MECS Modern Energy Cooking Services

Situational and Context Assessment: Ethiopia

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1.1 Cooking habits and main types of dishes in Ethiopia

Ethiopia is a country of diverse cultures and traditions, containing over eighty ethnic groups with their own defined languages and cultural practices. The cultures and traditions have been shaped by the agro-ecologies within which people live. Traditionally the agro-ecological zones in Ethiopia are categorized into five zones: hot arid, warm-semiarid, cool sub-humid, cool and humid, and cold and moist. Agro-ecology governs the type of crops that grow in an area, which in turn determines the diet of those who live in the area. Densely populated areas in Ethiopia are located in the highlands and midlands with cool humid or sub-humid agro-ecologies, mainly in the central and northern parts of the country. These regions influence the main types of dishes in urban settlements across Ethiopia.

Types of main dishes and cooking habits

As part of the effort to list the main types of dishes prepared by households and the habits of cooking in Ethiopia, it was deemed necessary to use own the authors experiences combined with anecdotal information from friends and family who were raised and live in the different areas in Ethiopia. The most common staple foods in most parts of Ethiopia are listed below, with a view to mapping the culinary variety across the country. The information collected focused only on the types of food most regularly cooked and the habits of cooking by the households. It did not include any practices related to baking. The recipes for the preparation of the dishes listed below are shown in Annex B.

Main Type of dishes:

1) Sauce ('*wot*'): this is the most common type of dish in Ethiopia. It is eaten with '*injera*', a fluffy thin pancake type bread. The sauce can be made with a variety of ingredients including legumes, vegetables, and meat. The appliances used for *injera* baking and sauce preparation are mostly different in size and type. Sauce preparation may involve frying of onions and boiling.
2) Vegetables: spinach, round cabbage, potato, cassava and other roots, and onions are the common vegetables in the Ethiopian diet. These are mostly boiled or cooked as stew with other ingredients
3) Fried meat ('*tibs*'): can be meat alone but is usually fried with onion, green chilli and some other spices using flat frying pans.
4) Boiled meat: meat is separately pre-boiled before adding into a sauce as one of the ingredients or it can also be boiled with spices and onion as a dish on its own (i.e. '*kikil*').
5) Stiff porridge ('*genfo'*): preparation of genfo is widely practiced in almost all parts of Ethiopia. However, it is part of the regular diet in the Bale and Borena Zones in Oromia, almost all Gambella, and to a certain extent in other regions as well. The common ingredients are barely, maize or wheat flours.
6) Rice and pasta boiling: rice and pasta are increasingly adopted as frequently cooked dishes in most urban households. For most urban and rural households in regions such as Somali, Harari and to a certain extent Afar, rice and pasta are main dishes prepared by the households.

Cooking habits:

- Cooking and baking – In most cultures in Ethiopia different types of stoves are used for cooking and baking. For most baking, larger sized and higher intensity stoves are needed. In cultures where the bread size is smaller and rather thicker, the same stove that is used for cooking may also be used for baking but with a flat baking pan.
- In warm climates food is cooked right before serving as the temperature could spoil the food unless refrigerated. Hence, cooking meals several times a day is a common practice.
- In cool climates households usually cook once or twice a day for immediate and later consumption. Re-heating the food might be needed when it is consumed later.
- Cooking more than one dish at a time using more than one stove is a common practice in most urban households. Usually, there will be one main type of sauce and at least one side dish that goes with it. Side dishes are usually small in quantity and are mostly vegetables. Smaller sized stoves and smaller pans are mostly used.

Table 1.1 summarizes information informally collected about the main types of diets and cooking practices in different regions in Ethiopia. This information should be read with the caveat that it is not validated by a wider group, but is believed to be indicative of the general practice in Ethiopia. The number of households by region was taken from CSA population projection for 2020[1].

Table 1.1: Categorization of households by main diet or staple food

Categories of main dish types	Assumption of Percent of households in the Regions by type of dish prepared	Estimated No. of households	Total No. of Households	% of Households from total
Wot/sauce/ Vegetables cooking or boiling	All urban	5,688,544	15,028,765	62%
	All rural Tigray and all rural Amhara	4,825,300		
	40% of Rural Oromia, 30% of rural SNNP	3,588,378		
	All Rural Somali, 50% rural Afar	926,543		
Pasta/rice boiling	All Somali and 50% of rural Afar	1,065,832	1,151,589	5%
	50% of total Harari	51,957		
	30% of total Dire Dawa	33,800		
Roots/ meat boiling	90% of all rural SNNP, 30% of rural Gambella, all rural Benishangul, 50% rural Afar, 30% rural Oromia	5,349,803	5,349,803	22%
Stiff porridge	All Gambella, 30% of all Oromia, 5% of all SNNP, 50% of rural Benishangul	2,749,982	2,749,982	11%
Total of all households		**24,280,138**	**24,280,138**	**100%**

As shown in Table 1.1, the urban cultures seem to have adopted similar types of dishes and also cooking practices. Most dishes in Ethiopia seem to require a bit of frying (mainly onions) but most of the cooking is boiling and simmering. Pre-covid, there were plans to conduct the choice modelling survey in an urban vicinity

[1] CSA: Population Projection for Ethiopia for 2007 to 2037, July 2013

of Addis Ababa with some rural or peri-urban influence e.g. Akaki or Debreziet. However, due to covid, the research will remain in Addis Ababa.

1.2 Cooking fuel use

Primary cooking fuels in Ethiopia are heavily dominated by biomass, which all together account for 96% of all cooking fuels (Figure 1.1). In 2016, a slight reduction of biomass usage (3%) as a primary cooking fuel was observed. Among the biomass fuels firewood took about 85% and 82% of the share in 2011 and 2016 respectively. It was distantly followed by charcoal and dung. Next to firewood, dung was the second most widely used fuel in 2011. However, in 2016 charcoal became the second most widely used primary fuel. Electricity usage as a primary cooking fuel showed a big leap in 2016 to reach 5.3% from 1.3% in 2011. A comparison of cooking fuels used in 2011 and 2016 shows a significant change in the choice of cooking fuels by the households. One major change is in the significant increase in electricity used for cooking, largely in urban areas.

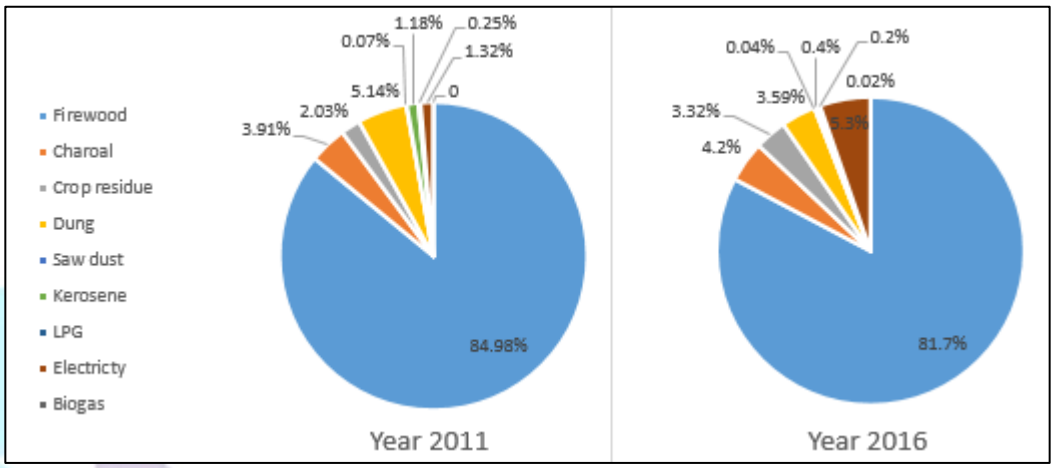

Figure 1.1: Country Level Primary Cooking Fuels in Ethiopian Households[2]

Even though biomass, in particular firewood, dominates the proportion of primary cooking fuels, the scale is significantly different between urban and rural households. In 2016, for about half of the urban households, firewood was a primary cooking fuel. Biomass as a primary cooking fuel for urban households shows about a 10% reduction in 2011. Electricity became the second primary cooking fuel in urban households in 2016, taking the position that charcoal had in 2011. As demonstrated in Figure 1.2 there was a significant shift, about 15%, towards use of electricity for cooking while the reduction from charcoal user households was only about 1%. This means most of the shifts in urban areas were from firewood and fuels other than charcoal.

[2] (CSA WMS Vol. II, 2011, 2016)

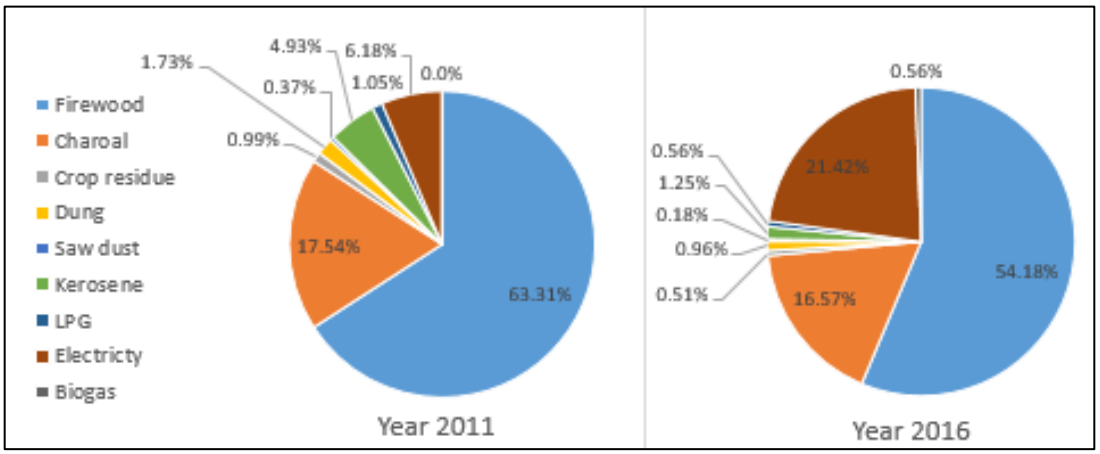

Figure 1.2: Primary Cooking Fuels for Urban Households in Ethiopian (CSA 2011, 2016)

A considerable shift in cooking fuels use has been observed in households in Ethiopia in the past decade. Despite such a shift in cooking fuels, firewood remains by far the largest source. Figure 1.3 shows this trend for four of the most widely used cooking fuels by households in different regions across Ethiopia between 2011 and 2016.

Firewood, charcoal, kerosene, and electricity have been the main cooking fuels for households. Fuel stacking in Ethiopian households is a major coping practice in response to fuel price fluctuation and availability of cooking fuels. Such practices also influence the type of stoves that households adopt and stack. It is apparent that there is a significant reduction in the percentage of households that use firewood as a main source of energy for cooking, even though it still is the most widely used fuel. As shown in Figure 1.3, except in the Oromia and Somali regions, the precentage of households that use firewood as a main cooking fuel declined between 2011 and 2016. Similarly, use of kerosene as a major cooking fuel is observed to be less in 2016 than it was in 2011. Use of charcoal as a main cooking fuel seems to have decreased in Addis Ababa, Harari, and Dire Dawa while an inceased use of it was observed in Gambella and Afar in particular. The shift towards electricity as a main source of cooking fuel is apparent in all regions in the country.

