Fuel Stacking Practices in Myanmar

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Modern Energy Cooking Services (MECS) is pleased to present the research report on Fuel Stacking Practices in Urban Myanmar. The research has been under taken by MECS and funded by UK Aid through the Foreign, Commonwealth, and Development Office.

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1. INTRODUCTION AND BACKGROUND

The objective of this research report is to explore the drivers of fuel stacking practices and the barriers to a full transition to clean cooking in specific urban contexts in Myanmar. The research has been initiated by the Modern Energy Cooking Services (MECS) and funded by UK Aid through the Foreign, Commonwealth, and Development Office.

Section1 provides an overview of the project background and a context of fuel usage in Myanmar. Section 2 outlines the objectives and methodology of this report. Section 3 presents the main research findings. Section 4 provides recommendations for future actions.

1.1. CONTEXT OF STUDY

MECS is supporting the transition of low-income economies from biomass to the use of modern energy cooking services (i.e. cooking with electricity or gas). It calls for a greater focus on modern energy as the source of clean cooking, and has evidenced that cooking with modern energy using energy-efficient appliances can be cost-effective, particularly for urban communities.

The introduction of new fuels and technologies does not mean the complete abandonment of other fuels, resulting in what scholars refer to as fuel stacking. Fuel stacking can often be misunderstood as an interim phase of transition as households continue to use polluting fuels until they have sufficiently familiarised themselves with cleaner fuels and technologies. Rather, fuel stacking can often be an end in itself, providing households with fuel security and the flexibility to meet a range of cooking needs. As Shankar et al. (2020) have recently argued, “everybody stacks” and yet little is known about the implications of fuel stacking on public health and the environment, or how a transition towards cleaner stacking can be achieved. As the idea of a clean fuel stack gains traction within the clean-cooking sector, to meet sustainable development goals and household needs relating to fuel security and flexible cooking practices, more research is needed to understand (a) the economic, social and cultural dynamics of fuel stacking in urban contexts and (b) how modern energy cooking technologies can integrate within different kinds of fuel-stacking practices.

Yangon and Mandalay, our study sites, are the two most important cities of Myanmar and they are the primary urban migrant destinations. Yangon is Myanmar’s most populated metropolis and commercial and financial capital, with a population five times that of Mandalay, the country’s second-largest city. Yangon’s population, which is primarily young and educated, is predicted to increase from 7 million in 2018 to 10 million by 2030.Yangon contributes 23% of the country’s GDP and is expanding at a rate of 9.2% per year on average. Yangon is unique in that motorcycles are outlawed, resulting in a low rate of motorisation compared to other states and regions in Myanmar. In Yangon, 45% of trips are accomplished on foot, with another 7% completed by bicycle. Only 25% of Yangon households have access to formal housing such as condominiums, apartments, and brick houses, according to the World

Bank's Myanmar Urbanization report, while the remaining 75% live in semi-pucca houses (made with some durable materials such as stone, brick, or cement) or in temporary structures.[1]

Mandalay, the capital of Mandalay Region and former royal capital, is a major economic hub in the country's central and northern regions. With a population of about 1.3 million people in 2018, it is Myanmar's second-largest city, and it is predicted to grow to 2.4 million people in the next 20 years. Mandalay contributes 11% of the country's GDP and is rising at a rate of 12.4% per year on average. If Yangon is Myanmar's business capital, Mandalay is the country's cultural and religious capital. Mandalay residents are proud of their heritage and see themselves as Myanmar's cultural guardians. Mandalay is strategically placed on a major river and land connections connecting India, China, Thailand, and other Southeast Asian countries. Mandalay's favourable geographic location aided its development as a major Myanmar commerce centre. Motorcycles are the most common mode of transportation in Mandalay, with public transportation playing a minor part. 70% of all trips are taken on motorcycles.

The majority of the fieldwork was carried out in peri-urban townships of Yangon and Mandalay. They have a dense population, low income, inadequate basic amenities, poor water and sanitation management, and poor housing conditions. Informal and migrant, as well as low-income communities, live in these townships. The majority of blue-collar and some white-collar workers reside in peri-urban townships. We recruited some of the respondents from urban townships to gain a better understanding of households that use modern cooking fuels more. These townships are located in the central part of Yangon and Mandalay city. White-collar employees make up the majority of the population in these urban townships.

1.2. RESEARCH OBJECTIVES

The overall objective of the research was to explore the drivers of fuel stacking practices and the barriers to a full transition to clean cooking in specific urban contexts. The specific objective of the research was to explore the following research questions:

1. Which fuels and devices are used for cooking and related activities (heating water, food preparation, and refrigeration)?
2. How are these fuels and devices stacked on a daily, weekly, or ad hoc basis?
3. What factors explain these fuel stacking practices in the chosen contexts? (Economic, socio-cultural, networks, etc.)
4. As a multi-dimensional phenomenon, what does 'access' to various cooking fuels and devices entail for these households?
5. How much importance is placed on the use of modern energy cooking fuels and appliances in these urban contexts?
6. What makes a complete transition to modern energy cooking possible in the selected contexts?

[1]Myanmar's Urbanization (Vol. 3): Creating Opportunities for All - Full Report (English). Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/807471559656318146/Creating-Opportunities-for-All-Full-Report

2. DESK RESEARCH SUMMARY

2.1. Cooking fuel usage in Myanmar

According to the Multi-Tier Framework's survey 2019[2] in Myanmar, the majority of households use only one type of stove; however, 13% rely on multiple stove types to meet their cooking needs. The cooking stove usage includes three-stone stoves (45.6%), traditional stoves (12.8%), improved cookstoves (ICSs) (15.4%), electric stoves (12%), or liquefied petroleum gas (LPG) stoves (0.8%). A significant gap exists between rural and urban households in access to modern energy cooking solutions. A total of 56.2% of urban households use an electric stove either exclusively (33.8%) or a supplementary stove (22.4%) in combination with biomass stoves. Of urban households, 21.8% use improved stoves exclusively, 10% use LPG stoves either exclusively (2.6%) or in combination with electric stoves (3.4%). In rural areas, 58.0% of households use three-stone stoves; 15.9% use traditional stoves, and 13.2% use improved stoves. In rural areas, 7.5% of households use electric stoves, along with biomass stoves, while a mere 4.5% use electric stoves exclusively. Among households, 86.5% have access to at least one source of electricity; 38.6% have access through the national grid, and 48.0% have access through off-grid solutions.

2.2. Food habits and cuisines of Myanmar

Burmese cuisine encompasses Myanmar's diverse regional culinary traditions, which have been influenced and developed over centuries of socio-political and economic change, as well as cross-cultural contact and trade with countries at the confluence of South Asia, Southeast Asia, and East Asia, such as India, China, and Thailand. For its specific ingredients and seasonality of dishes, Burmese cuisine is influenced by the local geography. Rice, fish, and curry dishes are popular in the central part of Myanmar, where rice cultivation is extensive. Noodle-based foods are popular in the country's east, particularly in Shan State, which borders China and Thailand. Although most well-known dishes from around the world are available in restaurants, the majority of Myanmar residents still value their own cuisine, ensuring that its essence and distinctiveness are preserved

The colonial period in Myanmar, as well as globalisation and trade liberalisation, influenced not only religion, culture, and the arts, but also food preparation. Chinese and Indian influences on Myanmar cuisine are evident today - the Indian in the use of onions, spices and curry dishes; the Chinese in the use of ingredients such as soy sauce, noodles, tofu, and stir-frying techniques and the Thai in the sweet and spicy flavours of some cuisine. However, "Myanmar food is not as spicy as Indian or as hot as Thai food and it doesn't resemble Chinese food, with the exception of stir-fried vegetables".[3]

[2] "Koo, Bryan Bonsuk; Yoo, Han Kyul; Keller, Sandra; Rysankova, Dana; Portale, Elisa. 2019. Myanmar - Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/32381 License: CC BY 3.0 IGO."

