

“Commercialization of a New Stove and Fuel System for Household Energy in Ethiopia Using Ethanol from Sugar Cane Residues and Methanol from Natural Gas”

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Purpose of Project: To revolutionize the household energy economy of Africa

How: By leading the way to alcohol fuels derived from wasted or underused resources, both biomass and clean hydrocarbon resources, for use in the household—for cooking, heating, lighting, refrigeration and even for electrical generation.

This undertaking has been named
"Project Gaia" after the Greek Goddess
of the earth.



Coming together for this project are

- Dometic of Sweden, the world's largest maker of alcohol appliances
- Iacona Engineering, a metal goods manufacturer in Addis Ababa
- The Finchaa Sugar Company
- Others who are ready to help:
 - The Ethiopian Rural Energy Development & Promotion Center
 - The Government of Ethiopia
 - The Government of Sweden
 - Shell Ethiopia
 - Others

The Shell Foundation, a U.K. non-profit development facilitator, has given a grant to help us get started.

A unique set of circumstances exist to make this possible in Ethiopia right now—and for Ethiopia to lead the way for Africa.

First, Ethiopia possesses an important sugar industry. Millions of liters per annum of ethanol are produced right now in Ethiopia.

Second, a stove manufacturer in Europe and North America has associated with an appliance manufacturer here who can make Dometic appliances in Ethiopia.

And third...

Third, there is a great need in Ethiopia for better energy choices in the household.

- **All petroleum fuels are imported, at great cost to the nation.**
- **Because of the heavy reliance on fuel wood and charcoal, the nation is being rapidly deforested.**
- **Solid biomass fuels are smoky and produce dangerous pollutants indoors and out.**
- **Kerosene smells bad and is dangerous.**
- **All fuels, even the traditional ones, are becoming more and more expensive in the city.**