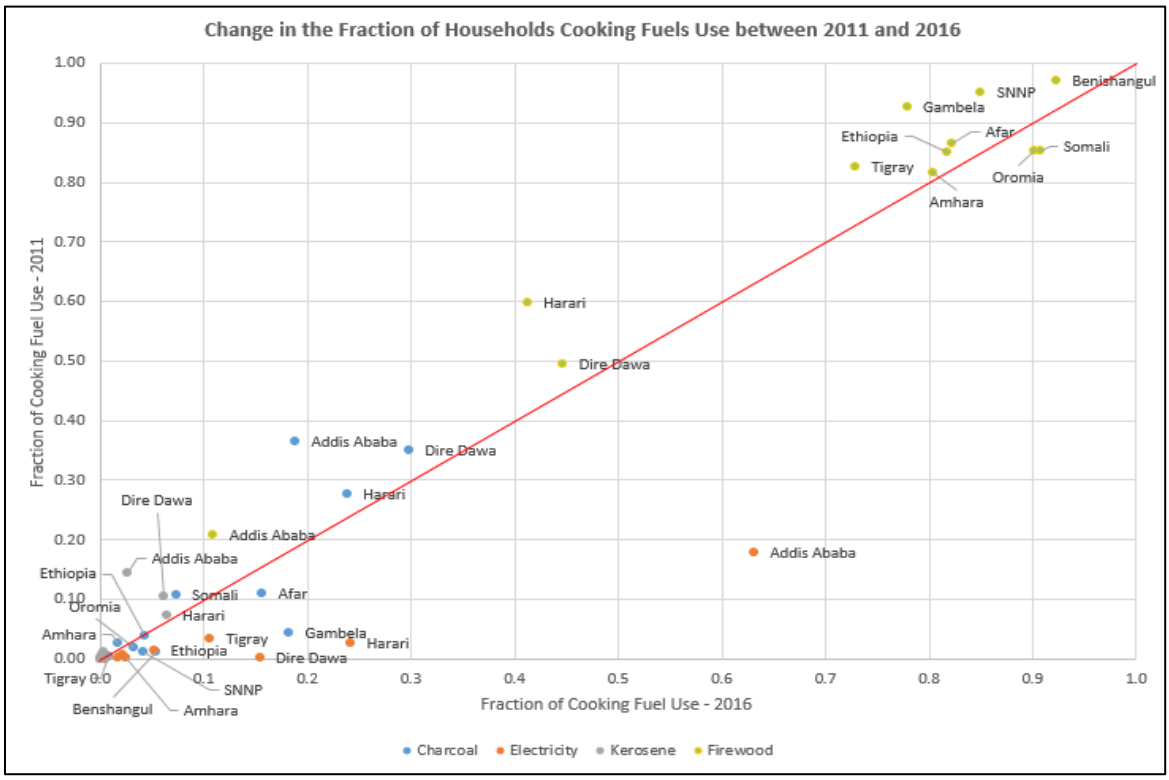

Figure 1.3 Change in the fraction of household cooking fuel use between 2011 and 2016 (CSA, WMS, 2011 and 2016)

1.3 Driving factors for shift of cooking fuel use

Several factors seem to determine choices of cooking fuels in Ethiopian households. Some of them can be traditional attachment to certain type of fuels and limited awareness of alternatives, availability of cooking appliances and fuels, and prevailing trends in prices of cooking fuels. Some of these factors, such as attachment to certain types of fuels and appliance, and limited awareness for new fuels, encourage households to stay with what they are used to. However, declining availability and high price rise of fuels seem compelling to make a shift to more available and affordable fuels.

Tradition and limited awareness about alternative fuels

High adoption rates of electric '*injera*' baking stoves were observed since the late 1970s by Ethiopian households that enjoyed a connection to the national grid. These were almost all urban households. On the other hand, until recently the adoption rate for electric cooking stoves was very low. This can partly be explained by the availability of other affordable fuels for cooking including kerosene, charcoal and LPG, and also a strong traditional tie to these fuels and stoves.

Limited availability of electric stoves for cooking in the market coupled with the low level of awareness about the benefits of electric cooking could also be part of the reasons for low rates of adoption of the stoves until around 2010. Prior to 2010, there were more households that used electricity for '*injera*' baking than households that used electricity for cooking. It seems that convenience rather than price drove wide scale

adoption of electric 'injera' baking stoves during those years. The choice of fuels for baking are limited to either firewood or electricity. Baking 'injera' with electricity gives a far greater benefit in terms of convenience and cleanliness. However, the situation changed for electric cooking from around 2010 and onwards.

Fuel Price

Increasing prices for fuels has also been another factor that stimulated a shift to the use of electricity for cooking. As kerosene prices started to increase since the 2008 petroleum fuel price hike, more households shifted to charcoal, which drove increases in the price of charcoal. Electricity was the only fuel that remained unchanged in terms of the cost. In real terms, electricity has become cheaper every year until the electricity tariff revision that occurred in December 2018. Lifting of subsidy on kerosene around 2015, primarily for the purpose of tackling the problem of petroleum adulteration, forced more households shift to the use of electricity as their main cooking fuel.

Figure 1.4 shows a rise in prices of cooking fuels between 2010 and 2014 in Addis Ababa – the average rise for the main cooking fuels excluding electricity was 220%, the highest rise was for charcoal and LPG (270%). During the same period the electricity price stayed constant, increasing the price competitiveness of electricity compared to all other cooking fuels.

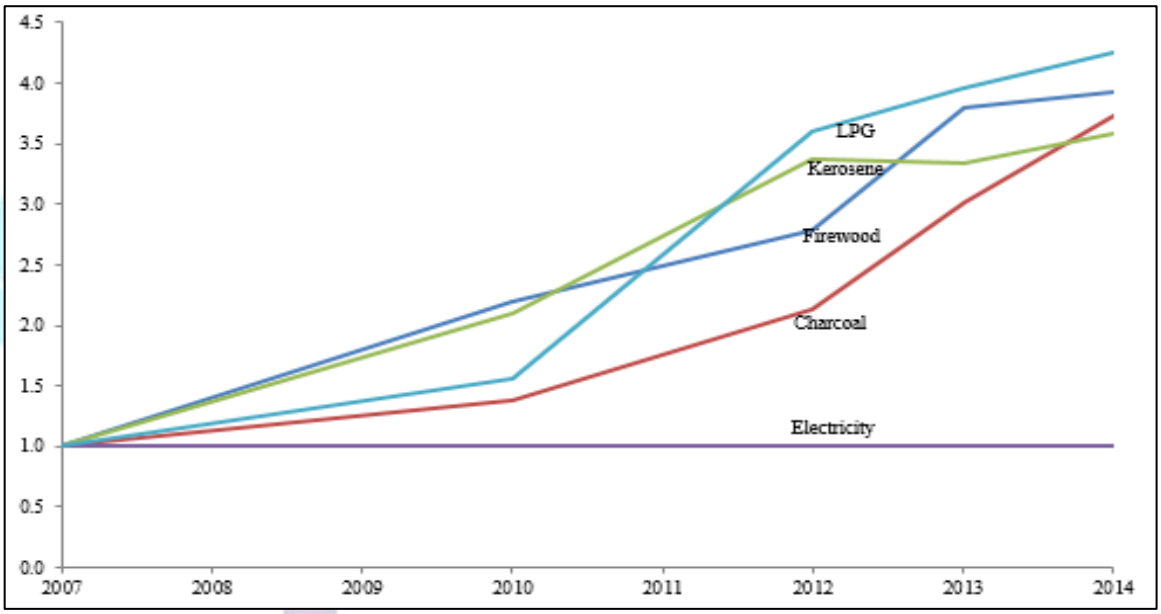

Figure 1.4 Price development for cooking fuels in Addis Ababa (2010-2014)
CSA, Annual Average Retail Price of Goods and Services by Region and Selected Market Places

http://www.csa.gov.et/component/phocadownload/category/20-retail-price-of-goods-and-survice

Note: Prices for fuels in 2014 (mean for Addis Ababa): Fuelwood (m3)=ETB 491, Charcoal (kg)=ETB 10, Kerosene (litre)=ETB 14.9, LPG (12kg)=ETB 574, Electricity (kWh)=ETB 0.27

The sharp rise of most cooking fuels, except electricity, forced households who have access to grid electricity to make the shift to electric cooking. Parallel to this, import of electric cooking appliances and local production continued to supply the ever growing demand from mostly urban households. Relative prices of cooking fuels

(wood, charcoal, kerosene, electricity, LPG) for selected cities (Addis Ababa, Mekele, Bahir Dar, Jima, Adama), are shown in Figure 1.5. Although the rise in electric stove ownership in Addis Ababa has been very rapid, the other cities have also seen a rapid uptake of electric cooking. The rise in urban areas such as Dire Dawa has been no less impressive.

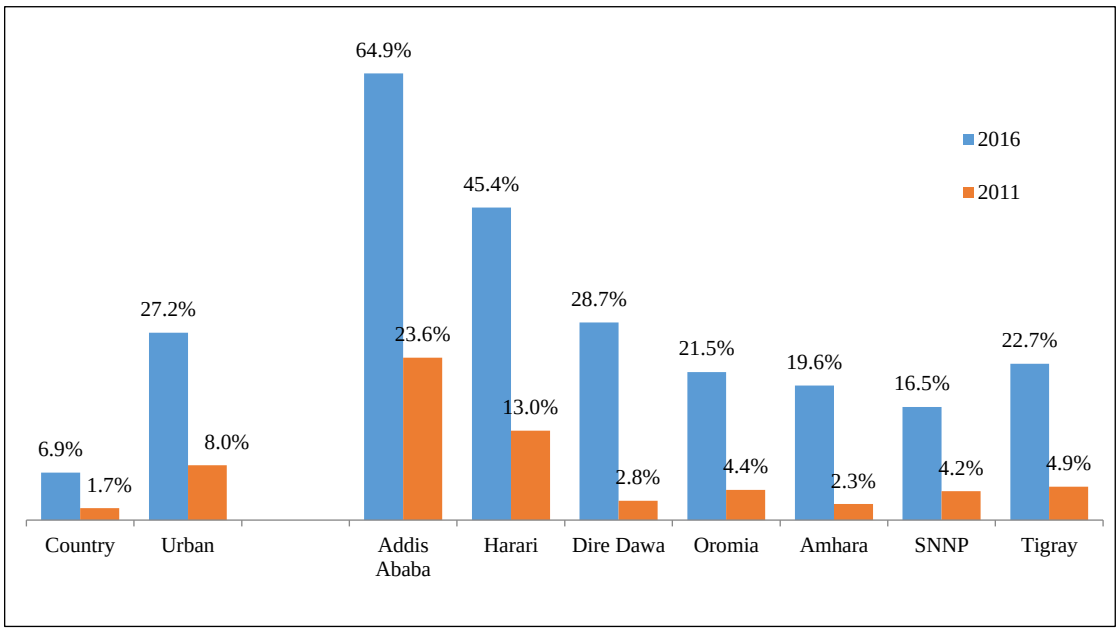

Figure 1.6 Electric stove ownership in urban areas of selected regional states (excludes electric Mitads)

The increasing demand for electric cooking has meant that both local production and import of electric stoves increased. Anecdotal information indicates that the proportion of imported electric stoves, relative to locally produced types, is high. These are often poor quality and easily breakable. Lack of replacement of parts and absence of local maintenance for imported stoves has created an opportunity for increased local production. Despite some limitations that locally produced electric stoves face, such as absence of a power regulator and poor aesthetics, the demand for them has grown continuously. Local stoves carry the advantage of access to maintenance at low cost by artisans in the neighbourhood. In terms of price, there is no significant difference between the imported and locally manufactured types for single or double pot tabletop type appliances.

2 What is the impact of current households cooking fuel choices?

Solid biomass fuels are used for cooking by 90% of Ethiopians (CSA, NBE, World Bank, 2017). Rural households rely almost exclusively on solid biomass fuels (98%), but even in the main cities more than 70% of households still use solid biomass fuels for cooking (Figure 2.1).

Heavy dependence on solid biomass fuels for cooking combined with the low quality of the stoves used for cooking with biomass fuels (mostly an open fire but also basic enclosed stoves) exposes households to health problems (air pollution, heavy burdens), limits the social and economic participation of women (because of the long hours spent in fuel collection and transport), and has environmental impacts (deforestation and forest degradation) which contributes to climate change.

