eCook Myanmar National Policy & Markets Review

October 2019 Working Paper

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Executive Summary

This report summarises the findings **a review of national policy and the market for clean cooking and electricity in Myanmar**, with the aim of informing the development of a battery-supported electric cooking concept, eCook. It is part of a broader programme of work, designed to identify and investigate the opportunities and challenges that await in high impact markets such as Myanmar.

This study has confirmed that there is a strong market for eCook products and services in Myanmar, as electricity is without doubt the aspirational source of energy for cooking. However, cooking fuel in Myanmar is currently overwhelmingly from unsustainable sources (primarily charcoal, firewood, & LPG). Firewood dominates rural cooking, whilst electricity & charcoal are both much more popular in peri-urban and urban areas.

Myanmar has gas reserves, but they are either used for electricity generation or exported, meaning there is little to no spare capacity for domestic LPG production. Ironically, LPG is imported from Thailand and china, much of which was originally exported from Myanmar, refined and then reimported as LPG.

Many fuelwood users are now paying for wood, as collecting has become more challenging due to dwindling forest reserves. This creates an emerging opportunity to capture these new expenditures on polluting fuels with clean & modern eCook products/services.

Households in Yangon switching from charcoal to LPG & electricity for cooking has slowed deforestation in the Ayeyarwady delta region's mangroves. eCook could build upon this success story by extending access to reliable electricity for cooking to many more households.

Charcoal prices vary considerably throughout the country – the same sack of charcoal sells for half the price in the charcoal producing regions of Magway and Tanitharyi than it does in Yangon. In fact, it is even more expensive in Shan State, showing that the opportunity to capture existing expenditures on commercialised polluting fuels is much more attractive in certain parts of the country.

Myanmar's ageing electrical generation & distribution infrastructure is in need of major investment. eCook systems can offer decentralised energy storage that can strengthen weak-grids without having to wait for upgrades to the centralised system.

Table of Contents

1 Introduction

This report presents one part of the detailed in country research carried out to explore the market for eCook in Myanmar. In particular, this in country work aims to gain much greater insight into culturally distinct cooking practices and explore how compatible they are with battery-supported electric cooking. The report is rich with detail and is intended to provide decision makers, practitioners and researchers with new knowledge and evidence.

This report presents findings from a review of national policy and the market for clean cooking and electricity designed to inform the future development of eCook within Myanmar. It is one component of a broader study designed to assess the opportunities and challenges that lay ahead for eCook in high impact potential markets, such as Myanmar, funded through Innovate UK's Energy Catalyst Round 4 by DfID UK Aid and Gamos Ltd. (https://elstove.com/innovate-reports/). A much deeper analysis of the data collected during this project was supported by the Modern Energy Cooking Services (MECS) programme, which included the writing of this report.

The overall aims of the Innovate project, plus the series of interrelated projects that precede and follow on from it are summarised in in *Appendix A: Problem statement and background to Innovate eCook project*.

1.1 Background

1.1.1 Context of the potential landscape change by eCook

The use of biomass and solid fuels for cooking is the everyday experience of nearly 3 billion people. This pervasive use of solid fuels and traditional cookstoves results in high levels of household air pollution with serious health impacts; extensive daily drudgery required to collect fuels, light and tend fires; and environmental degradation. Where households seek to use 'clean' fuels, they are often hindered by lack of access to affordable and reliable electricity and/or LPG. The enduring problem of biomass cooking is discussed further in *Appendix A: Problem statement and background to Innovate eCook project*, which not only describes the scale of the problem, but also how changes in renewable energy technology and energy storage open up new possibilities for addressing it.

1.1.2 Introducing 'eCook'

eCook is a potentially transformative battery-supported electric cooking concept designed to offer access to clean cooking and electricity to poorer households (HHs) currently cooking on charcoal or other polluting fuels (Batchelor, 2013, 2015a, 2015b). Enabling affordable electric cooking sourced from renewable energy technologies, could also provide households with sustainable, reliable, modern energy for a variety of other purposes.

A series of initial feasibility studies were funded by UK Aid (DfID) under the PEAKS mechanism (available from https://elstove.com/dfid-uk-aid-reports/). Slade (2015) investigated the technical viability of the proposition, highlighting the need for further work defining the performance of various battery chemistries under high discharge and elevated temperature. Leach & Oduro (2015) constructed an economic model, breaking down PV-eCook into its component parts and tracking key price trends, concluding that by 2020, monthly repayments on PV-eCook were likely to be comparable with the cost of cooking on charcoal. Brown & Sumanik-Leary's (2015), review of behavioural change challenges highlighted two distinct opportunities, which open up very different markets for eCook:

- PV-eCook uses a PV array, charge controller and battery in a comparable configuration to the popular Solar Home System (SHS) and is best matched with rural, off-grid contexts.
- Grid-eCook uses a mains-fed AC charger and battery to create distributed HH storage for unreliable or unbalanced grids and is expected to best meet the needs of people living in urban slums or peri-urban areas at the fringes of the grid (or on a mini-grid) where blackouts are common.

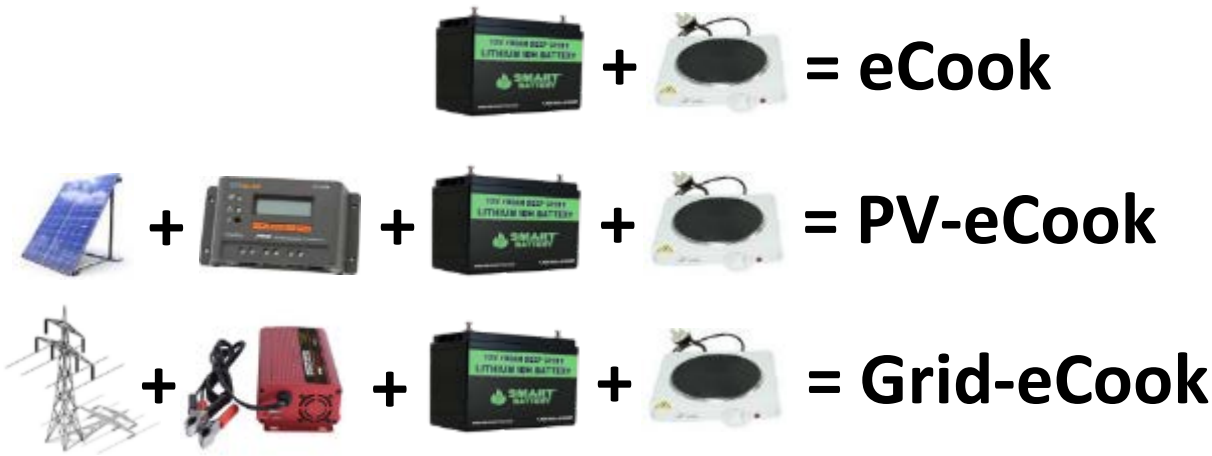


Figure 1: Pictorial definitions of 'eCook' terminology used in this report.

1.1.3 eCook in Myanmar

Given the technical and socio-economic feasibility of the systems in the near future, Gamos, Loughborough University and the University of Surrey have sought to identify where to focus initial

marketing for eCook. Each country has unique market dynamics that must be understood in order to determine which market segments to target are and how best to reach them. Leary et al. (2018) carried out a global market assessment, highlighting that the liberalisation of Myanmar opens the door to a significant charcoal market, with a small percentage of users already cooking on electricity, paving the way for eCook.

The accompanying reports from the other activities carried out in Myanmar can be found at: https://elstove.com/innovate-reports/ and www.MECS.org.uk.

1.2 Aim

The aim of this study was to understand the intersect between 'cooking', which has traditionally meant biomass, in particular improved biomass stoves, and 'energy access', which has tended to focus on electricity and grid access.

The objectives are twofold:

- To review the current regulatory framework in Myanmar and assess which polices are likely to accelerate the uptake of the eCook concept and which may present significant barriers.
- To assess the state of the existing clean cooking and grid/mini-grid/off-grid electrification markets, which may provide the foundation for future eCook products/services.

2 Methodology

A framework for the policy/markets analysis was developed by Gamos, Loughborough University and the University of Surrey, focussing on the following key areas:

- Clean cooking (health, deforestation, climate change, fuel/stove markets, etc.)
- Electrification (renewable energy, energy-efficiency, grid/mini-grid/off-grid markets etc.)
- Cross-cutting issues (gender, business environment, demographics, etc.)

The elements of the framework were based upon the factors that are most likely to affect the uptake of eCook products/services and the size of key market segments. These factors were first identified by Brown & Sumanik-Leary (2015), then further extended and contextualised by Leary et al. (2018).

Drawing upon their extensive experience in both the Myanmar clean cooking and electrification sectors, our Myanmar partners, REAM, prepared a series of responses to the questions posed by the framework, which was supplemented by a literature review. The full framework can be found in ***Error! Reference source not found.***.

Additional information was drawn from the following key sources identified by REAM:

- The Census Atlas of Myanmar (Department of Population, 2014)
- The EMC Myanmar Cookstoves Market Assessment (EMC *et al.*, 2015)
- The Alternative Vision for Myanmar's Power Sector (WWF *et al.*, 2016)

3 Results

3.1 Clean cooking

Who are the key government, NGO, research & private sector actors in the clean cooking sphere and what are their roles?

Table 1: Organization/Institution and their roles/

ORGAIZATION/INSTITUTION	ROLE
Ministry of Electricity and Energy	Electrification for Household including cooking
Ministry of Natural Resource and Environmental Conservation, Environmental Conservation Department	Policy formulation for Forest and Natural Resources concerning with Fuel-wood, Charcoal, Natural Gas etc.
Ministry of Natural Resource and Environmental Conservation, Forest Department	Efficient Stove promotion and public campaign
Ministry of Natural Resource and Environmental Conservation, Department of Rural Development	Rural Electrification All round rural development including firewood and stove improvement
Ministry of Education, Department of Research & Innovation	Research and formulating National level Standards & Specifications affair, National Laboratory for Scientific Tests and Certifications Research and development, Doing Pilot Research based on successful Academic Research to apply Commercial scale, Technology transfer, G2G (Government to Government & B2B (Business to Business) Parallel Program to promote Myanmar Private sector.
National Committee for Clean Cook Stove Standard & Specification	Regulating the Clean Cook Stove sector
Private sector	There are many firewood and charcoal stove manufacturers and sellers. Various types of cook stove are commercially trading in the country due to large bio-fuel based characteristic. Also, agricultural and forest wastes based stoves are available in the market. Existing Market of electric cooking appliances is very significant at the areas of on-grid as well as off-grid. There are many off-grid electrification by using Solar, Biomass and micro-hydro where rural areas are trying to use e-cookers at their own ways.
Local NGOs, CSOs and CBOs	Regarding to diverse issues of Poverty, Grassroots' Livelihood, Environment, Gender, Rural Development, Social Improvement, Deforestation, SME Development etc., many Public sector are conducting clean stove engaging activities for awareness and socio-economic promotion. No static data collection and studies on such function.
GERES	Joint Research with Forest Department to promote AI Cook Stove and establish a small lab for Stove Standard Test

What is the national cooking energy mix (i.e. how many people primarily cook with firewood, charcoal, kerosene, LPG & electricity)? How is this changing?

- Myanmar energy sources include Electricity, Petroleum, Coal, Biomass, Solar and Micro-hydro energy. Wood and Charcoal based fuel are widely used for household and cottage industry cooking. General proportions of use are shown in the table below:

Table 2: Share of BIOMASS use (census data).

Fuel		Proportion (%)
All kinds of Biomass including firewood, charcoal, Wastes from Agriculture and Forest	Country level in cooking fuel consumption	65
Firewood	Out of Biomass ratio	50
Charcoal		15

- Statistics data for usage of other fuels like LPG, Biogas, Producer-gas (Syn-gas), Diesel, Briquette etc. for cooking are not available. But it should be noted that these fuels are being used.
- The demand for alternative energies has seen significant growth in the recent years as the market requirement for changing cooking characteristic to save time and energy cost by the public themselves. Utilization of renewable energies is practical practice of the people of Myanmar by occurring commercial operation of micro-hydro and biomass power-based electrification since 3 decades ago. SPV application also become booming last one decade ago firstly for lighting only and then it is now growing toward customized SHS to Solar mini-grid for extensive usage including cooking.

