Off-grid:

World leading mini-grid & off-grid sectors: 174,000 mini-grid customers, 38 mini-grid developers, 13m off-grid lighting/appliance customers[2]

eCooking GMA viability scores/rankings

Overall: **6th/130**

On-grid eCooking: **0.48 –77th/130**

Mini-grid eCooking: **0.49 – 8th/130**

Off-grid eCooking: **0.53– 4th/130**

Key opportunities:

- Development of National Action Plan for Clean Cooking is underway which has ambitious goals of 100% clean cooking by 2030;
- Highly active mini-grid and off-grid energy sectors.
- Recent expansion of national grid and installed capacity of generation will have a negative economic impact on the power generation companies if the consumption of electricity does not increase within a short period of time. **Encouraging ecooking in grid-connected households (not using PNG) could be a two-way solution for increased power consumption and at the same time provide access to clean cooking for the households and move a step forward in achieving SDG 7**.

Key challenges:

- eCooking is actively discouraged by policymakers as it is popular opinion that eCooking would overload existing power lines and require more generation;
- Policy interventions are needed to ensure product standardization and labelling to ensure quality and energy-efficient appliances reach users;
- Cultural practice or habits are not easily shifted/changed regardless of the availability of alternatives;
- Constrained financial resources among households;
- Weak national grid infrastructure;
- Low existing use and awareness of electric cooking;
- Prevalence of low-quality electric cooking appliances;
- Private sector participation currently lacking.

Potential impacts of scaled uptake in most viable market segment

If 40% of Bangladesh's grid-connected firewood users (25m ppl, 5m HHs) switched to eCooking, the WHO's BAR-HAP tool suggests that:

- 77,578 DALYs/yr avoided
- 12.7m tonnes/yr CO2eq emissions reduced

[2] Please note that many of the these off-grid customers are now grid-connected and are likely using the off-grid/mini-grid supply as a backup, most likely in instances of loadshedding.

- 6m tonnes/yr reduction in unsustainable wood harvest
- 1,640m hrs/yr of women's time saved (329hrs/HH/yr)
- 12 months payback for eCooking appliances ($80/HH upfront cost, $73/HH/yr savings on fuel energy costs – assuming the firewood purchasers transition, rather than collectors)
- 3,277 GWh demand for electricity stimulated

For further detail, please see Appendix 1: Impact of Scaled Uptake.

1 Introduction

Clean cooking and electricity access in Bangladesh

One of the most densely populated countries in the world, with over 160 million people (64% living in rural areas), Bangladesh transitioned to a middle-income country in 2015 and continues to rapidly grow economically and in human development terms. Despite recent progress, the country still performs relatively poorly on a number of human indicators including gender, Ease of Doing Business, and ICT/internet adoption. The country has made rapid progress towards universal electrification with around 99%[3] of the population having access to electricity, although the grid is plagued by issues of unreliability and is only 2% renewable.

In spite of economic growth and urbanisation, firewood remains the dominant fuel choice of rural Bangladeshi households[4] and there is relatively little use of clean cooking fuels (electricity primary fuel 0%; gas primary fuel 22%). This has severe implications on the environment. The Sustainable Development Goals are hugely important to Bangladesh which is highly vulnerable to the effects of climate change (ranking 76th out of 77 countries in terms of climate resilience)[5] while forest loss is also an issue with 50% of wood fuel harvested being unsustainable.[6] The Forest Department estimates that around 600,000 trees are cut down each year to use as wood fuel. Between 2011-2019, the country lost 9% of its tree cover – the global average being 9.2%![7]

Bangladesh has the lowest access to clean cooking fuels and technologies in SE Asia[8] with around 76-81% of the population lacking access to clean cooking. Despite a high electrification rate, ecooking is actively dismissed by policy makers under the assumption that the extra load would put pressure on the national grid. Thus, there is no integration between the electrification and clean cooking sectors. Clean cooking – and cooking with electricity (or eCooking) specifically – is not supported at policy level and a multiplicity of barriers to uptake have been identified at both supply and demand ends. Poor customer perceptions remain a challenge. Cooks have identified concerns around the taste of food cooked on electrical appliances, and high prices as being significant barriers to uptake. Meanwhile, poor after sale services is a further deterrent in continued use.