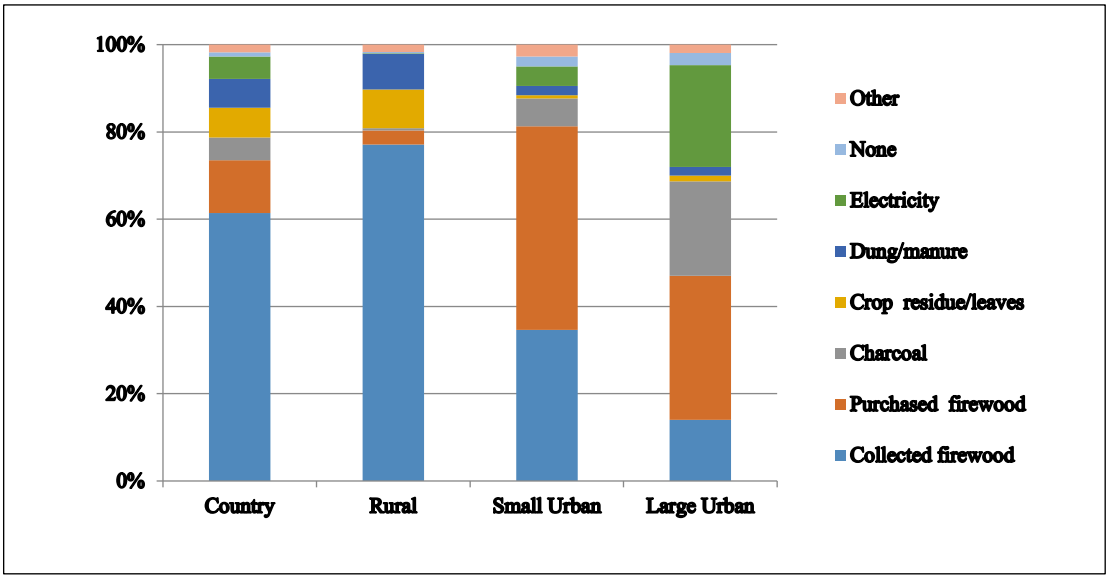

Figure 2.1 Cooking fuel use in Ethiopia, 2016
Source: CSA, NBE, World Bank, 2017. Integrated surveys on agriculture, Ethiopia socioeconomic survey (ESS), 2015/2016

Household Air Pollution (HAP)

Incomplete combustion of solid biomass fuels (and kerosene) produces air pollutants including carbon monoxide (CO) and particulate matter (PM) which can be detrimental to human health at high concentrations. Exposures to these air pollutants produce respiratory, heart, and eye diseases. According to the WHO, 3.8 million people die every year from household air pollution due to the burning of solid biomass fuels and kerosene in the home. For Ethiopia the WHO estimate 64,735 annual deaths and 3.1 million disability-adjusted life years (DALY) from HAP (see Table 2.1).

	Deaths	DALY
ALRI	36,144	2,270,060
IHD	13,776	368,618
Stroke	9,025	246,921
COPD	4,927	139,491
Cataract		60,924
Lung cancer	864	29,754
All	64,735	3,115,768

Table 2.1 HAP related deaths and DALYs in Ethiopia, 2016
Source: WHO, 2018. (http://www.who.int/airpollution/data/ hap_bod_may2018_v0.xlsx?ua=1)

Social and economic costs

Households that depend on solid biomass fuels for cooking spend a significant part of their day collecting cooking fuels for their homes. According to a CSA survey in 2013, about 70% of rural households collect their cooking fuels from two areas, two hours away from home (Figure 2.2). This means they spend more than two hours (including collection time) during each fuel collection session. Households usually collect fuel two or three times a week – implying that each household allocates 8 to 10 hours for collecting fuel alone. Women and girls are particularly impacted by this household chore. The heavy loads (often more than 20kg) impacts their health (back pains); travelling long distances for fuel also exposes them to gender based violence (GBV). Current cooking fuel use choices thus impact the social and engagement of women in their communities.

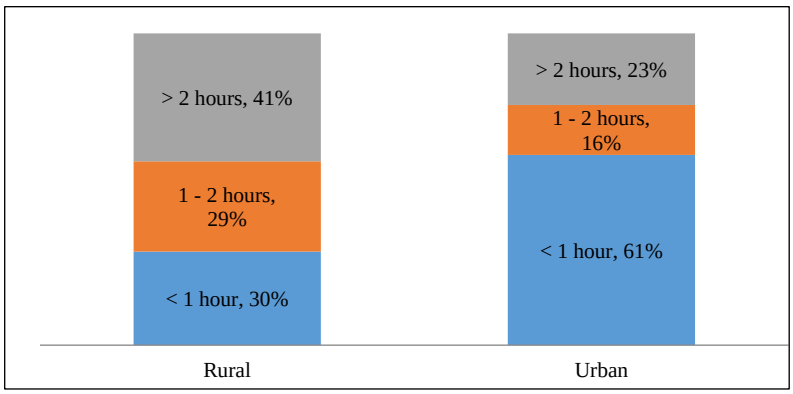

Figure 2.2. Fuel collection distances in rural and urban areas (hours per trip)
Source: CSA (2013) Ethiopia Time Use Survey 2013

Impact on the local environment

The MOWIE estimates 94 million tons of biomass fuels were consumed by households for cooking in 2017. Wood and charcoal account for 80% of this total (or 75 million tons) and agricultural residue 20% (19 million tons) (see Figure 2.3). Harvesting of wood for cooking contributes to forest degradation, harvesting of wood for charcoal production contributes to deforestation. Deforestation and forest degradation have related impacts on soil erosion and water quality deterioration (siltation in water bodies including dams).

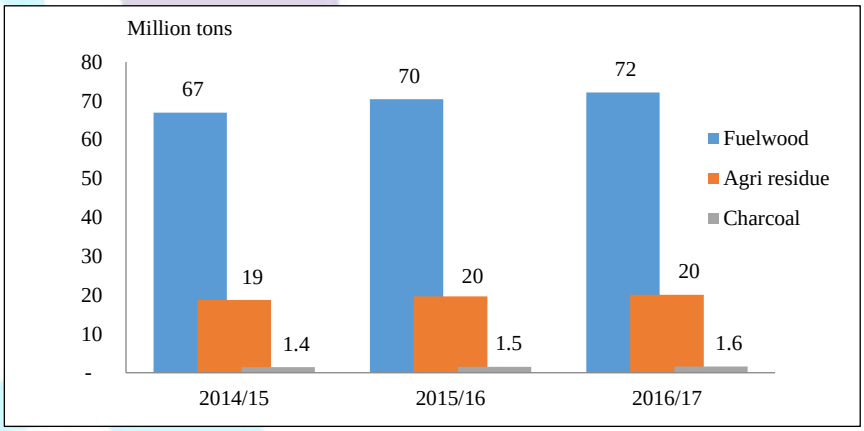

Figure 2.3. Biomass energy consumption

Impact on the climate

Deforestation and forest degradation due to household cooking fuel use contributed 24MtCO2e to Ethiopia's GHG emissions in 2010 (i.e. 16% of the total GHG emission from Ethiopia for 2010)[3]. Emission from cooking fuels is expected to rise to 41MtCO2e in 2030 (or 10% of total emissions). GHG reduction through efficient biomass stoves and through fuel substation (mainly to electricity but also to LPG and biogas) is one of four priority actions identified by the CRGE. Clean cooking stove distribution is expected to contribute 20% of the total emission reductions from Ethiopia by 2030.

3 The state of clean cooking sector

3.1 Clean cooking policies and institutions

Cooking fuel choices can have multi-dimensional impacts depending on the types of fuels and technologies used, as well as the cooking environment. In Ethiopia more than 90% of households cook with solid biomass fuels (wood, charcoal and agricultural residues) using the open fire in poorly ventilated rooms or in the open air. Such high dependence on solid biomass fuels and the way they are sourced and used impact a) access to these fuels – fuel from forests and woodlands are harder to get as yields decline (degradation) and sources recede (deforestation); b) deteriorating access increases the burden of fuel collection and purchase for households; c) cooking with solid biomass fuels using an open fire in poorly ventilated spaces expose people to air pollutants that impact their health. In the Ethiopian context therefore, cooking fuel and technology choices have impacts on health, agriculture and natural resources, social, and environmental sectors and policies and institutions in these sectors are relevant for clean cooking actions (Figure 3.1).

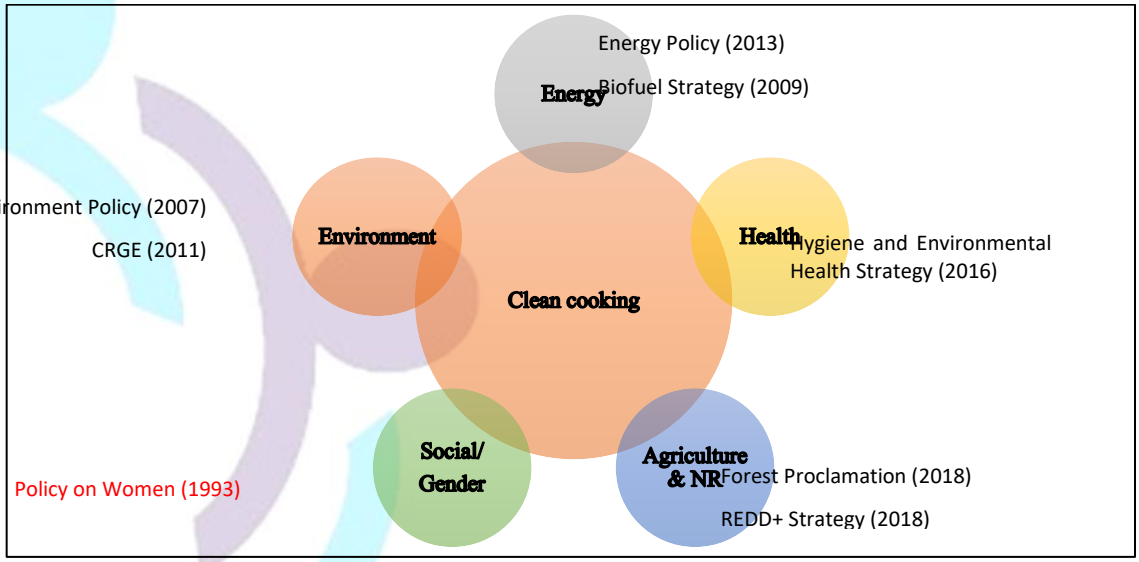

Figure 3.1 Main sector policies and strategies

[3] FDRE, 2011. Ethiopia's Climate Resilient Green Economy (Green economy strategy)

3.1.1 Energy

Three federal government institutions are responsible for the energy sector in Ethiopia. The *Ministry of Water, Irrigation and Energy (MOWIE)* oversees state owned power companies (EEP and EEU), the energy regulator (EEA), and departments that promote and support non-public sector energy actions including off-grid electrification and alternative energy technology promotion. The *Ministry of Mines and Petroleum (MOMP)* is responsible for exploration and development of fossil fuels (coal, petroleum, and natural gas) and biofuels as well as regulation of downstream operations for these. The *Environment, Forest, and Climate Change Commission (EFCCC)* guides environment and forestry activities (including promotion of improved cook stoves). These three institutions have regional level counterparts that implement projects and programs at the regional and local levels.

Two other federal institutions are relevant for the energy sector, the Ministry of Finance (MOF) for financing of public sector energy projects and for fiscal and monetary regulation and the National Planning Commission (NPC) for planning, monitoring and evaluation of federal agencies. Multilateral DFIs and bilateral NGOs are important in energy project financing and technical assistance – key among these are the World Bank and the African Development Bank for DFIs and GIZ and SNV for NGOs. Private enterprises are important in off-grid energy supply – including clean cooking fuels and stoves – in Ethiopia. Private enterprises supply off-grid electrification technologies for rural households as well as fuels and stoves for cooking in both urban and rural areas.

