Business Plan for Ethanol Cooking Fuel and Dometic CleanCook Stove Market Development in Addis Ababa, Ethiopia

Presented to

Makobu Enterprises PLC
Gaia Association
United Nations Development Programme (UNDP)

Submitted by

Mekonnen Kassa
Partners Consultancy and Information Services
P O Box 25682 Addis Ababa, Ethiopia
Tel. 251114400469/70, 251911248622
E-mail: mekonnenkasa@yahoo.com

January 2007

Contents

Abbreviations and Acronyms

Introduction **1**

Country Context **2**
Socioeconomic Situation 2
National Policies and Strategies 4

The Energy Sector **7**
Energy Resources, Supply and Consumption 7
The Household Sector 9
Key Issues in the Household Sector 10
The Urban Household Fuel Market 11

Fuel and Stove Market **12**
Household Cooking Fuels and Stoves Use in Addis Ababa 12
Domestic Cooking Fuel Use in Other Urban Areas 14
Comparative Cooking Costs in Addis Ababa 14
Consumer Preferences and Expectations 17
Viability of Major Cooking Fuels and Stoves 18
Prospects Local Production of CleanCook Stove 23

Competition - Market Analysis **25**
Competitors in the Stove and Fuel Market 25
Analysis of Competition for Ethanol and CC Stove 26

Stakeholders Roles and Contributions **29**

Awareness and Promotional Campaigns **32**
Awareness Creation 32
Promotional Campaigns 32
Design and Execution of Campaigns 33

Financing Strategies **34**
Direct Subsidies from Government 34
Opportunities for CDM Financing 35
Stove Financing Methods 36

Supply and Distribution of Fuel and Stove **37**

Financial Plan **38**
Assumptions 38
Investment Costs and Financing Sources 38
Projected Sales Revenue 40
Projected Costs and Expenses 40
Projected Financial Statements 41
Financial Returns 43
Breakeven Analyses 43
Sensitivity Analyses 44

Economic, Social and Environmental Impacts **46**
Foreign Exchange Savings 46
Employment and Social Impacts 46
Health and environmental benefits 47

List of Tables, Figures and Annexes

Figures

Figure 1	Energy consumption by sector, Ethiopia, 1998	8
Figure 2	Trends in Kerosene Prices in Addis Ababa	10
Figure 3	Energy expenditure, 2000	11
Figure 4	Distribution of urban households by fuel for cooking, 1996	13
Figure 5	Comparative Cooking Costs per household per month, 2006	16
Figure 6	The Dometic CleanCook Stove	23
Figure 7	Proposed Distribution Chain	37
Figure 8	Sensitivity of the IRR and NPV to Selected Variables	45

Tables

Table 1	Ethiopia: Selected Indicators	3
Table 2	Energy Resources and Uses	7
Table 3	National Energy Supply and Consumption	8
Table 4	Fuel use by End use in the Household Sector	9
Table 5	Estimates of the Household Fuel Market	11
Table 6	Distribution of households by fuel and stoves used for cooking	12
Table 7	Types and quantities of cooking fuel used in Addis Ababa, 2004	13
Table 8	Distribution of households by fuel used for cooking, 1996-2004	14
Table 9	Cooking costs – comparison on a useful energy basis	15
Table 10	Petroleum Fuels Price Build-up	17
Table 11	Fuel and stove characteristics sought by households	18
Table 12	Potential ethanol production and demand, 2007-2012	13
Table 13	Clean Cook Stove Sales	13
Table 14	Cost components and Price of CC Stoves	24
Table 15	Key Actors the Fuel Market	25
Table 16	Key Stakeholders and Contributions	30
Table 17	Price Build-up of Ethanol	34
Table 18	Emission Reduction Potential and Sales of CERs	35
Table 19	Stove Financing Methods	36
Table 20	Basic Assumptions for Financial Analyses	38
Table 21	Summary of Investment Costs	39
Table 22	Projected Revenue	40
Table 23	Projected Costs and Expenses	41
Table 24	Summary of Financial Projections	42
Table 25	Loan Repayment Schedule	43
Table 26	Summary of Project Worth With and Without CDM Financing	43
Table 27	Breakeven Determination	44
Table 28	Sensitivity of the IRR and NPV to Selected Variables	45
Table 29	Impact on Foreign Exchange	46

Annexes

Annex I	Household Energy Survey in Addis Ababa: Methods and Results
Annex II	Projected Financial Statements

Abbreviations and Acronyms

ADLI	Agricultural Development Led Industrialization
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CSA	Central Statistics Authority
EPA	Environment Protection Authority
EREDPC	Ethiopian rural Energy Development and Promotion Center
ETB	Ethiopian Birr
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GJ	Giga Joules
HICE	Household Income, Consumption and Expenditure
IRR	Internal Rate of Return
kWh	kilo Watt hour
LPG	Liquefied Petroleum Gas
MME	Ministry of Mines and Energy
MoTI	Ministry of Trade and Industry
MW	Mega Watt
NPV	Net Present Value
QSAE	Quality and Standards Authority of Ethiopia
RSP	Repairable Suspended Particulates
SDPRP	Sustainable Development and Poverty Reduction Programme
VAT	Value Added Tax

Calorific Values

Fuel	Calorific Value
Fuelwood	14.5 MJ/kg air-dry, 10-15% moisture content, wet basis
Crop Residues	15.5 MJ/kg
Animal Residues	13.8 MJ/kg (15% moisture content, wet basis
Charcoal	29.0 MJ/kg
Sawmill Residues	14.5 MJ/kg
Bagasse	10.0 MJ/kg
Biogas	18.9 MJ/cubic meter
LPG	45.5 MJ/liter
Kerosene	35.3 MJ/liter
Electricity	3.6 MJ/kWh

Aggregative Prefixes

Symbol	Prefix	Factor
P	peta	10^{15}
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	Kilo	10^{3}
h	hecta	10^{2}
da	deca	10

Conversion Factors

1 joule	Amount of energy to move 9.81 kg one meter
1 kJ	0.240 calories
1kcal	4.19 kJ
1 kWh	3600 kJ

Currency Equivalents

US$1 = ETB8.8422

1 INTRODUCTION

This report presents the results of a study on market development of locally produced ethanol as a domestic cooking fuel and the Dometic CleanCook ethanol stove in Addis Ababa. The goal is to promote ethanol as efficient, clean, safe, and affordable cooking fuel with substantial health, economic, social and environmental benefits.