[3] https://tripanthropologist.com/culture-through-food-in-myanmar/

Myanmar is an agrarian country whose main crop is rice .Rice accounts for around 75% of the diet. It is said that "if a Burmese person hasn't eaten rice over the course of a day, they will complain that their stomach doesn't feel full".[4]Burmese style curries, fried vegetables, Burmese salads, soups and a variety of dips customarily served with white rice are among the foods that characterize Burmese cuisine. All of the items are set out on the table and served together during meals so that guests can make their own choices and combinations. Meat can be slow-cooked, grilled, fried, stewed, or steamed as the main dish. As a side dish, salads and fried vegetables are frequently provided. Myanmar style curries are somewhat oily and meat-based, ranging from mutton, pig, and beef to fish and shrimp. The most common way of making Burmese style curry is to cook an onion, garlic, ginger, turmeric, chilli, and spice paste in heated oil until the oil separates from the paste, then add the meat or fish and slowly cooked until all or most of the liquid has evaporated and meat is tender. Burmese style curries are milder because they are prepared with a lot of oil, which breaks down the harshness of ingredients like chilli and ginger when cooked for a long time on low heat.[5]

Tea and tea shops have long been associated with Myanmar culture. Tea shops can be found all around Myanmar. These shops are frequented by older men, and it is a place for chatting and discussing politics and current events. A Myanmar hot tea is made with a strong black tea mixed with condensed or evaporated milk.


Myanmar cuisines

Myanmar Tea Shop

Burmese snacks include Samosa, naan, biryani, various noodle dishes, fried insects, and curries. Noodles can be found in a variety of forms in Burmese cuisine, including fried or dried noodles, noodle soups, and noodle salads.

Any Burmese traditional meal must have *Ngapi*, a pungent, dry, fermented fish or shrimp paste used heavily in southern and western Myanmar. It is used as a dip for fresh vegetables and as a condiment. It is the main ingredient in soup bases, salad dressings, main dishes, sauces, and plain cooked rice.

Mohinga and *Laphet* are Myanmar's most popular dishes. *Mohinga*, or rice noodles eaten with fish soup, is a popular Myanmar breakfast dish or offered on special occasions. *Laphet* or pickled tea leaves with a dash of oil and served with sesame seeds, fried garlic, fried yellow split peas, and roasted peanuts. The *laphet* can be eaten on its own at the end of a meal or as a snack. "The contrasting flavour profile of Burmese cuisine is broadly captured in the phrase *chin ngan sat*, which means "sour, salty,

[4]Ibid 3
[5]https://www.huffpost.com/entry/burmese-food_n_6044102

and spicy". A popular Burmese rhyme, "of all the fruit, the mango's the best; of all the meat, the pork's the best; and of all the leaves, *lahpet's* the best," sums up the traditional favourites.[6]

Laphet

Mohinga

Ngapi and fresh vegetables

2.3. Access to electricity and tariff in Myanmar

Myanmar's power industry is a major stumbling block to the country's continued development, with demand far outstripping supply and frequent power outages. The access to electricity in Myanmar is one of the lowest in Asia at 68.4% % in 2019 (92.7% urban areas and 57.5% rural areas).[7]The Myanmar Sustainable Development Plan 2018–2030 prioritizes (i) reliable and affordable electricity to support economic development and poverty reduction, and (ii) universal electricity access by 2030.[8]Myanmar's National Electrification Plan has also set targets that 75% of the population will have access to electricity by 2025, and 100% by 2030. In 2020, the main sources of electricity generation in Myanmar were hydropower (52%) and natural gas power plants (45%). In the same year, total installed capacity was 6,034 megawatts, with hydro accounting for 54%, natural gas 41%, coal 2%, diesel 2%, and solar 1% . Myanmar's electricity consumption is increasing at a rate of at least 15% per year, and in 2020-2021, it was estimated the country consumed roughly 4,531 megawatts of electricity. The total annual electricity generation is currently 3,828 megawatts, with 703 megawatts still required.[9]

Table1: Electricity Installed Capacity and Generation in Myanmar (2020)

Source of Supply and generation	Hydro	Natural Gas	Coal	Diesel	Solar	Total
Total Installed Capacity (In megawatt)	3,262 (54%)	2,496 (41%)	120 (2%)	116 (2%)	40 (1%)	6,034 (100%)
Total Generation Mix (in megawatt)	1,990 (52%)	1,722 (45%)	76 (2%)		40 (1%)	3,828 (100%)

Source: The Ministry of Electricity and Energy (MOEE)

Myanmar had the lowest electricity tariffs in the region as of June 2021.[10]Prior to June 2019, electricity tariffs were even lower. Electricity tariff hikes were introduced in July 2019 to encourage more efficient

[6]https://en.wikipedia.org/wiki/Burmese_cuisine

[7]https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=MM

[8] Government of Myanmar, Ministry of Planning and Finance. 2018. Myanmar Sustainable Development Plan, 2018–2030. Nay Pyi Taw.

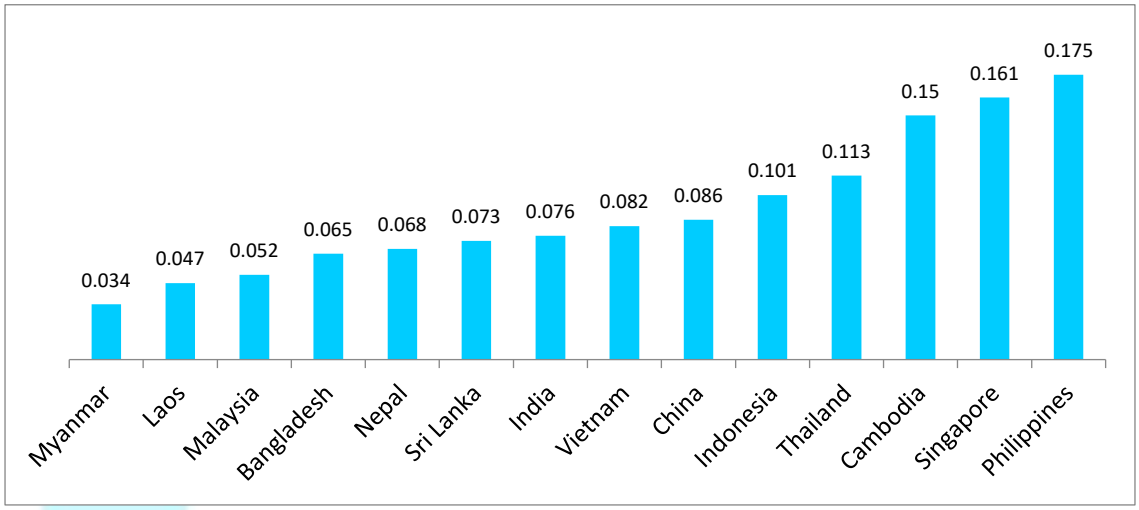
[9]https://www.moee.gov.mm/en/ignite/contentView/405

[10]https://www.globalpetrolprices.com/Burma-Myanmar/electricity_prices/

use by consumers and businesses, as well as to reduce demand, marking the first price adjustment in five years. Consumers who previously paid 3,500 Myanmar Kyats for 100 units would now have to spend 6,050 Kyats, indicating a 72.9% increase.[11]

In response to the COVID-19 outbreak, the government announced exemptions and subsidies of household electricity charges starting July 2020 and extended to March 2021. Around 98% of electricity customers in Yangon region, 97% in Mandalay region, and 80% in other states and divisions have been refusing to pay their bills since the Myanmar military seized control in a coup in February 2021, in an act of civil disobedience aimed at depriving the military of a vital source of revenue.[12]

Figure 1: Electricity prices for households, June 2021 (kWh, U.S. Dollar)