Policies and strategies for the energy sector are contained in the national energy policy (2013) and the Biofuel Development Strategy (2008). A Biomass Energy Strategy was drafted in 2013 but this has not been adopted by the government.

Energy policy (Draft, 2013) – This policy was issued to update the 1994 energy policy – it addresses new issues and opportunities for the sector in Ethiopia. Among the new issues identified in the new policy include climate change, new transport technologies (electric rail, electric vehicles), biofuels, and air pollution. Specifically on household energy the new policy recognizes the need to improve end use appliance efficiency for households. It also promotes the use of a diverse range of energy sources and technologies including electricity, biogas, biofuels, solar, and kerosene. It specifically promotes cooking with electric injera mitad in rural and urban areas.

Biofuel Development Strategy (2007) – issued at the time of heightened international interest in liquid biofuels this strategy sought to promote production of liquid biofuels for the domestic market as well as for export. Domestic use of liquid biofuels was recommended for transport (ethanol and biodiesel) and for cooking fuel (ethanol). Ethanol production from sugarcane molasses from all existing and new sugar factories was proposed. The rationale for the biofuel strategy was based on its potential for job creation, reducing reliance on imports, and energy security.

Biomass Energy Strategy (2013) – this strategy was developed through support from the EU Policy Dialogue Facility (PDF) with the partnership of MOWIE and GIZ Ethiopia. Recommendations from the strategy included; a) increasing wood supplies with fast growing tree species, better management of existing forests, and improved charcoal production efficiency; b) promoting efficiency improvement for biomass cooking and

baking, promotion of electricity and other renewable fuels for cooking to substitute for solid biomass fuels; credit for stove producers; c) institutional review including issuing a national charcoal policy for legal charcoal production and distribution.

National Improved Cookstoves investment program (NICSP, 2013) – is aligned to the CRGE strategy with the aim to reduce GHG emissions from deforestation and forest degradation related to cooking with biomass. It had the goal of distributing 9 million ICS to 4.5 million households by 2018 by building sustainable markets (business skill development for stove manufacturers, supplier and consumer financing from financing institutions, carbon finance, consumer awareness), technology (stove standards and regulations, stove R&D), and institutions (program coordination, human resource development for sector institutions). The program was expected to reduce 2.1 tCO2e/y from each participating household for a total abatement of 14MtCO2e, avoid 1000-2000 IAP related deaths, and create 5000 jobs.

National Electrification Program (NEP 2.0, 2019) – universal electrification in 2025 through grid and off-grid connections (65% on grid, 35% off-grid) and universal access to the grid by 2030. The on-grid electrification plan – 15 million and 24 million households on the grid in 2020 and 2030 respectively. The current electrification rate is 7 million households on the grid and about 3 million households served with off-grid solar solutions. The NEP does not provide plans or estimates on electricity use by consumer groups or end uses (such as cooking).

Ethiopian Power System Expansion Master Plan Study (2014) – this master plan envisioned electrification of 95% of Ethiopian households through the grid by 2037. The plan assumes that a large segment of households will use electricity for cooking in the long run. The following is for newly connected households: "*As time passes the newly connected households would purchase more electrical equipment, and it is assumed that an average household would have 8 x 10 W lights operating for 3 hours per day, a 50 W radio operating for 6 hours (less usage due to TV set), a 200 W TV operating for 3 hours per day and a 1000 W electrical cooker operating for 1.2 hours per day for 365 days which gives 854 kWh*."

Energy standards and regulations – A new Ethiopian Standard has been issued for clean cooking in 2019. This standard called the "Clean Cook Stove and Clean Cooking Solution, Performance Requirements and Test Methods (ES 6085: 2019)" is aligned with the international clean cooking standard ISO19867-1. The new Ethiopian standard applies for both cooking and baking, for domestic, small-scale enterprise and institutional applications with firepower less than 20kW and cooking vessel volume less than 150l.

3.1.2 Health

National Hygiene and Environmental Health Strategy: 2016 – 2020 (2016) - household air pollution from burning solid biomass fuels is recognized as an important environmental health problem, particularly for rural homes in Ethiopia. The strategy identified the following activities to address this; a) mobilize households to purchase or build local energy saving and smokeless stoves with chimney and to make these stoves well above ground so that children will not be exposed to burns, and b) support households to build separate kitchens and to ensure that kitchens are well ventilated. The goal of the strategy was to have all households using cleaner cook stoves in well ventilated kitchens to eliminate ARI and eye problems by 2020.

3.1.3 Agriculture and natural resources

Forest Development, Conservation and Utilization Proclamation (2018) – this proclamation states the role of forests in preventing erosion, desertification and loss of biodiversity, agricultural productivity and food security. The proclamation provides for the right and incentives for forest developers (private community, association, and state). Key among these is the fact that it gives private forest developers the right to acquire land with title deed, to sell their forest products in the local and export market and benefit from ecosystem services including carbon sales.

Reducing Emissions from Deforestation and Forest Degradation Strategy (REDD+, 2016) – the strategy estimated that 92,000ha of forest is lost annually due to the expansion of agriculture and harvesting of wood for fuel. The strategy seeks to reduce greenhouse gas emissions from deforestation and forest degradation through: a) afforestation, reforestation and forest restoration and b) reducing demand for wood products including wood fuels. This strategy makes a direct link between forest degradation and fuelwood consumption and proposes distribution of clean cook stoves as a key action (target for 2030 – 3 million ICS, 0.8 million biogas plants, 1 million other stoves (electric, LPG and solar).

3.1.4 Environment

Environment Policy of Ethiopia (1997) - the Environment Policy recognized the impacts of traditional biomass energy use on deforestation and forest degradation, reduced availability of animal feed due to diversion of crop residue to fuel, loss of inputs that would have improved soil quality from use of cattle waste as soil nutrient supplements. The policy put numerical estimates to the annual losses of 0.55 million tons of grain crops and 1.1 million heads of cattle. The main policy recommendations to address these issues were; a) to increase fuelwood supply from homestead planting; b) tree planting by industries that consume large volumes of wood as fuel; and c) improved and integrated planning.

Climate Resilient Green Economy (CRGE) green economy strategy (and the Nationally Determined Contributions or NDCs) – clean cooking has an important place in both the green economy and resilience strategies. Clean cooking is the largest source of GHG mitigation in the energy sector in Ethiopia; it is one of four fast track interventions prioritized for implementation with the plan to reduce emissions by 51MtCOe (20% of the total national emission reduction) by distributing 27 million clean stoves. The climate resilience strategy places energy efficiency from cook stoves as an important resilience action (Table 3.1). The shift from biomass to electric cooking is the second largest mitigation action 14MtCO2e (from a total gross mitigation potential of 250MtCO2e in 2030).

Table 3.1 Clean and improved cook stove distribution plan under the CRGE

Type of stove	*Household reach (millions)*		*Gross abatement potential, MtCO2e*
	Rural	*Urban*	
Fuelwood efficient stoves	15.7	0.3	34.3
Electric stoves and mitads	1.0	up to 4.9	14.0
Biogas stoves	1.0	0.0	2.3
LPG stoves	0.0	0.3	0.6

FDRE, 2011. Ethiopia's Climate Resilient Green Economy (Green economy strategy)

CRGE resilience strategy for water and energy (2015) – the resilience strategy for the water and energy sector promotes diversity and efficiency for electricity supply on the grid; it promotes increasing access through off-grid technologies and biomass energy efficiency for off-grid or rural areas. The resilience strategy highlighted the need for end use energy efficiency including lighting and electric motors but overlooked electric cooking.

4 Electrification, renewable energy and energy efficiency

4.1 Electricity infrastructure and connection rate

4.1.1 Energy resources

Ethiopia is endowed with diverse renewable energy resources including hydropower, wind, solar, and biomass, but to date only a very small proportion of these resources are developed (Table 4.1). The hydropower resources are distributed in nine major river basins with an economically exploitable potential of 260 TWH/year. Exploitable wind resource potential is about 1,350 GW with an average wind speed of 6.5m/s. The average solar energy resource potential is 5.5 kWh/m^2/day. The geothermal resource is mainly along the Great Rift Valley which extends about 1,000 km. Its potential is estimated at 7,000 MW. Biomass resources which include wood and agricultural residues amount to over one million tons, mainly used to meet households cooking energy demand. None of the hydrocarbon resources are expolited so far.

Table 4.1 Energy resources potential of Ethiopia and Exploited Percentages

Resource	Unit	Exploitable Reserve	Exploited Percent
Hydropower	MW	45,000	<5%
Solar Irradiance Average	kWh/m^2	5.5	<1%
Wind: Power	GW	1,350	<1%
Wind: Speed	m/s	>6.5	<1%
Geothermal	MW	7,000	<1%
Wood	Million tons	1,120	50%
Agricultural waste	Million tons	15 – 20	30%
Natural gas	Billion m^3	113	0%
Coal	Million tons	300	0%
Oil shale	Million tons	253	0%

4.1.2 Generation, transmission, and distribution infrastructure

The electrification rate in Ethiopia was below 10% in 2005, connecting only about 700 major cities and towns in the country. With the launch of Universal Electrification Program in 2005, infrastructure development in the electricity sector and the electrification rate grew rapidly, reaching over 7,000 cities, towns, and rural villages in 2018[4].

Existing power generation capacity in Ethiopia stands at 4.3 GW. Generation plants that are under construction and commissioning will soon come online with an additional capacity of 8.0 GW within the next decade. Along with the development of the generation capacity, transmission and distribution networks are also progressing. Currently the electricity sector managed to construct 12,825 km transmission lines, 145 substations, and 150,000 km distribution lines. With this capacity, currently, 3.2 million customers are connected (EEU, 2019).

4.1.3 Connection rate

According to the New Electrification Program (NEP 2.0), about 44% of the population in Ethiopia had access to electricity either through the national electricity grid (33%) or through off-grid solutions (11%)[5].

Grid connection rate and plan

The National Electrification Program (NEP 2.0) aims to bring the existing 33% grid connected households to 65% by 2025 and ultimately 96% by 2030 by connecting an additional 8.2 million and 5 million households respectively. The grid connection plan will be executed first by giving priority to the least cost option which is densification of existing grid by low voltage lines to connect households that are located within 1 km radius of the existing grid. It then, through intensification of the grid mainly with a mix of low and medium voltage lines, targets to connect households that are located between 1 km and 2.5 km radius of the existing grid. On the third level, extension of the grid with medium voltage lines to connect remaining households that are located less than 25 km away from the grid[6]. Given the rapid uptake of electrical cooking across urban and peri-urban Ethiopia, the expansion of the electricity network is likely to promote a greater shift to electrical cooking.

Off-grid connection rate and plan

The NEP 2.0 aims to scale up off-grid electrification to 33% by 2025. Its current level of 11% includes solar lanterns, solar home systems, and mini-grids (World Bank 2018). NEP 2 sees off-grid solutions as an intermediate means of electricity access provision. The plan is to phase out off-grid solutions by 2030, leaving about 4% of the population in deep rural areas to be served through off-grid means. There are PV cooking options in the market that could be introduced in Ethiopia as part of the process of electrifying cooking, delivering clean options.

