

Clean Cooking With Ethanol



The Ethiopian Clean Cooking Alliance Association (ECCA) took the initiative to support the Energy Policy update by MoWIE by collecting data from various sources including Ethiopian Sugar Corporation, and the two sugar factories that currently produce ethanol, Metehara and Fincha. Ethio Resource Group and the Modern Energy Cooking Services Program conducted the analysis of ethanol use for cooking and developed this Policy Brief document. SNV and Gaia Clean Energy provided experts input and experiences in the sector.

Report Submitted to: MoWIE

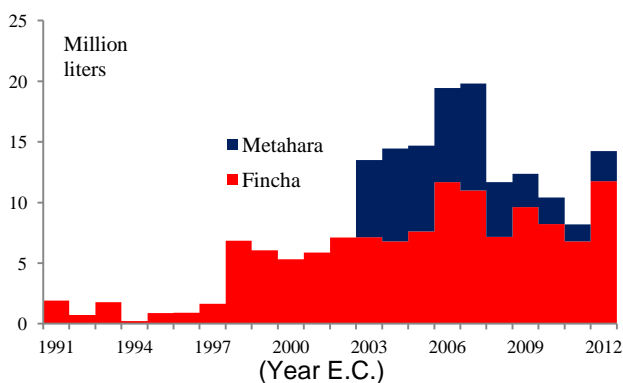
November 2020,
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Ethiopia started producing ethanol fuel at the *Fincha* sugar factory in 1999. Initial production from the *Fincha* plant was about 2 million liters, which grew to nearly 12 million liters in 2019. The second ethanol plant at *Metahara* started production in 2011, producing 6.3 million liters in 2011, which dropped to 2.4 million liters in 2019. These two plants are still the only ethanol fuel producers in the country with a combined nameplate annual production capacity of 30 million liters of ethanol.

The Fincha and Metahara factories produce ethanol from sugar cane molasses – a waste stream from the sugar refining process. In sugar factories without ethanol distilleries, molasses is treated as waste with limited market value - a small proportion of it is sold in the local market for potable alcoholic beverage refineries and for other uses such as cattle feed.

There are currently seven operating sugar factories in Ethiopia. These have combined annual cane crushing capacity of 12 million tons (to produce 1.2 million tons of sugar, 0.4 million tons of molasses). The factories currently operate at 40% capacity producing about 0.5 million tons of sugar and 0.16 million tons of molasses (only half of which is converted to ethanol at Fincha and Metahara). Five new sugar factories are under construction – these are expected to increase capacity by 150%, or to 30 million tons of cane crushed when commissioned. Planned ethanol production when all factories are commissioned is around 200 million liters.

In 2007 Ethiopia issued the National Biofuel Development Strategy and Regulations were put in place to use ethanol as gasoline blend (E5) and to promote it as domestic cooking fuel. An ethanol-gasoline blending facility was commissioned in 2008 just outside of Addis Ababa and E5 was sold in all gasoline distribution stations in Addis Ababa beginning in September 2008. In the same period the government issued a letter to the sugar corporation to allocate sufficient ethanol for cooking purposes. The ethanol price for both the gasoline blend and for cooking fuel was set at ETB 10.78/liter at the time.



Ethanol production from Fincha and Metahara sugar factories

Ethanol production has become uneven in the past five years; production from the Metahara plant falling precipitously. The markets for ethanol both for gasoline blend and for domestic cooking has not been stable. The blending of ethanol with gasoline is halted; ethanol allocation for cooking declined, despite there being a demonstrable need. All of the ethanol currently produced

is now sold to potable alcohol producers and other industries (including production of sanitizers).

	Supply 2008	Supply 2020	Capacity 2020	Potential 2025
Total supply	7	14	30	60
Gasoline blend		0		50
Cooking allocation		0		
Potable alcohol Industries				300
				100

Current demand for alcohol is several times what can be produced from sugar factories. Current production capacity is 30 million liters and the short term potential is 60 million liters. This compares to demand exceeding 400 million liters:

- 30 to 60 million liters as gasoline blend (E5 and E10 respectively). Gasoline consumption has grown by 350% since 2007 when the biofuel strategy was issued.
- 5 million liters allocated for domestic cooking (assuming the amount allocated in 2007/8 still holds)
- 300 million liters of technical alcohol at 96% concentration for the alcoholic beverage industries (per capita alcohol consumption in Ethiopia is 2.8 liters, WHO)¹
- 100+ million liters for industrial use (current high demand for production of sanitizers)²

There is so much demand for alcohol right now that the sugar factories can and do sell their ethanol at high prices. Sugar factories not producing ethanol can also sell molasses to alcoholic beverage producers that own distilleries.

ETHANOL AS COOKING FUEL

Ethanol was first produced in Ethiopia as a potential gasoline blend in the early 2000s. When *Fincha* found it difficult to penetrate this market it started trials to use it as cooking fuel. The first cooking fuel trial was to blend fuel-grade ethanol with kerosene as a substitute to kerosene (a 50% blend of ethanol with 50% kerosene or K50). The cooking fuel trial failed because of unresolved safety issues with using K50 with the standard kerosene wick stove.