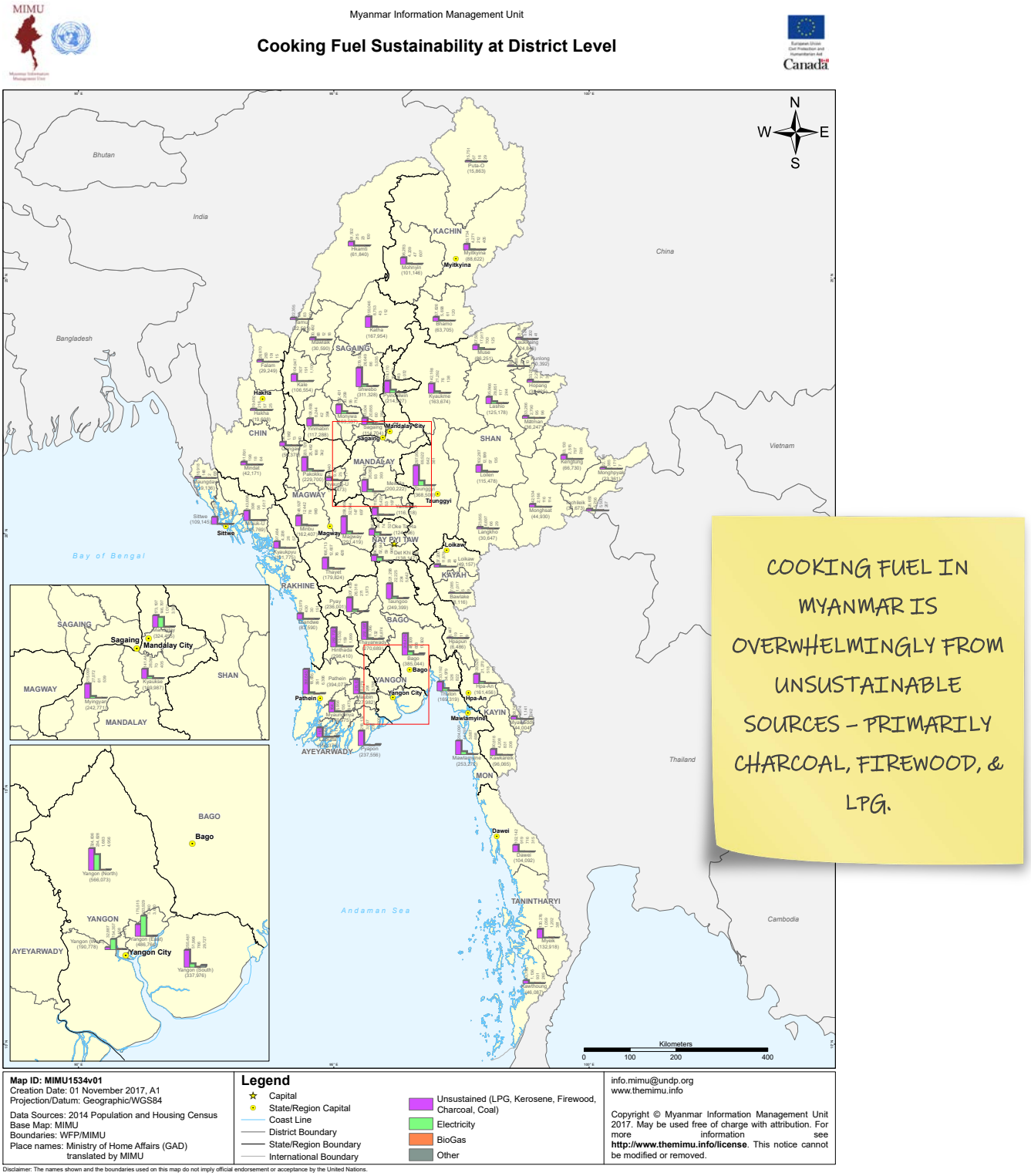
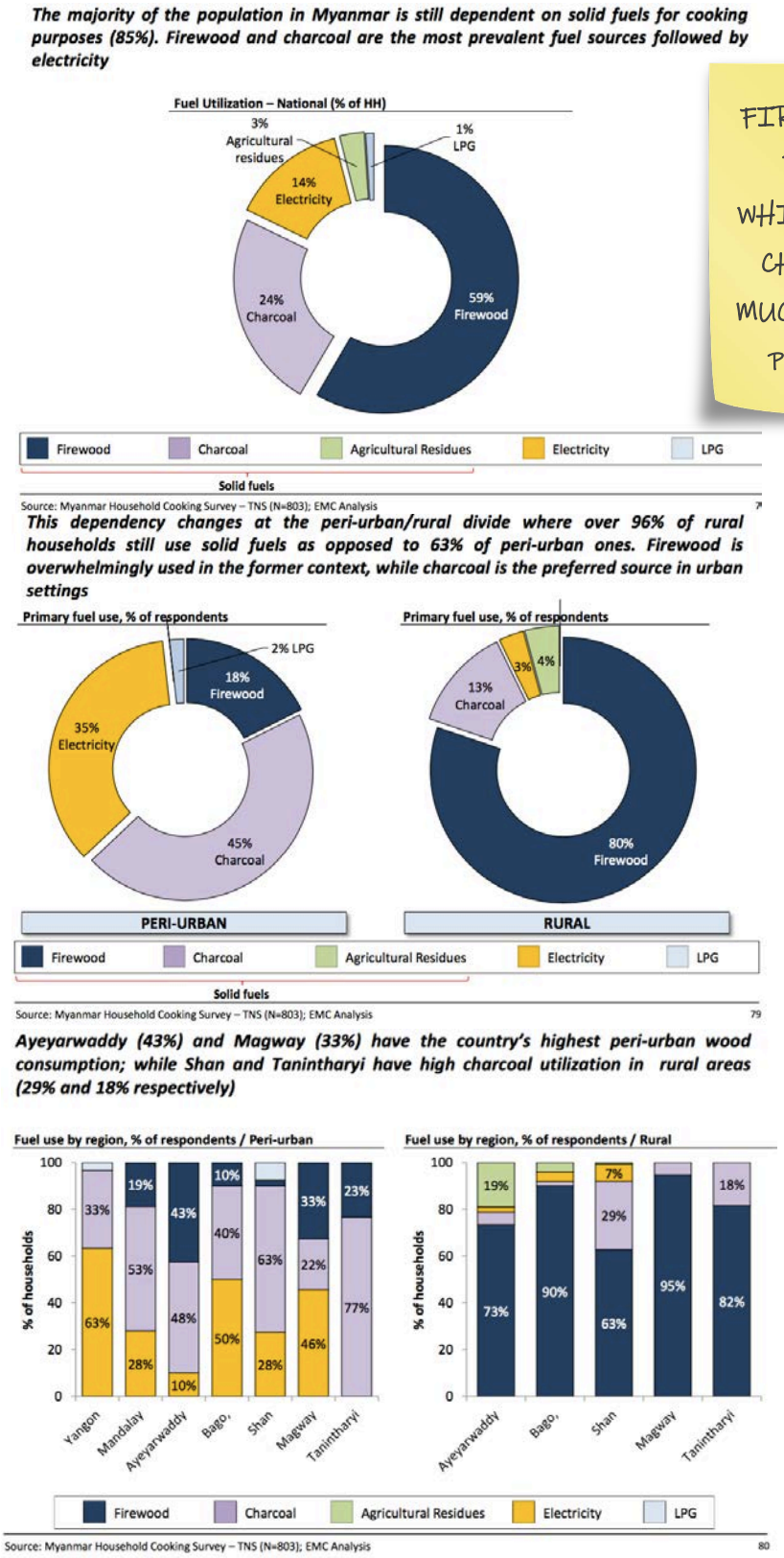


Figure 2: Cooking fuel sustainability at district level (Department of Population, 2014).



FIREWOOD DOMINATES RURAL COOKING, WHILST ELECTRICITY & CHARCOAL ARE BOTH MUCH MORE POPULAR IN PERI-URBAN AREAS.

Figure 3: Fuel choices in peri-urban and rural Myanmar (EMC et al., 2015).

Households in Myanmar: 11.431,111	Low income		Medium/Low income		Medium/High income		High income	
Peri-Urban Wood users	Purchase	130,561	Purchase	305,851	Purchase	45,585	Purchase	22,015
	Not-purchase	44,924	Not-purchase	57,392	Not-purchase	4,730	Not-purchase	2,528
Rural Wood users	Purchase	902,857	Purchase	1,243,186	Purchase	385,695	Purchase	81,904
	Not-purchase	1,909,781	Not-purchase	1,569,452	Not-purchase	434,933	Not-purchase	90,163
Urban Charcoal users	Purchase	135,811	Purchase	799,501	Purchase	308,530	Purchase	55,039
	Not-purchase	46,731	Not-purchase	150,025	Not-purchase	32,011	Not-purchase	6,320
Rural Charcoal users	Purchase	114,955	Purchase	230,538	Purchase	45,996	Purchase	46,583
	Not-purchase	243,160	Not-purchase	291,041	Not-purchase	51,868	Not-purchase	51,280
Urban Agric. Residues users	Purchase	0	Purchase	0	Purchase	0	Purchase	0
	Not-purchase	0	Not-purchase	0	Not-purchase	1400	Not-purchase	0
Rural Agric. Residues users	Purchase	48,329	Purchase	59,819	Purchase	6850	Purchase	14,333
	Not-purchase	102,229	Not-purchase	75,518	Not-purchase	7,892	Not-purchase	15,779

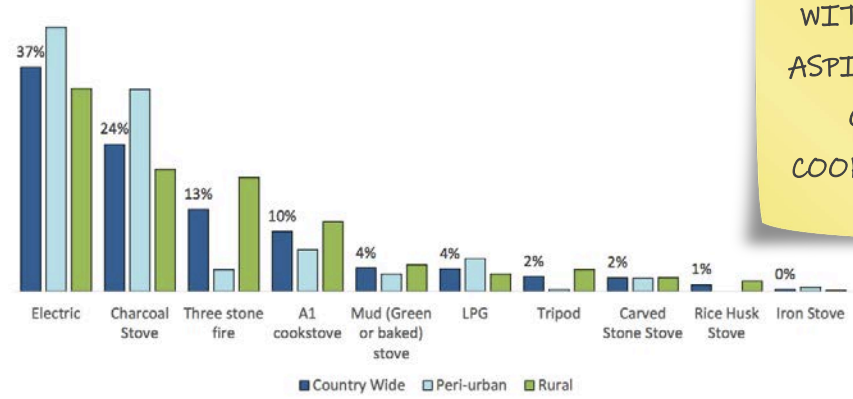
Segment 1 | Segment 2 | Segment 3

172

EMC

Across the country, the electric stove was reported to be the aspirational stove for most peri-urban (43%) and rural (33%) respondents

Preferred Stove, % of respondents (Country, Peri-Urban and Rural)



ELECTRICITY IS WITHOUT DOUBT THE ASPIRATIONAL SOURCE OF ENERGY FOR COOKING IN MYANMAR.

Figure 4: Aspirational fuel choices in Myanmar (EMC et al., 2015).

Which successful interventions have facilitated transitions to cleaner cooking solutions? Which have failed and why?