In the past, Bangladeshi people have been hesitant to make the shift due to socio-cultural perceptions, lack of awareness and concerns around affordability. This resistance has largely been enabled by the lack of top-down support to clean cooking: policy makers themselves had previously not prioritised clean cooking and, indeed, expressed concern that ecooking would add pressure to the grid. However, things are shifting, albeit slowly. The Government of Bangladesh (GoB) are putting together a National Country Action Plan for clean cooking (under construction) and are, surprisingly aiming for 100% clean cooking by 2030 (the target was previously much lower). This is positive news and a step in the right direction. Additionally, local companies are committed to addressing perceptions by reducing prices of appliances and making them more accessible over the last few years, these barriers will need to be key considerations in any transitionary process.

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[3] Please note this is different to the RISE scores which are not electricity access or ecooking specific, but rather refers to how conducive the policy environment is.

[4] ESMAP (2015) "Beyond Connections: Energy Access Redefined"

[5] HSBC (2020). "Fragile Planet 2020"

[6] Bailis et al. (2015). "Environmental Burden of Traditional Bioenergy Use"

[7] https://www.seforall.org/system/files/2020-12/EF-2020-UL-Bangladesh-SEforALL.pdf

[8] https://www.tbsnews.net/bangladesh/bangladesh-has-lowest-clean-cooking-access-south-asia-257407

2 Enabling environment

eCooking policy outlook: Clean cooking – and specifically electric cooking – is not encouraged at the policy level. It is popular opinion, at policy maker level, that electric cooking may overload the existing power lines and may require more power generation. So, significant capital investment may be required if electric cooking is encouraged at the policy level.

Key policy stakeholders include SREDA, Clean Cooking Alliance, Practical Action, UIU, SNV, University of Southampton, GIZ, USAID, World Bank.

RISE (Regulatory Indicators for Sustainable Energy) scores:

81%	61%	44%	44%
Electricity Access	Clean Cooking	Renewable Energy	Energy Efficiency

Targets[9]:

Electricity access	**Clean cooking**
100% electricity access by 2030 (grid/off-grid)	100% clean cooking access by 2030[10]
40,000MW renewable grid electricity by 2030	40% modern energy cooking access by 2030

Key government/NGO programmes creating the enabling environment in which eCooking can scale:

- Sustainable and Renewable Energy Development Authority (SREDA) currently updating the National Country Action Plan for Clean Cooking (2020-2030) to promote 100% clean cooking systems by 2030;
- The Power Sector Master Plan aims to generate 82000 MW by 2041 (including 3864 MW from renewable energy sources). Government supported development bank (IDCOL) - providing subsidies to establish biogas plants (via low interest loans);
- Improved biomass cookstoves (ICS) promoted by IDCOL, Bangladesh Climate Change Trust Fund and GIZ.
- Government KABITA programme promotes ICS for free.;
- EnDev are beginning the second phase of project promoting the productive use of solar energy and clean cooking technologies;
- Clean Cooking Alliance have launched behaviour change campaigns to reach consumers.
- To help increase the adoption of clean cooking solutions, the Bangladesh Country Action Plan for Clean Cookstoves (CAP) was launched in 2013 by the Power Division of the Ministry of Power, Energy and Mineral Resources.

[9]https://www.unescap.org/sites/default/files/Country%20presentations%20SDG7%20Bangladesh%20Mr.%20Mohamad%20Osman%20Goni.pdf

[10] Slide 4 of SREDA's PowerPoint found here

- Successful implementation of the priority interventions in CAP aligned to the government's priorities and vision of smoke-free kitchens by 2030.[11]
- Based on CAP, new National Action Plan for Clean Cooking in Bangladesh (2020-2030)[12] is currently under development.
- The National Action Plan aims to prioritise clean cooking in order to achieve 100% clean cooking access by 20230 in Bangladesh.

Key barriers/drivers in the enabling environment:

Drivers

- Significant efforts by government and nodal agencies (such as SREDA) to encourage a clean cooking agenda;
- Sustained human and economic growth trend shows increasing purchasing power;
- Highly active mini-grid and off-grid energy sectors.

Barriers

- eCooking is actively discouraged by policymakers as it is popular opinion that ecooking would overload existing power lines and require more generation;
- Government KABITA programme promotes ICS for free which often negatively affects commercial viability of other technologies;
- Weak national grid infrastructure resulting in frequent load shedding/power failures (especially in summer);
- Private sector participation currently lacking.

For further detail, please see Appendix 2: Enabling Environment.