Source: https://www.globalpetrolprices.com/Burma-Myanmar/electricity_prices/

2.4. LPG gas cost in Myanmar

LPG use in Myanmar is low when compared to Thailand and Bangladesh. Gas stoves are used in 90 out of 100 kitchens in other ASEAN countries, but only five out of 100 in Myanmar.[13] As part of a national initiative to reduce the use of electricity and firewood in cooking, the government is promoting LPG as a clean alternative cooking fuel, and aimed to reach 1.5 million households by 2020. Following the increase in electricity tariffs in June 2019, consumers are also looking for a cheaper alternative source of cooking energy. The rate of LPG adoption is expected to increase once the government approves LPG-specific legislation, which will be aided by increased household awareness.[14]Myanmar depends on LPG imports from Thailand and other neighbouring countries because there are no refrigerated terminals and limited government production. According to the Ministry of Commerce and Custom Department data, Myanmar imported 103,776 metric tons (MT) of LPG in 2019. Currently, business is

[11] https://www.mmtimes.com/news/myanmar-announces-first-power-tariff-hike-five-years.html
[12] https://www.rfa.org/english/news/myanmar/power-09152021192918.html
[13] https://www.mmtimes.com/news/gas-use-cooking-myanmar-much-lower-other-asean-countries.html
[14] Eurocham Myanmar, Energy Guide 2020

being conducted in LPG stores with gas being transferred from 48 kg cylinders to smaller cylinders of 5kg, 8kg, 12kg 16kg and 20kg using a manual transfer method.[15]

In 2018, the Ministry of Electricity and Energy's MYANMAR Petrochemical Enterprise (MPE) collaborated with Yadanar Su Company Limited to open four gas stations in Yangon Region townships. Yadanar Su Co Ltd manufactures LPG gas at its Nyaungdon plant. Their prices are lower than those of other LPG gas distributors and retailers. Only 15kg and 48kg LPG gas are refilled by Yadanar Su Co Ltd. Some retailers purchase 15kg/48kg gas from them and transfer the contents to smaller gas canisters.[16]

The prices of LPG gas cylinders, stoves, and accessories are listed in Table 2 below. The cost of LPG gas was obtained from a physical store and an online site[17] in Yangon that sells LPG gas cylinders, stoves, and accessories.

Table 2: Cost of the LPG gas cylinder, stoves and accessories in Yangon

	Minimum cost in Kyats	Maximum cost in Kyats
Cost of gas stove		
Single burner stove	30,000	150,000
Double burner stove	50,000	300,000
Triple burner stove	300,000	
Portable single burner gas stove	30,000	45,000
Cost of gas cylinder		
Portable gas canister (400 gm)	2,500	3,000
5 kg cylinder (3 Viss)	55,000	
8 kg cylinder (5 Viss)	75,000	
12.5kg cylinder (7.5 Viss)	90,000	
16 kg cylinder (10 Viss)	110,000	
20 kg cylinder (12 Viss)	167,600	
Cost of accessories		
Gas regulator and pipe	10,000	15,000
Cost of gas refill		
Gas canister refill cost (Per can)	600	1,000
Gas cylinder refill cost (Per Viss)		

Year	Parami gas/ retailer price	Yadanar Su Company price
2020	2,700	1,200
2021	3,000	1,500
2022	3,700	1,800

Note: Viss is a Burmese unit of measure for weight, approximately 1.63293 kilograms
Market exchange rate as on 24 January 2022: 1 USD = 1950 Kyats

[15] https://www.mlpggroup.com/myanmar-lpg-market-overview/
[16] https://www.frontiermyanmar.net/en/lpg-bright-prospects-but-growth-constraints/
[17] https://paramilpg.com

3. METHODOLOGY

The research design used a qualitative approach using desk research, in-depth interviews (IDIs) and observation, focusing on.

- Desk research to explain the use of cooking fuels and devices in the chosen contexts, and for background research into fuel stacking.
- Place-based qualitative research (e.g. interviews, participant observation) was conducted with individuals from 20 households in Yangon and Mandalay, in order to shed light on fuel stacking practices in the local community, and the factors that explain these practices.

  The interviews were unstructured, direct and personal, and respondents were probed by one of our qualitative moderators to encourage participants to elaborate on their answers or to continue the discussion further. Each IDI lasted approximately 30 to 45 minutes. Each interview was audio-recorded and detailed backup notes were taken by the interviewers. Please refer to Annex A for a full list of the participants.

The research instruments were developed by ARM and MECS in partnership.

The research team conducted an ongoing analysis of data through regular, scheduled team meetings and informal discussions among team members. After the fieldwork IDI data was transcribed both in Myanmar and English, and as far as possible, verbatim.

The team used descriptive and thematic analyses to examine the data. In evaluating the results, comparisons were made between interviews held with young adults, older adults, different fuel usage, and Yangon and Mandalay participants. Validity was ensured through data triangulation (i.e. the convergence of multiple data sources) wherever data was available. Based on the analysis, the team developed findings, conclusions and recommendations.

4. FINDINGS

The main findings from this study are organised into five sections. The findings analyse the households' economic, social and cultural dynamics of fuel stacking in urban contexts.

4.1. Fuel Usage

Nearly all households in Yangon and Mandalay practice fuel and device stacking for cooking. Many households use an electric stove, charcoal stove, portable gas stove along with 4-5 gas can or single burner gas stove with 16 Kg or 8 Kg gas cylinder, electric rice cooker, electric frying pan (known in Myanmar as 'redpot'), 3-minuteelectric kettle and noodle pot. A three-stone firewood stove or a simple firewood stove is also used by some households. Only households with higher incomes have an induction stove, and microwave oven.

The fuel stacking among respondents in this study is shown in Table 3 below. The majority of respondents in Mandalay and Yangon use electricity as their primary cooking fuel because the cost of electricity is lower than in other countries in the region, and supply is reliable, especially in Mandalay and Yangon. Although the cost of electricity has risen marginally, people are accustomed to cooking with it. In Myanmar, there are a range of electric devices used for different foods, including a simple electric coil stove or hot plate, rice cooker, redpot, kettle and noodle pot, as well as a modern induction stove, microwave oven, and air fryer. Later in the report, a brief overview of the aforementioned electric cooking appliances is provided.

Table 3: Fuel stacking among respondents

	Location	Age	Gender	Primary fuel	Other fuel stacked
1	Mandalay	50	Female	Electricity	Charcoal and Portable gas stove
2	Mandalay	27	Female	Electricity	
3	Mandalay	50	Female	Electricity	Charcoal
4	Mandalay	42	Female	Electricity	Charcoal and Portable gas stove
5	Mandalay	29	Female	Firewood	Electricity and Charcoal
6	Mandalay	27	Female	Electricity	Portable gas stove
7	Mandalay	38	Female	Electricity	Charcoal
8	Mandalay	39	Female	LPG - 16 Kg Cylinder	Electricity
9	Mandalay	33	Female	Electricity	Portable gas stove
10	Mandalay	52	Female	Firewood	Charcoal
11	Yangon	48	Female	Electricity	Charcoal, Firewood and Portable gas stove
12	Yangon	54	Female	Electricity	LPG - 8 Kg Cylinder
13	Yangon	30	Male	Electricity	
14	Yangon	42	Female	Charcoal	Firewood
15	Yangon	35	Female	LPG - 16 Kg Cylinder	Electricity
16	Yangon	27	Female	Electricity	Charcoal
17	Yangon	34	Female	Electricity	Portable stove with gas can
18	Yangon	35	Female	LPG - 16 Kg Cylinder	Electricity
19	Yangon	33	Female	Electricity	Charcoal
20	Yangon	35	Female	Electricity	Charcoal

The cooking device stacking among respondents in this study is shown in Table 4 below. The most prevalent electric cooking appliances in Myanmar households are rice cookers, electric frying pans (redpots), and kettles. A typical household using electric cooking appliances will have 2-3 redpots, 1-2 rice cookers, a kettle, a noodle pot, a grinder/blender and a refrigerator. Some households have a microwave, an oven, a digital stove/induction stove and a toaster.

The use of electric coil stoves is declining because of better and modern electric appliances available in the market, yet they were the first electric cooking appliances in most Myanmar households. When the redpot stove was introduced to the market, it quickly displaced the electric coil stove.