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[4] Ethiopian Electricity Utility, Ethiopian Power Sector Progress Briefing, December 2019

[5] National Electrification Program (NEP 2.0), Integrated Plan for Universal Access, 2019. The World Bank's Muti-tier Framework for Ethiopia gives a highe value of 24% for off-grid electrification. The World Bank (2018), Ethiopia Beyond Connections, Energy Access Diagnostic Report Based on the Multi-tier Framework, June 2018

[6] National Electrification Program (NEP 2.0), Integrated Plan for Universal Access, 2019

4.1.4 Reliability of grid electricity

Grid electricity quality is characterized by frequent interruptions and voltage fluctuations. A national survey conducted in 2016 indicated that 63% of rural households and 53% of urban households experienced interruptions three or more times in the week (Figure 4.1). Power interruptions were reported to usually last for several hours and occasionally several days. Comparison of power disruption statistics between 2011 and 2016 shows that disruptions have increased and were affecting a larger proportion of households. For instance, while 50% of households in large urban areas experienced disruptions three or more times a week in 2011, the proportion of households affected in 2016 was 53%[7]. The situation is similar to commercial and industrial customers as well. As power interruptions have become so frequent, customers have been forced to invest in power backup systems - households use solar lanterns and rechargeable light-emitting diode (LED) lanterns for backup[8]; commercial and industrial customers have gasoline and diesel generators.

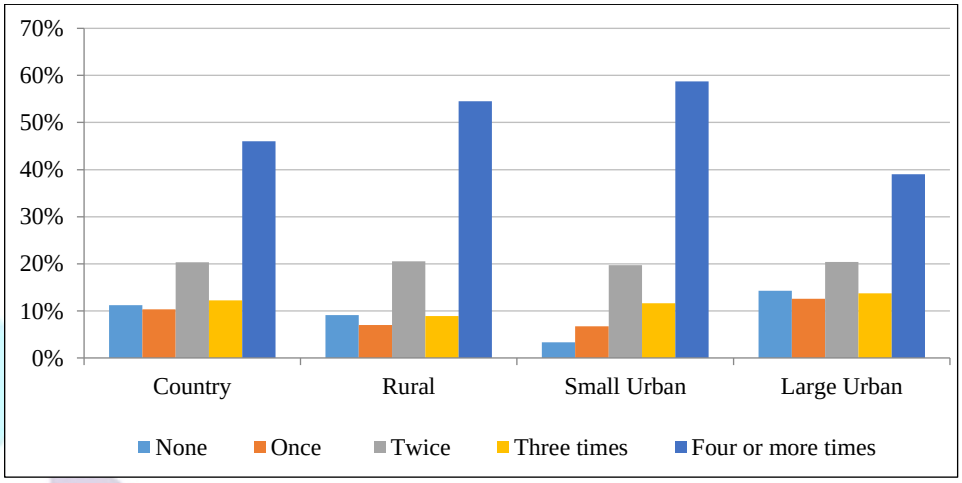


Figure 4.1 Percentage of households experiencing power disruptions (disruptions/week, 2016)
Source: CSA, NBE, World Bank, 2017. Ethiopia Socio-economy survey (ESS) – 2015/2016

The Muti-Tier Framework (MTF) survey that was conducted in 2017 also showed that about 58% of electrified households faced 4 -14 disruptions a week while 2.8% of the surveyed households faced more than 14 disruptions a week. Grid electricity quality issues are also manifested in voltage fluctuations. The MTF also indicted that about 16% of the households faced voltage issues which can damage electrical appliances and limit their use[9].

[7] CSA, NBE, World Bank 2017, Ethiopian Socio-economic survey (ESS) 2015/16,
[8] ERG, 2017, Market Intelligence Survey Report, Off-grid Solar Development in Ethiopia
[9] The World Bank 2018

4.2 Electricity tariff (grid electricity & off-grid private developer tariff)

Ethiopian Energy Authority (EEA) is mandated to regulate electricity operations and approval of tariffs proposed by electricity service providers[10]. EEA is delegated by the Ethiopian Investment Agency to provide investment permits and by the Ministry of Trade to issue licenses to investors who would like to engage in electricity generation, distribution, and sales. The regulation for electricity service provision, however, makes no distinction by capacity of systems and hence makes regulatory procedures lengthy and costly for small-scale off-grid electricity service delivery.

The recent grid electricity tariff revision was made in December 2018. EEU plans to adjust the grid tariff to be cost reflecting by implementing tariff revision measures in four phases. The first and second phase of tariff revisions already happened in December 2018 and 2019. The next two revisions will be implemented in December 2020 and 2021. See Annex C for the grid electricity tariff and revision plan.

4.3 Energy efficiency measures

The Ethiopian Standards Authority (ESA) oversees facilitation of standardization processes for locally produced or imported products and services including electricity. Requests for establishing a standard for products or services can be made either by sector government organizations such as MoWIE and Ethiopian Energy Authority (EEA) in the case of electricity products and services, or user group. Following the request, ESA works with several stakeholders including relevant sector government organizations, regulatory bodies, consumer associations and the private sector representatives. The National Standardization Council (NSC) approves products and services for mandatory standard requirements.

Standards for electrical appliances such as light bulbs, electric motors, off-grid solar products and locally produced electric cooking appliances are major standards developed for electric appliances. For off-grid solar products including solar lanterns and pico Solar Home Systems (SHS) less than 15-watt peak (Wp), the standards approved by the Lighting Africa (LA) program, which was later referred to as Lighting Global (LG) as it included global level intervention, of the International Finance Corporation (IFC) and the World Bank, has been accepted to be mandatory by the government of Ethiopia. Recently, ESA established a voluntary Minimum Energy Performance Standard (MEPS) for locally produced electric injera baking stove. An MEPS for locally produced electric cook stoves is under way.

Enforcement of product or service standards is the responsibility of regulatory bodies. In the case of electricity products and services, EEA is the regulatory body for the sector and is responsible for approving the electricity tariff and ensuring that electric products and services comply with the required standards.

[10] Council of Ministers Regulation No. 49/1999, Ethiopian Energy Authority (EEA) Establishment Council of Ministers Regulation No. 308/2014. Proclamation No. 810/2013 defines regulations which deals with regulations on electricity generation, transmission, distribution and sales.

4.4 Policy, regulatory and institutional framework for clean cooking

Relevant policies for clean cooking include the CRGE strategy, the energy policy, the national electrification program (NEP 2.0) and the electrification master plan, the national improved stove investment program, and relevant standards and regulations. These were discussed in section 3.1.1 along with other relevant sector policies from health and environmental protection. What is clear is that Ethiopia has multiple policies and strategies that address challenges and opportunities in clean cooking. As indicated in the discussion in 3.1.1, the CRGE strategy and the national energy policy give a prominent place for electric cooking. The CRGE envisions significant GHG mitigation (14MtCO2e) by 2030 through the distribution of 5 million electric stoves. Moreover, the energy policy specifically mentions promotion of electric injera mitads in both rural and urban areas, a practice that started in the late 1970s when Ethiopia had surplus electricity for urban areas. Today, the challenge is that demand for electricity, including for cooking, has been growing at a very rapid rate, often placing considerable pressure on the grid infrastructure. This trend will continue into the future such that pricing of different cooking fuels, grid reliability, growth in demand and access to technologies will interact in dynamic ways to give rise to higher levels of uncertainty and outcomes. According to the power system expansion master plan, electric cooking will account for half of electricity consumption for residential customers that have been on the grid for more than five years.

Table 4.3 shows the institutions with a responsibility for cooking and it presents a complex terrain. Various government ministries and agencies play a role in different aspects of cooking. The key question is how these institutions interact and cooperate (or not) to impact on the direction of cooking for energy activities. This requires further exploration.

Table 4.3 Relevant sector institutions and their roles

No.	Institution	Major Role
1	Ministry of Water, Irrigation and Electricity (MOWIE)	Oversees the Ethiopian electricity sector. Coordination of off-grid energy solutions in the country with other organizations, including EEU. It is also the mandated government organization for development and promotion of alternative energy resources and technologies, including biofuels.
2	Ethiopian Energy Authority (EEA)	Independent regulatory agency; responsible for developing rules, directives, and standards for governing the electricity sector. Regulates energy conservation and efficiency, is mandated to prioritize off-grid companies[11]. EEA is also drafting the Directive for off-grid mini-grids, tariff methodologies for mini-grids as well as technical and safety standards for mini-grids[12].
3	Ethiopian Electric Utility (EEU)	Responsible for power distribution and sales. EEU has assigned a specific person who will be leading off-grid planning for the utility. EEU also plans to have a dedicated off-grid person in each of its main regions (11) and two major cities. EEU has been providing support to

[11] This is as per Power Africa Report, October 2019

[12] See draft Off-grid electricity regulation in Annex x

No.	Institution	Major Role
		EEA in the development of regulations for mini grids, on tariffs and technical specifications.
4	Ethiopian Electric Power (EEP)	Responsible for generation, transmission, and system operation for the national electricity grid. EEP's contribution to the mini-grid sub-sector is a better coordination with EEU and MOWIE for a better demarcation of off-grid areas in line with grid expansion plans.
4	Ministry of Mines and Petroleum (MoMP)	Beside other mining related operations, MoMP regulates petroleum operations, importation, and pricing.
5	Environment and Forest Commissions	Responsible for implementation of the National Improved Cookstove Program.
6	Regional Energy Bureaus (REBs)	Represent regional power priorities and facilitate grid and off-grid expansion. Facilitate off-grid expansion.

5 Clean cooking with electricity

Electricity as a source of either cooking or baking energy has been practicied by households particularly in Addis Ababa since the 1970s. Government programmes in the 1980s were promoting eCooking (and baking) for two main reasons. The first one was demand creation for surplus power that the utility, the then Ethiopian Electric Power Authority (EELPA), had in the national grid. EELPA not only promoted but also got involved in the production and selling of electric injera baking stoves and electric cooking stoves. For government employees, EELPA established a form of hire-purchase financing, an extended payment system in collaboration with different government organizations where they deducted costs from salaries over several months.

The second reason was to address the then household energy problem and the environmental consequence of high biomass consumption for cooking with inefficient traditional stoves. The Cooking Efficiency and New Fuels Marketing Project was one of the government's interventions to address this problem. The focus of this project was improving performance of biomass injera baking stoves and charcoal stoves for cooking. The effort on electric injera baking stoves was focused on cost reduction of the stoves by introducing alternative low-cost materials. The project however, did not work on electric stoves that are used for cooking purposes. Perhaps, for this and other reasons, adoption rates of electric stoves for cooking were much less than adoption rates of electric injera baking stoves. Households prefered to use electricity for baking than cooking.

A study conducted in 582 hosueholds in Addis Ababa in 1986 indicated that only about 3% of the households owned an electric stove for cooking. The study also indicated that, out of the total number of households surveyed, only 6.2% of them prefered to use electricy for cooking. On the other hand, the same study indicated that 22.7% of the surveyed households owned electric Injera baking stoves. It was also noted that 65.8% of these households prefered to bake with the electric injera baking stove[13].

This situation changes from 2008 onwards as commonly used cooking fuels such as kerosene, LPG, and charcoal became more expensive. The preference for using a certain type of fuel over another seemed to be governed by convinience, such as ease of use and cooking speed, than by energy consumption reduction. Until

[13] CEPPE, 1986 (P.14), CEPPE, Final Report 1987 (P. 101, 183)

around 2010, the proportion of electric stoves for cooking to electric injera baking stove was lower[14]. However, since around 2010, increased adoption of electric stoves for cooking has been observed. Comparison of proportion of electric stoves to electric Injera mitad shows the reverse to the previous trends.

Figure 5.1 shows the adoption rate of electric stoves with respect to the adoption rate of electric injera mitad and the trend between 2011 and 2016 for different regions in Ethiopia. With the exception of Benishangul Gumuz region which does not show any progress in terms of increased adoption of electric stoves, in all other regions the percentage of households who owned electric stoves was greater than the percentage of those households who owned electric injera stove. In Benishangul, Somali, and Tigray regions, the percentage of households that own electric stoves for cooking was still less than the percentage of households that own electric injera stoves even though some progress in electric stove adoption was observed in Tigray and Somali regions in 2016 compared to 2011. A much greater change was observed in the Gambella region. Hence, for all regions except Somali and Tigray, the percentage of households that own electric stoves was greater than the percentage of households that own electric injera baking stoves.