[11] MTF Bangladesh

[12] https://www.seforall.org/system/files/2020-12/EF-2020-UL-Bangladesh-SEforALL.pdf

3 Consumer demand

What's on the menu?

In a typical week, a Bangladeshi household might prepare:

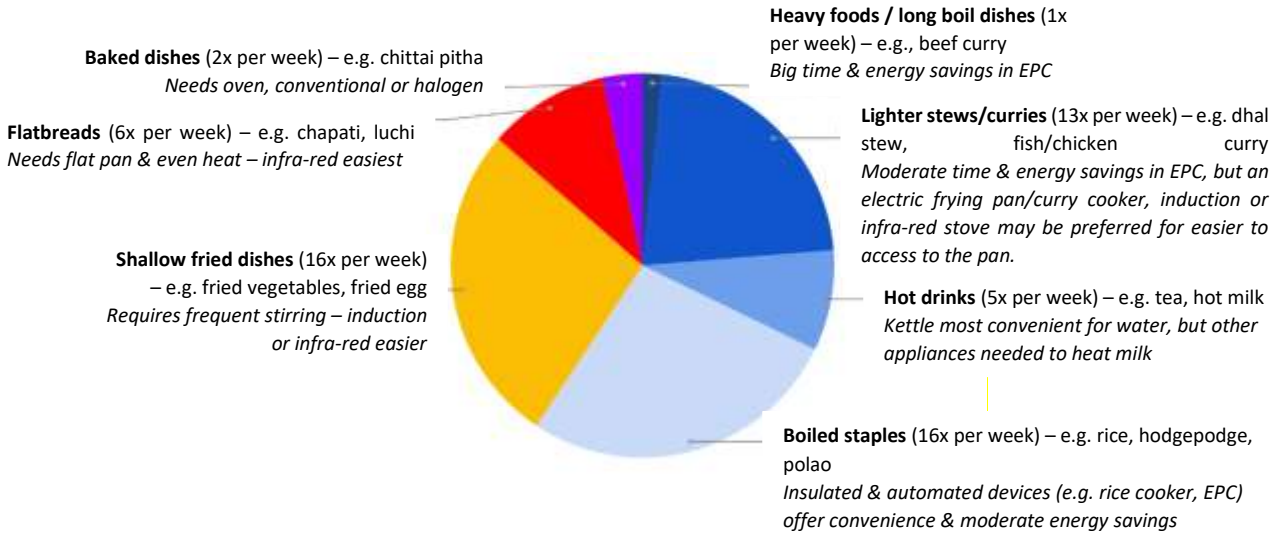


Figure 1: Visualisation of the results of a culinary analysis carried out during this market assessment by asking local team members to map out the dishes that a typical Bangladeshi household might prepare in an average week and assessing their compatibility with modern energy-efficient appliances.

Popular meal combinations in Bangladesh include:

- A typical Bangladeshi meal includes an assortment of *dhal* (yellow lentil soup) and curry (fish, chicken, beef, egg, mutton, or vegetables). Rice and sometimes, *bhaji* (fried vegetables) or *shuk* (fried greens) will accompany the meal.
- Rice cookers have an important role to play as boiled rice is the major staple in Bangladesh, and in rural areas is eaten three times a day (i.e. Including for breakfast).
- Noodles, which migrated to Bangladesh from China, have become a popular mealtime choice in many homes. The Bangladeshi style is to fry the noodles with spices, onions, and vegetables, so access to the pan is required for stirring, making an induction/infra-red stove a popular choice;
- *Chapati* is a common breakfast item in Bangladesh, and the making of *chapati* is an energy-intensive process. Chapati is a flatbread that requires a flat pan with even heating, meaning that an infra-red stove is best, but an induction stove with a thick-bottomed pan can also work.
- Most meals are prepared at home, and most dishes take on average 20-60 minutes to prepare each.

Most viable energy-efficient appliances: **induction cookers, infrared cookers, electric oven (countertop), curry cookers, rice cookers** and **electric pressure cookers**.[13]

[13] https://mecs.org.uk/wp-content/uploads/2021/05/FINAL-Bangaldesh-Market-Mapping_March-2021.pdf

Key marketing messages: **energy-efficient appliances offer substantial time and cost savings and enable multi-tasking, whilst improving household health. EPCs are the cheapest and most convenient way to cook foods that are time and energy consuming**.