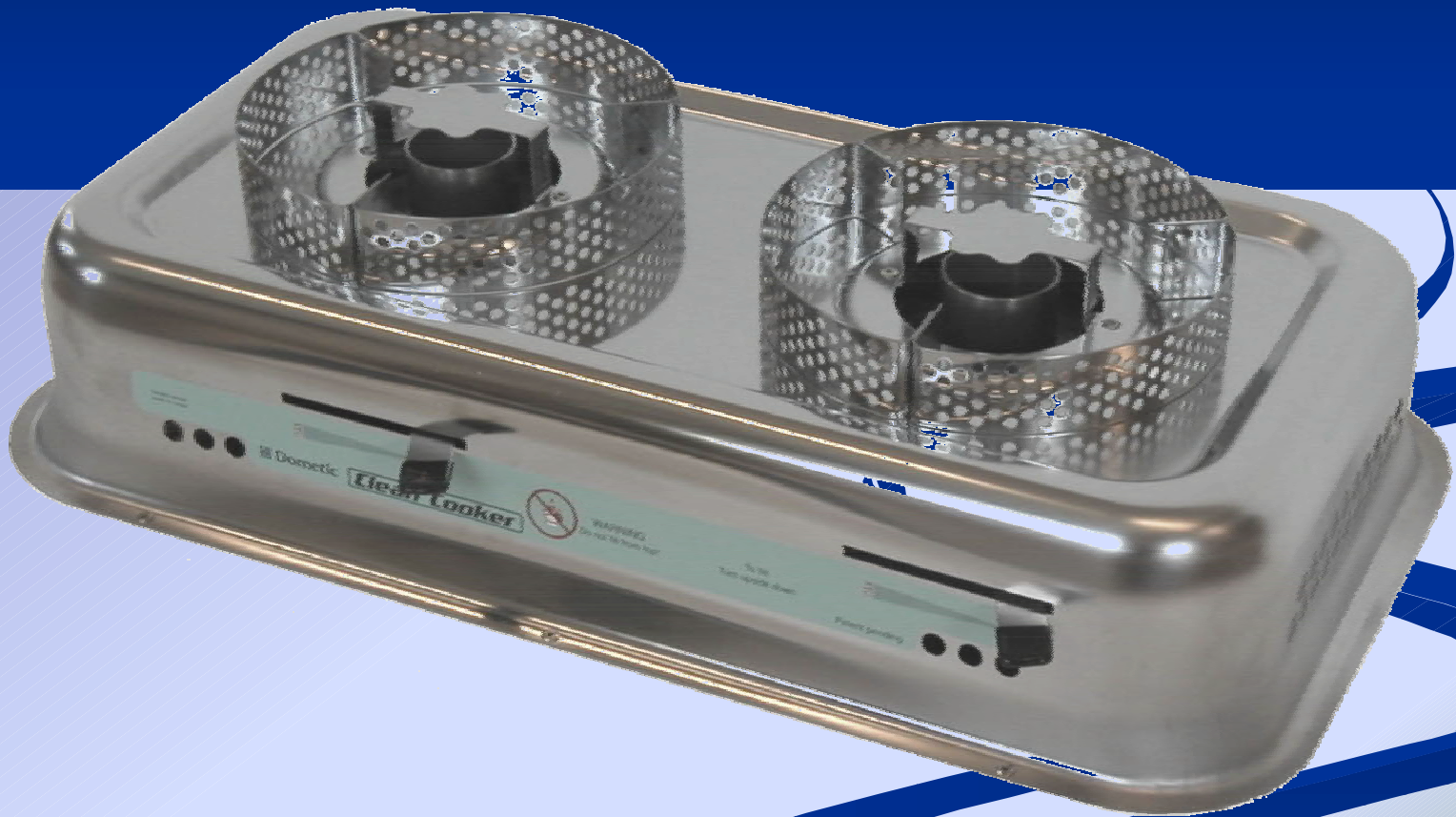


Charcoal Sales in Addis Ababa

When the evening cooking fires are lit, the air in Addis Ababa fills with smoke.

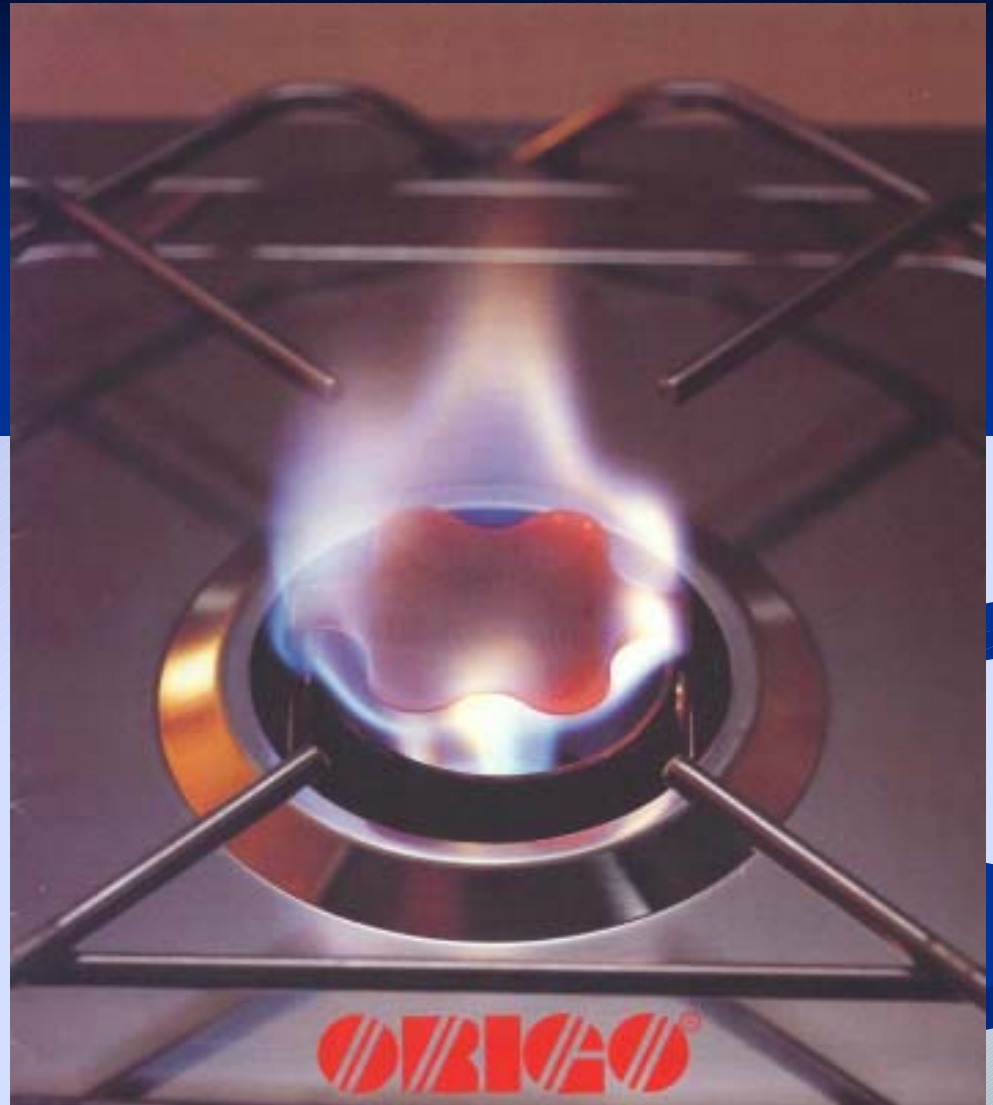


Introducing: the Dometic "CleanCook" Stove



Alcohol's typical blue flame.