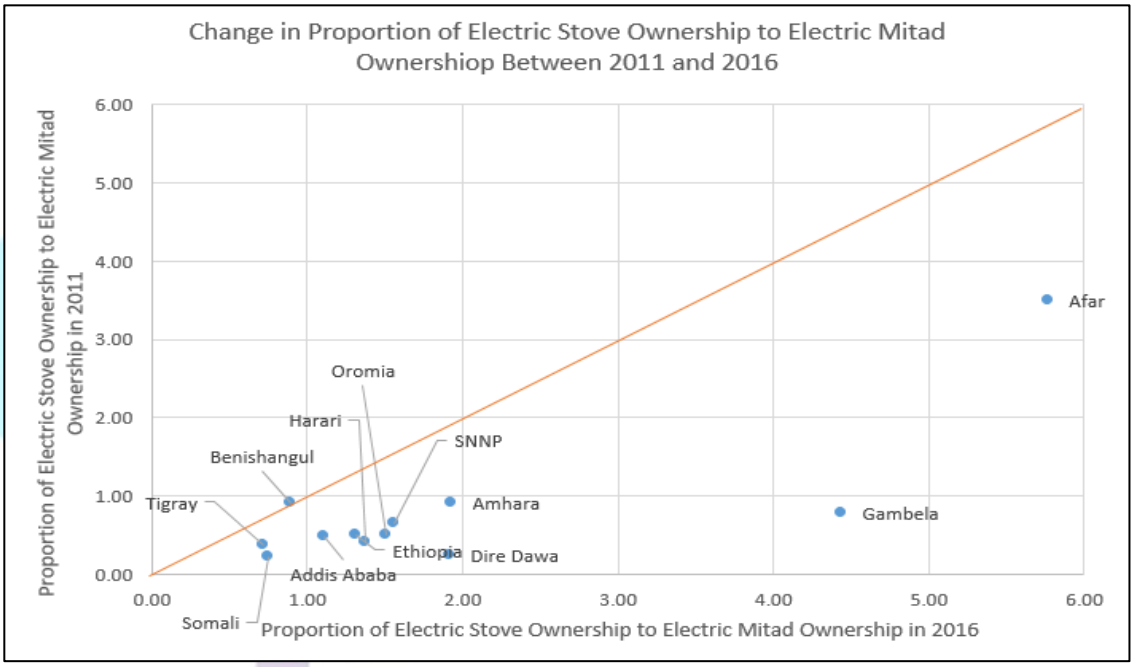


Figure 5.1 Change in proportion of electric stove ownership to electric mitad ownership between 2011 and 2016

Source: CSA, WMS 2011 and 2016

[14] CSA, WMS, 2004

5.1 Electric Cooking Appliances in the Market

There are a range of electrical cooking appliances in the market across Ethiopia (Figure 5.2 and 5.3). This includes both imported and locally manufactured types. Locally manufactured electric stoves are typically electric ring stoves with exposed resistor types. They are produced in different power ratings, sizes, and types as single or double pot type.

Type of Electric stove		Description
Single pot		Single pot, hot plate or spiral resistor, 1000 W. Price: ETB 350 - 470
Double pot		Double pot, hot plate, 1,200 W with each. Price: ETB 1,400 - 1,500
		Double pot, spiral ring, 1,200W each. Price: ETB 650 –700
Gas and electric cook top and electric oven		Mixed gas and electric hot plate with an oven. Price: ETB 8,000 - 15,000 depending on brand and quality.

Type of Electric stove		Description
Induction stove		Glass ceramic single pot, 2,500W. Price: ETB 3,000 more. Also comes in double pot type. Very rarely available in the market
Infrared stove		Glass ceramic, single pot, ETB 2,000+ Rarely available in the market.

Figure 5.2 Types of Imported Electric Stoves that are widely available on the market

Imported electric stoves generally have more attractive aesthetics but vary in terms of their durability. Most of the lower end price products, which are under ETB 1000 for a single or double pot type, do not last long. Usually they work for six months before they need maintenance or replacement. Customers complain about frequent breakdowns and the need for their frequent replacement as spare parts are mostly not available for local maintenance. Those in the price range of ETB 1000 and above are more or less similar in looks but tend to be more durable. Feedback from users show that these stoves, on average, last for about three years. The other category of tabletop electric stoves is induction and infrared stoves, in the range of ETB 2000 - 3500, but are not widely available in the market.

Analysis of import data show that about 80% of those imported electric stoves are of the cheapest price and inferior quality that need frequent replacement. Customers' complaints on such inferior quality of imported electric stoves created an opportunity for locally produced electric stoves. Even though the locally produced ones are of low aesthetics, possibility of local maintenance makes them preferable among the electric stoves that are available at the low-price end.

Type of Electric stove		Description
Single pot		Single pot, exposed resistor, flat or bowel shaped fired clay liner, 1450 W. No power regulator, Price: ETB 350 -450

Type of Electric stove		Description
		Single pot, exposed resistor, flat or bowel shaped fired clay liner, 600 W to 800W. Mainly for coffee boiling. No power regulator, Price: ETB 250-300
Double pot		Double pot, exposed resistor, bowel shaped fired clay liner, 1450 W each. No power regulator, Price: ETB 650 - 750.
		Double pot, exposed resistor, flat fired clay liner, 1450 W each. No power regulator, Price: ETB 600 - 700.

Figure 5.3 Locally manufactured electric stoves that are widely available in the market

Similar to production of charcoal and other biomass stoves, almost all locally manufactured electric stoves are produced in the informal sector. The value chain includes several players where there are clay liner suppliers, which are traditional potters in the suburb of cities, metal artisans that supply the metal body, and electric component suppliers (resistors, cables, switches, plugs, connectors). Most of the locally produced electric stoves are supplied to the market by assemblers who purchase all the different parts from different suppliers, assemble them, and distribute them in the market. Electric stove assemblers only need a small working place and basic tools to assemble them. Only very few manufacturers produce the metal part, modify the clay liner, and assemble them all together in one place. The later requires a larger working place, better working tools, and a number of semi-skilled workers.

Minimum requirement of resources such as space, tools, and finance to assemble local stoves provide employment opportunities for many people. Information from the largest local electric stove manufacturing and market place indicate that from 50% to 70% of all locally produced stoves in Ethiopia are sourced from Merkato in Addis Ababa.

5.2 Market Size for Electric Stoves

Observations in Merkato market indicate that most of the electric stoves supplied to the market are the locally produced ones. An assessment also confirms that local production of electric stoves is far greater than imports[15].

High quality imported electric stoves are available usually in larger supermarkets and malls where household appliances are sold. On the other hand, cheaper imported stoves are available in most electrical equipment shops. Electric equipment shops also source better quality locally produced electric stoves.

Market for locally produced Electric stoves (Informal Sector in Merkato, Addis Ababa)

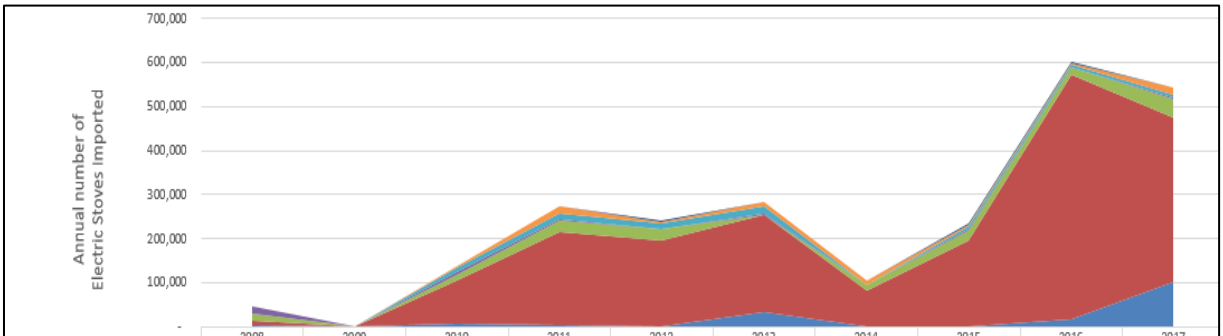
5.3 Import volumes of electric stoves

The electric stove market in Ethiopia was boosted after the petroleum price hike in 2007. As prices of cooking fuels such as kerosene and LPG soared, urban households in particular shifted towards cheaper and more available fuels such as charcoal and firewood. This led a rapid increase in demand for charcoal, leading to a charcoal price hike. As discussed in section 1, electricity was the only fuel for which the cost remained unchanged during this period of volatile fuel prices.

Even though there was some local manufacturing of electric stoves, production methods, facilities and skills were very rudimentary. Hence, import of electric stoves grew year by year to meet the growing demand. Import figures for electric stoves grew from a few tens of thousands in 2008 to over six hundred thousand in 2016.

Figure 5.4 shows the annual volume of electric stoves imported by price range (CIF and taxes). Taxes that apply to imported electric stoves total 67% (including Duty 30%, Sur Tax 10%, VAT 15%). Consecutive taxes build on the taxed value of each type of tax applied, increasing costs further. The electric stoves included in Figure 5.4 are those that are applicable for household use. To avoid including commercial electric stoves, only electric stoves with CIF and tax values less than ETB 6,000 were considered, equating to a top consumer price of ETB 15,000. This is the high end of stoves such as the 'gas and electric cook top and electric oven' type described in Figure 5. Consumer prices for such types of stoves range from ETB 9,000- 15,000. The price category included in this analysis (i.e. CIF + tax less than or equal to ETB 6,000) accounts for 99% of the total number of all types of electric stoves imported.

[15] DANAS Electrical Engineering (January 2017)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
B/n ETB 3500 and ETB 6000	70	163	498	630	1,786	1,278	53	1,702	4,081	128
B/n ETB 2000 and ETB 3500	214	56	4,042	16,737	3,869	7,183	10,676	4,060	3,484	16,613
B/n ETB 1000 and ETB 2000	13	112	9,018	12,451	13,737	18,307	114	7,927	5,454	5,357
B/n ETB 701 and ETB 1000	15,544	15	7,450	2,588	952	1,855	36	1,648	602	1,256
B/n ETB 301 to ETB 700	16,092	685	12,985	26,362	24,452	1,383	12,749	24,775	15,383	42,510
B/nETB 100 and ETB 300	7,759	418	97,257	209,854	195,621	220,583	81,094	194,431	557,967	376,312
Less than ETB 100	5,587	-	6,585	5,289	270	33,385	1,020	275	15,985	100,313
Total	**45,279**	**1,449**	**138,204**	**273,911**	**240,687**	**283,974**	**105,742**	**234,818**	**602,956**	**542,489**

Figure 5.4 Annual number of Electric Stoves Imported by Price Range (Electric Stoves Imported under ETB 6,000).

Source: ERCA 2008-17

As shown in Table 5.1, about 85% of the stoves imported are in the price range ETB 300 and lower. These are stoves that are sold to consumers from ETB 300- 700 depending on whether they are single or double pot types. As also explained above, these are poor quality stoves which break after a short time of use, usually less than a year.

Tabel 5.1 Average price range of stoves imported between 2010 and 2017

Price range of imported stoves (CIF + taxes)	% of total imported
Less than ETB 100	6.7%
ETB 100 and ETB 300	79.2%
ETB 301 to ETB 700	6.6%
ETB 701 and ETB 1000	0.7%
ETB 1000 and ETB 2000	3.0%
ETB 2000 and ETB 3500	2.7%
ETB 3500 and ETB 6000	0.4%
Above ETB 6,000	0.7%
All	**100.0%**
Total number of stoves with prices less than ETB 6000	***99.3%***

5.4 Electric Stove Ownership

A decent estimation of electric stove ownership in the country would give a good indication to estimate the volume of annual local production of electric stoves with reasonable accuracy.