Key demand side barriers/drivers:

Drivers

- Improved health due to reduced HAP;
- Cleaner pots and kitchens due to reduced smoke/soot;
- Less time spent on fuel collection means increased time spent on other activities (whatever they may be);
- Shortened cooking time (instant heat for cooking) and increased convenience;

Barriers

- Cultural practice or habits that cannot be easily changed regardless of the availability of alternate options;
- Low existing use and awareness of electric cooking and its cost benefits;
- Constrained financial resources among households prevents uptake.

Key demand creation programmes: n/a

Key market segments:

- *Firewood* – Around **45.6%** of Bangladeshi households relay on firewood for cooking, with the majority of rural households relaying on wood fuel (**58.1%).**[14]
- *Other* biomass fuels – the mix consists of **dung/animal waste (9.2%), crop residue** and **other biomass (10.6%)**.[15]
- *Clean fuels* – Approximately **34.6%** of households in Bangladesh use clean fuels – specifically liquified petroleum gas (LPG), piped natural gas (PNG), biogas and electricity. [16]
- Of the 34.6% above, PNG is the fuel choice of 81.7% of households and **electricity** accounts for under **1%** of this![17]

For further detail, please see Appendix 3: Consumer Demand.

[14] MTF Bangladesh
[15] MTF Bangladesh
[16] MTF Bangladesh
[17] MTF Bangladesh

4 Supply chain

Key domestic eCooking appliance manufacturers: Pran-rfl, Walton, Hamko, Kiam, Miyako, Nova, Jamuna, Singer.[18]

Key eCooking appliance distributors: Vision Emporium, MS. Brothers Electronics, Best Electronics, Marcel (Ahna) Electronics, Walton Plaza.

Innovative eCooking pilot projects:

MECS: Country Partners: *UIU and Practical Action*

- Cooking Diary and Appliance Testing Bangladesh
- Cooking Performance of Modern Clean Cookstoves: Household Survey
- Market Mapping of modern energy cooking appliances, Bangladesh
- ***Collaboration with ENDEV****:* Solar PV integrated clean cooking for grid connected areas: a field implementation
- MECS-ECO: University of Southampton / UIU / SNV*: Ecooking in Urban Slums: Benefits and Barriers to Implementation (A pilot study)* [underway]

Key supply side barriers/drivers:

Barriers

- Market is flooded by poor/low quality electrical appliances causes distrust in products;
- This is due to a lack of policy interventions to ensure product standardization and labelling to ensure quality and energy-efficient appliances reach users;
- High import duties;
- Poor after sales service (i.e. poor access to repair and maintenance);
- Constrained financial resources among households;

Drivers

- Manufacturers and importers have already established supply chains and an electrical cooking appliance market;
- The National Action Plan for Clean Cooking in Bangladesh 2020-2030 (previously CAP) has revised targets to disseminate clean cooking solutions as follows: LPG (60%), NG (13%) and electric cookstoves (8%);
- Based on the above, market actors have potential to capitalize on the opportunity by implementing electrical appliances.

Popular appliances in Bangladesh today: Microwave oven, electric oven, electric kettle, toaster, induction and infrared cookstoves, auto-fire and mechanical gas stoves, hot plate, multicookers and rice cookers.

[18] https://mecs.org.uk/wp-content/uploads/2021/05/FINAL-Bangaldesh-Market-Mapping_March-2021.pdf

Relative costs of cooking with electricity & popular cooking fuels:

- eCooking is perceived to be unfeasible by policy makers – the belief is that the increased demand would put too much pressure on the grid;
- However, MECS-UIU undertook a Cooking Diary and lab testing study and found that the cost of eCooking is comparable with that of LPG and firewood:

	Firewood	LPG	Electricity
Monthly cooking energy cost for a family of 6	800 BDT	784 BDT	552 BDT (avg)

- The same study found that consumers were willing to buy ecooking appliances if there were an opportunity for monthly instalments.