- Some successes have been occurred with the utilization of the ICS commercially attempted by private sector. Various types of local-made ICS of the many small businesses are using charcoal and firewood, and wastes from agriculture and forest which are familiar fuels.
- Despite years of campaigns and demonstrations of the AI stove (named by the Forest Department), there is no standard and specification norm due to inelegance of strategic encouragement of the government.
- Commercial ICS intervention in Myanmar include:
    - ICS project by Forest Research Institute (FRI), Department of Forest, Ministry of Natural Resource and Environmental Conservation
    - GERES
    - INGO sector
    - LNGO sector
    - Mangrove Service Network (MSN) - Myanmar local NGO

A variety of ICS programs have been launched in Myanmar since the 1990s

Organization	Location	Duration
Ecodev	Kachin State	2008 – Present
	Sagaing Division	1997 – 2001
	Magway Division	1997 – 2002
Ever Green Group	Shan State	2007 – 2009
	Ayeyarwady	2008 - 2009
Forest Resource Environment Development and Conservation Association	Sagaing Division	2000 – Present
	Southern Shan State	2004 – Present
	Ayeyarwady	2004 – Present
Mangrove Service Network	Rakhine State	2007 – Present
	Kachin State	2005 – 2006
	Chin State	2006 – 2007
	Mon State	2006 – 2007
United Nation Development Program	Ayeyarwady Division	2000 – Present
Metta Foundation	Kachin State	2008 – Present
	Shan State	2008 – Present
	Kayah State	2008 – Present
	Ayeyarwady Division	2008 – Present
	Mon State	2008 – Present

Figure 1: ICS programmes in Myanmar (EMC et al., 2015).

How many biomass users have adopted improved stoves?

Three Stone Fires

- MATERIALS: Stone and/or bricks
- FUEL USED: Almost exclusively wood, and rarely with charcoal
- NAME ON THE MARKET: Open fire, 3-stone
- REGION OF USE: All rural areas where wood is plentiful
- THERMAL EFFICIENCY: 10%
- MANUFACTURER: households
- KEY FEATURES:
- COST: Free or very low cost

Tripods

- MATERIALS: Metallic frame
- FUEL USED: Almost exclusively wood
- NAME ON THE MARKET: Tripod
- REGION OF USE: All rural areas where wood is plentiful
- THERMAL EFFICIENCY: 10%
- KEY FEATURES: Portable
- COST: 1,000 to 2,000 MMK

Mud Stoves

- MATERIALS: Mud
- FUEL USED: Wood, charcoal or biomass
- NAME ON THE MARKET: Baked, green or mud cookstove
- REGION OF USE: Mainly in the Delta region
- THERMAL EFFICIENCY: 17%
- MANUFACTURER: Mangrove Service Network is the largest
- KEY FEATURES: Fired in kiln or baked through use
- COST: 3,000 to 5,000 MMK

Carved Stone Stoves

- MATERIALS: Carved stone
- FUEL USED: Mainly wood but also charcoal and residue
- NAME ON THE MARKET: Carved stone stove
- REGION OF USE: Found in the Delta Region as well as in Shan and Tanintharyi
- THERMAL EFFICIENCY: to be tested
- MANUFACTURER: unknown
- KEY FEATURES: Heavy and durable
- COST: ~5,000 MMK

A1 Stoves

- MATERIALS: Clay
- FUEL USED: Wood or charcoal
- NAME ON THE MARKET: A1 cookstove
- REGION OF USE: Mainly in the Delta and Dry Zones of peri-urban and urban areas
- THERMAL EFFICIENCY: to be tested
- MANUFACTURER: Various. Promoted by GoM and UNDP, largest producer in Magway
- COST: 3,000 to 5,000 MMK

Charcoal / Multipurpose Stoves

- MATERIALS: Clay, concrete, and metal
- FUEL USED: Mainly charcoal but also wood identified
- NAME ON THE MARKET: Charcoal or multi-purpose stove
- REGION OF USE: All across the country
- THERMAL EFFICIENCY: to be tested
- MANUFACTURER: clay production mostly in Magway
- KEY FEATURES: Thai bucket design
- COST: 3,000 to 6,000 MMK

Rice Husk Stoves

- MATERIALS: Metal
- FUEL USED: Mainly rice husks, but also other agricultural residues
- NAME ON THE MARKET: Rice husk stoves
- REGION OF USE: Only identified in the Delta region
- THERMAL EFFICIENCY: unknown
- KEY FEATURES: Promoted by NGOs
- COST: ~5,000 MMK

Iron Stoves

- MATERIALS: Iron
- FUEL USED: Use only with wood was identified
- NAME ON THE MARKET: Iron stove
- REGION OF USE: Only identified in Magway and peri-urban Tanintharyi
- THERMAL EFFICIENCY: unknown
- MANUFACTURER: Locally manufactured
- COST: 2,000 to 4,000 MMK

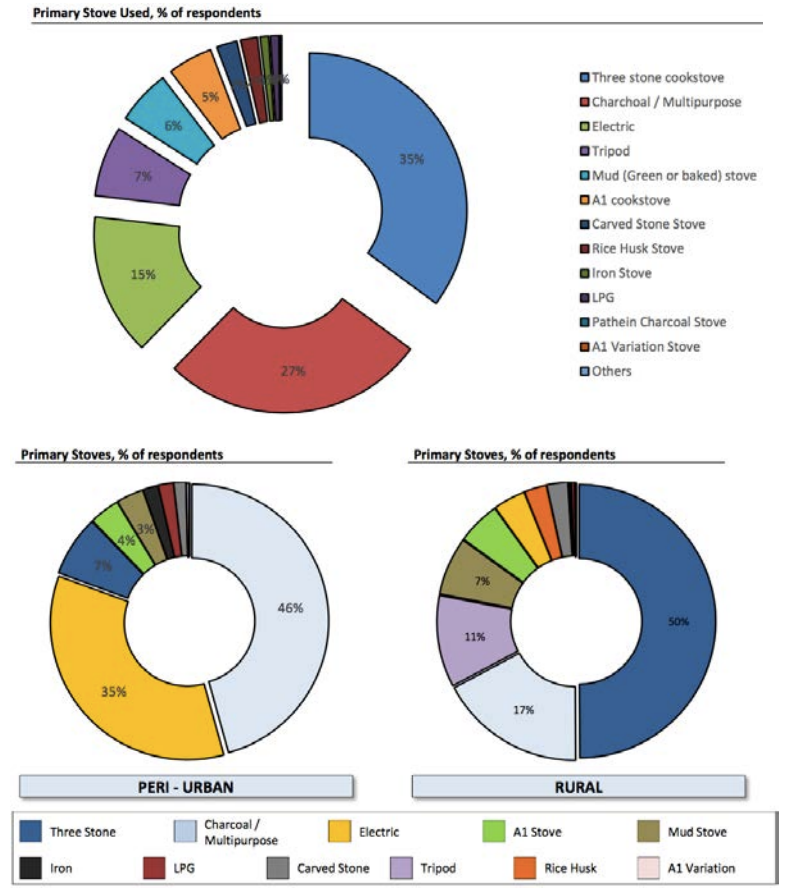
Electric Stoves

- FUEL USED: Electricity
- NAME ON THE MARKET: Electric stove
- REGION OF USE: Mainly in peri-urban areas, especially Yangon, Bago and Magway
- DISTRIBUTION CHANNELS: mostly in peri – urban areas
- COST: 15,000 MMK and above depending on models

LPG Stoves

- MATERIALS: Metallic tank
- FUEL USED: Liquid petroleum
- NAME ON THE MARKET: LPG stove
- REGION OF USE: Penetration is very limited due to price instability
- KEY FEATURES: directly applied above the tank or through a pipe
- COST: 15,000 MMK

Figure 5: Popular cooking technologies in Myanmar (Department of Population, 2014).



Stove Penetration, % of respondents / region

		Three stone cookstove	A1 cookstove	Mud (Green or baked) stove	Rice Husk Stove	Carved Stone Stove	Charcoal / Multipurpose Stove	Iron Stove	Electric	LPG	Tripod
Peri-urban	Yangon	-	3%	3%	-	-	28%	-	62%	3%	-
	Mandalay	6%	-	-	-	-	66%	-	28%	-	-
	Ayeyarwaddy	25%	-	15%	-	5%	45%	-	10%	-	-
	Bago,	7%	-	3%	-	-	40%	-	50%	-	-
	Shan	-	13%	0%	-	3%	50%	-	28%	8%	-
	Magway	9%	2%	0%	-	-	33%	9%	46%	-	2%
	Tanintharyi	7%	7%	0%	-	3%	80%	3%	-	-	-
Rural	Ayeyarwaddy	58%	1%	6%	12%	13%	8%	-	2%	-	-
	Bago,	65%	-	24%	3%	-	3%	-	4%	-	1%
	Shan	24%	1%	1%	-	-	31%	-	9%	1%	34%
	Magway	63%	18%	4%	-	-	7%	1%	-	-	7%
	Tanintharyi	43%	-	2%	-	2%	47%	-	3%	2%	-

Figure 6: Popular cookstoves in Myanmar (EMC et al., 2015).

How and where are improved stoves manufactured?

- Mostly, ICS are produced inside the country as cottage-industry level. Very few China and S Korea made models of ICS are found sometimes in the market or introduced by some market-promoters and socio-economic-developers.
- A1 and clay stoves are produced in Magway and Pathein respectively (EMC et al., 2015).

What are the most popular cooking appliances?

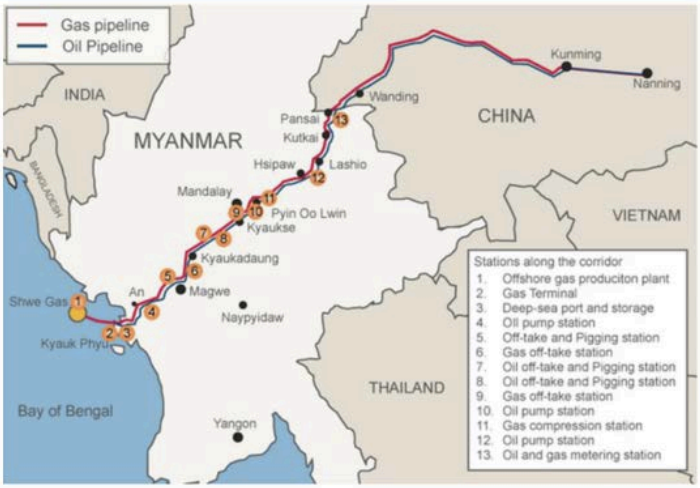
- The electric rice-cooker, single hotplate cooker, various types of boiling appliances are very common for Myanmar families dwelling in urban as well as rural. Electric pressure cookers, red electric frying pan and thermo-pot, induction cookers are also familiar with most urban people.
- Local-made ICS are highest numbers in Myanmar household kitchen of charcoal and firewood users who live in majority of small towns. Other cooking appliances include the infra-red cooker, microwave, heater-kettle, gas-stove and pressure multi-cooker can also be found in the market.

How compatible are the popular electrical appliances with battery-supported electricity?

- Low power consuming appliances have high potential for huge demand from off grid areas.
- Rice cookers and electric jar-pot/kettle are in use at remote villages but battery usage for power supply is difficult due to market availability of efficient batteries and cost barrier.
- Those low-power consuming cooking appliances are compatible with battery-supported electricity, depending on cooking characteristic and size of the system to meet within the margin of users' affordability and materials availability.

Are there national fossil fuel reserves? If so, how significant are they and how are they exploited?

