Briefing on early results: Project to promote efficient cooking with electricity in Ethiopia

MECS Modern Energy Cooking Services

The project addresses constraints to electric cooking in Ethiopia. It will evaluate challenges for transition from cooking with biomass to electricity as well as constraints for efficient use of electricity for households already cooking with electricity. Project activities include surveys of electric stove adoption in urban areas, testing the performance of electric stoves to select efficient stoves that may be promoted in Ethiopia, evaluating impact of electric cooking on power and energy demand on the grid, and piloting of efficient electric cookers in selected markets in Ethiopia.

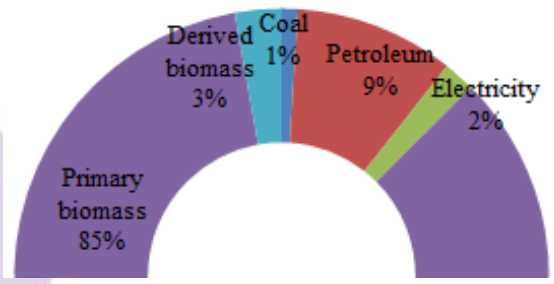
The project has so far conducted a survey of electric stove adoption in Addis Ababa, kitchen performance tests of local electric stoves and efficient imported stoves for Ethiopian diets and made initial estimates of the impact of electric cooking on the power system. Some of our initial findings are highlighted in this note.

Residential cooking accounts for 80% of the total energy consumed in Ethiopia. Solid biomass fuels are the most important sources of cooking in the country. In rural areas food is cooked mostly with freely collected wood and agricultural residues and in urban areas with purchased fuels (wood, charcoal, electricity, kerosene, and LPG).

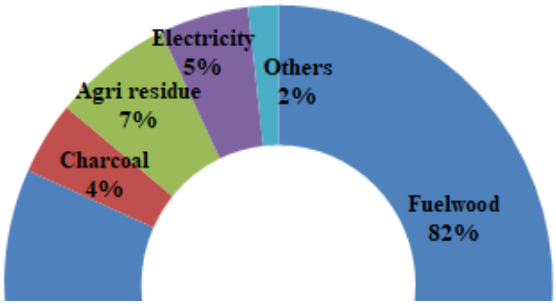
Ethiopia has a diversity of cooking cultures. Notwithstanding this diversity, for most of the population diets consist of different types of breads eaten with stews made from pulses, vegetables or meat. Therefore, two types of stoves are used – one for baking breads (and *Injera*) and another for cooking stews. Generally, breads are cooked two or three times a week while stews are cooked once or several times a day.

Figure1. Ethiopia energy supply by source (Total, cooking)

Total energy supply, 2017

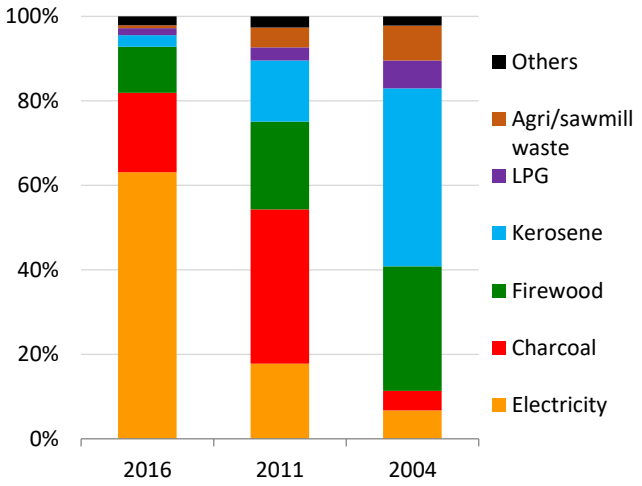


Cooking supply, 2016



In the past ten years electricity has become the second most important cooking fuel in urban areas, second to wood (used by 21% of the urban population or 1 million households in 2016). For large cities, including Addis Ababa and regional state capitals, electricity has become the most widely used source of energy for cooking (for Addis Ababa the proportion of households cooking with electricity was 63%, or 0.52 million households in 2016).