Avg Grid electricity tariffs:
BDT 5.65 (0.066 $ /kWh)
Isolated Mini-grid tariffs (2015):
BDT 29 (0.37 $/kWH)

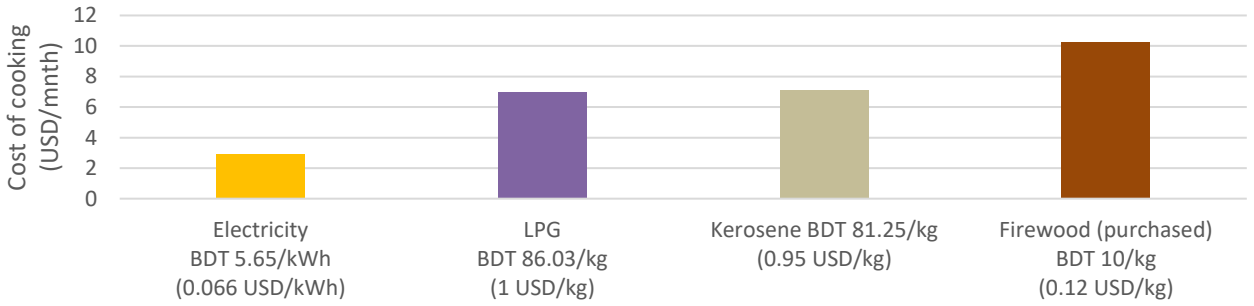


Figure 2: Cost comparison of different cooking fuels based on international averages for cooking energy demand from ESMAP (2020) and local electricity/fuel prices obtained during this market assessment.

For further detail, please see Appendix 4: Supply Chain.

5 Recommendations for interventions

Table 1: Decision matrix/board highlighting key factors and viability of specific interventions.

		Current status	Recommended interventions
Market segments	**On-grid**	Weak national grid infrastructure resulting in frequent load shedding/power failures (especially in summer). Recent expansion of national grid and installed capacity of generation will have a negative economic impact on the power generation companies if the consumption of electricity does not increase within a short period of time.	*Pilot battery-supported eCooking devices to mitigate unreliability in grid electricity. Potential for integration of rooftop solar PV based grid connected eCooking solutions.*[19]
	Mini grid	Bangladesh performed particularly well in the MECS eCooking GMA on the mini-grid and off-grid scenarios (ranked 8th and 4th respectively). Bangladesh has the highest off-grid renewables capacity. IDCOL financed 17 solar mini-grid projects in remote areas (river and sea islands) and plans to finance a further 200 solar mini-grid projects by 2025.	*Support IDCOL to integrate eCooking into the planning for forthcoming solar mini-grids and leverage carbon financing to offer reduced tariffs for cooking and/or subsidise appliance costs.*
	Off-grid (SHS)	Bangladesh is a global pioneer of off-grid solar with the 3rd highest number of off-grid lighting/appliance customers with over 13m SHS, but most designed for lighting. Innovative low cost solar electric cooking technology being developed by UIU. Many of off-grid customers now grid-connected and are likely using the off-grid/mini-grid supply as a backup, most likely in instances of loadshedding.	*Support Bangladesh's established SHS sector to venture into cooking, in particular:* • *direct drive DC solutions under development by UIU* • *swarm electrification (e.g. SolShare) to enable existing SHS to pool their generation/storage and potentially support eCooking*
TToC dimensions	***Supply chain***	Manufacturers and importers have already established supply chains and an electrical cooking appliance market. However, the influx of low-	*Lobby government for policy interventions around product labelling and standardization to ensure quality and energy-efficient appliances are on*

[19] https://mecs.org.uk/wp-content/uploads/2021/06/Solar-PV-integrated-clean-cooking-for-grid-connected-areas-A-field-implementation.pdf

		quality eCooking appliances and poor after sales service or access to repair & maintenance deters consumers.	*the market. Targeted local capacity building to develop a more geographically even spread (outside city hubs) of after sales services for electric cooking.*
	Consumer demand	Electric cooking appliance market has rapidly grown since 2018. Majority of cuisine can be cooked on electricity. Affordability (both upfront and monthly) is the main barriers to uptake especially in rural areas. Cultural beliefs/perceptions not easily shifted, especially in an environment where there is a lack of awareness not only on the benefits of eCooking and available appliances.	*To support wide scale dissemination of eCooking solutions across rural & low-income groups:* • *investigate viability of incentive-based programmes and consumer financing for ecooking appliances.* • *set up country-wide campaigns to increase awareness of eCooking as a clean cooking option.* • *address consumer concerns on safety and usability of eCooking – potentially through training campaigns.*
	Enabling environment	Current policy does not recognise the importance of clean cooking and does not take an integrated approach to electrification and clean cooking.	*Support the development and aims of the National Action Plan for Clean Cooking (2020-2030) by raising awareness of key findings from completed and ongoing eCooking projects from MECS and other development organisations.*

Appendices

Appendix 1: Impact of Scaled Uptake

This section explores the likely costs and benefits for one simple illustrative scenario of scale-up of eCooking in selected key segments. The World Health Organisation (WHO) revised "Benefits of Action to Reduce Household Air Pollution" (BAR-HAP) tool[20] has been applied to quantify the expected financial costs, health and environmental benefits of the scale-up.