- Myanmar has limited measure of oil, gas and coal (low-quality) [data have to sought out]
- Myanmar has gas reserves, but they are either used for electricity generation or exported, meaning there is little to no spare capacity for domestic LPG production. Ironically, LPG is imported from Thailand and China, much of which was originally exported from Myanmar, refined and then reimported as LPG.
- "Domestically, Myanmar's electricity sector accounts for around 60% of natural gas consumption. Other major gas users are the government-owned factories (20%), fertiliser plants (7.9%), a compressed natural gas facility (7.2%) and LPG production (0.9%). In absolute terms, the amount of natural gas used for power generation has increased nearly two-fold over the period 2001 – 2013, from 29,066 MMcf to 57,333 MMcf per year." (WWF *et al.*, 2016)



Source: Reuters International 2013

Figure 7: Oil and gas export pipelines from Myanmar to China (WWF *et al.*, 2016)

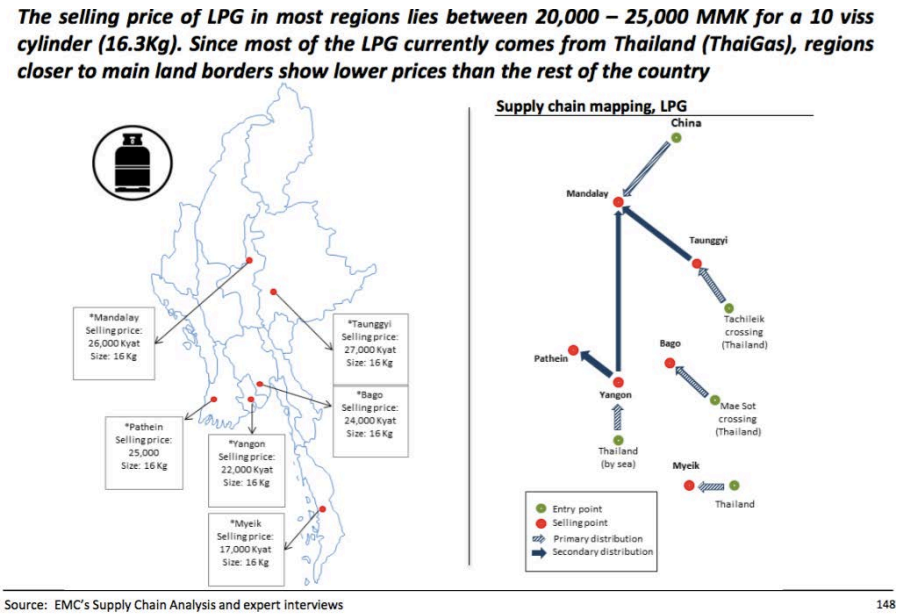


Figure 8: LPG supply chain in Myanmar (EMC et al., 2015).

MYANMAR HAS GAS RESERVES, BUT THEY ARE EITHER USED FOR ELECTRICITY GENERATION OR EXPORTED, MEANING THERE IS LITTLE TO NO SPARE CAPACITY FOR DOMESTIC LPG PRODUCTION. IRONICALLY, LPG IS IMPORTED FROM THAILAND AND CHINA, MUCH OF WHICH WAS ORIGINALLY EXPORTED FROM MYANMAR, REFINED AND THEN REIMPORTED AS LPG.

What do people cook and how do they cook it?

- Rice cooking is key component in Myanmar as essential requirement of staple-food. Daily food items of one curry with one kind of meat, one kind of vegetable item and one kind of soap are common. Hot water for plain-tea is also very common to serve in every household. Frying and boiling is characteristically practiced.
- Cooking characteristic is likely to change as a result of less time available for urban people and also save money for cooking energy. Also, in modern age, many ready-made food-items become available to make easy for living style.

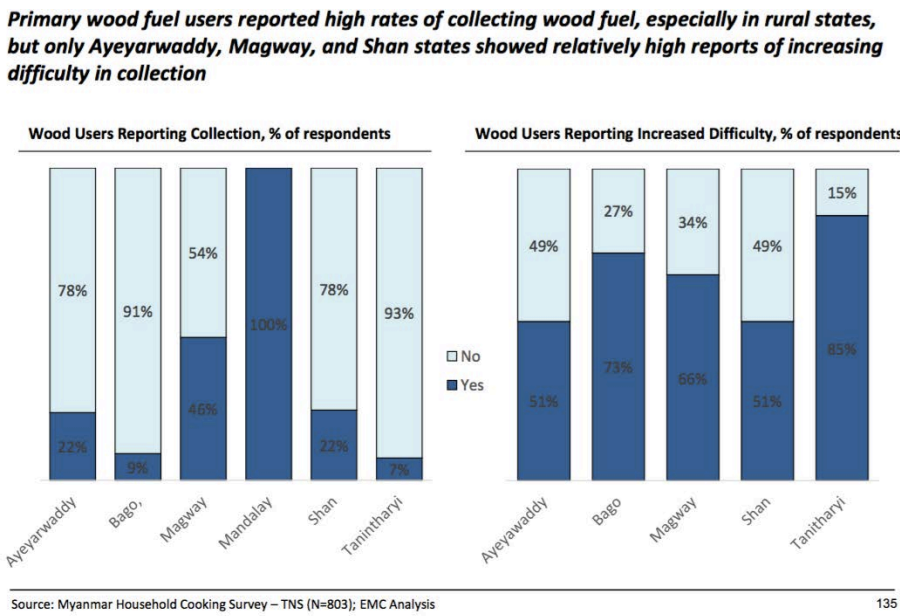


Figure 9: Woodfuel collection versus purchase (EMC et al., 2015).

MANY FUELWOOD USERS ARE NOW PAYING FOR WOOD, AS COLLECTING HAS BECOME MORE CHALLENGING DUE TO DWINDLING FOREST RESERVES. THIS CREATES AN EMERGING OPPORTUNITY TO CAPTURE THIS NEW EXPENDITURES ON POLLUTING FUELS WITH CLEAN & MODERN ECOOK PRODUCTS/SERVICES.

How many people are suffering from acute respiratory illnesses due to cooking on polluting fuels?

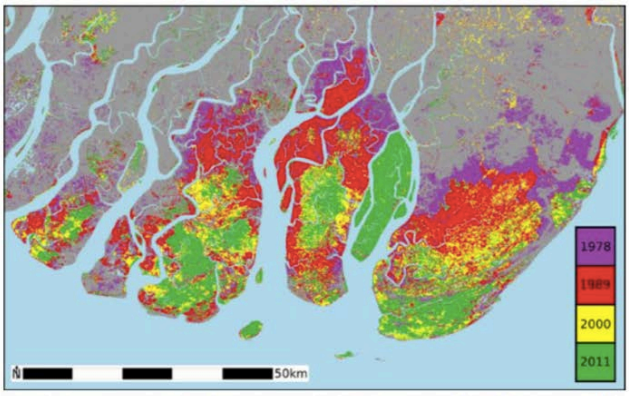
- In National Clean Cook Stove Specification and Standard meeting, participants from the ministry of health have great concern upon such in-door air pollution issue. PM standard requirement has been expressed to practice but regulation is still under preparation.
- No data available specifically but may be some report by relevant organizations and government sectors need to find in further survey.

What initiatives have addressed this? How successful have they been?

- Government – MONREC/FD has ICS campaign, but not efficiently.
- Energy Efficiency and Conservation function is also one of the areas trying to promote by the government – Ministry of industry, EE&C Division – to make efficient energy including fuel and electric appliances.
- Use of biogas such as Methane and Syn-gas are also been encouraged in relevant Policies but no strategic support at the moment.

How severe is deforestation?

Stakeholder interviews and recent research indicates that historically the Mangroves in the Ayeyarwaddy Delta suffered heavy deforestation from years of widespread conversion to charcoal, cyclones, and agricultural expansion. However, this may have slowed in the past 15 years as more households in Yangon switched from charcoal to LPG and electricity for cooking



Map showing mangrove land cover in the Ayeyarwady Delta, Myanmar, in 1978, 1989, 2000 and 2011. The large island that has remained completely forested is the Meinmahla Kyun Wildlife Sanctuary.

Source: MongaBay.com http://news.mongabay.com/2013/1126-myanmar-mangroves.html; from Webb et al (2013) Deforestation in the Ayeyarwady Delta and the conservation implications of an internationally-engaged Myanmar. Global Environmental Change (2013)

HOUSEHOLDS IN YANGON SWITCHING FROM CHARCOAL TO LPG & ELECTRICITY FOR COOKING HAS SLOWED DEFORESTATION IN THE AYEYARWADDY DELTA REGION'S MANGROVES. ECOOK COULD BUILD UPON THIS SUCCESS STORY BY EXTENDING ACCESS TO RELIABLE ELECTRICITY FOR COOKING TO MANY MORE HOUSEHOLDS.

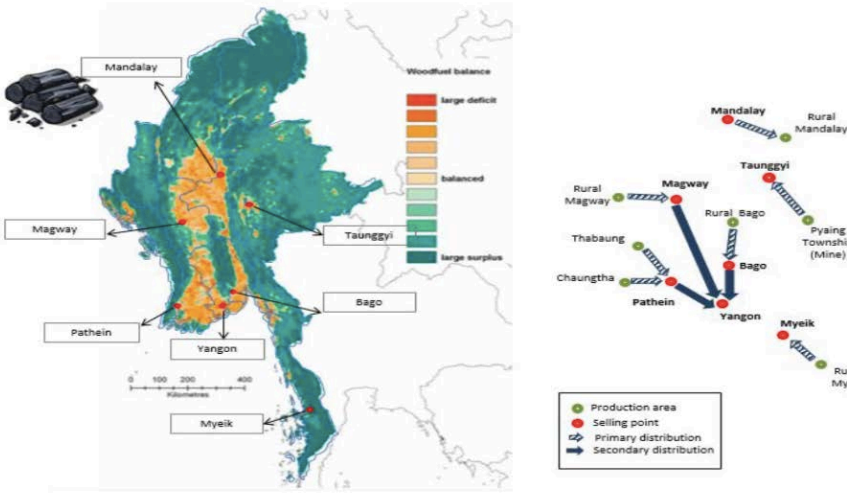
Recent study (Bailis 2015) on the carbon footprint of woodfuels using FAO data from 2009 argues that the woodfuel collection may be mostly considered renewable for Myanmar overall due to high plantation production; however this could vary significantly from state to state, with higher non-renewability in Rakhine, Chin, Kachin, and eastern Shan states. This argument should be verified with more recent and reliable wood and charcoal consumption data.

Bailis (2015) Expected fraction of Non-Renewable Biomass (NRB) with high plantation productivity estimates, (%)

Rakhine	Chin	Ayeyawaddy	Kachin	Kayin	Kayar	Magway	Mandalay	Mon	Sagaing	Tanintharyi	Yangon	Bago (E)	Bago (W)	Shan (E)	Shan (N)	Shan (S)
100	31.7	2.7	13.7	4.5	4.1	0.4	1.4	2.1	2.4	8.9	2.6	1.7	1.3	14.3	5.5	4.3

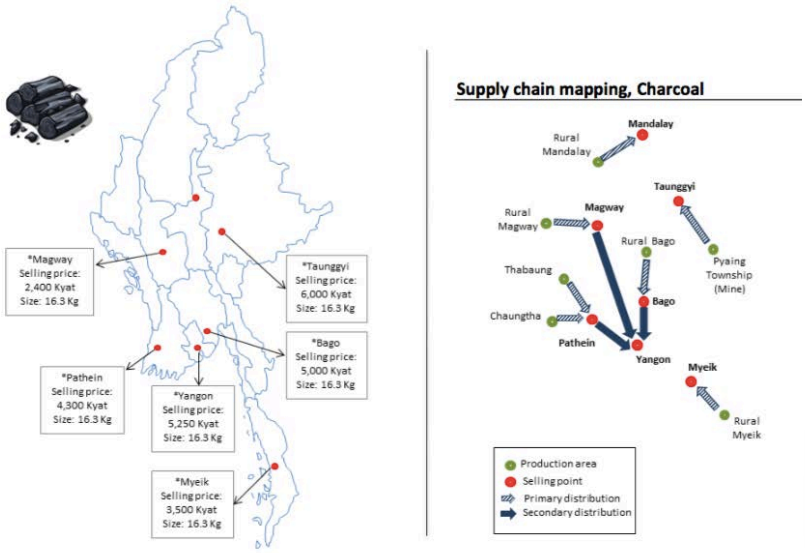
Figure 10: Woodfuel sustainability and the effects of deforestation in Myanmar (EMC et al., 2015).