Tests and pilot studies to use technical ethanol for cooking in Ethiopia date back to 2003. A high quality stove that burns alcohol only was imported, tested and piloted in Ethiopia by Project Gaia (a nonprofit organization from the USA) – results showed very high technical quality for the stove-fuel combination. Project Gaia (and later its Ethiopian associate, formerly Gaia Association and now Gaia Clean Energy) have been working with private companies (Makobu Enterprises and others) to commercialize the stove and the fuel in Ethiopia since 2005.

¹ According to a recent report ethanol is sold to 145 potable alcohol producers in the country (Fortune).

² Hand sanitizer production capacity is reported to be 1.2 million liters per day (Fortune). To be effective sanitizers must contain at least 60% pure alcohol – which means daily demand for alcohol for sanitizers is 0.7 million liters (or annual demand of about 140 million liters).

In 2007 government commitment to promoting ethanol for cooking was made through the national biofuel strategy (2007). Based on recommendations of this strategy it started allocating supply quotas for ethanol produced from state-owned sugar factories. The initial allocations were much higher than what distributors of ethanol as cooking fuel could market at the time.

Ethanol is sold as cooking fuel mainly in Addis Ababa for a consumer base that is smaller than 3000 households, and in refugee households in the camps. There are only two distributors of the fuel and the stove (one sold the imported ethanol stove, the other a local adaptation of that same stove). These suppliers distributed ethanol fuel from storage/distribution facilities set up on their premises.

The volume of ethanol distributed by the two distributors has steadily declined and at present they have altogether ceased their operations because of the shortage of supply of ethanol from the sugar factories. The two main reasons for this are rising prices for ethanol (now ETB 25.53 at factory gate for non-fuel purposes) and availability.

ETHANOL PRODUCTION COST AND MARKET PRICE

The current factory gate price for technical ethanol is ETB 25.53/liter (USD 0.7/liter) for non-fuel purposes. Price of Ethanol for fuel is regulated and is ETB 10.78/liter. Production cost for ethanol as reported by the Ethiopian Sugar Corporation was ETB 10.96/Liter at Metehara in 2016, and ETB 6.58/Liter at Fincha in 2018. The cost of production for ethanol from sugar cane molasses in other countries is within the range between USD 0.25-0.30/l)³ – production costs are generally lower if ethanol production facilities are larger and if ethanol production is integrated with sugar production.

	2020	2016	2008
Price at factory gate*	25.53	10.78	10.78
Excise tax (80%)	20.44		
Price with excise tax	45.95		
Price with VAT	52.84		

*This is unregulated price the factory sets for non-fuel purposes.

Fuel grade ethanol is sold in the European market at USD 0.7/l. Prices had dropped by more than 30% in the first few months of 2020 but they are going back up again.



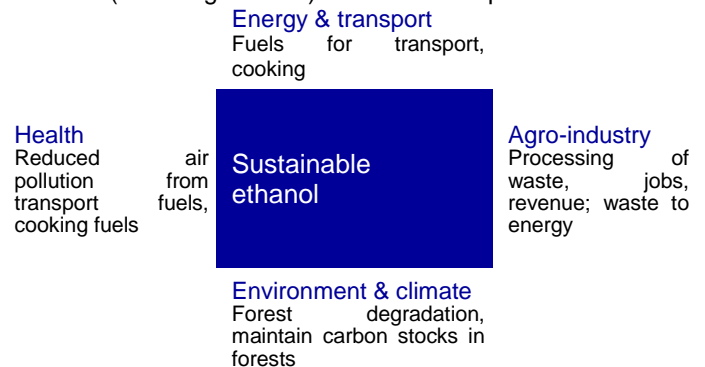
Fuel grade ethanol price in Europe (<https://www.icis.com/>)

At factory gate price of ETB 25, VAT and distribution margins, the market price for fuel-grade ethanol could be over ETB 30/l. At this price, ethanol is not competitive with gasoline (sold at ETB 21/l) or kerosene (ETB 18.75/l).

THE POLICY CONTEXT

Ethiopia issued a biofuels strategy at the height of global interest in biofuels in 2007. This strategy was grounded in the rationale that biofuels could improve energy security, increase investment and export trade, and create jobs. The strategy envisioned producing ethanol from all existing and new cane sugar factories, and its projected supply would reach 200 million liters by 2025. The strategy promoted ethanol as gasoline blend (E10) and as cooking fuel.

The national energy policy draft that was issued in 2013 and later revised in 2018 still puts biofuels and particularly ethanol as priorities. It specifically mentions limited supply, lack of distribution capability, high cost of ethanol cookstoves, as issues that hinder the use of ethanol as cooking fuel in Ethiopia. This policy, however, has not proposed any policy instruments to address supply issues for ethanol. On the demand side, however, the policy includes measures to promote the use of biofuels in the residential sector as well as increasing biofuel (including ethanol) blends in transport fuels.