Table 4: Cooking device stacking among respondents

	Location	Primary cooking fuel	Refrigerator	Charcoal	Electric Stove	Digital Stove	Red pot	Rice cooker	Kettle	Noodle pot	Oven	Microwave	Blender/Grin	Toaster	Pressure
1	Mandalay	Electricity	1	2			2	1	1	1					
2	Mandalay	Electricity	1			1	1	1		1			1		
3	Mandalay	Electricity					2	1	1	1			1		
4	Mandalay	Electricity	1	1			1	1	1	1			1		
5	Mandalay	Firewood	1	1		1	3	2	1	1		1			1
6	Mandalay	Electricity	1			1	2	1	1	1			1		1
7	Mandalay	Electricity	1	1		1	2	2	1	1					1
8	Mandalay	LPG - 15 Kg cylinder	1					1							
9	Mandalay	Electricity	3			1	2	2	1		1		1	1	
10	Mandalay	Firewood		1											
11	Yangon	Electricity	1	1	1	1	2	1	1	1			1		
12	Yangon	Electricity	3				2	2	1		1				
13	Yangon	Electricity	1			1	2	1	2	1			1		
14	Yangon	Charcoal	1	1					1						
15	Yangon	LPG - 15 Kg cylinder	1		1	1		1	2		1	1	1		
16	Yangon	Electricity	1	1			1	1	1				1	1	
17	Yangon	Electricity	1				1	1	1	2					
18	Yangon	LPG - 15 Kg cylinder	1				1	1	1					1	
19	Yangon	Electricity	1	1	1	1	1	2	1	1			1		1
20	Yangon	Electricity	1	1	1		1	3	1		1				

	**Rice Cooker:** Rice is a staple dish in Myanmar, and rice cookers have grown in popularity due to its ability to constantly cook flawless rice and keep it warm, as well as their low power consumption and ease of use. Rice cookers eliminate the need for manual intervention while cooking. It stops automatically when it's cooked so that the rice is neither overcooked nor under-cooked.
	**Electric frying pan**: Electric frying pans are commonly known in Myanmar as redpot because red coloured pans are popular. However, a yellow, blue, or white electric pan is also available. It includes an electric heating element within the pan itself and so can function independently. The adjustable thermostat on the electric pan allows you to manage the temperature and maintain a relatively constant temperature. It has heat-insulated legs for standing on a countertop It comes with a detachable power cord that makes cleaning easier. In Myanmar, redpots are used to prepare the main dish, including frying, stewing, and grilling.
	**Kettle**: Myanmar people drink a like to drink tea and some coffee. To boil water and brew instant tea or coffee at home, people usually use an electric kettle. The heating element is placed higher in the kettle. The immersion heating element in an electric kettle is not conducive to proper cleaning when exposed to food particles, so it is generally not used to boil milk or make noodle.
	**Noodle pot**: An electric noodle pot is similar to an electric pan. It has the heating element in the base. They are easier to clean than a kettle but it takes longer to boil water. The noodle pot can also be used as a bowl for eating.
	**Electric coil stove**: This type of stove has a flattened spiral coil that heats up as electric current is passed through it. Although there is no flame, the intensity of the electric flow can be seen by the glow of the coil. The heat directly transfers from these coils to the utensils. Cooking time on an electric stove is typically longer than on a gas stove. This is due to the fact that it takes a long time for the coil to heat up, transfer heat to the cookware, and then to the food. When you turn off an electric stove, it takes a while for it to cool down. It is relatively cheap as uses a simple technology. Electric stoves may have coils that are visible or covered beneath a sheet of glass-ceramic that covers the cook top surface.
	**Digital stove/Induction stove**: In Myanmar, induction stoves and smooth top electric stoves are referred to as 'digital stoves'. However, they are very different in the way they generate heat. Electric stoves have coils that heat up and transfer heat to cookware via conduction. The magnetic property of steel is used to heat the cooking pot directly on an induction stove. The fact that it only works with flat iron or stainless steel cookware is a disadvantage of the induction stove. Induction cooking is much more expensive than gas or electric cooking. In Myanmar, smooth top electric stoves are used for grilling or roasting dry fish and meat.
	**Portable gas stove**: The portable gas stove come with integrated gas canisters. It combines the portability and usefulness of a small gas canister with the heat output required to prepare a meal. These stoves were first introduced in other countries for camping and outdoor activities, but they are also used indoors in Myanmar. In Myanmar portable gas stove is used as secondary stove and frying or heating food quickly.

Multiple devices are kept so that more than one dish can be cooked simultaneously. On a typical day in Myanmar, most households prepare three dishes: meat curry, soup, and fried vegetables. Within a household, several cooking fuels are frequently used for specific culinary purposes, such as a charcoal

stove for cooking meat, a redpot or LPG stove for preparing soup and frying vegetables, and a rice cooker for cooking rice. Some families cook all of the dishes in the morning and only rice in the evening.

> *"We always have at least three dishes. A soup is necessary, so is a meat curry and some vegetables. Sometimes I cook Burmese styles, sometimes stewed or sometimes kachin style. It takes a long time cooking with electric pan, but faster with charcoal stove*."
> Mya, 50-year-old female, Electric - Charcoal and Portable gas stove user, Mandalay
>
> *"I am a school teacher, so need to finish cooking on time for work. I use charcoal stove for fish curry or steamed fish, and also for making Mohinga or milk noodles for family. I use redpot for curry dishes and frying vegetables. I need to use different stoves together because I need to cook in the minimum time available."*
> Tin, 48-year-old female, Electric – Charcoal- Firewood and Portable gas stove user, Yangon
>
> *"It depends on the dishes you cook. Charcoal stove is good to cook meat and electric pan is good to fry some vegetables."*
> Zin, 38-year-old female, Electric and Charcoal user, Mandalay
>
> *"After marriage, I used to use red electric stove and digital stove. I also used charcoal and pressure cooker. All were useful for me. I can use all of them at the same time to cook different curries."*
> Thinzar, 27-year-old female, Electric and Charcoal user, Yangon

4.2. Factors influencing fuel choices

A household´s fuel usage and choice are strongly influenced by fuel accessibility, affordability and convenience. These factors are linked to one other and are also influenced by household socio-economic status and cultural context. This section compares different cooking fuels, both traditional and modern, in terms of fuel accessibility, affordability, reliability and other factor affecting fuel choice and usage.

4.2.1. Socio-economic status and fuel choices

Cooking fuel usage is influenced by household socioeconomic status and house type.

Charcoal stove usage is less likely among households living in a multi-stored apartment or condominium because charcoal smoke can be a nuisance to other households in the building. Despite the fact that most apartment buildings and condominiums in Yangon and Mandalay have no rules about what kind of cooking fuels residents can use or should not use, respondents stated that they chose not to use charcoal stoves out of concern for their neighbours.

> *"My neighbours as well mostly use electric pan and gas stove. I don't see anyone who uses charcoal for cooking in this building. Charcoal stove isn't good to cook in the apartment as it releases smoke"*.
> Lwin Lwin, 34-year-oldfemale, Electric and portable gas stove user, Yangon

"We are not using charcoal or wood. Because I'm staying in apartment, it's troublesome when a lot of smoke comes out."
Aye Aye, 33-years-old female, Electric and Portable gas stove user, Mandalay

Urban households using charcoal generally have in an independent (free-standing) house with a backyard or front garden. Low-income households feel concerned about the charcoal or firewood smoke, particularly if no one else in the neighbourhood uses it. They worry that the smoke might be annoying to their neighbours and their financial status doesn't allow them to afford alternative, modern energy cooking fuels.