The charcoal supply chain analysis[1] shows that charcoal production is occurring in wood surplus areas which feed into the dry zone and peri-urban and urban areas. Informatic the type of land where wood for charcoal was sourced was not included in the analysis



Source: Supply Chain Analysis of Charcoal, EMC interviews with charcoal resellers

Magway and Tanintharyi have the lowest prices due to closeness to production while Shan State and Yangon show the highest prices



Source: EMC's Supply Chain Analysis and expert interviews

CHARCOAL PRICES VARY CONSIDERABLY THROUGHOUT THE COUNTRY – THE SAME SACK OF CHARCOAL SELLS FOR HALF THE PRICE IN THE CHARCOAL PRODUCING REGIONS OF MAGWAY AND TANITHARYI THAN IT DOES IN YANGON. IN FACT, IT IS EVEN MORE EXPENSIVE IN SHAN STATE, SHOWING THAT THE OPPORTUNITY TO CAPTURE EXISTING EXPENDITURES ON COMMERCIALISED POLLUTING FUELS IS MUCH MORE ATTRACTIVE IN CERTAIN PARTS OF THE COUNTRY.

Figure 11: The charcoal supply chain in Myanmar (EMC et al., 2015).

Which policies currently enable or constrain the roll out of cleaner cooking solutions?

- Combat Desertification and Deforestation is occurred as government national campaign to save and conserve the country environmental issue.
- REDD++ Program is one of the main functions of the government.
- Also, national level Climate Change Mitigation and Adaptation program is functioning now.
- There are many reports and papers on those matters by various stakeholders

Are there any specific targets for the quality of clean cooking solutions and the number of people who should gain access to them by a certain date?

- There is no specific target to ensure quality and "Clean Cook Stove Standard Committee" is preparing necessary standards but there is no set target to accomplish with road-map.

Table 3: Policies developed to enable clean cooking solutions

POLICY	
Environmental Law	Launched in 2012, now trying to review by parliament
EIA Regulation	Launched in 2015

Is there a national biomass energy or cleaner cooking strategy?

- No Cleaner Cooking Strategy for Biomass Energy nationally.

Is charcoal production/transportation/wholesale/retail legal? If so, is it taxed and by how much? If not, how does the sector get around the law?

- Charcoal production, transportation in-country and sale are attempted to be banned by the Government. But it is not easy to practice, due to the low capacity and awareness of all relevant stakeholders of people and government. Charcoal production, transportation and taxation are not well monitored (by the Forestry Department) resulting in a lot of leakages.

Are there national carbon emissions reductions targets? If so, which policies have been developed to enable this and are there a government budget assigned to it? Do they specifically mention cookstoves?

- Ministry of Natural Resource and Environmental Conservation (MONREC), Department of Environmental Conservation is focal agency to produce Myanmar NDC. INDC report was already produced by the government.
- INDC targets: 30% forest cover by 2030, 30% RE in rural electrification, distribute 260,000 improved cookstoves by 2031, 9.4GW hydropower by 2030, 20% electricity saving on forecast potential demand by 2030,

Is kerosene or LPG use for cooking encouraged or discouraged by current national policy?

- Application of LPG has been encouraged in current national guideline to use imported LPG Fuel for country urgent need electrification.
- Energy Policy (NEP 2015), National Energy Master Plan and National Electrification Master Plan is strategically produced. But practical follow up implementation action is weak for all round energy sector reformation and development.
- Kerosene was used for cooking until the 80s when the price went up significantly
- LPG is now under national plan. Not much transparent information in detail at the moment.

3.2 Electrification, renewable energy and energy efficiency

3.2.1 Grid electrification

What is the state of the national grid? Who has access and who does not, what are the key generation sources, how efficient is the transmission & distribution infrastructure, how frequent are blackouts/load shedding, does peak time demand exceed supply?

> "That electricity only reached a third of the population in 2014 means that attaining Sustainable Development Goal 7…will require Myanmar to invest very heavily in electricity generation and distribution infrastructure. This will pose major financial and engineering challenges, but it also represents a great opportunity for Myanmar to modernize its energy sector in ways that are innovative, efficient and sustainable."
> (Department of Population, 2014)

MYANMAR'S AGEING ELECTICAL GENERATION & DISTRIBUTION INFRASTRUCTURE IS IN NEED OF MAJOR INVESTMENT. ECOOK SYSTEMS CAN OFFER DECENTRALISED ENERGY STORAGE THAT CAN STRENGTHEN WEAK-GRIDS WITHOUT HAVING TO WAIT FOR UPGRADES TO THE CENTRALISED SYSTEM.

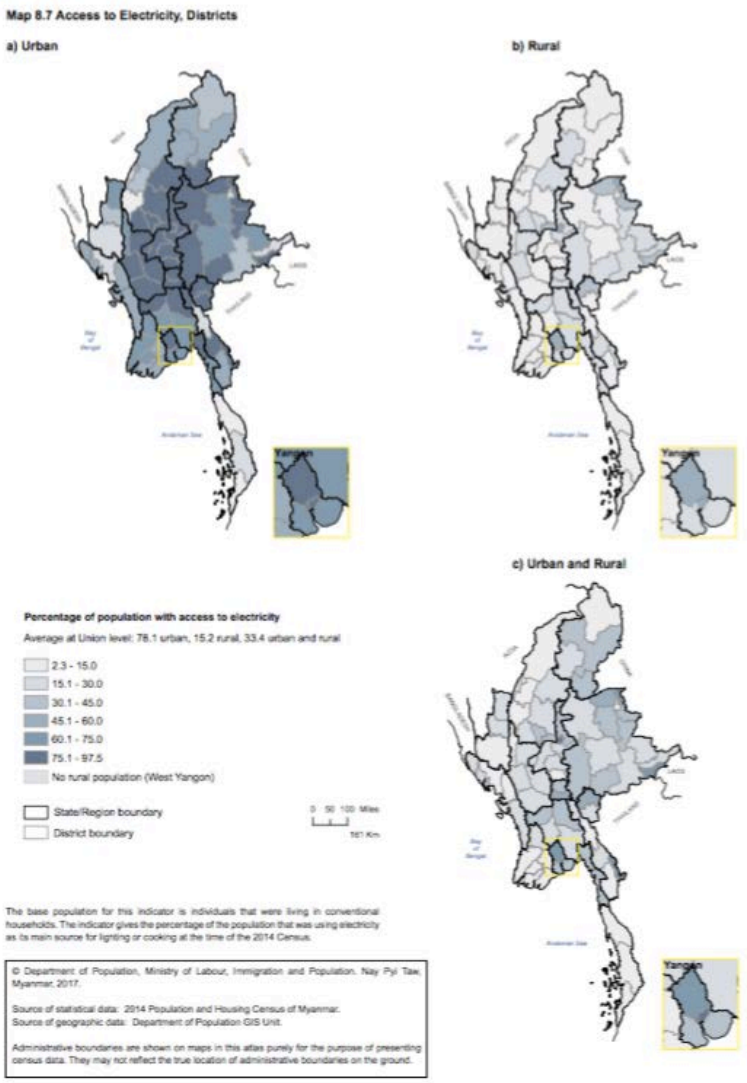


Figure 12: Rural and urban electricity access in Myanmar by district (Department of Population, 2014).

What policies currently enable/inhibit sustainable grid electrification?

- Myanmar Electricity Law launched no by-laws and regulations at the moment.

3.2.2 Electricity access

Are there national targets for electricity access? If so, which policies have been developed to enable this and are there a government budget assigned to it?

- NEP targets are from the current 100% by 2030 (Vision 2030).
- For 2030 target, WB is prevailing driving agency with initiative loan budget integrated some others of ADB, JICA, KfC etc.

Do the targets specify a service level (hours of availability, maximum power/energy, etc.)?

- No

What is the connection fee?

- It is hard to mention about this specific information for country-wide situation. Need systematic survey to explain correctly.

Are subsidies, tax exemptions, utility loans/on-bill financing or micro-loans available to support connection fees for poorer/rural households?

- Subsidies were now practicing by the Department of Rural Development as focal agency of the government to electrify off grid areas of the country.

Is there a standard tariff structure for residential customers (e.g. fixed rate, rising block, declining block)?

- Yes, there is a standard tariff structure for residential and industrial customers.

Is there a cross-subsidised/social/lifeline tariff for poorer households?

- No

Are grid connections pre-paid, post-paid or a mixture of the two?

- Post-pay system

3.2.3 Renewable energy

Are there national targets for increasing the proportion of renewable energy? If so, which policies have been developed to enable this and are there a government budget assigned to it?

- Renewable Energy Policy was prepared by National Renewable Energy Working Group headed by the Department of Research and Innovation. It is nearly finished as final draft since 2015, but now it is pending due to present Government trend is not place RE in priority.

Is there a feed-in-tariff that is applicable to residential-scale generation?

- Little residential-scale electricity generation has been attempted with SPV Roof-top power integration to grid system by there is no in the REfiT strategy in Myanmar at the moment.

3.2.4 Energy efficiency

Are there national targets for energy efficiency? If so, which policies have been developed to enable this and are there a government budget assigned to it?

- Ministry of Industry organized a separation division for Energy Efficiency and Conservation (EE&C) to promote EE&C in Myanmar. That Department is now preparing EE&C law.

Do/es the national utility/ies have a demand side management department/s? If so, what is their mandate and what activities have they carried out?

- No DSM

Are there time-of-use tariffs?

- No

Are subsidies, tax exemptions, utility loans/on-bill financing or micro-loans available to support consumer purchasing of energy efficient appliances (especially cooking appliances)?

- Particularly not available

3.2.5 Mini-grid & off-grid systems

What is the state of the mini-grid and off-grid electrification sectors? How many mini-grids/standalone systems are in operation, what are the key generation sources, who developed/operates them, how many people do they serve, what level of service do they offer, what tariffs do they charge?

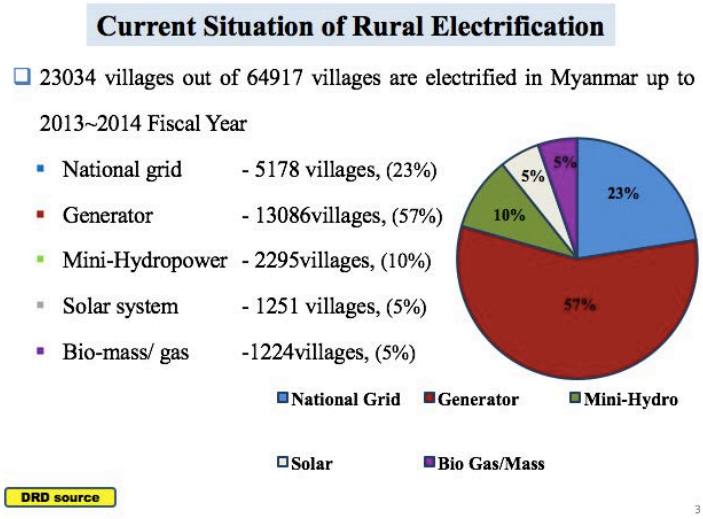


Figure 13: Current status of rural electrification in Myanmar (Myint, 2014).

TWO THIRDS OF VILLAGES IN MYANMAR DO NOT HAVE ACCESS TO ELECTRICITY. ONLY 23% OF ELECTRIFIED VILLAGES ARE CONNECTED TO THE NATIONAL GRID. THE MAJORITY USE GENERATORS (57%), BUT A SUBSTANTIAL NUMBER, IN PARTICULAR THOSE IN RAINY & MOUNTAINOUS SHAN STATE, ARE CONNECTED TO MINI-HYDROPOWER SYSTEMS.

Are there national targets for mini-grid/off-grid electrification?