This is the burner of the Origo Stove, the predecessor to the CleanCook stove. It has a heat output of 1.5 to 2 kW, similar to the burner of an LP gas stove.



Health benefits accruing from the cleanliness of ethanol and methanol when they burn — as compared to the smoke, particulate matter and complex mix of organic compounds produced by the burning of biomass fuels and kerosene — are very significant.

Analyte	Unit	Test 1	Test 2	Test 3	Test 4
Time to burn 500mL fuel	minutes	129	127	130	125
Water left from 2500mL	mL	509	899	412	738
Carbon monoxide, CO	ppm	19	17	20	20
Carbon dioxide, CO ₂	ppm	2050	2100	2450	2400
Nitrous fumes, NO _x	ppm	<1	<1	<1	<1
Formaldehyde, HCHO	ppm/hrs	<1	<1	<1	<1
Ethanol, C ₂ H ₆ O	mg/m ³	2.97	<0.01	3.77	<0.01
Methanol, CH ₄ O	mg/m ³	<0.01	6.54	<0.01	11.15

Stove Efficiency & Emissions Across Different Fuel Types

Fuel	Stove Efficiency %	Emissions (g/MJ delivered energy)				
		CO ₂	CO	Methane	Total Non-Methane Organic Compounds	N ₂ O
Alcohol Fuels	Similar to LPG Stove	<LPG*	=Biogas*	None	=Biogas	Negligible
LP Gas	53.6	126	0.61	Negligible	0.19	0.002
Biogas	57.4	144	0.19	0.10	0.06	0.002
Kerosene	49.5	138	1.9	0.03	0.79	0.002
Fuelwood	22.8	305	11.4	1.47	3.13	0.018
Crop Residue	14.6	565	36.1	4.13	8.99	0.028
Charcoal	14.1	710	64.0	2.37	5.60	0.018
Dung Cakes	10.0	876	38.9	7.30	21.80	0.022

Source: US EPA data cited in Smith, et al (1998), cited in World LPG Assoc. publication noted above. Adapted here with Alcohol Fuels qualifications added.

Which stoves will the CleanCook replace?

Our pilot study will help to answer that question.

But the brief analysis shown by the following chart indicates what might be possible.

This chart was put together for Addis Ababa. It considers what is often true for fuels in Addis. They may not be available, or may be costly, may not be convenient to purchase and bring home, or may not be pleasant or safe.

Which stoves will the CleanCook replace?

Below are “change motivators” that could encourage a switch

Q=Quality, C=Convenience, S=Safety, A=Availability, E=Economy, H=Health

Market Sector	Electric	LPG	Kero	Charcoal	Wood	Dung	Leaves & Twigs
Upper Income	A	A		A			
Middle Income	AE		HQSAE	HICAE	HQCAE	HQCA	HQC
Lower Income			SAE	CAE	CAE	CA	C

A Recent Cost Comparison of Stoves & Fuel in Addis Ababa

	Fuel Cost per day per family	Typical Cost of Stove	Life of stove	Efficiency of stove
Purchased Fuelwood	\$1.00 +	0 to \$5.00		10%
Charcoal	45¢ +	\$3.50 to \$12.00	1 Year	20%
Kerosene	24¢ (subsidized)	\$5 to \$15.00 (one burner)	Less than 1 Year	35%
LPG	58¢	\$50 + tank, hose and regulator	2 Years?	55%
Electricity	\$1.25	\$70 (two burner)	3 to 5 Years?	50%
Clean Cook Stove	22¢ (?)	\$35(?) (two burner)	10 Years +	55%

Where we are now:

- Field studies will begin in July.
- We are recruiting up to 500 homes in and around Addis and 350 institutional settings.
- We are recruiting Addis Ababa University students who will assist with the survey work.
- Field studies will occur in three parts:
 - Baseline Study
 - Stove Use Study
 - Follow-Study

Harvesting the Last Tree