Thirteen sections make up this report. Section 2 provides country context including socioeconomic situation and national policies and priorities. Section 3 reviews the energy sector in Ethiopia. This includes discussions on energy resources, supply and consumption patterns; key issues in the urban household fuel market. Section 4 deals with market analysis including household cooking fuels and stoves use in Addis Ababa and other major urban areas; and comparative cooking costs in Addis Ababa; consumer preferences and expectations; viability of major cooking fuels and stoves and local production of Dometic CleanCook stove. Section 5 deals with industry analysis: competitors in the household fuel market and competition for ethanol fuel and stove, i.e., power of suppliers, threats of new entrants, power of buyers, barriers for entry as well as degree of rivalry.

Section 6 discusses roles of actors and key stakeholders in the ethanol cooking fuel and stove market development. Section 7 discusses awareness and promotional measures for ethanol fuel and stove. Financing strategies for the stove and the fuel including subsidies from the Government, opportunities for CDM financing, and consumer financing models are dealt with in Section 8.

Section 9 discusses supply and distribution channels for the fuel and the stove. Section 10 presents the financial plan: investment costs and financing sources, revenues and expenses, projected financial statements, financial returns, and breakeven and sensitivity analyses. Section 11 discusses the economic, social, environmental, and health benefits associated with the promotion of ethanol as household cooking fuel. Section 12 presents proposed implementation arrangement and plan. Finally, Section 13 summarizes some of the conclusions and recommendations

Annexes include household energy survey methodology and summary of survey results, and projected financial statements.

2 COUNTRY CONTEXT

2.1 Socioeconomic Situation

With a total area of 1.14 million square kilometers and a population of 71.1 million in 2004[1], Ethiopia stands as the ninth largest in size and the second most populous country in Africa. Overall population density is 62 persons per square kilometer. Approximately 16 percent of the Country's population resides in urban areas. Selected demographic and socioeconomic indicators are presented in Table 1.

Ethiopia is among the poorest countries in the world. This is reflected in low per capita income of US$ 97 in 2003[2]), very poor social indicators, poor conditions of the productive sectors, poorly developed infrastructure and degraded environment. The Country's economy is based predominantly on rain-fed subsistence agriculture. The Gross Domestic Product (GDP) at market prices in 2003 was US$6.7 billion[3]. The agricultural sector contributed 43 percent; the manufacturing industry, including small-scale and handicrafts, 12 percent and service sector about and 45 percent to GDP.

The Government's Sustainable Development and Poverty Reduction Programme (SDPRP) describe poverty in Ethiopia as "widespread and multi-faceted". Malnutrition and under nourishment are immense both in rural and urban areas. A survey on household income, consumption and expenditure indicated that in 1999/2000 about 45 percent of the population was below the poverty line measured in terms of food consumption set at a minimum nutrition requirement of 2,200 calories per adult per day. With a national population of around 71 million, these proportions imply that 32 million are below poverty line.

The household income, consumption and expenditure survey of the 1999/2000 also found that 60 percent of household income was spent on food, and that the average daily intake per adult was equivalent to 1,954 calories.

[1] Central Statistical Agency, Statistical Abstract, 2005.
[2] UNDP, Human Development Report, 2005.
[3] ibid

Table 1. Ethiopia: Selected Indicators

Indicators	Value	Year
1. COUNTRY PROFILE		
Land Area	1.14 million square km	
Arable Land	45.0 % of total area	
Irrigated Land	3.0 % of total area	(1999/00)
Area covered by forest	4.2 % of total area	(2000)
2. SOCIAL INDICATORS		
Population	73.0 millions	(2005)
Urban population	15.8 %	
Population growth rate	2.9 %	
Pop. living below $1 a day	81.9 %	(2001)
Life expectancy at Birth		(2003)
Male	53 years	
Female	55 years	
Infant Mortality Rate (IMR)	96.8 per 1,000 live births	(2003)
Maternal Mortality Rate (MMR)	1,800 per 100,000	(2003/04)
Access to improved water source	32.0 percent	(2000)
Urban	81.0 percent	
Rural	12.0 percent	
Access to improved Sanitation	33.0 percent	(2000)
Urban	71.0 percent	
Rural	7.0 percent	
Literacy Rate	39.7 percent	(2000/01)
Urban	69.9 percent	
Rural	21.7 percent	
Gross primary school enrolment	45.8 percent	1999/2000
Female net enrolment (%)		(2000/01)
Primary	41 percent	
Secondary	11 percent	
Female tertiary students (% of total)	1 percent	
HIV/AIDS Prevalence rate	4.4 percent	(2003)
Male	3.8 percent	
Female	5.0 percent	
Urban areas	12.6 percent	
Rural areas	2.6 percent	
3. MACROECONOMIC INDICATORS		
GDP at Market Prices	69.2 billion ETB	(2003/04)
GDP at 1996 Factor Cost	18.9 billion ETB	(2003/04)
Agriculture	43.2% of GDP	
Industry	11.5% of GDP	
Services	45.3% of GDP	

Sources; UNDP Human Development Report, 2003; The 1994 G.C. Population and Housing Census of Ethiopia; Ministry of Finance and Economic Development; and AIDS in Ethiopia, Fact Sheet 2003, Fifth Report.

2.2 National Policies and Priorities

Overall Long-term Development Strategy

Ethiopia has adopted a long-term development strategy of Agricultural Development-Led Industrialization (ADLI). The Strategy envisions rapid transformation of the previously centrally planned economy into a market-based and private sector-driven. More specifically, the Strategy hinges on the smallholder agriculture as the primary stimulus to generate employment and income, reduce poverty, promote industrialization and ensure a dynamic and self-sustaining growth. The rationale for the ADLI strategy lies on the agrarian nature of the economy and for its high potential for growth with abundant unemployed factor endowments of land and labor.

Poverty Reduction

Poverty reduction is at the top of Government's development agenda. The strategies to reduce poverty, as outlined in the Sustainable Development and Poverty Reduction Programme (SDPRP), are ensuring macro-economic stability, promoting market liberalization, and increasing social sector spending. Specific strategies include development programmes in agriculture, education, health and infrastructure.

Stimulating Economic Growth

The Government recognizes that substantial and sustained progress in poverty alleviation can only come about with faster and sustained economic growth. Ethiopia's overall economic growth performance has been relatively robust during the period 2003/04-2004/05growing at a rate of about 11 percent per year. However, the country needs faster and sustained growth in per capita income for rapid poverty reduction and significant improvement in the quality of life.

Private Sector Development

The private sector is expected to play a leading role in the economic and social development of the Country. However, the Country is yet to attract significant private investment. Private sector investment, particularly foreign capital, is critically dependent on the Government's ability to address social and economic infrastructure constraints, create a stable macroeconomic environment, develop efficient sources of capital for investment, and hasten the pace of sector reforms and privatization of public enterprises.