- No

3.3 Cross cutting issues

3.3.1 Electrification/clean cooking crossover

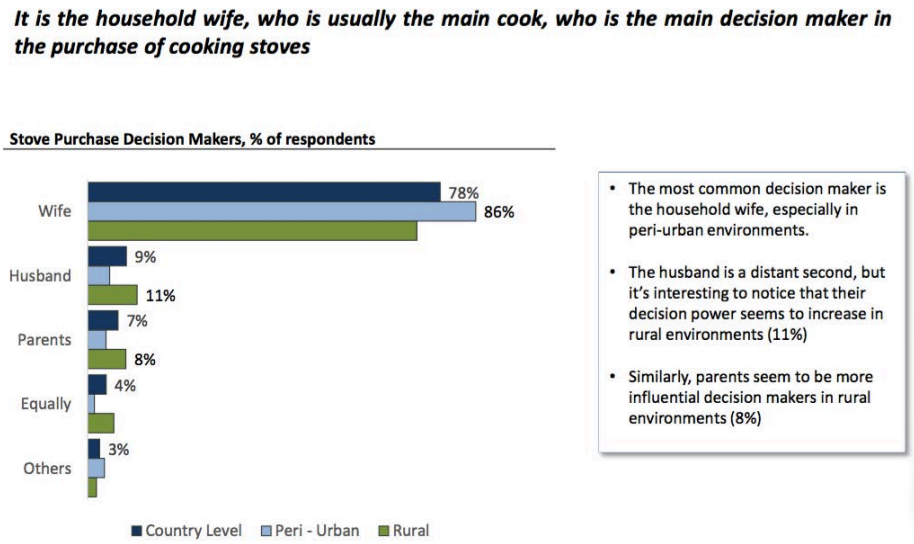
Is there any overlap between the clean cooking and electrification sectors (e.g. SHS suppliers also selling improved cookstoves, energy efficiency programs targeting electric cooking)?

- It is really cross-cutting practice on ground Myanmar Market.
- Availability of Electricity is key driving force in clean cooking by people choice and prevailing market growth of better cooking appliances.
- Market development of SHS will happen together with reliable material availability of dependable goods – all kinds of components - of SPV System, Household appliances including cookers and EE devices as well.
- In this cross-cutting consideration, Government Policy, Guidelines and Encouragements are in key position to happen successfully all together.
- All are together naturally

3.3.2 Gender

Who are the main household decision makers?

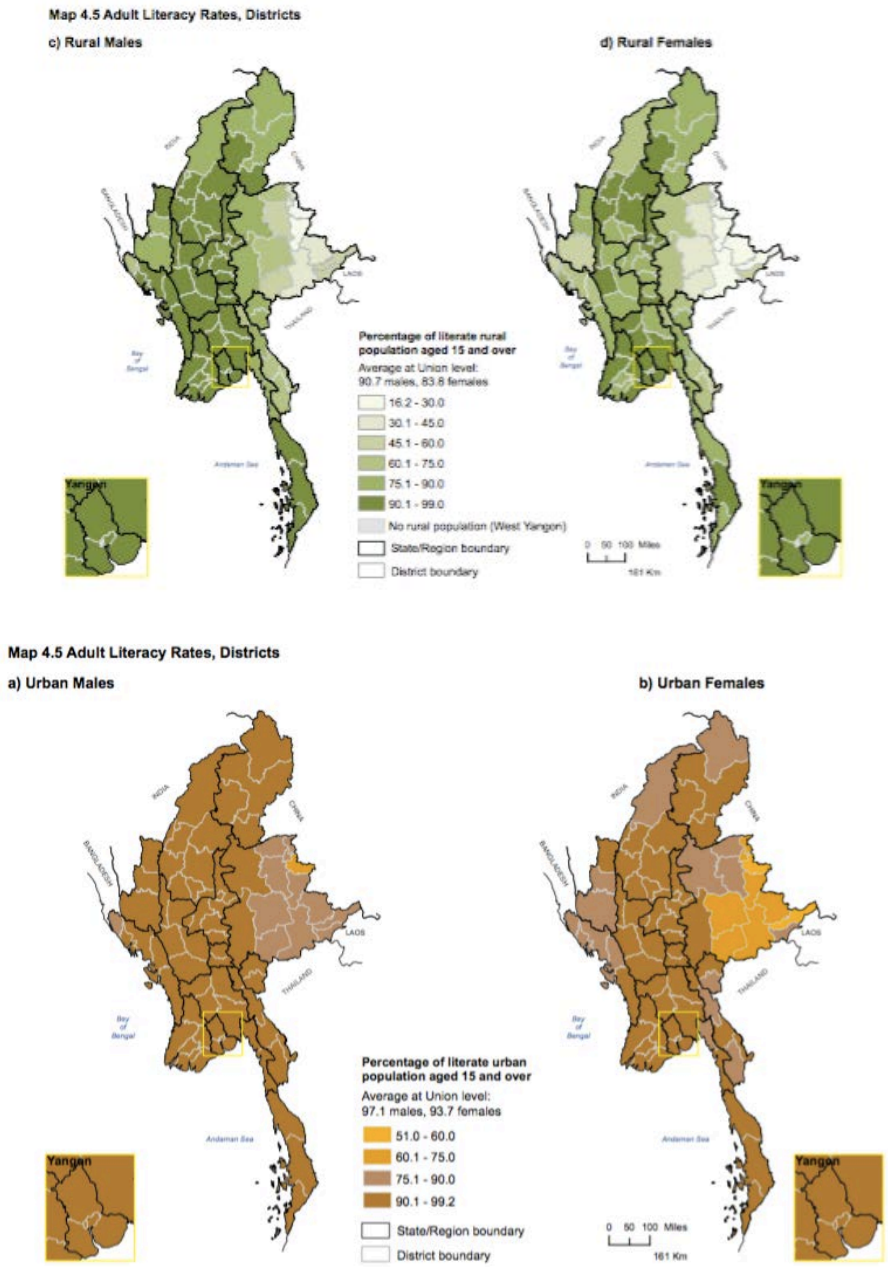
- Commonly together



WOMEN ARE OVERWHELMINGLY FOUND TO BE THE DECISION MAKERS WHEN IT COMES TO PURCHASING NEW COOKSTOVES, IMPLYING THAT MARKETING STRATEGIES FOR ECOOK IN MYANMAR SHOULD FOCUS ON WOMEN.

Figure 14: Household decision making for cookstove purchasing (EMC et al., 2015).

How well educated are women and how does this compare to men?



LITERACY RATES ARE CONSIDERABLY LOWER FOR WOMEN THAN MEN. AS A RESULT, MORE CAPACITY BUILDING IS LIKELY TO BE NECESSARY FOR FEMALE ECOOK ENTREPRENEURS , ESPECIALLY IN RURAL AREAS. ECOOK DEVICES, ESPECIALLY PV-ECOOK DEVICES AIMED AT THE RURAL MARKET, SHOULD BE DESIGNED TO BE INTUATIVE & NOT RELY UPON WRITTEN INSTRUCTIONS.

Figure 15: Literacy rates disaggregated by gender, rural/urban and district (Department of Population, 2014).

Have any electrification or clean cooking initiatives specifically targeted women as entrepreneurs, as well as end users?

- Barefoot Women Program by WWF

3.3.3 Business & finance

What are the key contextual factors that enable and constrain the development of new and existing businesses?

- Weakness in Myanmar Banking System
- High inflation rate at the moment
- Foreign currency Exchange rate fluctuation
- Need improvement in relevant Commercial Laws and Regulations

Are there specific government or market-based financing facilities designed to support developers of mini-grids/off-grid systems and/or manufacturers/retailers of cleaner cookstoves?

- Some supportive projects funded by the international NGOs.
- Government has no specific financing facilities to encourage off/mini grid system establishment for private sector.

Are there specific government or market-based financing facilities designed to support consumers of cleaner cookstoves/mini-grids/off-grid systems (e.g. village banking systems, community revolving funds, pay-as-you-go solutions, nationally subsidy programmes)?

- Some supportive projects funded by the international NGOs.
- Government has no specific financing facilities to encourage off/mini grid system establishment for private sector.

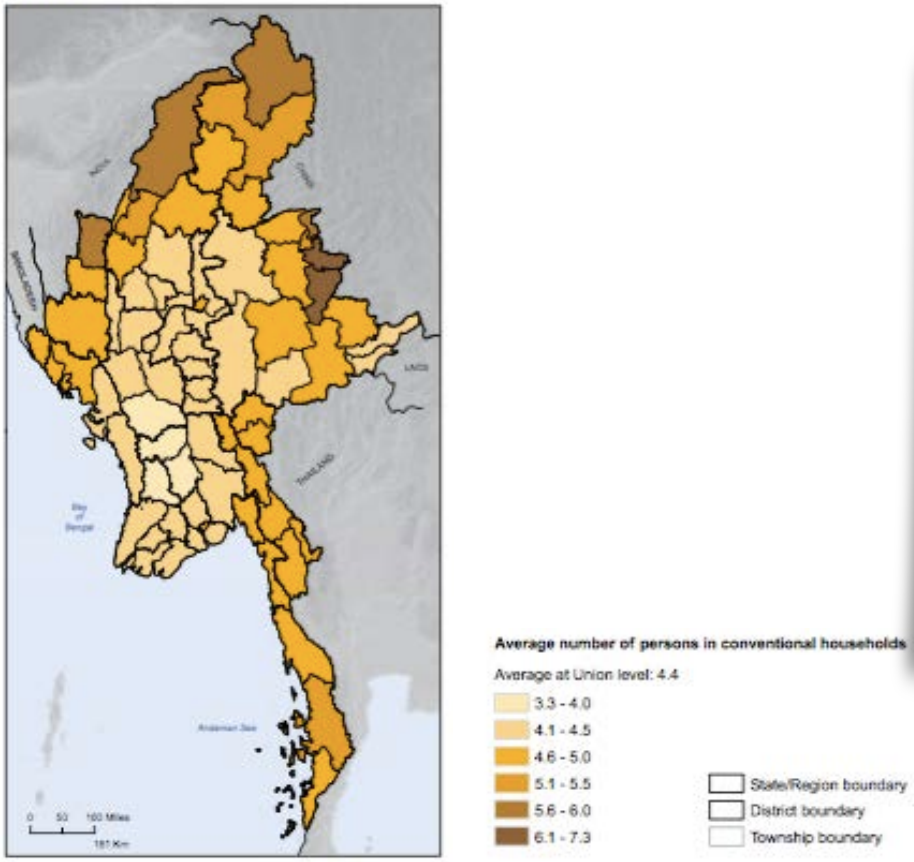
How developed is the mobile money industry?

- Mobile money is now start growing in Myanmar to transfer money.
- Mobile phones have only recently started to become available to the general public. 10 years ago, a SIM card cost over $50 and was only available to government officials. Now they are available for less than $0.50. Many people have gone straight to smart phones, leapfrogging the basic phones seen in many other contexts.

3.3.4 Demographics

How many people live in urban/rural areas and how is this balance changing?

- The population of Myanmar is 52 million according to last census of 5 years ago. Of this, 70% was reported to be rural population .



WHILST URBAN HOUSEHOLDS TEND TO CONSIST OF AROUND 4 PEOPLE, RURAL HOUSEHOLDS IN SOME DISTRICTS AVERAGE ABOVE 6. THIS WILL HAVE CONSIDERAL IMPACT ON THE SIZE OF THE MOST EXPENSIVE COMPONENT OF AN ECOOKING SYSTEM – THE BATTERY.

Figure 16: Average household size in Myanmar by district (Department of Population, 2014)

3.3.5 Climate

Are cookstoves also used for space heating?

- Yes they are, especially in high land of coal areas.

Are there extended cloudy periods?

- Yes, especially in Lower Myanmar has heavy rain characteristic.

Where are the key hydropower resources located?

- Whole hilly region of the country, especially in Shan State.