"I have been cooking with charcoal and firewood all my life, and I don't want to try cooking with electricity as I don't have enough money to buy Red Pot and pay electric bill. I feel quite bad every time I build the fire though because the smoke coming out can irritate my neighbours. But still, I don't have any other choices."
Cho Cho, 50-year-oldfemale, Charcoal and firewood user, Mandalay

4.2.2. Family size and fuel choices

The cooking fuel choices to some extent are influenced by the size of the family. A large family of 6 or more individuals is more likely to cook with charcoal and firewood; a medium-sized family of 4-5 members' primary cooking fuel can be LPG gas or electric cooking. Electric cooking is preferred by a smaller family of 2-3 individuals. A larger cooking pot may not fit properly with an electric cooking device, resulting in longer cooking times and a higher power bill. A large family is more likely to have low education and a low income, limiting their ability to purchase LPG gas or electric cooking appliances. Cooking with a charcoal stove, for example, is convenient and less expensive if they need to cook food for donation to monks or for a large number of people, or if they need to create beef stew/curry that requires long cooking for improved tenderness and taste. In Myanmar, most families donate food to monasteries 4-5 times a year on special occasions such as birthdays, anniversaries, and religious holidays. Many families, on the other hand, donate a modest amount of cooked rice and one or two dishes to a group of monks that pass by on a daily basis.

"I use charcoal when I need to cook big meals to treat our guests. Sometimes, I offer meals to monks and so I need to cook more. Whenever I cook meals for three or more people, I use charcoal. Electric pan is not big enough."
HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay

"If I do food donation to monks, I use charcoal for cooking Mohinga and Vermicelli soup."
Thinzar, 27-year-old female, Electric and Charcoal user, Yangon

4.2.3 Fuel and stove affordability

Fuel affordability, in terms of high upfront and recurrent costs, is a key barrier to the adoption of modern energy cooking fuel by low-income households.

The firewood charcoal is considered a relatively inexpensive source of cooking fuel. Despite the fact that the monthly market cost of firewood and charcoal fuel is nearly identical in urban areas, firewood is perceived as being less expensive than charcoal, because it can be collected and is occasionally available for free from any house undergoing renovation. A firewood stove has minimal or no upfront cost, whereas a charcoal stove costs 2,500 to 3,000 Kyats. A bag of charcoal costs around 5,000 to 6,000 Kyats and lasts for a month if used as a secondary cooking fuel by a family of 4-5 persons. Similarly, a bundle of firewood costs 600 Kyats, and the monthly cost for a household of 4-5 persons using it as a primary cooking fuel with charcoal or electricity as a secondary fuel is roughly 9,000 Kyats.

The upfront cost of an electric cooking appliance varies and it depends upon the type of device, brand, model, capacity and material used. In Myanmar, an unknown brand of rice cooker cost roughly 18,000 Kyats, whereas a branded one costs 385,000 Kyats and a second-hand costs 10,000 MMK. Similarly, redpots, kettles, noodle pots, and digital electric stoves come in both low-cost and high-cost varieties. A Microwave costs at least 72,000 Kyats, whereas an expensive one can cost 425,000 Kyats. Electric cooking is perceived differently in terms of recurring costs. Some people think electric cooking is cheap, while others think it is highly expensive. The reasons are

- It is difficult to know the cost of electric cooking because electricity bills cannot be separated by cooking, lighting, cooling, and heating; for a light user of electricity, bills will be in the lower range and will not vary much due to the cooking; however, for a heavy user of electricity, bills will be in the upper range and will vary a lot, the household can attribute it to cooking.
- Many people believe that rice cookers, redpots, kettles, and noodle pots use very little electricity, whereas electric coil stoves, digital stoves, and microwave ovens use a lot of electricity.

"Charcoal is expensive and the price is rising. The cheapest is using electric pan, and then gas."
Mya Mya, 50-year-old female, Electric, charcoal and portable gas stove user, Mandalay

"I think charcoal cost more. Cooking with electric stoves can cost less. My electricity bill is roughly 10,000 Kyats. With charcoal, it costs 12000 Kyats per month."
Thinzar, 27-year-old female, Electric and Charcoal user, Yangon

"Gas tank is cheaper than cooking with electricity. Most of my friends use it. They say cooking with electricity is more expensive."
Yamin, 27-year-old female, Electric and portable gas stove user, Mandalay

"I don't use electric cooking much because of the electricity bill. Redpots are worse. Now, I have to pay 90,000 Kyats for the bill and if I use electric stove, it will cost me more."
HtetHtet, 35-year-old female, LPG gas cylinder and Electric user, Yangon

Many people perceive cooking with an LPG gas cylinder as cheaper than electricity, despite high upfront and recurring costs. The upfront cost of a gas cylinder is very high. A 16kg cylinder, combined with a stove and other accessories, costs roughly 200,000 Kyats. In the recent months, the cost of refilling gas has risen significantly. For a 16kg cylinder, the refill costs roughly 37,000 Kyats in January

2022, while it was 31,000 Kyats in July 2021 and 25,000 Kyats in December 2020. A portable gas stove costs roughly 45,000 Kyats when purchased with 3-4 canisters. The monthly cost for a household of 4-5 persons using it as a secondary cooking fuel is roughly 10,000.

> *"Gas is not very expensive to use. It's about 650 kyats a can (*portable gas canister*). It was 500 kyats before. We can use a can for two days. So, it is cheaper than charcoal."*
> Lwin Lwin, 34-year-old female, Electric and portable gas stove user, Yangon

4.2.4 Fuel supply reliability

Cooking fuel supply reliability is a key decision-making factor for households.

The supply of firewood and charcoal in urban areas is predictable throughout the year. They're readily available in the neighbourhood. Because shops selling firewood and charcoal typically store them outside under the open sky, during the rainy season they become wet or absorb moisture, making them difficult to use. Wet or damp firewood/charcoal is difficult to light, slow to burn, and produces thicker smoke.

> *"It is not convenient to use charcoal stove in rainy season. It releases a lot of smoke. Mostly, I cook with electricity during rainy season."*
> Zin Zin, 38-year-old female, Electric and Charcoal user, Mandalay

The supply of LPG gas cylinders and portable gas canisters is sufficient at the household level because demand is modest. However, given Myanmar's reliance on imports for LPG, the cost of refilling will continue to be expensive and may rise in the future. The other variable in the LPG gas cylinder supply is that it can run out in the middle of a meal. The majority of households only have one gas cylinder. Households that use portable gas canisters don't have this problem because three to four canisters are usually kept on hand.

The electricity supply is unreliable in Myanmar due to the frequent power outage. At least five respondents in our sample who use electricity for cooking (2 in Yangon and 3 in Mandalay) mentioned they require a backup cooking fuel since power outages/blackouts and low voltage are regular. Electricity blackouts have been more common across the country since the military coup on 1 February 2021, particularly in Yangon and Mandalay. Before the coup, scheduled electrical outages lasting 1 to 2 hours per day during peak hours—between 9 a.m. and 11 a.m. and 7 a.m. and 8 a.m.—were typical, especially during the summer when demand is high but supply is low because hydro accounts for more than half of electricity generation in Myanmar. For some households, electricity is unreliable, especially in the mornings, when many households in the neighbourhood use it for cooking.

> *"In the morning, as all houses are using electricity for cooking, the voltage usually drops. It makes cooking time longer than usual."*
> HtetHtet, 35-year-old female, LPG gas cylinder and Electric user, Yangon

4.2.5Fuel procurement, transportation and storage

Fuel procurement, transportation and storage reflect the household's perception of the ease of obtaining, transporting and storing fuel. There are no special requirements for procuring, transporting and storing the electricity for cooking. LPG gas cylinder has varying levels of ease for procuring and transporting, most shops provide free home delivery service, but some need you to carry it to the gas refill station or pay a delivery fee of 4,000 Kyats. The fact that motorcycles are banned in Yangon, transporting a heavy LPG cylinder is difficult on a bicycle and by taxi, expensive. The LPG gas cylinder requires some storage space in the kitchen. Not many Myanmar kitchens are designed to accommodate an LPG gas cylinder. Portable gas canisters are small and light, and can be purchased in any neighbourhood during a shopping trip and stored easily. The procurement of firewood is difficult because of its bulky size and related transportation or the need to be collected from the neighbourhood. Procuring charcoal is also easy. It is available in small and big bags at the neighbourhood shops and some of them will bring it to your house for free if you buy a big bag. In comparison to charcoal, firewood requires more storage space.