The national level Welfare Monitoring Surveys conducted by the Central Statistical Agency (CSA) in 2011 and 2016 indicated that 1.7% and 6.9% of households owned electric stoves in the respective years (Figure 5.5). This translates to 301,656 households in 2011 and 1,349,739 in 2016 owning electric cookstoves both in urban and rural areas in Ethiopia. On the other hand, import data obtained from the Ethiopian Customs Authority from 2008 to 2017 shows a growth in imported electric stoves. Several factors such as the lag between import time and the time stoves reach households, breakage and replacement of stoves, ownership of more than one stove per household, mean it is not possible to directly match ownership of stoves and import data. However, assuming that ownership of stoves follows a somewhat similar growth curve to that of import data would be reasonable. This is further adjusted using the electric stove ownership figures obtained from the 2011 and 2016 CSA WMS surveys. Hence, it is assumed that in 2017 about 1.8 million households in Ethiopia own at least one electric stove. This is 2.5 times greater than the 710,000 estimated by EEA for the same year (EEA 2017).

Year	Electric Stove Ownership	
	CSA/WMS	Projected
2008		122,774
2009		165,669
2010		223,551
2011	**301,656**	**301,656**
2012		407,049
2013		549,264
2014		741,167
2015		1,000,118
2016	**1,349,739**	**1,349,541**
2017		1,821,046

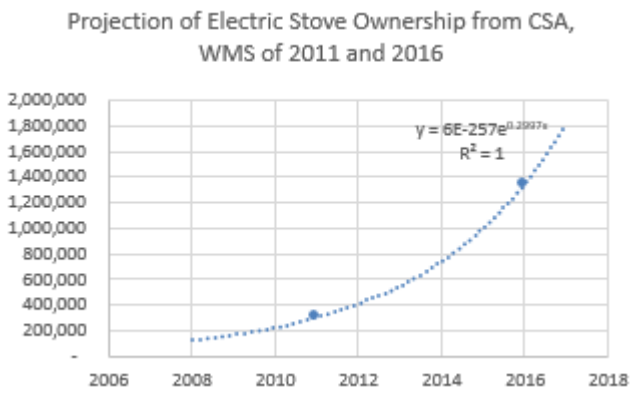


Figure 5.5 Projection of Electric Stove Ownership from CSA WMS for year 2008 to 2017

Several other facts such total import of electric stoves in 2016 and 2017 alone was more than 1.1 million stoves. Additionally, locally produced stoves in a quantity greater than the imported stoves were added to the market. Hence, electric stove ownership by 1.8 million household seems sufficiently reasonable.

5.5 Estimation of Local Production of Electric Stoves

Direct evidence to support estimation of annual volume of locally produced electric stoves has not been obtained during this assessment. The only estimation obtained during this assessment period was one done by Ethiopian Electric Authority[16].

Estimation by Ethiopian Energy Authority (EEA)

EEA estimated the number of locally produced electric stoves based on an assessment of 150 local electric stove manufacturers in Addis Ababa and monthly consumption of electricity power by households. Monthly electricity consumption figure of households was obtained from the power utility, Ethiopian Electricity Utility (EEU). The assumption is that households that consume 100 kWh and above in a month own and use electric

[16] EEA, Danas Electrical Engineering (January 2017)

stoves for cooking. Based on this, EEA estimated that 528,000 households owned and used an electric stove in 2014. This represents the number of households whose monthly electricity consumption was above 100 kWh. A further forecast of electric stove ownership for 2017 was made based on the planned annual electricity connection growth rate of 11.6% for years between 2015 and 2017. This estimated the number of households that owned electric stoves in 2017 to about 710,000. Of this number of households, 10%, about 70,000, were assumed to own imported stoves. Hence, the number of households who own locally produced electric stoves in 2017 was estimated at 640,000. Based on the information obtained from the 150 electric stove producers in Addis Ababa, EEA further estimated that about 70% of these stoves are single pot type while the remaining 30% were double pot type.

Estimation of local electric stove production based on stove ownership and import data

With time series data for actual number of electric stoves imported into the country (ERCA, 2008 to 2017) together with sufficiently reasonable estimations of electric stove ownership by the households (CSA WMS 2011, 2016) we can estimate annual local production of electric stoves with reasonable accuracy. Based on the authors own experiences, observations in the market, the scale of annual volume of imported stoves, and informal discussions with user households, the following conservative assumptions were made to estimate annual local production.

Assumptions:

i. 25% of imported stoves with CIF and Tax price less than ETB 300 only last for 6 months
ii. 75% of imported stoves with CIF and Tax price less than ETB 300 last for 1 year
iii. All other imported stoves with CIF and Tax prices above ETB 300 last for 3 years
iv. Locally produced stoves also last 3 years as can be maintained by artisans in the neighbourhood

Demand for locally produced stoves comes from:

i. meeting the demand gap that imported stoves leave (note also that some households own more than one electric stove)
ii. replacement of broken imported stoves
iii. replacement of imported and locally produced stoves after 3 years

Note that the demand for replacement of broken or worn out stoves is to maintain the annual ownership of electric stoves estimated based on the CSA survey. Any deficit or excess of imported stoves is considered in the estimation of annual demand or production for locally produced stoves.

Based on this analysis, the number of annually produced stoves is estimated to be about 175,000 in 2008, expanding to an annual production of 2.1 million stoves in 2017. Figure 5.6 shows the estimation of annual local production, import, and number of households who own electric stoves.

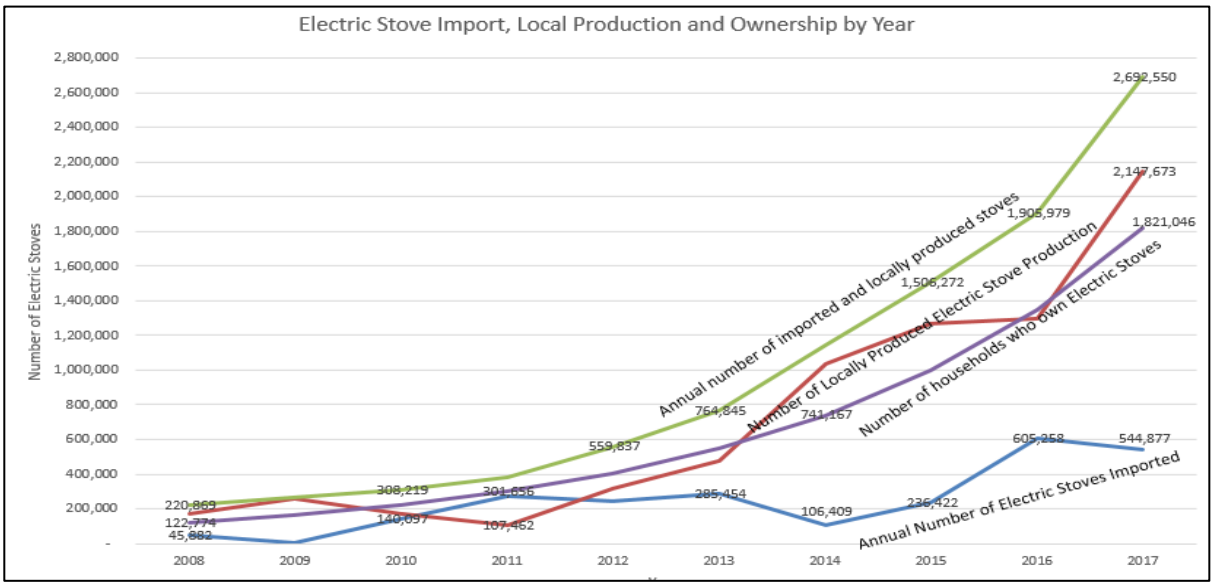


Figure 5.6: Estimation of electric stoves ownership, annual import, and local production

It should also be noted that the total number of new stoves added to the market each year, including all locally produced and imported ones, is about 1.5 times more than the number of households who owned at least one electric stove in the same year. Such a large quantity of supply is primarily because of large numbers of replacement of stoves needed, as inferior quality stoves break frequently. This calls for the need for product quality improvement not only in terms of energy efficiency but also from a durability point of view. Second, the electric stove ownership figure from the CSA statistics is the number of households who own at least one electric stoves. In reality, a household may own more than one electric stove for either parallel cooking or different sizes of stoves for different purposes. It is not uncommon for households to own separate stoves – a larger size for cooking and a smaller size for coffee boiling.

5.6 National Electric Stove Standard

The mandated government organization to set standards for products is the Ethiopian Standard Agency (ESA). Ethiopian Energy Agency (EEA) is the government regulatory body on electrical products and service provision. Being cognizant of the low energy efficiency of locally produced electric stoves and its implication on the peak power demand, EEA together with ESA established standards for locally manufactured electric *injera* baking stoves and electric cooking stoves in 2016[17]. The standard's main focus is on safety and performance (energy efficiency) requirements. Following the safety and performance standard document that was published for locally produced electric injera baking stoves, a Minimum Energy Performance Standard (MEPS) and the associated performance labelling system was published at a draft level by ESA in March 2020. MEPS for locally produced single open resistor based electric injera stove is a voluntary compliance standard. Similarly, ESA

[17] Ethiopian Standard Agency, ES ISO 04090:2016 – Electric Power Supply System and Machines – Technical and Performance Requirement for Household Single Resistor Based Electric Injera Mitad.

together with EEA is developing a safety and performance standard for locally produced electric stoves. Parallel to this, MEPS for locally produced electric stoves is also being drafted.

It should be noted that these standards and MEPS are developed for specific type of stoves, though most are common ones. The standards and MEPS do not apply to imported electric stoves and locally produced ones with different specifications. The initiatives taken by ESA and EEA towards setting the MEPS for specific types of locally produced electric stoves should be praised. However, sooner rather than later, similar but mandatory standard regulations need to be passed on imported electric stoves as well.

Manufacturing of electric baking and cooking stoves has mainly been a private sector initiative which has been driven by growing demand for the products. Recently, with the intention of improving performance of locally produced electric injera stoves, EEA identified major parameters that determine performance and provided production capacity building and technical training to a few local producers.

6 Financing and delivery mechanisms

Financing for RETs have increased from the government and its development partners in the past decade. This increased access to finance has helped accelerate the development of the RET sector and uptake of renewable energy technologies by consumers. Despite these gains however, demand for financing is growing due to growing demand for RETs in rural areas. Finance institutions (banks and MFIs) seek increased availability of funds for lending and increased coverage of risk from borrowers. Consumers need more financing as they move to higher quality off-grid energy products.

Improved cook stoves

Improved cook stoves have been promoted through commercial channels since the early 1990s. More than 10 million charcoal and firewood improved stoves have been distributed in the country in the past 10 years[18]. Distribution of improved cookstoves is considered a key mitigation action in Ethiopia's Climate Resilient Green Economy strategy. Improved cookstoves are expected to contribute about 15% of the national greenhouse gas emission reduction by 2030[19].

Commercial markets have been created for improved cook stoves in both rural and urban areas. In urban areas the demand is mainly for charcoal stoves, while in rural areas demand is for wood stoves. Improved stove producers have received financing from the government and its development partners in the form of start-up capital including space for workshops, investment in production equipment, and initial material purchases since the early 1990s[20]. Improved cookstove producers have also received financing from Micro Finance Institutions (MFIs) and from the Renewable Energy Technology (RET) financing facility created by the World Bank at the Development Bank of Ethiopia (DBE)[21].

[18] National Plan Commission (2015), The Second Growth and Transformation for 20015 – 2018.