4 Conclusion

This study has confirmed that there is a strong market for eCook products and services in Myanmar, as electricity is without doubt the aspirational source of energy for cooking. Myanmar has gas reserves, but they are either used for electricity generation or exported. Many fuelwood users are now paying for wood, as collecting has become more challenging due to dwindling forest reserves. Households in Yangon switching from charcoal to LPG & electricity for cooking has slowed deforestation in the Ayeyarwady delta region's mangroves. eCook could build upon this success story by extending access to reliable electricity for cooking to many more households. However, the opportunity to capture existing expenditures on commercialised polluting fuels is much more attractive in certain parts of the country, as charcoal prices vary considerably. Myanmar's ageing electrical generation & distribution infrastructure is in need of major investment. eCook systems can offer decentralised energy storage that can strengthen weak-grids without having to wait for upgrades to the centralised system.

The findings from this study will be combined with those from the other activities that have been carried under the eCook Myanmar Market Assessment. Together they will build a more complete picture of the opportunities and challenges that await this emerging concept. Further outputs will be available from https://elstove.com/innovate-reports/ and www.MECS.org.uk.

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6 Appendix

6.1 Appendix A: Problem statement and background to Innovate eCook project

6.1.1 Beyond business as usual

The use of biomass and solid fuels for cooking is the everyday experience of nearly 3 Billion people. This pervasive use of solid fuels—including wood, coal, straw, and dung—and traditional cookstoves results in high levels of household air pollution, extensive daily drudgery required to collect fuels, and serious health impacts. It is well known that open fires and primitive stoves are inefficient ways of converting energy into heat for cooking. The average amount of biomass cooking fuel used by a typical family can be as high as two tons per year. Indoor biomass cooking smoke also is associated with a number of diseases, including acute respiratory illnesses, cataracts, heart disease and even cancer. Women and children in particular are exposed to indoor cooking smoke in the form of small particulates up to 20 times higher than the maximum recommended levels of the World Health Organization. It is estimated that smoke from cooking fuels accounts for nearly 4 million premature deaths annually worldwide –more than the deaths from malaria and tuberculosis combined.

While there has been considerable investment in improving the use of energy for cooking, the emphasis so far has been on improving the energy conversion efficiency of biomass. Indeed in a recent overview of the state of the art in Improved Cookstoves (ICS), ESMAP & GACC (2015), World Bank (2014), note that the use of biomass for cooking is likely to continue to dominate through to 2030.

> "Consider, for a moment, the simple act of cooking. Imagine if we could change the way nearly five hundred million families cook their food each day. It could slow climate change, drive gender equality, and reduce poverty. The health benefits would be enormous." ESMAP & GACC (2015)

The main report goes on to say that "The "business-as-usual" scenario for the sector is encouraging but will fall far short of potential." (ibid,) It notes that without major new interventions, over 180 million households globally will gain access to, at least, minimally improved[1] cooking solutions by the end of the decade. However, they state that this business-as-usual scenario will still leave over one-half (57%) of the developing world's population without access to clean cooking in 2020, and 38% without even minimally improved cooking solutions. The report also states that 'cleaner' stoves are barely affecting the health issues, and that only those with forced gasification make a significant

[1] A minimally improved stove does not significantly change the health impacts of kitchen emissions. "For biomass cooking, pending further evidence from the field, significant health benefits are possible only with the highest quality fan gasifier stoves; more moderate health impacts may be realized with natural draft gasifiers and vented intermediate ICS" (ibid)

improvement to health. Against this backdrop, there is a need for a different approach aimed at accelerating the uptake of truly 'clean' cooking.

Even though improved cooking solutions are expected to reach an increasing proportion of the poor, the absolute numbers of people without access to even 'cleaner' energy, let alone 'clean' energy, will increase due to population growth. The new Sustainable Development Goal 7 calls for the world to "ensure access to affordable, reliable, sustainable and modern energy for all". Modern energy (electricity or LPG) would indeed be 'clean' energy for cooking, with virtually no kitchen emissions (other than those from the pot). However, in the past, modern energy has tended to mean access to electricity (mainly light) and cooking was often left off the agenda for sustainable energy for all.

Even in relation to electricity access, key papers emphasise the need for a step change in investment finance, a change from 'business as usual'. IEG World Bank Group (2015) note that 22 countries in the Africa Region have less than 25 percent access, and of those, 7 have less than 10 percent access. Their tone is pessimistic in line with much of the recent literature on access to modern energy, albeit in contrast to the stated SDG7. They discuss how population growth is likely to outstrip new supplies and they argue that "unless there is a big break from recent trends the population without electricity access in Sub-Saharan Africa is projected to increase by 58 percent, from 591 million in 2010 to 935 million in 2030." They lament that about 40% of Sub-Saharan Africa's population is under 14 years old and conclude that if the current level of investment in access continues, yet another generation of children will be denied the benefits of modern service delivery facilitated by the provision of electricity (IEG World Bank Group, 2015).

> "Achieving universal access within 15 years for the low-access countries (those with under 50 percent coverage) requires a quantum leap from their present pace of 1.6 million connections per year to 14.6 million per year until 2030." (ibid)

Once again, the language is a call for a something other than business as usual. The World Bank conceives of this as a step change in investment. It estimates that the investment needed to really address global electricity access targets would be about $37 billion per year, including erasing generation deficits and additional electrical infrastructure to meet demand from economic growth. "By comparison, in recent years, low-access countries received an average of $3.6 billion per year for their electricity sectors from public and private sources" (ibid). The document calls for the Bank Group's energy practice to adopt a new and transformative strategy to help country clients orchestrate a national, sustained, sector-level engagement for universal access.

In the following paragraphs, we explore how increasing access to electricity could include the use of solar electric cooking systems, meeting the needs of both supplying electricity and clean cooking to a number of households in developing countries with sufficient income.

6.1.2 Building on previous research

Gamos first noted the trends in PV and battery prices in May 2013. We asked ourselves the question, is it now cost effective to cook with solar photovoltaics? The answer in 2013 was 'no', but the trends suggested that by 2020 the answer would be yes. We published a concept note and started to present the idea to industry and government. Considerable interest was shown but uncertainty about the cost model held back significant support. Gamos has since used its own funds to undertake many of the activities, as well as IP protection (a defensive patent application has been made for the battery/cooker combination) with the intention is to make all learning and technology developed in this project open access, and awareness raising amongst the electrification and clean cooking communities (e.g. creation of the infographic shown in Figure 17 to communicate the concept quickly to busy research and policy actors).

Gamos has made a number of strategic alliances, in particular with the University of Surrey (the Centre for Environmental Strategy) and Loughborough University Department of Geography and seat of the Low Carbon Energy for Development Network). In October 2015, DFID commissioned these actors to explore assumptions surrounding solar electric cooking[2] (Batchelor, 2015b; Brown and Sumanik-Leary, 2015; Leach and Oduro, 2015; Slade, 2015). The commission arose from discussions between consortium members, DFID, and a number of other entities with an interest in technological options for cleaner cooking e.g. Shell Foundation and the Global Alliance for Clean Cookstoves.

Drawing on evidence from the literature, the papers show that the concept is technically feasible and could increase household access to a clean and reliable modern source of energy. Using a bespoke economic model, the Leach and Oduro paper also confirm that by 2020 a solar based cooking system could be comparable in terms of monthly repayments to the most common alternative fuels, charcoal and LPG. Drawing on published and grey literatures, many variables were considered (e.g. cooking energy needs, technology performance, component costs). There is uncertainty in many of the parameter values, including in the assumptions about future cost reductions for PV and batteries, but the cost ranges for the solar system and for the alternatives overlap considerably. The model includes both a conservative 5% discount rate representing government and donor involvement, and a 25% discount rate representing a private sector led initiative with a viable return. In both cases, the solar system shows cost effectiveness in 2020.

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[2] The project has been commissioned through the PEAKS framework agreement held by DAI Europe Ltd.

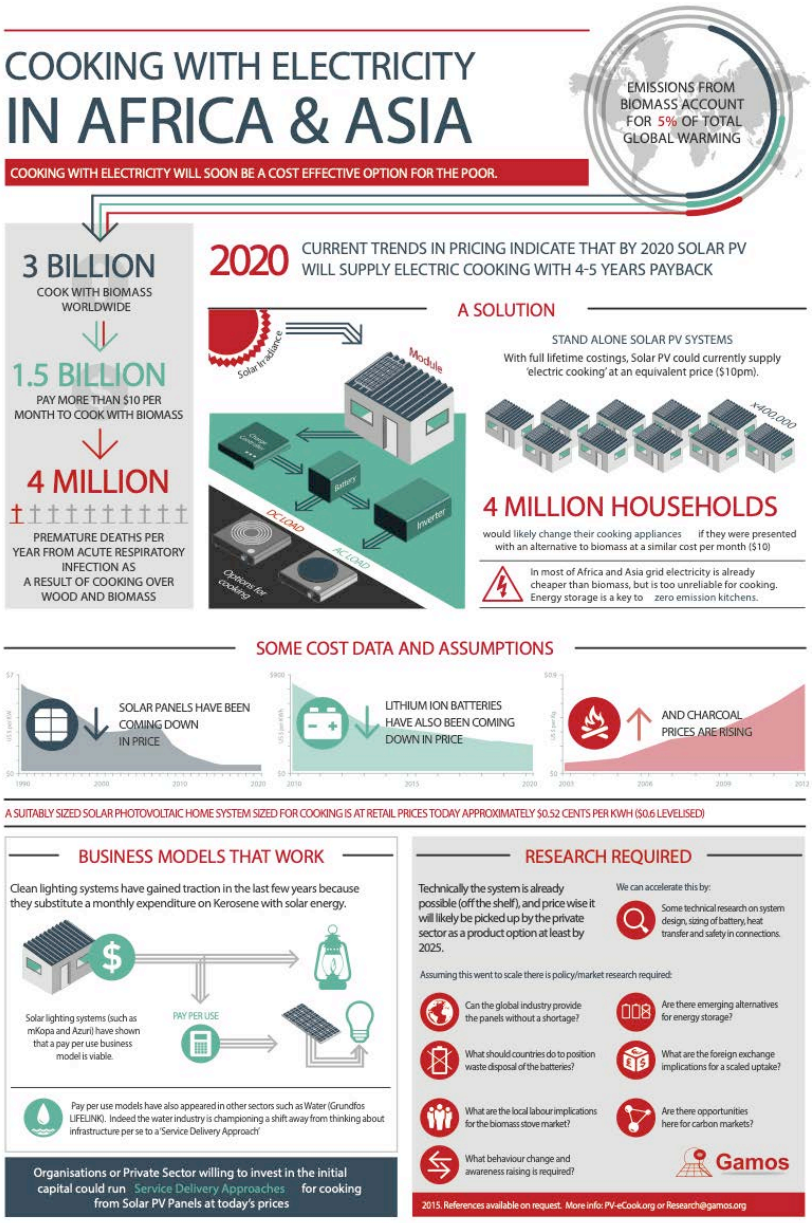

Figure 17 Infographic summarising the concept in order to lobby research and policy actors.

The Brown and Sumanik-Leary paper in the series examines the lessons learned from four transitions – the uptake of electric cooking in South Africa, the roll out of Improved Cookstoves (ICS), the use of LPG and the uptake of Solar Home Systems (SHS). They present many behavioural concerns, none of which preclude the proposition as such, but all of which suggest that any action to create a scaled use of solar electric cooking would need in depth market analysis; products that are modular and paired with locally appropriate appliances; the creation of new, or upgrading of existing, service networks; consumer awareness raising; and room for participatory development of the products and associated equipment.

A synthesis paper summarising the above concludes by emphasising that the proposition is not a single product – it is a new genre of action and is potentially transformative. Whether solar energy is

utilised within household systems or as part of a mini, micro or nano grid, linking descending solar PV and battery costs with the role of cooking in African households (and the Global South more broadly) creates a significant potential contribution to SDG7. Cooking is a major expenditure of 500 million households. It is a major consumer of time and health. Where households pay for their fuelwood and charcoal (approximately 300 Million) this is a significant cash expense. Solar electric cooking holds the potential to turn this (fuelwood and charcoal) cash into investment in modern energy. This “consumer expenditure” is of an order of magnitude more than current investment in modern energy in Africa and to harness it might fulfil the calls for a step change in investment in electrical infrastructure.