4.2.6 Fuel heat control

In cooking, the ability to control the fire or heat from the stove is crucial. The inability to manage heat is cited by several respondents as a drawback of a cooking fuel. The difficulty of managing heat in a charcoal stove, an LPG stove, or an electric stove was mentioned by respondents. However, most people believe that controlling the heat with the cooking fuel they use is easier, whereas controlling the heat with the one they don't use is difficult. This means that heat can be adjusted in all types of cooking fuel after regular use and experience. Most electric cooking appliances, such as redpots, digital stoves, and microwave ovens, contain heat control functions; however, open single-coil electric stoves do not. In Myanmar, there are double coil electric stoves with two buttons, one for the inner coil and the other for the outer coil, so at least some heat may be controlled. Another advantage with gas and electric cooking is that it can be halted immediately by turning the knob off and heat can be controlled. Cooking with charcoal and firewood, on the other hand, is not possible.

"I can't control the heat as I need with a charcoal stove. But I can easily control it in redpot. Gas can produce high heat and it is easy to adjust the heat"
Lwin Lwin, 34-year-old female, Electric and portable gas stove user, Yangon

"I can also adjust the heat with gas , same with using electric stove"
HtetHtet, 35-year-old female, LPG gas cylinder and Electric user, Yangon

"It is not ok to cook with charcoal if you work, because I have to take care of this as It can burn. In case of gas I can control over heat easily and it's ok."
Yamin, 27-year-old female, Electric and portable gas stove user, Mandalay

"We can leave the meat stew with a small heat on the charcoal stove. But if we use electric pan, we need to take care of this while cooking.
HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay

"*The temperature is consistent with using charcoal stove. When I'm using gas stove, I need to be really careful of the heat."*
Moe Moe, 54-year-old female, Electric and LPG gas user, Yangon

4.2.7 Fuel suitability for different cooking styles, utensils and dishes

The suitability of a fuel for a wide range of cooking styles, utensils, and dishes, is an important consideration in fuel choices. There are differing viewpoints on cooking fuel in terms of speed, care required, and fuel efficiency, all of which influence their suitability for various foods. Many urban households have switched to electric or LPG cooking, however, some households have a strong preference for charcoal stoves for cooking certain Burmese dishes like meat stew to save on gas and electricity costs. Burmese meat stew is a high-energy-intensity dish and many slow cook the dish over 5-6 hours using charcoal stoves or redpots (during free electricity time).

"*Cooking meat stew with electricity is also good, but charcoal is better. And we can leave the stew with a small heat on the charcoal stove. But if we use electric pan, we need to take care of this while cooking"*
HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay

"When I cook meat with electric pan, I can leave it with low heat. But I can't cook like that with gas as it will cost much"
ThiThi, 42-year-old female, Electric, Charcoal and portable gas stove user, Mandalay

Charcoal is perceived better for slow cooking dishes; grilling and steaming; and meat stews. Gas is perceived better for preparing breakfast, quick-cooking dishes, frying meat, snacks and vegetables. Electricity is perceived better for small and fast cooking dishes and frying vegetables. Microwaves are used to heat meals and ovens are used to grill meat in some households. To roast and grill dry fish and meat, several households utilize digital electric stoves (not induction).

"

"It depends on the dishes you cook. Charcoal stove is good to cook meat and electric pan is good to fry some vegetables."
Zin Zin, 38-year-old female, Electric and Charcoal user, Mandalay

"Gas is better for vegetable. Because it's fast, and vegetable looks more fresh. Red pot is better for meat. I can cover up the lid and it can make meat tender a lot. For gas, meat can easily get burnt if I am not careful."
Moe Moe, 54-year-old female, Electric and LPG gas user, Yangon

Not all utensils are suited for electric cooking. For example, only flat-bottomed utensils work best with electric stoves; induction stoves require iron and steel utensils; and only microwave-safe utensils (heat-resistant glassware, plastic, ceramic) can be used in microwaves. Electric and induction cooking is limited by the lack of flame, which is essential for cooking certain foods in Myanmar like 'Smoky Mashed Eggplant' or barbeque.

Due to medical conditions such as diabetes, some households prefer to cook rice using traditional ways on wood fuel stoves. For diabetic rice cooking, one can use wood, charcoal, gas, or an electric stove, but not an electric rice cooker. Generally, a 1:3 rice-to-water ratio is employed, which means that one cup of rice requires 3 cups of water. Rice is cooked in a pot on the stove until it is soft and tender. The pot is taken off the heat and the extra white starchy water is strained out.

"I have to cook rice with firewood as I have diabetes. So I need to care about my food".
Cho Cho, 52-year-old female, Firewood and Charcoal user, Mandalay.

4.2.8 Taste of food on different cooking fuel

Though different perspectives exist, dishes cooked over charcoal and firewood, particularly meat and chicken, are often perceived to (i) taste better; (ii) be cooked properly; and (iii) require less supervision/attention. People who are accustomed to using a certain fuel, on the other hand, begin to enjoy the taste of the food. It is thought to be difficult to cook meat tenderly on a redpot/electric stove, and to cook meat tenderly on a gas stove, it is necessary to cook at low heat.

"We only use charcoal whenever we cook steamed dishes. Charcoal makes the dishes soft and tender, it is the best."
Mya Mya, 50-year-old female, Electric - Charcoal and Portable gas stove user, Mandalay

"Electric pan is not good to cook meat. The heat is not enough. It takes time to make the meat tender. I have to use charcoal to cook meat and it even makes the dish more delicious."
Ma Htike, 33-year-old female, Electric and Charcoal user, Yangon

"I cook beef on a charcoal stove. I also fry some chicken on it. The taste is different. The taste is good if we fry the chicken over low heat with charcoal."
Zin Zin, 38-year-old female, Electric and Charcoal user, Mandalay

"It is better to cook beef with charcoal as it makes beef more delicious and tender."
HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay

"Using charcoal makes the meat tenderer. Red pot can't be used for a long time. I'm afraid that using it won't cook the meat well for my kid, so I use charcoal"-
Tin Tin, 48-year-old female, Electric – Charcoal- Firewood and Portable gas stove user, Yangon

4.2.9 Cooking time

The amount of time spent cooking has an impact on household fuel choices. Cooking time is determined by stove preparation time, heat transfer to the utensil and heat intensity. When compared to electricity, which is slower than LPG but faster than firewood and charcoal, LPG gas appears to take less time to cook food. The slowest cooking fuel is charcoal, which is followed by firewood. Because charcoal takes longer to cook, many urban households who use it as a secondary fuel only use it 2-3 times a week, especially on weekends when everyone has more free time and special Burmese dishes are prepared. Cooking time is also affected by the quality of the charcoal or firewood used; poor quality charcoal or slow-burning firewood will take longer to cook than usual. Various electric cooking

appliances take different amounts of time to cook food. Electric stoves and redpots are slower than LPG stoves, although induction stoves are faster. Water can be heated in a kettle, and noodles can be made in a noodle pot faster than with LPG.

"Sometimes, charcoal is not used for a whole week because of high voltage electricity. Cooking with charcoal takes time, so we mostly cook with it in weekends as my daughter doesn't have to go office. When we want to have some meat stews or mohinga, we use charcoal."
HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay

"I cook with electric stove and gas. I rarely use charcoal as it takes time to prepare."
ThiThi, 42-year-old female, Electric, Charcoal and portable gas stove user, Mandalay

"Sometimes, it takes time to cook with redpot if the voltage is low. It is the same with charcoal if the charcoal quality is not good."
Thinzar, 27-year-old female, Electric and Charcoal user, Yangon

4.2.10 Fuel safety

The safety of the fuels and cooking devices is an important consideration for consumers. Every type of cooking fuel carries some level of risk. The level of risk varies depending on the type of fuel and cooking devices used. Exposure to heated surfaces, fire, explosion owing to leaking, and electric shock are all potential hazards. Firewood has a low to medium risk of fire hazard, while charcoal has a low risk of fire hazard. The perceived risk of electric shock and burn when cooking with electricity is high, especially among the elderly, families with children, and low-income populations.