The scenario modelled is chosen to consistent with the MECS programme's suggested "40, 60, by 2030" goals: a target of 40% for all households connected to grid or off-grid electricity in low- and middle-income countries to be using it for cooking by 2030, and a target of 60% of households utilising modern energy for cooking to be utilising energy generated from low carbon sources by 2030 (low carbon interpreted here to include electricity coming from relatively low carbon fuel mix, and excluding fossil-derived LPG). For this illustrative analysis of costs and benefits, the focus is just on households that are grid connected, but currently cooking with firewood, which they purchase. While specific data are not available for this demographic, an estimate was made based on the evidence earlier in the report about different categories of users, suggesting approximately 5 million households. Details are in the first part of the table. BAR-HAP models a ramp-up of transitioning households over the first 5 years to 2025 and then a further 5 years operation.

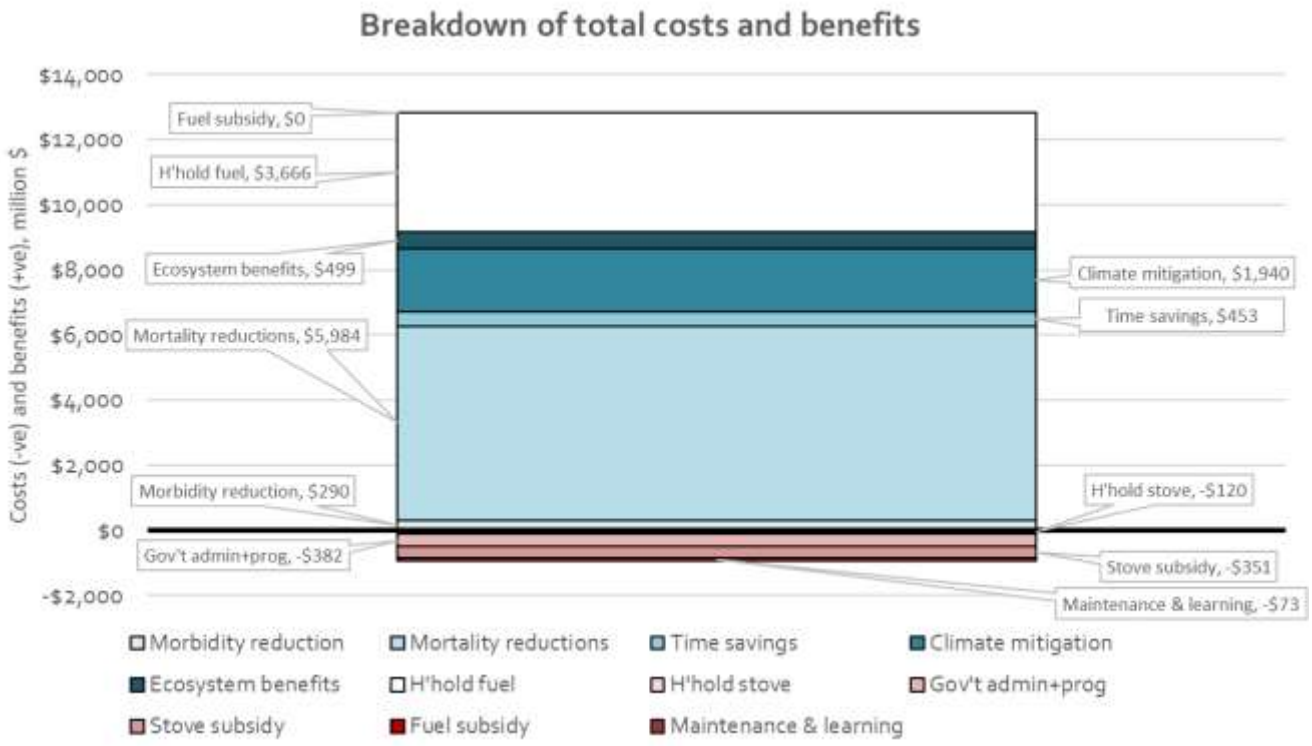
BAR-HAP has been implemented here using its policy option of a ban on firewood use, which comes in gradually from 2020 to 2030. This is clearly not a realistic policy and is simply used here to effect the transition wanted for this illustration, with clarity about the impacts and where costs fall; it can be regarded as a proxy for other specific actions used to mobilise a major transition from wood to eCooking. The assumption is that transitioning households are fuel stacking, with 20% of cooking still delivered using firewood. The full costs of the new MECS devices have been assumed to be paid for by the Government, as a convenient simplification for this illustration. Other policy options that could have been modelled would see a different distribution of stove and fuel costs and savings between parties. eCook devices are assumed to cost $80 and to have an average efficiency of 75% (MJ input to MJ useful heat output). eCooking is assumed to save 30% of the typical 3 hours cooking per day. Bangladesh's grid electricity generation mix comprises mainly fossil fuels, but this is mainly natural gas, with some oil.