Human Development

In recent years, there have been improvements in human development in several areas, including raising school enrollment, improving health and sanitation, water supply services. Despite these positive developments, Ethiopia's human development index continues to be lower than that of most Sub Saharan African countries. The UNDP's 2005 Human Development Report of 2005 ranks Ethiopia 170th out of 175 countries in

Human Development Index (HDI)[4]. Progress in human development needs to be accelerated for rapid and sustained poverty reduction.

Strengthening Governance

It is now widely recognized that strengthening governance is a pre-requisite for creating an enabling environment for economic and social development. While progress has been made in some areas, the Government realizes that further improvement is needed in several aspects of governance. In recognition of serious capacity gaps in the Country, the Government has also issued a National Capacity Building Policy and Strategy in 1998. The capacity building policies and strategies are streamlined into the Government's overall development strategy of Agricultural Development-Led Industrialization (ADLI).

The Government has launched the Public Sector Capacity Building Programme (PSCAP) to implement the Capacity Building Policies in the public sector. The PSCAP covers the following six sub-programmes:

- Civil Service Reform Programme;
- District-level Decentralized Service Delivery;
- Information and Communications Technologies;
- Justice System Reform;
- Tax Reform; and
- Urban Management.

The Civil Service Reform Programme (CSRP), a component of the PSCAP, aims at creating an 'enabling environment which will allow the civil service to function effectively and efficiently.' It focuses on the development and implementation of appropriate legal and regulatory frameworks, and institutional and human resources as well as the introduction of improved management systems and best practices.

Gender and Development

Women in Ethiopia, as elsewhere in the world, occupy low status in the society. Women in Ethiopia are marginalized economically, politically and socially. They face multiple forms of deprivations. Discrimination against women, lack of protection of basic human rights, violence, lack of access to productive resources, education and training, basic health services, and employment are widespread.[5]

The Constitution accords women equal rights. The Government has endorsed the National Policy on Women (NPW) in 1993. The NPW aims to institutionalize the political and socio-economic rights of women by creating appropriate structures in government institutions and address the critical areas of concern: poverty reduction and economic empowerment of women and girls, human rights of women and violence against women and girls, provision of education and training of women and girls, institutional mechanism for the advancement of women, empowering women in

[4] ibid

[5] A National report on Progress made in the implementation of the Beijing Platform for Action (Beijing + 10), Prime Minister's Office/Women's Affairs Sub Sector, March 2004, pp. 1.

decision making, women and environment and reproductive rights and health including HIV/AIDS.[6]

HIV/AIDS

Ethiopia is among the worst HIV/AIDS affected counties in the world. HIV prevalence in 2003 was 4.4 percent; 12.6 percent in urban areas and 2.6 percent among the rural population.[7] At the end of 2001 an estimated 2.1 million people were living with HIV/AIDS[8].

The highest HIV prevalence rates are concentrated among the youth. The high-risk ages for women and men are between 15 and 24 years, and between 25 and 34 years, in their respective orders. Reported AIDS cases show that 91 percent of infections occur among adults between 15 and 49 years. Eighty to ninety percent of all HIV infections are caused by heterosexual transmission. The two most important risk factors are heterosexual contact, and having sexually transmitted infections.

The Government has formulated policies, strategies, programmes and the requisite institutional structures to prevent and control HIV/AIDS and to mitigate its devastating impact. A comprehensive HIV/AIDS policy was approved in 1998 with the objective of providing "an enabling environment for a multi-sectoral approach" for the prevention and control of the epidemic (NAC, 2001)[9].

In addition, the Government has developed a five-year Strategic Framework (2001-2005) and a three-year Ethiopian Multi-Sectoral AIDS Project (EMSAP) to implement that policy. The priority areas of intervention include behavioral change and communication, voluntary counseling and testing, providing comprehensive treatment, care and support, mitigating impacts of HIV/AIDS, prevention of mother-to-child transmission, control of sexually transmitted infections, condom promotion and distribution, blood safety, universal precautions and post-exposure prophylaxis, legal and human rights, surveillance and research, capacity building and mainstreaming HIV/AIDS.

---

[6] Ibid, pp. 4 - 13

[7] Ministry of Health, AIDS in Ethiopia, Fact Sheet 2003, Fifth Report.

[8] UNAIDS, Report on the Global HIV/AIDS, 2002.

[9] HAPCO, *Strategic Framework for the National Response to HIV/AIDS in Ethiopia* (2001-2005).

3 THE ENERGY SECTOR

3.1 Energy Resources, Supply and Consumption

Ethiopia is well endowed with a variety of energy and other natural resources. However, much of the energy resource available has yet to be exploited. The renewable energy resources with potential include biomass, hydropower, and alternative forms of energy- solar, wind and geothermal energy (Table 2). There are also considerable reserves of coal and natural gas.

Woodfuel is the predominant energy source in Ethiopia. These resources are being depleting rapidly as a result of over-exploitation and lack of adequate management. In spite of its large hydropower potential of 30,000 MW, Ethiopia has developed only 790MW of hydropower, which supplies below 1 percent of the total energy consumption. Imported petroleum makes up a little more than five per cent of the total consumption.

Table 2. Energy resources and uses

Resource	Unit	Total Reserves	Exploitable Potential	Currently Exploited	Exploited Percent
Woody biomass	Million tons	767	37/year	40/year	
Crop and animal waste	Million tons		38/year	8/Year	
Hydropower	MW		30,000	790	2.6%
Solar	kWh/m^2		5–6	1,200 kWpe	
Wind	m/s		3.5–5.5	100 pumps	
Geothermal	MW		700	7.3	1.0%
Natural gas	TCF	2.7	NA	0.0	0.0%
Coal	Million tons	70	14	0.0	0.0%

Notes: kwpe = kilowatt peak electric

Source: Energy Database Ethiopian Rural Energy Development and Promotion Center.

Despite the presence of considerable energy resources, the energy sector in the Country is one of the least developed in the world. This situation is reflected in low per capita energy consumption, excessive dependence on biomass energy and very low efficiency in its use. The most recent National Energy Balance sheet shows that a total of 750PJ of energy was consumed in Ethiopia in 1999. Ninety-two percent of this energy was consumed for domestic applications and ninety-six percent of the supply came from biomass energy sources.

The distribution of energy consumption by sector was as follows: the rural household sector accounted for 84 percent of the total energy consumed; the urban household sector for 7.3%; the industrial and services sectors for 3.5% each; the transport sector for 1.3%; and the agriculture sector for 0.2% of total energy consumed.

In terms of gross supply, biomass is the most important energy source in Ethiopia. It meets 94% of total energy demand in the country and it is the only source of cooking fuel for practically all rural households as well as a large section of the urban population. Fuelwood, agricultural residue, dung and charcoal have shares of 77.5%, 7.0%, 8%, and 1.2% from total final energy consumption.