"Charcoal is already good enough for me. I don't use a Redpot. I am scared of the electric shock."
Ma Kyi, 42-year-old female, Charcoal and firewood user, Yangon

"I used to get electric shock. That is why I am scared of using electricity."
Cho Cho, 52-year-old female, Firewood and charcoal users, Mandalay

"*I have never used a digital stove. I think it's quite similar to coil stove. I'm scared that it might cause electric shock too."*
Moe Moe, 54-year-old female, Electric and LPG gas user, Yangon

"Electricity has electrical hazard. Most people use electric stove and redpot. Redpot needs to be washed with the coils attached. So, it is dangerous. I also don't like digital stove. As I cannot know the plate is hot or not, I feel like it is dangerous for my children"
HtetHtet, 35-year-old female, LPG gas cylinder and Electric user, Yangon

"It is not good to use electric pan for a long time as it could burn the coils. I stop using the redpot when it is very hot. I am afraid of a wire shock.
Zin Zin, 38-year-old female, Electric and Charcoal user, Mandalay

For LGP gas cylinders, the perceived danger of gas leakage and explosion is very high. Many users are scared and hesitant to use a large cylinder LPG because of reports of gas leaks and explosions. People in Myanmar are unaware of the safe LPG usage guidelines because LPG usage is minimal. Consumers are more concerned about their children playing with the knob and accidentally creating a gas leak and explosion. However, the perceived risk of using a portable gas burner is modest.

> *" In case of gas, the fire is burning to outside, and I'm scared of that. I've heard that people died from a gas tank explosion in Aung San area. I don't dare use it."*
> Ma Kyi, 42-year-old female, Charcoal and firewood user, Yangon
>
> *"I am concerned of explosion with those big cylinders because I have children here. That's why I use only charcoal. But I think it doesn't need to worry about with small bottle of gas."*
> Thinzar,27-year-old female, Electric and Charcoal user, Yangon
>
> *I used to cook with big gas stove before I gave birth to kids. Now, I'm afraid that they may play with it, so I switched to small gas stove. I gave the big gas container to my mom.*
> Tin Tin, 48-year-old female, Electric – Charcoal- Firewood and Portable gas stove user, Yangon
>
> *"I dare not to have gas stove. Children might touch it and it is dangerous for them. It's explosive."*
> Ma Htike, 33-year-old female, Electric and Charcoal user, Yangon
>
> *"No, I don't use gas. I am afraid of gas. I've heard of gas exploding if I cannot use it very well."*
> HtayHtay, 50-year-old female, Electric and charcoal user, Mandalay
>
> I *use gas only when power outage because I'm afraid that it'll start fire. Gas stove has more fire power than redpot. I'm used to the of Redpot.*
> *Aye Aye*, 33-year-old female, Electric and Portable gas stove user, Mandalay

4.2.11 Health impacts of fuel usage

The harmful health effects of cooking with firewood and charcoal in a poorly ventilated dwelling are widely established, however, their health risk is poorly understood in Myanmar by people using them. In fact, some charcoal users think that charcoal has no negative health consequences and that cooking with charcoal is beneficial to one's health. Most people who cook with charcoal or firewood do so in the front or backyard of their homes, so they may not realise they are inhaling smoke. Few charcoal users believe that smoke can be absorbed by food, which is harmful to children.

> "I'm afraid of my younger son's health because of all the smoke that charcoal gives out."
> Tin Tin, 48-year-old female, Electric – Charcoal- Firewood and Portable gas stove user, Yangon

4.3 Relative importance of factors affecting fuel choices

Table 5 below summarizes the factors affecting fuel choice and usage as discussed in the preceding section. A qualitative assessment of the relative importance (high/medium/low priority issues) of all the factors is also given. The comparison shows that each cooking fuel has its own specific advantages, disadvantages, inconveniences and limitations. The comparison and relative importance rating is based on respondents' perceptions of different cooking fuels and our analysis of respondents' responses.

Table 5: Relative importance and comparison among cooking fuel

Criteria	Relative importance	Firewood	Charcoal	LPG gas	Electric
Family size	Medium	Suitable for large family	Suitable for large family	Suitable for medium family	Suitable for small family
Fuel Accessibility	High	Easy in rural but not in urban area	Easily available in urban area	Easy in urban but not in rural area	Easy in urban but not in rural area
Fuel affordability	High	Perceived to be cheaper than the charcoal, sometime can get free	Perceived to be cheaper than the gas and electricity	Perceived to be cheaper than electricity. Wide range in market price refill	Perspective varies, but generally perceived to be expensive than LPG. Use of redpot, rice cooker, kettle, Noodle pot use less electricity
Stove cost (affordability)	High	Low- Three stone stove is free of cost	Low- Can be self-made or bought locally	High – Need to buy stove, cylinder and accessories	Medium – Variety of models available both cheaper and expensive brands
Fuel supply reliability	Medium to High	Predictable. However, wet wood is a concern during the rainy season.	Fuel supply is predictable and can be stored indoor during the rainy season.	Gas can finish in the middle of cooking	Electric supply cannot be relied upon
Procurement	Low	Difficult, sometime need to collect	Charcoal available in small and big bags in the neighbourhood	Free home delivery generally available	No need for special procurement
Storage	Medium	Need more space to store	Need space but less than wood	Less space specially gas can or need space in kitchen for keeping the big cylinder	No storage requirement
Cooking time	High	Faster than charcoal	Slowest	Faster	Slower than LPG but faster than wood and charcoal

Energy efficiency (heat loss)	Low	Low energy efficiency. Make kitchen hotter due to the heat lost	Low energy efficiency. Less heat lost than firewood	High energy efficiency but less than the electricity	High energy efficiency
Heat control	High	Perceived to be difficult to control	Perceived to be difficult to control	Perceived to be easy to control. Can turn of cooking immediately.	Perceived to be easy to control in most devices but difficult in single coil electric stove. Can turn of cooking immediately as well.
Convenience: Attention need during cooking	Low	Need full attention	Need full attention	Need minimum attention	Need minimum attention
Fuel suitability for different cooking styles, utensils and dishes	Medium	Better for fast cooking dish.	Better for slow cooking dish. Good for grilling and steaming, cooking meat stew	Better for fast cooking dish, Quick to fry and Good for frying vegetables.	Better for small and fast cooking dish. Good for frying vegetables and meat curries.
Taste of food	Low to medium	Food taste better particularly meat is more tender	Food taste best particularly meat is more tender	To make meat more tender, need to cook at low flame	Difficult to cook meat for better tenderness
Kitchen cleanliness/smoke	Low	Perceived as cleaner than the charcoal	Charcoal smoke is nuisance for the neighbourhood	Very clean	Very clean
Kitchen and utensil cleaning time	Low	Need more time to clean	Need more time to clean	Quick cleaning	Quick cleaning. Redpot need to clean after cooking every dish.
Impact on Health	Low	Higher	Lower than wood	Lower than wood and Charcoal	No
Safety	High	Fire hazard Perceived risk is low	Fire hazard Perceived risk is low	Gas leakage and explosion Perceived risk is very high.	Electric shock Perceived risk is high

Fuel affordability, safety, heat control, cooking time, and accessibility are the most important (high priority issues) factors influencing fuel choices for the household, while fuel supply reliability; suitability for different cooking styles, utensils, and dishes; family size and storage are of medium importance,

and food taste, procurement, attention needed during cooking, Kitchen cleanliness/smoke, Kitchen and utensil cleaning time, and impact on health are of low importance.