The lower part of the table shows the outputs of BAR-HAP for the modelled scenario. The chart shows the structure of costs and benefits.

[20] https://www.who.int/tools/benefits-of-action-to-reduce-household-air-pollution-tool

Grid connections projections and eCook target		Population (millions)	households (millions)	% grid connected			
National population, 2020		164.60	32.72				
Grid connections, 2020		140.30	27.89	85%			
Of which, using firewood (assume paying for it)		64.54	12.55				
Scenario modelled		Population (millions)	households (millions)				
Transition from firewood to eCooking		25.82	5.02				
Costing (costs are -ve, benefits are +ve)				$/yr	$/yr per household transitioning	$M total	$total per household
Total present value (ie net social benefits of the transition)				1,190,475,206	238	11,905	2383
Total costs of transition, government+private				273,906,500	55	2,739	548
Private cost to housholds: total				347,243,714	70	3,472	695
Stove				*-12,042,756*	-2	-120	-24
Fuel				*366,588,601*	73	3,666	734
Maintenance				*-7,302,132*	-1	-73	-15
Costs to government: total				-73,337,214	-15	-733	-147
Stove				*-35,124,704*	-7	-351	-70
Fuel				*0*	0		
Admin+Programme				*-38,212,510*	-8	-382	-77
Health, Time, and Environmental Benefits: total		Physical: change/yr	Physical: % of national cooking total	916,568,706	183	9,166	1835
Health impacts total: DALYs avoided	DALYs	77,578		627,432,102	126	6,274	1256
Mortality reduction	*YLL*	*42,504*	1.5%	*598,391,819*	120	*5,984*	1198
Mortality reduction	*Lives*	*3553*	2.3%				
Morbidity reduction	*YLD*	*35,074*	4.5%	*29,040,283*	6	*290*	58
Morbidity reduction	*Cases*	*199,922*	4.2%				
Time savings	Hours	1,640,853,420	21.4%	45,256,032	9	453	91
Time savings per adopting household	*Hours/HH*	*329*					
Electricity use	*MWh*	*3,277,205*					
CO2-eq reduction (CO2,CH4,N2O)	Tonnes	12,702,986	22.7%	193,957,741	39	1,940	388
Unsustainable wood harvest reduction	Tonnes	6,025,987	21.1%	49,922,832	10	499	100
Note: costs are discounted across programme period.							
Totals are Net Present values; costs/year are NPV divided by the ten years of the programme							

The table shows that while this transition would cost government some $147 per household for equipment and programme costs, it would save households several times that in reduced energy bills over the ten years of the program: electricity prices are low and the firewood prices are relatively high. Furthermore, health benefits would include more than 3500 lives saved per year. Some 21% of current unsustainable wood harvesting would be avoided and greenhouse gas emissions from the national cooking sector would be reduced by more than 22%. These climate change benefits at fist sight seem surprising, since the power generation mix is almost 100% fossil fuels. But natural gas dominates, with its relatively lower emission factors, and most of the firewood substituted is assumed to come from unsustainable sources.



The figure summaries the various physical and financial impacts of the transition in monetary terms. The economic benefits of lower fuel bills, reduced GHG emissions, and reduction in deaths from avoided indoor air pollution dominate the chart. The social benefits from avoided time spent cooking are smaller but significant, reflecting mainly time savings using an EPC, and the opportunity cost for peoples' time, as used in BAR-HAP. The largest element of cost is for the purchase of modern stoves by government; households are assumed to benefit further by avoiding the need to pay for their traditional charcoal stoves.