Table 3. National Energy Supply and Consumption, 1998/99 **Tera Joules**

Fuel	Woody Biomass	Crop Residue	Dung	Charcoal	Electricity	Petroleum	TOTAL	**Percent**
Total Final Consumption	581,352	54,450	56,333	8,785	4,841	40,476	746,238	100
Household	542,141	52,010	53,891	8,565	1,832	7,332	665,771	89.2
Urban	34,969	2,824	3,263	5,856	1,832	4,161	52,905	7.1
Rural	507,172	49,186	50,629	2,709		3,171	612,867	82.1
Agriculture	0	0	0	0	0	1,497	1,497	0.2
Transport	0	0	0	0	0	26,743	26,743	3.6
Industry	17,101	1,409	1,396	112	1,864	4,573	26,455	3.5
Services	22,110	1,031	1,046	109	1,145	331	25,772	3.5
Percent	77.5	7.0	8.0	1.2	0.7	5.4	100.0	

Source: Ethiopian Rural Energy Development and Promotion Center

Total petroleum product consumption was 23PJ (0.5 million Ton) in 1999. Petroleum fuels are mainly used in transport (40%), industry (20%), and households (32%). Rural households use kerosene for lighting while urban households use kerosene for cooking.

Electricity consumption was 4.8PJ (1345 GWh) in 1999. Demand was equally divided between domestic and industrial customers (38% each) and the rest went for the service sector.

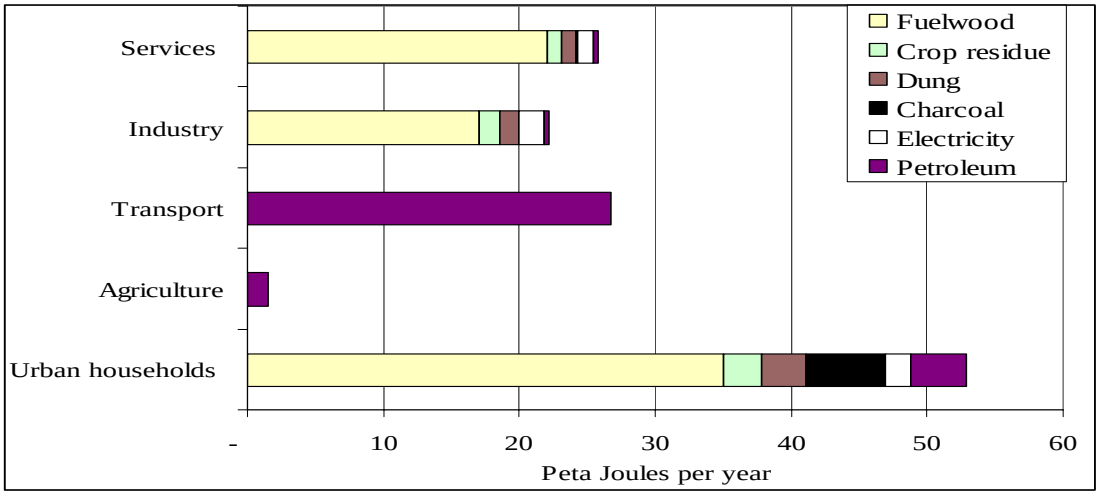

Figure 1. Energy consumption by sector, Ethiopia, 1998/99.

3.2 The Household Sector

The household sector consumed 666PJ (46 million tons in wood equivalent) in 1998. The rural household sub-sector accounted for 92% of total energy demand in the sector. End uses for energy in the sector are for cooking, baking, lighting, water heating, and electric appliances. Cooking and baking are the most energy intensive end uses, each requiring about 2.6 GJ/household-year.

Energy demand in rural households is mainly for cooking fuels and for lighting; incomes are generally low for them to enjoy other end uses (electric appliances, water heating). The modern energy infrastructure does not reach them and this limits them from obtaining modern energy affordably.

Table 4. Fuel use by End use in the Household Sector

End use	*Rural*	*Urban*
Cooking	Biomass	Biomass/kerosene/electricity
Baking	Biomass	Biomass/electricity
Lighting	Kerosene/biomass	Electricity/kerosene
Electric appliances	None	Electricity
Space heating	None/biomass	Biomass
Water heating	None/biomass	Biomass/kerosene/electricity

The household sector has experienced substantial transformation in the past three decades. In both urban and rural households access to fuels has changed significantly. As a result there have been shifts and reversals in fuel use. In rural areas the shift has been mainly negative: diminishing access to wood fuels has resulted in increasing use of crop residue and animal dung for fuel and an increasing commercialization of rural fuel supplies. The rural transition is the natural result of declining productivity and accessibility of wood fuels due to over-exploitation of forests and Enterpriseations for fuel, construction, and expansion of agricultural lands.

In urban areas the shift has been towards cleaner and efficient fuels and devices. For cooking, households have moved from biomass (especially fuelwood) to kerosene and towards the efficient *Lakech* charcoal stove. For *injera* baking they have moved from biomass to electricity and the efficient *Mirte* biomass stove. The urban household energy transition is mainly the result of government-led intervention in several fronts: pricing policy for kerosene, technology development and pricing policy for electric m*itads* and efficient charcoal stoves. The urban household sector is, in fact, a very successful example of government led multi-faceted intervention and cooperation:

- The efficient charcoal stove development and dissemination program is an example where the government developed the stove then disseminated the stove through the private sector. The impact has been immediate and large scale: it is estimated that more than a million *Lakech* stoves have been disseminated since 1994.

- The kerosene fuel introduction was carried out in the early eighties. Since then it has become the most important cooking fuel in the major urban centers of the country. The government has supported mass uptake of the fuel through price subsidies.

- The electric *injera mitad* was also introduced in the early eighties as part of the government strategy for full utilization of the country's power generation capacity. After the completion of the Finchaa power generation station, there was considerable capacity surplus on the grid and the government set tariff incentives for industry and encouraged the development of electric bakers for households.

3.3 Key Issues in the Household Sector

The main issues in the sector may be broadly divided into two. The first is the widening gap between sustainable supply and demand for biomass and the second is the adverse environmental impact of household energy use at the indoor, local and global scale.

Wood fuels covered 82% of household energy requirements in 1999 (66% urban, 83% rural). The share of wood fuels in the total energy balance in the sector had been even higher in earlier decades. It is estimated that every person in the country consumes about half a ton of wood per year. This level of demand from a fast growing population is met from a resource stock that is diminishing in both size and productivity.

Naturally, this has resulted in declining access to wood fuels. In rural areas this is exhibited in longer collection distances and commercialization of fuel supplies and in urban areas in higher prices. Fuelwood and charcoal prices have risen by more than 600 percent in the past three decades. This is an average annual growth rate of 20%.