Figure 2.Energy use for cooking, Addis Ababa



The increased adoption of electric stoves for cooking in cities is the result of convenience including cleanness, easy access to electricity, low cost of energy and stoves. Prices for cooking fuels have risen considerably over the past decade; but electricity remains the cheapest source of cooking in the major cities in Ethiopia.

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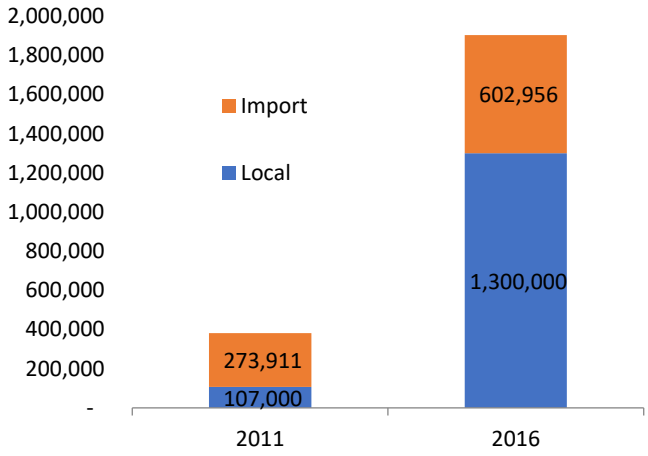
Both imports and locally produced electric stoves are available in the market. While supply of both have increased rapidly since 2010 (to an estimated 2 million in 2016), locally produced stoves are estimated to account for two-thirds of the total annual supply. The market for electric stoves is dominated by cheap stoves (e.g. 95% of the stoves imported had CIF cost of USD 15/stove in 2016) which have a very short working life (less than a year). Note that while electric stove supply is around 2 million annually, the number of households that owned electric stoves was only about half of this (or 1 million households) indicating that households purchase multiple stoves annually.

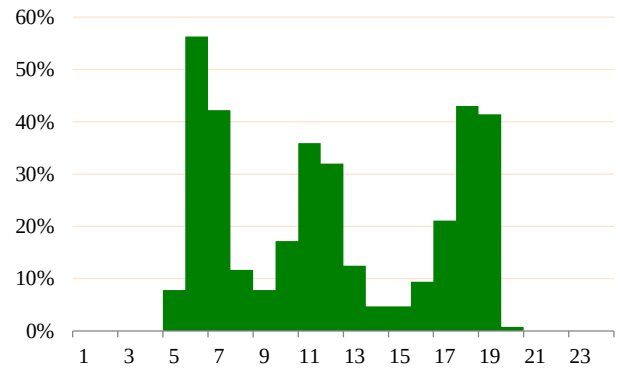
Figure 3. Electric cook stove supply



Impact of electric stoves on the national power grid

Electric stoves have a significant share in energy and power demand on the national power grid. Most households cook their meals at about the same time each day, early morning, midday, and in the evening. At these times 30% to 50% of all stoves will be turned on at the same time contributing 15% (evening) to 30% (early morning) to power demand at these times (Figure 5).

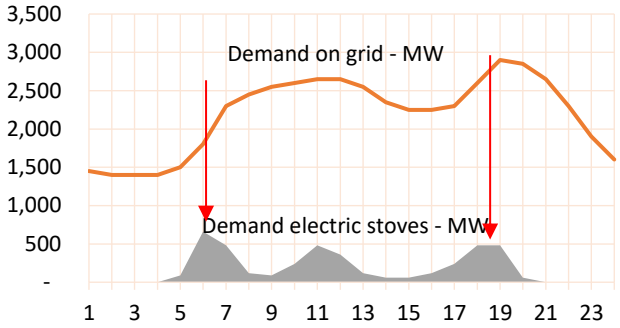
Figure 4. Daily electric stove use pattern in Addis Ababa
(% of stoves used at that hour)



Energy consumed by electric stoves is also high. Electric stoves are used daily for an average of about three hours, which means each electric stove will consume about 1000kWh/y (1kW*3h/d*365d/y) and 1 million stoves consume 1GWh/y. This is about 12% of the total electricity sold on the grid. This is confirmed by energy surveys. According to a 2016 World Bank survey for households in Addis Ababa it was found that 50% of the electricity consumed was for cooking and baking (35% for cooking, 15% for baking). Since the residential sector accounts for 35% of total electricity consumed on the grid, cooking accounts for 12% of total electricity consumption on the grid (35% residential total * 35% cooking in residential consumption).