This is an impact analysis for one simple scenario for just one particular segment (grid connected firewood users) of Bangaldesh's population. However, it demonstrates very significant net benefits that could be achieved, based on the WHO's physical impact and impact monetisation methodologies.

Appendix 2: Enabling Environment

Further info to programmes and policies above:

- The Power Sector Master Plan aims to generate 82000 MW by 2041 (including 3864 MW from renewable energy sources).
- Government supported development bank (IDCOL) – providing subsidies to establish biogas plants (via low interest loans).
- IDCOL is now implementing phase II of their programme for the dissemination of 5m ICS financed by grants from the Green Climate Fund (GCF) and credit from the International Development Association (IDA).
- Improved biomass cookstoves (ICS) promoted by IDCOL, Bangladesh Climate Change Trust Fund and GIZ.

Appendix 3: Consumer demand

Fuel stacking

Fuel stacking is fairly common with around 75% of household across Bangladesh stacking firewood with biomass fuels (62.4% in urban hh; 77.5% in rural hh). Of the 'other' biomass fuels, crop residue is the most common fuel stacked alongside firewood, followed by animal waste.[21]

Stove stacking

Although 89% of households exclusively use one stove, stove stacking is practiced in Bangladeshi kitchens due to the multiple cooking needs of various dishes.[22] Additionally, MTF surveys found that stove stacking occurs as households often use certain stoves explicitly for certain cooking activities – LPG stoves purely for boiling water for tea whilst using a traditional cookstove for cooking meals.

Fifty-five percent of households that use clean stoves in rural areas also use biomass (traditional) stoves – compared to 10% of urban clean cookstove users who stove stack with biomass stoves. "Overall, the extent of stove stacking is less than 25% among clean cookstove users."[23] Of households stacking stoves, biomass stoves are still the preferred stove over the clean counterpart – 104.6 min/day vs 66.6 min/day. Thus, main meals are **not** being cooked on clean cookstoves even if they are present in the kitchen.

Cost of ecooking/willingness to pay

- A financial analysis shows that the cost of electric cooking for a family of 6 in Bangladesh is around to BDT 600 (GBP 5.45) per month, whereas the LPG and firewood-based cooking costs BDT 800 (GBP 7.27) per month.
- By cooking with efficient electric cooking appliances or adopting slow cooking for appropriate dishes, the UIU found that the cost of ecooking could be reduced by around 25%.
- Further research by UIU, funded by MECS, showed that if it is possible to implement low-cost integration of solar photovoltaic (PV) in households, monthly costs could be further reduced to BDT 350 (GBP 3.25).[24]
- According to MTF data[25], gender is a consideration in willingness to pay for electricity. Female-headed households reportedly cite cost of connection and usage as reasons for not connecting to the grid.

Appendix 4: Supply Chain

Access to electricity:

- Access to electricity nationwide as of 2019 = **92.2%** (urban = 97.8%; rural = 88.8%)[26]
- On-grid generation
  - Oil/gas/coal generation = 98%
  - Renewable generation = 1.5%
- Access is predicted to reach 100% by 2021.

[21] MTF Bangladesh
[22] MTF Bangladesh
[23] ibid
[24] https://mecs.org.uk/wp-content/uploads/2021/03/Cooking-Diary-and-Appliance-Testing-Bangladesh.pdf
[25] MTF Bangladesh
[26] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?end=2019&locations=BD&start=1991

- However**, 76%-81%** of the national population still lack widespread access to clean cooking facilities.

Mini-grid and off-grid:

- As of 2017, around 8% of electricity in the country is provided through off-grid solar.
- Solar coverage was predicted to increase by 10% by 2020 and 100% by 2050.
- Import of low-quality solar products has been problematic. GoB introduced minimum quality standards on solar modules, inverters, charge controllers and batteries.
- IDCOL financed 17 solar mini-grid projects in remote areas (river and sea islands) and plans to finance a further 200 solar mini-grid projects by 2025.
- The Regulatory Indicators for Sustainable Energy (RISE), Bangladesh, has a comprehensive electricity access policy framework and well- developed policies and regulations to bolster mini-grids and stand-alone systems.[27]

Evolution of mini-grid tariffs, 2011-2015

	2011	2012	2013	2014	2015
BDT/kWh	32	32	32	31	29
US$/kWh	0.41	0.40	0/41	0.39	0.37

Source: Global Climatescope

[27] Renewable Energy Policy Network for the 21st Century (REN21)