The Climate Resilient Green Economy strategy (CRGE, 2010) had high expectations for ethanol to reduce CO₂ emission from vehicles. It projected that an E15 mandate would be feasible to reduce emissions by 1 MtCO₂e by 2030. However, the CRGE did not consider ethanol for cooking as an emission reduction strategy.

Ethanol production and consumption has direct impacts in the industry and health sectors. In industry it creates added value to a waste stream that is usually not exploited fully. In the health sector it has significant benefits to reducing air pollution (household pollution when replacing biomass and petroleum cooking fuels; ambient air when used as gasoline blend. Kerosene import substitution and foreign exchange saving and avoided energy-related deforestation are also additional benefits of ethanol when used for cooking fuel.

ISSUES FOR USING ETHANOL AS COOKING FUEL

The challenge for commercialization of ethanol has always been on the supply side since the beginning.

While technical quality was the issue at first this was quickly resolved with the imported ethanol stove (which was also locally made later). Supply availability was the most important issue up until a few years ago, then

prices went up dramatically and suppliers ceased their operations. The main issues and recommendations for commercialization of ethanol as cooking fuel are summarized below.

<i>Issues</i>		<i>Recommendations</i>	
Fuel availability	Ethanol production and production capacity has increased (although not as planned). However, the supply is still much smaller than the domestic demand for fuel and other purposes.	Increase production from existing ethanol plants (now producing below capacity). Invite PPP for new ethanol plants at existing and new sugar factories.	Increase production from existing factories; PPP for new ones
Fuel access/distribution	<ul style="list-style-type: none"> The government had stipulated special allocation of ethanol for cooking from the state owned ethanol producers. This is no longer available (or price is so high, hence allocations cannot be taken). Ethanol handled by the suppliers: The supply of ethanol from factories is too small at present to invest in larger and higher quality distribution facilities 	<ul style="list-style-type: none"> Allocate sufficient amounts for cooking at slightly subsidized prices (production cost + 10% gross margin or ETB 18/l at factory gate). Sustainable supply of ethanol fuel determines the availability and capacity of higher quality distribution facilities. 	<p>Allocate ethanol for cooking (5million l/y initially)</p> <p>Encourage private sector including fuel distribution companies to engage in ethanol fuel distribution. /</p>
Standard (ethanol fuel & stove)	<ul style="list-style-type: none"> Distribution facilities used by ethanol fuel suppliers may not meet fuel handling standards (or not until very recently) National Clean Cook Stove (CCS) standard including ethanol stove is in place. However, the labelling and labelling framework is not in place yet. 	Promote the enforcement of the national CCS standard including the standard for ethanol stove.	Implement short term safety standards for storage and distribution of the fuel
Fuel price	Ethanol price has shot up recently (now ETB 25 at factory gate). Cooking with ethanol is not cost competitive with kerosene and electricity, but is with charcoal and LPG – the main markets for ethanol.	Set special price for ethanol for cooking – prices covering costs but not high production margins (e.g. ETB 18/l or lower at factory gate). Consumer prices may go up to ETB 23/l but will still be competitive with charcoal, kerosene, LPG.	Set special price for ethanol for cooking (ETB 18/l or lower at factory gate; ETB 23/l or lower initial price should be encouraged to consumers).
Stove and price	Imported ethanol stoves are relatively expensive. Locally produced stoves are cheaper but they are also less efficient and appealing.	Production of high quality ethanol stoves. The viability of this, however, depends on production volumes.	Allow imports for the short term; local production for the mid term
Consumer requirements	With the reduced cost advantages of ethanol there is now need to reevaluate the attributes that may induce consumers to choose ethanol over other fuels	Ethanol has attributes that are appreciated by users including cleanness, handling ease, safety, and health. Certain segments of the market may be willing to purchase ethanol even at higher prices than competing fuels for these reasons.	Devise strategy that respond to consumers' willingness to pay and desired attributes
Economic, environment and climate	Ethanol blending with gasoline is one of the measures stated in the CRGE. But gasoline blending has stopped. Ethanol use in vehicles and for cooking has positive benefits for air pollution reduction.	Cooking with ethanol removes household air pollution; replacing charcoal and kerosene will also reduce CO and CO2 emissions. These benefits should be factored in setting the price for ethanol. Climate and environment grants and carbon finance can also be used to support prices for ethanol.	Considering its positive impact on economic, environment & climate, taking measure to reduce price of ethanol for cooking use and saving foreign currency through displacing kerosene
Social costs	State owned ethanol producers are now selling most or all of their ethanol to alcoholic beverage industries. Social costs and benefits of supply as alcohol to the beverage industries versus as cooking fuel are not well analyzed	Study the social costs of using ethanol as cooking fuel (also vehicle fuel) versus its use as input for potable alcohol production. This costing should justify subsidies for ethanol as cooking fuel.	Allocation and pricing of ethanol among the alternative use needs to be revised