Prices for other cooking fuels have also risen considerably in the past two decades. Kerosene prices have risen from ETB 0.65 per liter in 1990 to ETB 4.12 per liter today (an increase of 634%, Figure 2). The average domestic tariff has increased from ETB 0.15 per kWh in 1990 to ETB 0.4 per kWh today (an increase of 266%).

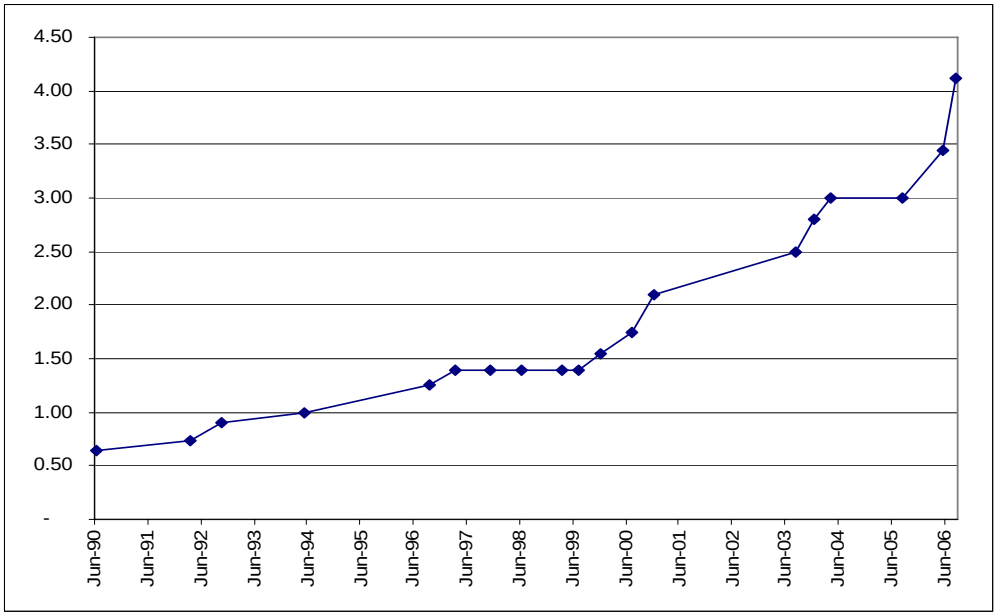

Figure 2. Trends in Kerosene Prices in Addis Ababa, ETB/Liter

More than 75 percent of households in urban areas have annual income of less than ETB 6,000. The average household spends 10% of its income on energy. For urban households the average expenditure is about 6% of total income. Households in the lowest segment spend as much as 16 percent of their income on energy and those at the highest segment about 4 percent (Figure 3). The proportion of income spent on energy may have increased even further (than that shown in the figure) because prices have increased significantly since 2000 whereas incomes have not. Energy expenditure is eroding the incomes of poor and mid income households in urban areas. For very low-income households it may even compromise food security.

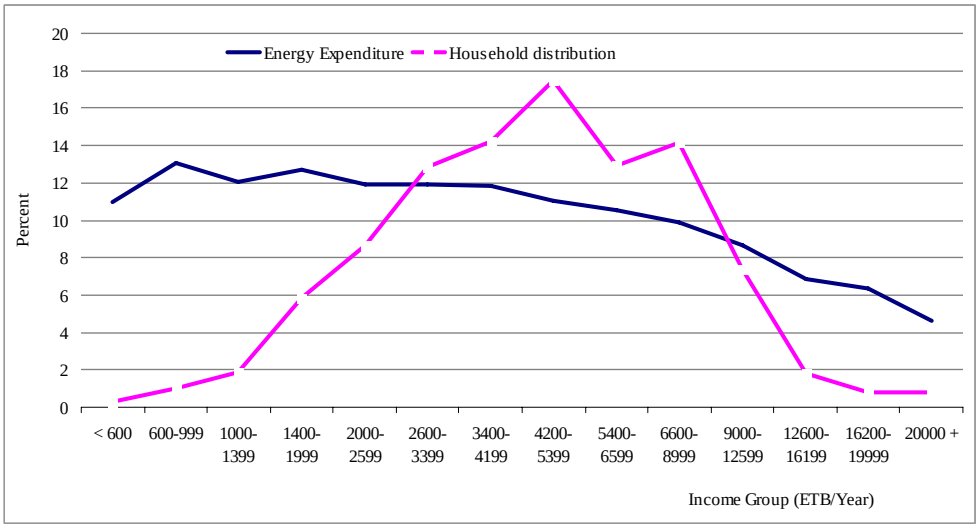

Figure 3. Energy expenditure, 2000 (CSA

3.4 The Urban Household Fuel Market

The urban domestic energy market is relatively huge. The estimated annual retail market value is close to ETB 3 billion. The main urban centers in the country constitute about half of the total urban population and would account for more than half of the total fuel consumed in urban areas because of higher incomes and better fuel availability. Therefore it would be reasonable to assume that two-thirds of the market would be in the major cities[10]with a total retail market of ETB 2 Billion.

Table 5. Estimates of the Household Fuel Market

Fuel	Unit	Urban domestic consumption (Million units)		Retail price (Addis Ababa, 2006)	Retail value	End uses
		1999	2006	ETB/unit	Mill ETB	
Kerosene	Liter	117	159	4.12	655	Cooking
Charcoal	kg	202	275	2.50	688	Cooking
Wood	kg	2412	3,282	0.35	1,149	Baking, cooking
Electricity	kWh	509	693	0.55	381	Lighting, baking, other
LPG	kg	0.44	0.60	8.25	5	Cooking
Total					2,877	

Source: Urban domestic consumption from the National Energy Balance for 1999; consumption is projected to 2006 using urban population growth rate of 4.5%.

[10] Addis Ababa, Awasa, Bahir Dar, Debre Zeit, Dessie, Dire Dawa, Gondar, Harar, Jimma, Mekele, and Nazret (these 11 cities had a total of 4.1 million people in 2002, CSA).

4 FUEL AND STOVE MARKET

4.1 Household Cooking Fuels and Stoves Use in Addis Ababa

The most widely used fuel cooking in Addis Ababa is kerosene (42.2%) followed by fuelwood (29.4%). Electricity, LPG, charcoal and residues are used by a much smaller section of city households. The primary cooking stove used in Addis Ababa is the single burner kerosene wick stove. The sample survey for this business plan indicates the single burner wick stove is used in 98 percent of Addis Ababa households. For the second most important fuel in the city, fuelwood, cooking is done over an open fire.

Charcoal cooking is made about equally with the *Lakech* and the metal stoves. LPG is used by the highest income group in the city and this group usually owns multiple burner LPG stoves. For electricity the most widely used stove is a single hot plate.