[19] CRGE 2011

[20] Ministry of Mines, Cooking Efficiency Improvement and New Fuels Marketing Project

[21] Development Bank of Ethiopia

Domestic biogas technology

The National Biogas Program has been promoting domestic (residential) biogas systems for rural households since 2009. The program has so far distributed 25,000 domestic biogas units in eight regions of Ethiopia. The program is developing a commercial biogas sector building the capacity of private enterprises to build and maintain biogas systems. The program facilitates purchase of biogas systems by households through a blend of financing from program subsidies, credit from MFIs and biogas owner equity. In the long-term, subsidies are expected to be covered by carbon credits due from reduced greenhouse gas emissions from better manure management, reduced forest degradation, reduced emission from kerosene lamps, and replacement of chemical fertilizers by bio-slurry.

The program has progressed through several phases since 2009 but implements essentially the same strategy adopted in the first phase: biogas systems are constructed by commercial biogas companies and sold to biogas owners at market prices with a subsidy component that will be recovered from carbon credits. The biogas sector has received ETB 67 million in credit from the World Bank renewable energy credit facility over the past five years. This credit has gone to meet the financing requirements of biogas owners[22].

Off-grid solar products for residential and commercial customers

The Rural Electrification Fund (REF) was established with a primary objective of making financing available to developers, suppliers, and consumers of off-grid Renewable Energy Technology (RET) products. Since its establishment in 2003, several thousand off-grid solar products have been commercially distributed to consumers. Financing to consumers was arranged through MFIs with interest rates between 15% and 20%. The RET financing approach implemented by the REF, the World Bank, and the DBE has been very successful in addressing the financing constraints of off-grid solar product importers and consumers. This facility has succeeded in distributing about 2 million solar lanterns and home systems since 2013. Recent measures for allocation of risk guarantee funds by the World Bank reduced the collateral requirements for loans. This enabled smaller businesses to benefit from the finance facility and as a result improved availability of off-grid solar products in the market. Interest rates for a loan from DBE is 12%.

Mobile banking and payment systems such as Pay-As-You-Go for off-grid solar products is yet at its infant stage. A couple of solar companies are piloting PAYG models in certain market areas. However, the absence of clear regulation for mobile banking and PAYG system support platforms have been some of the hiccups for wider implementation of such models.

[22] SNV Ethiopia. MoWIE, National Biogas Program

Annexes

A: Number of households by region and settlement type for 2020 (CSA: Population Projection for Ethiopia for 2007 to 2037, July 2013)

Estimation of Number of households by region and settlement type for 2020*

Region	No. of Households		
	Total	Urban	Rural
Country	21,289,236	5,688,544	16,008,338
Tigray	1,259,545	477,941	851,522
Afar	341,404	104,872	251,967
Amhara	5,160,930	1,305,758	3,973,778
Oromia	7,952,083	1,641,842	6,386,200
Somali	939,848	146,349	788,060
Benishangul	257,111	75,833	188,085
SNNP	4,194,286	872,381	3,446,327
Gambella	103,913	44,872	60,600
Harari	67,692	43,824	25,000
Addis Abab	899,756	899,756	N/A
Dire Dawa	112,667	75,116	36,800

**Calculated based on CSA Population Forecast for 2020, CSA Population Projection for Ethiopia for 2008 to 2037, and CSA 2007 Census household size by region, 2007*

B: Recipes for common Ethiopian dishes and their Ingredients

Dish 1: Shiro Wot with Injera / Injera is a flat, soft, and spongy bread made out of Teff. Wot is a sauce having different ingredients.

Ingredients	***Instructions***
2 onion (Red)	1. In a standard pot, cook onions on medium heat for a few minutes until they begin to soften.
2 tomatoes diced	2. Add the oil and fry for few minutes.
3 cups of water	3. Add tomatoes and salt and cook for 3-4 minutes. Add water continue to simmer.
3-4 tbsp oil	4. Start adding Shiro flour at a time while continuously stirring. (Shiro gets to be thicker).
½ cup Shiro (Chickpeas or Broad Beans)	5. Let it simmer for 15- 20 minutes.
1 tbs of salt	6. Add small amount of water until desired thickness is reached while stirring for 1-2 minutes.
2 cloves of garlic chopped	7. Add the garlic, stir well for additional 2 minutes until bubbles appear.
Injera	8. Finally, ready to be served with injera on the side.
***Cooking Time**: 25-30 Minutes / **Serving:** 4-6 people*	

Dish 2: Misir Wot with Injera

Ingredients	***Instructions***
3 onion (Red)	1. In a standard pot, cook onions on medium heat for several minutes until they begin to soften.
2 minced tomatoes	2. Add the oil or Butter and cook for few minutes.
3 cups of water	3. Add tomatoes and salt and cook for 3-4 minutes
3-4 tbsp oil or Butter	4. Add Berbere, garlic and small amount of water. Cook for 4-6 minutes.
1.5 cup of dry Misir (Red Lentiles)	5. Add Misir, let it cook for 20- 25 minutes.
1 tbs of salt	6. Add small amount of water until desired thickness is reached while stirring and let it cook for additional 8-12 minutes.
2 cloves of garlic chopped	7. Finally, ready to be served with injera on the side.
2 tbsp Berbere (Ethiopian spice mix)	
Injera	
***Cooking Time**: 45-50 Minutes / **Serving:** 4-6 people*	

Dish 3: Genfo (Stiff Porridge)

Ingredients	***Instructions***
3 Cups Genfo flour (Barley or Wheat flour)	1. In a stock pot, add the water and boil.
	2. Add the Genfo flour and stir until it becomes stiff .
5 Cups of water	3. Let it cook for 15-20 minutes, keep on stirring in between 3-4 minutes.
3 tbsp oil or Butter	4. Take the pot out from stove and make small portions on cereal plates.
2 tbsp Berbere (Ethiopian spice mix)	5. Make round hole in the middle of the stiff porridge.
	6. Add 3 tbsp of Oil or Butter on the hole.
	7. Add 2 tbsp of Berbere on the hole and mix.
	8. Finally, ready to be served.
***Cooking Time**: 25-30 Minutes / **Serving:** 3-5 people*	

Dish 4: Gomen (Spinach or cabbage) with Injera

Ingredients	***Instructions***
2 onion (Red) diced	1. In a Standard pot, cook onions on medium heat for several minutes until they begin to soften.
2 lb. Gomen (collard greens with Injera), washed & coarsely chopped	2. Add the oil or butter, and salt.
2 cloves of garlic	3. Add the Gomen and cook for 5-8 minutes, stir often so they don't get brown.
2-3 tbsp oil or Butter	4. Add the garlic and green chili.
3 chopped green chili	5. Finally, ready to be served with injera on the side.
1 tbs of salt	
Injera	
***Cooking Time**: 15-20 Minutes / **Serving:** 3-5 people*	

Dish 5: Spaghetti with Tomato or Meat Sauce

Ingredients	***Instructions***
3 Onion (Red)	1. Prepare two standard pots one to cook the sauce and the other to boil the spaghetti.
4 Tomatoes minced	2. Add 5 cups of water and boil.
3 tbsp of chopped meat (Optional)	3. Measure one and a half of hand full of spaghetti and add it on the boiling water.
4 Cloves of garlic	4. Let it cook for 10 – 15 minutes and take out the Spaghetti.
3-4 tbsp oil	5. Using the other pot, cook the onions on medium heat for several minutes until they begin to soften
1 tbsp of salt	6. Add tomatoes and salt and cook for 3-4 minutes. Add water continue to stir.
6 Cups of water	7. Add oil and Garlic.
	8. Add meat (Optional) Let it cook for additional 10 minutes.
	9. Prepare small portions of the spaghetti and sauce in cereal plates. And ready to be served
***Cooking Time**: 30-40 Minutes / **Serving:** 3-5 People*	

C: Electricity tariff prior to December 2018 and Later
(Source: Ministry of Water, Irrigation and Energy; Ethiopian Electric Utility; Ethiopian Electricity Power; December 2011)

No	Tarif Category	Monthly consumption (kWh)	Upto Nov 2018	Dec-18	Dec-19	Dec-20	Dec-21
			Tariff (ETB/kWh)				
1	**Domestic Tariff**						
	Average tariff		0.4735				
	First Block	Up to 50	0.2730	0.2730	0.2730	0.2730	0.2730
	Second Block	51-100	0.3564	0.4591	0.5617	0.6644	0.7670
	Third Block	101-200	0.4993	0.7807	1.0622	1.3436	1.6250
	Fourth Block	201 - 300	0.5500	0.9125	1.2750	1.6375	2.0000
	Fifth Block	301 - 400	0.5666	0.9750	1.3833	1.7917	2.2000
	Sixth Block	401 - 500	0.5880	1.0423	1.4965	1.9508	2.4050
	Seventh Block	Over 500	0.6943	1.1410	1.5870	2.0343	2.4810
2	**General tariff**				Single Tariff		
	Average tariff		0.6723	1.0352	1.3982	1.7611	2.1240
	First Block	Upto 50	0.6088				
	Second Block	Above 50	0.6943				
3	**Low voltage industrial tariff**				Single Tariff		
	Average tariff		0.5778	0.8161	1.0544	1.29270	1.53100
	Highest tariff		0.7426				
	Below highest		0.5453				
4	**Medium voltage tariff**				Single Tariff		
	Average tariff		0.4086	0.6047	0.8008	0.99690	1.19300
	Highest tariff		0.5085				
	Below highest		0.3933				
5	**High voltage tariff**				Single Tarif		
	Average tariff		0.3805	0.5174	0.6540	0.79110	0.92800
	Highest tariff		0.4736				
	Below highest		0.3664				
6	**Street Ligth Triff**		0.4843	1.0352	1.3982	1.76110	2.12400
7	**Bulk sales tariff**						
	Distribution tariff (kW)			39.2908	78.5815	117.8723	157.16
	Generation tariff (kWh)			0.2218	0.4435	0.6653	0.887

D: Cooking with other fuels

Policies, regulations & Institutions

Type of fuel	Policy/ Regulatory Framework	Mandated Government Institutions	Technical standards	Pricing
Firewood/ Biomass	Policies related to energy, forestry and environment	Environment and Forest Commission, Ministry of Water, Irrigation and Electricity	None	N/A
Charcoal	Policies related to energy, forestry and environment	Environment and Forest Commission, Ministry of Water, Irrigation and Electricity	None	N/A
Biogas	Policies related to energy, forestry and environment	Ministry of Water, Irrigation and Energy, Regional Energy Bureaus	Yes for domestic biogas disseminated under the Ethiopian National Biogas Program (ENBP)	ENBP
Ethanol	Policies related to energy, forestry, industry and environment	Ministry of Water, Irrigation and Energy, Ministry of Industry, Ethiopian Sugar Corporation	For technical alcohol and power alcohol	Price of ethanol for energy use is regulated by Ministry of Water, Irrigation and Energy
Liquefied Petroleum Gas	Energy and mining policies	Ministry of Mines and Petroleum, Ministry of Trade, Private companies import LPG. LPG is imported by private petroleum companies.	Ministry of mines sets the standard, Ethiopian Petroleum Enterprises regulates the standard	Deregulated price
Kerosene	Energy policy	Ministry of Mines and Petroleum, Ministry of Trade, Ethiopian Petroleum Enterprise is in charge of importing all petroleum fuels but LPG.	Ministry of mines sets the standard, Ethiopian Petroleum Enterprises regulates the standard	Price is regulated by Ministry of Trade

E: Prices of fuels in the Table below reflect Addis Ababa price.

Type of fuel	Unit	Pricing
Firewood	ETB/kg	2 – 4 (depends on purchase volume in meter cubes or small bundles)
Charcoal	ETB/kg	15 – 20 (Depends on volume of purchase in sacks or small bags)
Ethanol	ETB/Litre	17 (under revision of for energy use)
Liquefied Petroleum Gas	ETB/kg	40 - 60 (Fluctuates depending on supply availability)
Kerosene	ETB/litre	18.75