- Affordability of cooking fuel and stove is the most important factor influencing fuel choices for the household. This is unsurprising given Myanmar's is a developing country with a high poverty rate. Many families cannot afford to buy high-quality electric cooking appliances or pay for a large LPG cylinder upfront. Even if they know that high-quality electric appliances or a large LPG gas cylinder are substantially less expensive in the long run and better, many individuals continue to cook with traditional fuels, low-quality electric equipment, or a portable gas stove.
- The second most significant consideration in fuel selection is the safety of the cooking fuel and devices. Because of their high-risk perception, many households are hesitant to switch to electric or LPG gas cylinder stoves. If there are little children in the house, some people even cease using the LPG gas cylinder.
- After fuel affordability and safety, heat control and cooking time are the next most critical factors. They are especially significant in urban settings because there are many individuals in the family, including the cook, who may be working or who have school-aged children. Before everyone leaves the house in the morning, all cooking must be completed. They value better heat management and quick-cooking fuel.
- Fuel accessibility is also critical for consumers' fuel choices, which is especially important for rural residents. LPG is yet to be distributed in Myanmar's smaller towns and rural areas. In rural areas, access to grid electricity is also limited.
- Fuel supply reliability is of medium importance in fuel selection. Because many households have switched to electric cooking as their primary cooking fuel, a reliable electricity supply is critical. People, on the other hand, are accustomed to blackouts/power outages and, in most cases, have a backup fuel supply.
- Suitability for different cooking styles, utensils, and dishes; family size and storage are of medium importance factors to consider when choosing a fuel. If you need to prepare a meal for a large group of Burmese cuisine like beef stew, cooking with charcoal or firewood is more cost-effective, although most households adjust to cooking fuel they have. It is necessary to make arrangements for the storage of charcoal and firewood, and most Myanmar kitchens are either too small or not designed to accommodate an LPG cylinder.
- Food taste, procurement, attention needed during cooking, Kitchen cleanliness/smoke, Kitchen and utensil cleaning time are low importance factors influencing fuel choices for the household. Certain foods taste better when cooked on charcoal, yet the taste is passable or people grow accustomed to it when cooked on other fuels.
- The cooking fuel impacts on health are of least importance to households when choosing a cooking fuel.

Overall, there is a general lack of awareness and misconception about how to use various cooking fuels. For example, despite the fact that an induction stove heats faster, cooks faster, has better heat control, and is easier to clean, its use is low due to a lack of awareness, information, and misunderstanding. Its use is low due to the high upfront cost, the fact that not all utensils fit on it, and cooking requires induction cookware, as well as a lack of understanding.

"I got the digital stove (induction stove) because I won the lucky draw at the annual event of my company. However, it is inconvenient and unusual for me. As the digital stove has a glass plate, the cooking pot must be smooth and flat. It requires specific pots and is not suitable for a normal pot. So, I rarely use it. I gave it to another person."
Ko Tun, -year-old male, Electric fuel user, Yangon

4.4 Cooking Fuel Aspiration

When asked which cooking fuel they would like to use in the next 2-3 years, respondents answered they would like "*The one which is easy to use and low power consumption*". Many people aspire to buy and use a digital/induction stove, microwave, oven, and gas tank (16 kg LPG cylinder). Their aspiration is enforced by recommendations from friends and relatives. The digital/induction stove, microwave and oven are considered modern and serve certain purposes such as warming food and grilling, however, people are unable to purchase them due to a lack of financial resources. Cooking with a gas tank is perceived to be less expensive and more convenient; yet some of the barriers to its adoption include a high upfront cost, a high-risk perception of gas leakage and explosion, and the fact that many kitchens are not designed to accommodate a gas tank. Most households in Yangon and Mandalay use portable gas stoves with gas canisters.

"In the next 2-3 years, I will use what works best for me. I plan to buy a microwave, an oven and a digital stove if I have money. I really want to use gas tank but our kitchen is small, I think it will be cheaper to cook."
Lwin Lwin, 34-year-old female, Electric and portable gas stove user, Yangon

"I like digital stove and I think I will use digital stove more in the future. I like gas stove, too. But, if someone can explain that there is no hazard in using gas stove, I will use it.
Thida, 35-year-oldfemale, Electric and charcoal user, Yangon

"Cooking with a gas tank is cheaper than electricity. Most of my friends use it. They say cooking with electricity is more expensive. I would like to use gas tank. But I don't want to spend extra money. Gas is more convenient. But it is expensive to use as the price is rising at the moment."
Yamin, 27-year-old female, Electric and portable gas stove user, Mandalay

5 CONCLUSION AND RECOMMENDATION

Cooking fuel and device stacking is a common practice in Myanmar's urban houses. Cooking fuel security; the need to cook multiple dishes simultaneously during a busy morning urban lifestyle; Myanmar cuisine such as meat stew or curry, which require slow cooking and are better suited to cooking on charcoal stoves; and the convenience of using single-purpose devices such as noodle pot are just a few of the reasons for fuel and device stacking. These factors took precedence over cultural attachments to traditional stoves and accompanying culinary tastes. It is important to understand the Myanmar people psyche in terms of respect for tradition and culture. Traditional values and customs are thought to be superior and should be preserved. The following are overall recommendations based on the findings from the study:

- Myanmar households will continue to stack fuel. Both electricity and LPG gas as primary and secondary or backup cooking fuels should be promoted and the use of traditional cooking fuel should be discouraged in urban areas. To generate demand for modern energy cooking fuels, people must be aware of the negative consequences of using traditional energy cooking fuels. Affordability, negative perceptions, and fear of LPG explosions, as well as a lack of information about the safe usage function, are all significant barriers to LPG adoption. Training and information sharing will play an important role in family fuel decisions and choices.
    - A stable and adequate electricity supply should be ensured for the adoption of electricity for cooking. This will include investment in electricity generation, distribution and capacity development of electric supply institutions.
    - Work with appliances manufacturer to promote innovation in electric cooking appliances which are adapted for cooking the Burmese cuisines, energy-efficient, fault-free design and easy to use.
    - To increase the usage of LPG, policymakers should be lobbied for a reduction in upfront costs, either through a subsidy programme or by securing a lower-cost loan from banking institutions.
- When creating a behavioural intervention or behaviour change communication, the programme or communication should emphasise the benefits of modern cooking fuels rather than the drawbacks of traditional fuels like charcoal and wood.
- In Myanmar, social media and peer pressure are the most important factors influencing behaviour and opinions. Social media and peer pressure should be used to raise awareness about modern energy cooking fuels, with a focus on the health and environmental benefits for target populations. It is vital to enable community-level dialogues to influence negative perceptions and general lack of awareness of cooking with a large LPG cylinder.
- Many people in Myanmar believe that traditional meat curries cannot be cooked on an electric or LPG stove. The Myanmar eCookbook already published by MECS should be promoted via social media. A Facebook post with an individual recipe from the book can be shared with a link to the book. A competition on cooking with electricity and LPG should be organized.

6 ANNEX

ANNEX A: LIST OF PARTICIPANTS

	Pseudonym	Location	Age	Gender	Primary fuel	Other fuel stacked
1	Mya	Mandalay	50	Female	Electricity	Charcoal and Portable gas stove
2	Wah	Mandalay	27	Female	Electricity	
3	HtayHtay	Mandalay	50	Female	Electricity	Charcoal
4	ThiThi	Mandalay	42	Female	Electricity	Charcoal and Portable gas stove
5	MyintMyint	Mandalay	29	Female	Firewood	Electricity and Charcoal
6	Yamin	Mandalay	27	Female	Electricity	Portable stove with gas can
7	Zin	Mandalay	38	Female	Electricity	Charcoal
8	Ni	Mandalay	39	Female	LPG - 16 Kg Cylinder	Electricity
9	Aye	Mandalay	33	Female	Electricity	Portable stove with gas can
10	Cho	Mandalay	52	Female	Firewood	Charcoal
11	Tin	Yangon	48	Female	Electricity	Charcoal, Firewood and Portable gas stove
12	Moe	Yangon	54	Female	Electricity	LPG - 8 Kg Cylinder
13	Ko Tun	Yangon	30	Male	Electricity	
14	Ma Kyi	Yangon	42	Female	Charcoal	Firewood
15	HtetHtet	Yangon	35	Female	LPG - 16 Kg Cylinder	Electricity
16	Thinzar	Yangon	27	Female	Electricity	Charcoal
17	Lwin	Yangon	34	Female	Electricity	Portable gas stove
18	Ma Thet	Yangon	35	Female	LPG - 16 Kg Cylinder	Electricity
19	Ma Htike	Yangon	33	Female	Electricity	Charcoal
20	Thida	Yangon	35	Female	Electricity	Charcoal

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