Table 6. Distribution of households by fuel and stove used for cooking in Addis Ababa

	2000		2004		Stoves used		Stove use
Fuel	HHs	%	HHs	%	Primary	Secondary	changes
Collected fuelwood	11,686	2.9	19,558	4.0	Open fire		No change
Purchased fuelwood	43,143	10.8	124,022	25.4	Open fire		No change
Charcoal	17,124	4.3	22,579	4.6	Metal	Lakech	
Kerosene	263,306	66.1	205,881	42.2	Wick		
LPG	10,574	2.7	31,997	6.6	Multiple burner		
Electricity	14,516	3.6	32,951	6.7	Single hot plate		
Residue (crop/dung)	25,334	6.4	40,407	8.3	Open fire		No change
Other	12,509	3.1	10,663	2.2			
Total	398,202		488,058				

Note: The number of users is for the primary fuel used. Most households use more than one fuel and stove.
Source: CSA, Welfare monitoring surveys, 2000 and 2004.

Cooking fuels use in Addis Ababa changes quite frequently due to changes in prices and availability of fuels. A significant change has taken place between 2000 and 2004 where the number of households who reported kerosene as their primary cooking fuel has declined in both relative and absolute terms. The drop in the proportion of kerosene users (66 to 42 percent) implies that 116,000 households that would have used kerosene as their primary cooking fuel have switched to other fuels by 2004.

The reduction in kerosene users is accompanied by an increase in the number of households cooking with fuelwood. This suggests a large proportion of kerosene users may have shifted to fuelwood or moved from using mostly kerosene to using mostly fuelwood. Such a shift towards a less convenient and efficient fuel suggests price may have been the main driver.

Although the number of households who report kerosene as their primary cooking fuel has dropped significantly, the volume of kerosene used has in fact stayed level at about 80,000 tons per year. The conclusion is that the transition is in the level of use of the fuels rather than complete abandonment of one fuel in favor of the other.

Modern fuels are generally used by mid and high income groups in urban areas. As the figure below shows kerosene is used across a wide range of income classes from the lowest to the highest. Charcoal is mostly used by the mid to upper-middle classes, electricity by the middle to upper classes, and LPG mainly by the highest income classes.

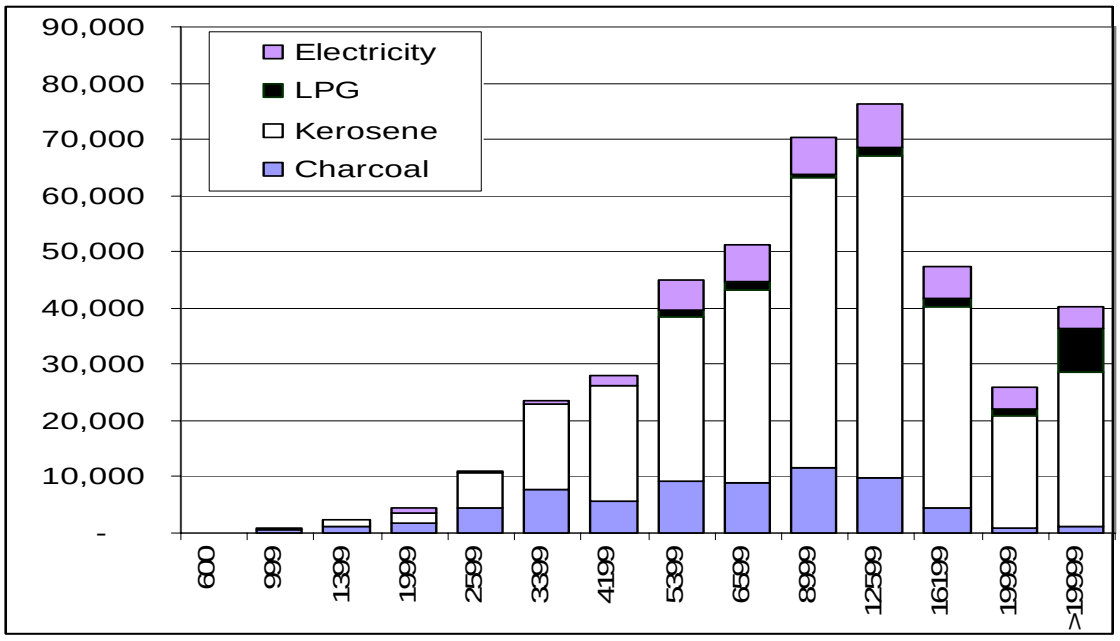

Figure 4. Distribution of urban households by fuel for cooking – 1996
Source: CSA, Report on the 1996 welfare monitoring survey, bulletin 205, pp. 325-330

There is no recent data for the total volume of domestic cooking fuel consumed in Addis Ababa. The volume of energy use is estimated indirectly from useful energy consumption per household (4GJ/household/year) and the distribution of users for the various fuels. The result shows that in Addis Ababa nearly 0.4 million tons of fuelwood and 56,000m^3 of kerosene is annually consumed for cooking.

Table 7. Types and quantities of cooking fuel used in Addis Ababa, 2004

	Standard Unit	Energy content	Households		Stove efficiency	Final energy per household		Total energy	
Fuel	(SU)	GJ/unit	Number	%	%	(SU)	GJ*	(SU)	TJ*
Collected fuelwood	Ton	14.5	19,558	4.0	10%	2.76	40	53,953	782
Purchased fuelwood	Ton	14.5	124,022	25.4	10%	2.76	40	342,130	4,961
Charcoal	Ton	29.0	22,579	4.6	42%	0.33	9.5	7,415	215
Kerosene	m^3	35.3	205,881	42.2	42%	0.27	9.5	55,546	1,961
LPG	Ton	45.5	31,997	6.6	55%	0.16	7.3	5,114	233
Electricity	MWh	3.6	32,951	6.7	60%	1.85	6.7	61,020	220
Residue (crop/dung)	Ton	14.5	40,407	8.3	10%	2.76	40	111,468	1,616
Total			488,058						9,988

Note: The user distribution data (CSA) provides information only on the primary fuel used by households. Most households use several fuels and stoves at the same time. For ease of analysis the CSA data is used assuming exclusive use of one fuel by each household.
Source: Own estimate based on CSA distribution data on cooking fuel use in Addis Ababa.

4.2 Domestic Cooking Fuel Use in Other Urban Areas

As one moves from Addis Ababa to the other urban centers access to modern fuels declines whereas access to traditional fuels increases. The result is fewer households use modern energy in the other urban centers compared to Addis Ababa. At the national level kerosene is used as the primary cooking fuel by only 13.8% of urban households compared to 42.2% in Addis Ababa. Similarly only 2.36% and 2.69% of households reported LPG and electricity as their primary cooking fuel at the national urban level compared to 6.56% and 6.75% for Addis Ababa.