6.1.3 Summary of related projects

A series of inter-related projects have led to and will follow on from the research presented in this report:

- Gamos Ltd.'s early conceptual work on eCook (Batchelor, 2013).
  - The key **CONCEPT NOTE** can be found here.
  - An early infographic and a 2018 infographic can be found here.
- Initial technical, economic and behavioural feasibility studies on eCook commissioned by DfID (UK Aid) through the CEIL-PEAKS Evidence on Demand service and implemented by Gamos Ltd., Loughborough University and University of Surrey.
  - The key **FINAL REPORTS** can be found here.
- Conceptual development, stakeholder engagement & prototyping in Kenya & Bangladesh during the "Low cost energy-efficient products for the bottom of the pyramid" project from the USES programme funded by DfID (UK Aid), EPSRC & DECC (now part of BEIS) & implemented by University of Sussex, Gamos Ltd., ACTS (Kenya), ITT & UIU (Bangladesh).
  - The key **PRELIMINARY RESULTS** (Q1 2019) can be found here.
- A series of global & local market assessments in Myanmar, Zambia and Tanzania under the "eCook - a transformational household solar battery-electric cooker for poverty alleviation" project funded by DfID (UK Aid) & Gamos Ltd. through Innovate UK's Energy Catalyst Round 4, implemented by Loughborough University, University of Surrey, Gamos Ltd., REAM (Myanmar), CEEEZ (Zambia) & TaTEDO (Tanzania).
  - The key **PRELIMINARY RESULTS** (Q1 2019) can be found here.
- At time of publication (Q1 2019), a new DfID (UK Aid) funded research programme 'Modern Energy Cooking Services' (MECS) lead by Prof. Ed Brown at Loughborough University is just beginning and will take forward these ideas & collaborations.

This data and material have been funded by UK AID from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies.

6.1.4 About the Modern Energy Cooking Services (MECS) Programme.

Sparking a cooking revolution: catalysing Africa's transition to clean electric/gas cooking.

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Modern Energy Cooking Services (MECS) is a five-year research and innovation programme funded by UK Aid (DFID). MECS hopes to leverage investment in renewable energies (both grid and off-grid) to address the clean cooking challenge by integrating modern energy cooking services into the planning for access to affordable, reliable and sustainable electricity.

Existing strategies are struggling to solve the problem of unsustainable, unhealthy but enduring cooking practices which place a particular burden on women. After decades of investments in improving biomass cooking, focused largely on increasing the efficiency of biomass use in domestic stoves, the technologies developed are said to have had limited impact on development outcomes. The Modern Energy Cooking Services (MECS) programme aims to break out of this "business-as-usual" cycle by investigating how to rapidly accelerate a transition from biomass to genuinely 'clean' cooking (i.e. with electricity or gas).

Worldwide, nearly three billion people rely on traditional solid fuels (such as wood or coal) and technologies for cooking and heating[3]. This has severe implications for health, gender relations, economic livelihoods, environmental quality and global and local climates. According to the World Health Organization (WHO), household air pollution from cooking with traditional solid fuels causes to 3.8 million premature deaths every year – more than HIV, malaria and tuberculosis combined[4]. Women and children are disproportionally affected by health impacts and bear much of the burden of collecting firewood or other traditional fuels.

Greenhouse gas emissions from non-renewable wood fuels alone total a gigaton of CO_2e per year (1.9-2.3% of global emissions)[5]. The short-lived climate pollutant black carbon, which results from incomplete combustion, is estimated to contribute the equivalent of 25 to 50 percent of carbon dioxide warming globally – residential solid fuel burning accounts for up to 25 percent of global black carbon emissions[6]. Up to 34% of woodfuel harvested is unsustainable, contributing to climate

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[3] http://www.who.int/indoorair/health_impacts/he_database/en/

[4] https://www.who.int/en/news-room/fact-sheets/detail/household-air-pollution-and-health https://www.who.int/gho/hiv/epidemic_status/deaths_text/en/, https://www.who.int/en/news-room/fact-sheets/detail/malaria, https://www.who.int/en/news-room/fact-sheets/detail/tuberculosis

[5] Nature Climate Change 5, 266–272 (2015) doi:10.1038/nclimate2491

[6] http://cleancookstoves.org/impact-areas/environment/

change and local forest degradation. In addition, approximately 275 million people live in woodfuel depletion 'hotspots' – concentrated in South Asia and East Africa – where most demand is unsustainable[7].

Africa's cities are growing – another Nigeria will be added to the continent's total urban population by 2025[8] which is set to double in size over the next 25 years, reaching 1 billion people by 2040. Within urban and peri-urban locations, much of Sub Saharan Africa continues to use purchased traditional biomass and kerosene for their cooking. Liquid Petroleum Gas (LPG) has achieved some penetration within urban conurbations, however, the supply chain is often weak resulting in strategies of fuel stacking with traditional fuels. Even where electricity is used for lighting and other amenities, it is rarely used for cooking (with the exception of South Africa). The same is true for parts of Asia and Latin America. Global commitments to rapidly increasing access to reliable and quality modern energy need to much more explicitly include cooking services or else household and localized pollution will continue to significantly erode the well-being of communities.

Where traditional biomass fuels are used, either collected in rural areas or purchased in peri urban and urban conurbations, they are a significant economic burden on households either in the form of time or expenditure. The McKinsey Global Institute outlines that much of women's unpaid work hours are spent on fuel collection and cooking[9]. The report shows that if the global gender gap embodied in such activities were to be closed, as much as $28 trillion, or 26 percent, could be added to the global annual GDP in 2025. Access to modern energy services for cooking could redress some of this imbalance by releasing women's time into the labour market.

To address this global issue and increase access to clean cooking services on a large scale, investment needs are estimated to be at least US$4.4 billion annually[10]. Despite some improvements in recent years, this cross-cutting sector continues to struggle to reach scale and remains the least

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[7] Nature Climate Change 5, 266–272 (2015) doi:10.1038/nclimate2491

[8] https://openknowledge.worldbank.org/handle/10986/25896

[9] McKinsey Global Institute. *The Power of Parity: How Advancing Women's Equality can add $12 Trillion to Global Growth*; McKinsey Global Institute: New York, NY, USA, 2015.

[10] The SE4ALL Global Tracking Report shows that the investment needed for universal access to modern cooking (not including heating) by 2030 is about $4.4 billion annually. In 2012 investment was in cooking was just $0.1 billion. Progress toward Sustainable Energy: Global Tracking Report 2015, World Bank.

likely SE4All target to be achieved by 2030[11], hindering the achievement of the UN's Sustainable Development Goal (SDG) 7 on access to affordable, reliable, sustainable and modern energy for all.

Against this backdrop, MECS draws on the UK's world-leading universities and innovators with the aim of sparking a revolution in this sector. A key driver is the cost trajectories that show that cooking with (clean, renewable) electricity has the potential to reach a price point of affordability with associated reliability and sustainability within a few years, which will open completely new possibilities and markets. Beyond the technologies, by engaging with the World Bank (ESMAP), MECS will also identify and generate evidence on other drivers for transition including understanding and optimisation of multi-fuel use (fuel stacking); cooking demand and behaviour change; and establishing the evidence base to support policy enabling environments that can underpin a pathway to scale and support well understood markets and enterprises.

The five-year programme combines creating a stronger evidence base for transitions to modern energy cooking services in DFID priority countries with socio-economic technological innovations that will drive the transition forward. It is managed as an integrated whole; however, the programme is contracted via two complementary workstream arrangements as follows:

- An Accountable Grant with Loughborough University (LU) as leader of the UK University Partnership.
- An amendment to the existing Administrative Arrangement underlying DFID's contribution to the ESMAP Trust Fund managed by the World Bank.

The intended outcome of MECS is a market-ready range of innovations (technology and business models) which lead to improved choice of affordable and reliable modern energy cooking services for consumers. Figure 18 shows how the key components of the programme fit together. We will seek to have the MECS principles adopted in the SDG 7.1 global tracking framework and hope that participating countries will incorporate modern energy cooking services in energy policies and planning.

[11] The 2017 SE4All Global Tracking Framework Report laments that, "Relative to electricity, only a small handful of countries are showing encouraging progress on access to clean cooking, most notably Indonesia, as well as Peru and Vietnam."

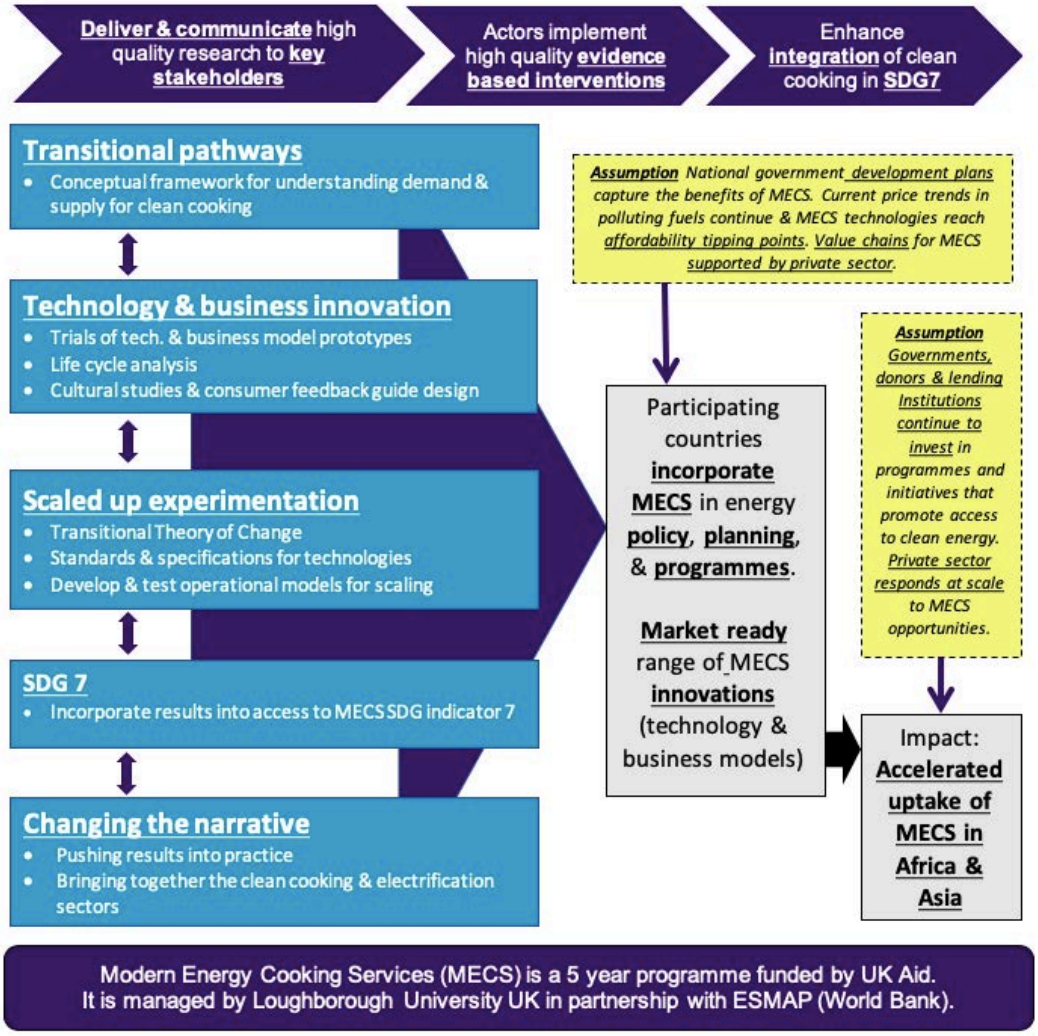

Figure 18: Overview of the MECS programme.