With growing incomes, the relatively low cost of electricity and electric stoves, and changing housing pattern in cities (growing share of apartment housing) demand for electricity for cooking will increase further. Although current ownership and use of electric stoves is not known we estimate that 1.5 million households may be using electric stoves for cooking in 2020.

Figure 5. Contribution of electric cooking to system peak on the national grid (peak in 2019 was 2,900MW)



Benefits of efficient electric stoves

Households in urban areas have adopted electric stoves, moving away from solid biomass fuels (wood and charcoal) and petroleum products (kerosene and LPG). This has had health, environmental, and economic benefits: health improvement due to removal of household air pollution, environmental gains in terms of avoiding forest degradation and greenhouse gas emissions, and economic gains for household due to lower cost of cooking.

While benefits are significant there are concerns that with increased electrification an even greater number of households may choose to cook with electricity, further burdening the power system. A strategy that will still keep benefits while reducing potential burden on the power system would be to introduce efficient

electric cooking in urban areas. Efficient electric stoves will lower both the power demand on the system (with low powered stoves and cookers) as well as energy consumed (both due to lower power and shorter cooking times).

Electric pressure cookers (EPCs) are efficient, low powered cookers that combine the stove with an insulated pot. The typical EPC draws only about 70% of the power of the standard electric stove (of 1kW) and cooks common stews cooked in Ethiopian homes (*Misir, Shiro,* and meat stews) in half the time (based on tests made on both the EPC and the standard stove with pot). This means energy savings will up to 70% while demand for power is reduced by 30%.

EPC prices range from USD 20 for units from Asia to USD 70 for units from the US (for 3L cookers). EPCs combine the stove with several high quality, stainless steel pots – they will be cost competitive to commonly used electric stoves and pots used by households in Ethiopian cities which means they will keep electricity costs down (at a time of rising electricity tariff) while keeping all the benefits of the standard electric stove.

Figure 6. Electric pressure cooker (3L capacity)

Adoption of the EPC by just 30% of electric stove users in Ethiopia will reduce electricity consumption on the national grid by 20% (70% saving from 30% of households) and power demand by 10% (30% saving from 30% of households). These savings are substantial today where total electricity consumption is just 8GWh/y and the peak is 2.9GW; savings will be proportionally higher when electricity consumption is expected to triple by 2030.

Dissemination of electric stoves is part of the fast-track action of the green economy strategy of Ethiopia.[1]It is also aligned with government strategy to use electricity more efficiently to lower investment requirements as well as provide more power and energy to the productive sectors of the economy including industry and agriculture. This project has broad support from government; it is expected to have wide acceptance from consumers due to the monetary savings they will realize.

Issues for further research

In this action research project the partners are working with the Ethiopian government (MOWIE) and other local stakeholders to

- Make more precise estimates of electric stove contribution to system peak and to energy demand on the national grid
- Estimate gains from low-powered (more efficient) stove promotion on system peak and energy demand
- Estimate gains for households on household cooking budget (cost savings with EPC compared to existing stoves and pots)
- Estimate gains in health and environment due to wide adoption of EPC in the Ethiopian market

Partners

- Ministry of Water, Irrigation and Energy (Ethiopia)
- Ethio Resource Group (Ethiopia)
- University College London (UK)

MECS is funded by UK Aid through the Foreign, Commonwealth, and Development Office. It is a partnership between researchers, innovators, policy makers, and ESMAP drawing on their expertise and relevant work from around the world to co-construct new knowledge with practitioners and the private sector. It is led by Loughborough University, UK. The views expressed do not necessarily reflect the UK government's official policies

[1] Under the National Improved Cook Stove or NICS program which seeks to reduce greenhouse gas emission due to deforestation and forest degradation from non-sustainable use of solid biomass fuels.