Similar trends are visible regarding changes in fuel use in Addis Ababa and the other urban centers. In the case of kerosene, the number of users has dropped substantially in both Addis Ababa and the other towns between 2000 and 2004. The share of kerosene has declined from 66% to 42% for Addis Ababa and from 22% to 14% at the national urban level. As in Addis Ababa the reduction of kerosene use is accompanied by an increase of fuelwood use.

Table 8. Distribution of households by fuel used for cooking in urban areas, 1996-2004

Fuel	1996	1998	2000	2004
Collected fire wood	17.2	13.8	16.6	16.0
Purchased fire wood	44.5	49.1	41.3	49.4
Charcoal	4.3	5.0	8.3	7.7
Leaves/dung cakes, others	7.6	5.3	6.3	5.3
Kerosene	18.9	17.2	21.5	13.8
LPG	1.0	2.5	1.4	2.7
Electricity	2.7	3.8	2.2	2.4
Others	3.8	3.2	2.4	0.8

Source: CSA, Welfare Monitoring Survey, 2004

4.3 Comparative Cooking Costs in Addis Ababa

Energy use by households is for *injera* baking and non-*injera* baking (making *wat*, tea, coffee, and other type of cooking). The comparative costs of cooking are based on useful energy demand for non-*injera* cooking.

The most widely used cooking fuel in Addis Ababa is kerosene. Kerosene was the cheapest cooking fuel in the city before 2004 when its price was below ETB3.0/liter. The cost advantage has, however, diminished over the years and at current prices, kerosene cooking is no longer the cheapest. At present (November 2006) fuelwood cooking is the cheapest followed by cooking with charcoal

Table 9. Cooking costs in Addis Ababa– comparison on a useful energy basis (December 2006 prices)

	Fuel	Wood	Charcoal	Kerosene		LPG	Elect-	Ethanol
	Stove	Open fire	Lakech	Wick	Wick		ricity	
	Unit	kg	kg	Liter	Liter	kg	kWh	Liter
Retail price of fuel	ETB/(kg, L, kWh)	0.35	2.50	4.12	5.70	8.25	0.55	3.0
Energy content of fuel	MJ/(kg, L, kWh)	14.5	29.0	35.3	35.3	45.5	3.6	21
Efficiency of stove	%	15%	42%	42%	42%	55%	60%	55%
Life	Years		4	5	5	5	3	10
Price	ETB		25	45	45	150	80	350
Useful energy cost	ETB/GJ	161	213	**291**	**397**	372	289	**323**
Energy	ETB/GJ	161	205	**278**	**384**	330	255	260
Stove	ETB/GJ		8	13	13	42	34	63
Energy Expenditure	ETB/Month	54	71	97	132	124	96	108
Rank		1	2	4	7	6	3	5

Notes: Discount rate of 12.5%/year is used to annualize stove costs; the ethanol single burner stove import price is US$50 (Makobu); for ethanol the export price (US$0.26/liter) is used. The price build-up for ethanol fuel is discussed in Section 5.

Sources: Stove efficiency data is from World Bank, Ethiopia Energy Assessment, 1996; heating value and efficiency of stove for ethanol is taken from the Gaia ethanol fuel and stove assessment (2005).

The findings from the above analysis are the following:

a. Among modern cooking fuels, electricity and kerosene are the cheapest cooking alternatives. However, kerosene will be the most expensive cooking fuel if its subsidy, which amounts to ETB1.6/liter[11], is removed. In the absence of the subsidy kerosene will cost 10-30% more than LPG and electricity.

b. Ethanol has the least energy cost among all the modern cooking alternatives (ETB260/GJ). But the stove adds substantially to the total cooking cost (15 to 25 percent) compared to the other stoves where the stoves contribute less than 10 percent to total cost. This fact leads to the need for price reduction for the ethanol stove as well as financing mechanisms to cover part of the cost of the stove.

c. Among the modern fuels ethanol will require the least foreign exchange per unit of useful energy. For ethanol the foreign exchange cost is about ETB 140/GJ (stove and fuel) compared to ETB350/GJ for kerosene. Foreign exchange requirements can be further reduced through local production of the CC stove.

d. Fuelwood is the cheapest cooking energy source (ETB 54 per month) followed by charcoal (ETB71), electricity (ETB 96) and kerosene (ETB 97). The monthly household expenditure for cooking with ethanol and LPG would be ETB 108 and ETB 124, respectively.

[11]The import cost for kerosene is ETB 5.23/liter (Mid 2006). Transport costs, wholesale and retail margins add ETB 0.47/liter.

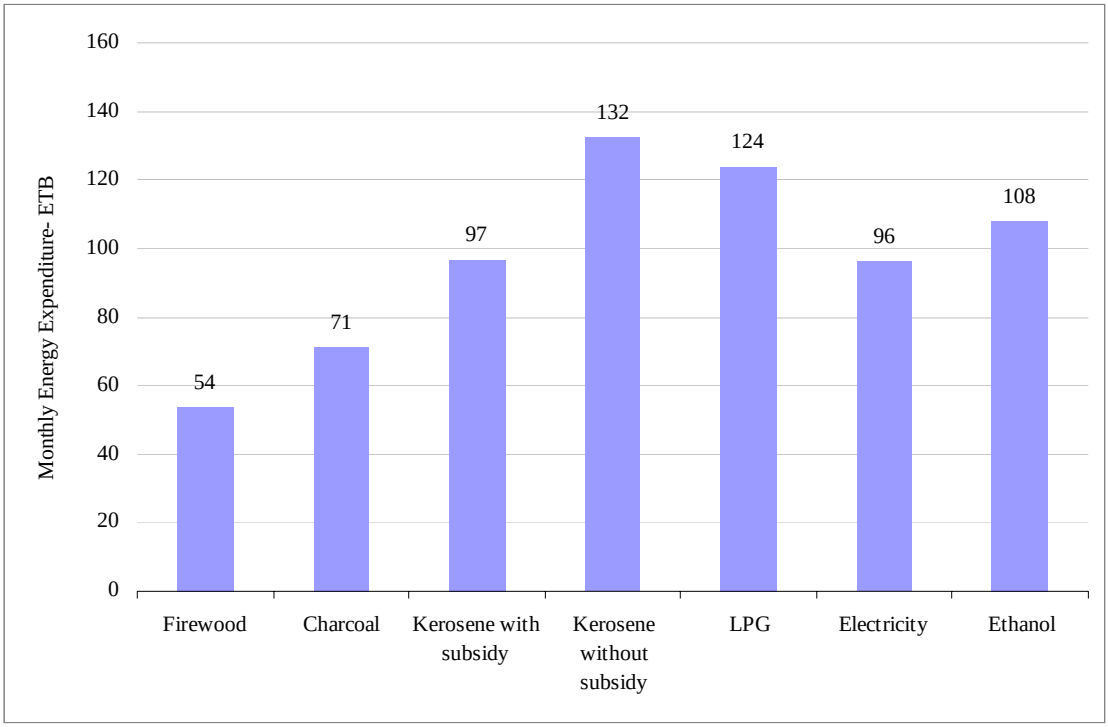

Figure 5. Comparative Cooking Costs in Addis Ababa, ETB per household per month - 2006

Relieving taxation and promotional pricing have helped lower the retail price of kerosene. Where the cooking fuel needs of an average household are met by kerosene without subsidy, this would result in monthly expenditure of 22 percent more compared with ethanol. Thus, on the basis of fuel costs alone, there would appear to be financial cost advantage to stimulating ethanol as a substitute for kerosene.

Kerosene at the moment is not subjected to any form of regular taxation and enjoys a promotional price reduction of ETB 1.6 per liter or about 30 percent from the stabilization fund (Table 10). The rationales for the kerosene subsidy have been (i) to prevent the further dwindling of biomass resources and the increased diversion of agricultural residues (dung and crop residue) for fuel instead of as soil nutrients; and (ii) to protect the low income groups. Kerosene is used by the urban poor for cooking and lighting and by the rural poor, mainly for lighting.

Table 10. Petroleum Fuels retail price build-up, Addis Ababa (Effective August, 2006)

	Description		Ex-Sudan	Ex-Djibouti#	Kerosene	ADO	Light fuel oil	Heavy fuel oil	Jet fuel
1	Ex-Djibouti price		484.89	519.70	523.26	507.53	319.92	313.09	523.56
2	Djibouti-Dewele/Galafi transport		29.60	7.66	7.66	7.66	8.35	8.35	7.66
3	Total border price	1+2	514.49	527.36	530.92	515.19	328.27	321.44	531.22
4	EPE margin		5.00	5.00	3.00	4.94	8.00	8.00	7.00
5	Product cost	3+4	519.49	532.36	533.92	520.13	336.27	329.44	538.22
6	Excise tax	30% of (1+2)	154.35	158.21	-	-	-	-	-
7	VAT	15% of (1+2+6)	100.33	102.84	-	77.28	49.24	48.21	-
8	Road fund		9.50	9.50	-	8.00	-	-	-
9	Municipality tax		2.00	2.00	-	2.00	-	-	-
10	Stabilization fund		15.52	(25.46)	(157.71)	(99.90)	(0.15)	(0.34)	(0.01)
11	Total duty	6 to 10	281.70	247.09	(157.71)	(12.62)	49.09	47.87	(0.01)
12	Invoice price	5 + 11	801.19	779.45	376.21	507.51	385.36	377.31	538.21
13	Distributors' margin		45.41	24.21	43.45	44.15	41.99	42.04	49.45
14	A.A. Retail price	12 + 13	817.00	796.00	412.00	544.00	419.00	411.00	580.00

All value added and municipality taxes will be transferred to the road fund
Distributors' margins include transport costs and retailers' margins
The Djibouti-Dewele/Galafi and Algaily-Metema transport costs are considered only for tax purposes
Source: Ethiopian Petroleum Enterprise.

The trend is for increasing cooking costs for both traditional and modern fuels. For most fuels prices have increased appreciably in the past five years. The kerosene price has doubled (from ETB2.0/liter to ETB4.12/liter between 2001 and 2006, electricity prices have gone up by 20 percent, wood and charcoal prices have also increased.

The recent fuel price rises have resulted in very large increases in households' cooking fuel budgets. For households using kerosene as their only cooking fuel the doubling of its price has doubled their annual cooking fuel budget from ETB 600 to ETB 1200. Further increase of the kerosene price to its full delivered (economic) cost will increase the expenditure of the average household to ETB 1600.

The conclusion is clear – such levels of price rises erode households' incomes significantly. For this reason cheaper and sustainable cooking fuel will have a very high level of acceptance by the population.

4.4 Consumer Preferences and Expectations

Household's decision to use a particular fuel and stove for cooking is mainly based on three criteria. These are, in order of priority, the fuel cost, the stove cost, and safety. Results obtained from the household sample survey conducted for this Business Plan indicates that for 79 percent of households the fuel price is the most important determinant for cooking fuel choice followed by stove cost (8%) and safety (8%). The more widely used fuels in the city (kerosene and biomass) score medium to high on the first two.

Table 11. Fuel and stove characteristics sought by households

Fuel and stove properties sought in a new domestic cooking fuel and stove: 99% of households are interested in a new cooking fuel	Top ranking of households	Kerosene with wick stove	Charcoal with Lakech/metal	Wood on open fire	LPG	Electricity	Ethanol on CC stove
Cheap fuel	79%	M	M	M	L	ND	H
Cheap stove	8%	H	H	H	L	ND	L
Safety	8%	L	M	L	ND	ND	H
Dependable availability	2%	H	H	M	L	ND	M
Cleanness and convenience	2%	L	L	L	ND	ND	H
Speed of cooking	1%	H	L	H	ND	ND	H

Note: H=High, M=Medium, L=Low, ND=Not Determined; for LPG and electricity the sample returns are too few to draw significant conclusions.
Source: Household energy survey for the ethanol Business Plan (Nov 2006).

Ethanol is expected to score high on fuel cost and safety criteria. The CC stove will be the most expensive stove among the cooking alternatives and this will be a barrier to low and mid income households. Again, it is evident that with the local production of the stove, ethanol has the potential to be a major cooking fuel in Addis Ababa and other cities.

4.5 Viability of Major Cooking Fuels and Stoves

Kerosene

Kerosene has been the most widely used fuel in the city for the past two decades. A combination of low fuel and stove prices has helped it become the least cost cooking fuel for households in Addis Ababa. Kerosene prices have however gone up in the last five years and this has resulted in some users moving to other fuels. Further price rises for kerosene are expected, as it will be difficult for the government to maintain past levels of subsidies as demand increases (for cooking in urban areas and for lighting in rural areas). Removal of the subsidy will put kerosene among the more expensive cooking fuels in the city.

Despite the price rises kerosene demand is expected to grow (but its market share may decline) due to rapid population growth, improving access to supplies and efficient and low cost stoves.

- The Addis Ababa population is growing at 5% per year. This will increase total cooking fuel requirements. Kerosene is easier to adopt by new consumers because of its low stove prices.

- The petroleum distribution infrastructure is expanding and this will increase access to kerosene supplies. On the end use side, kerosene pressure stoves, which are 25% more efficient than kerosene wick stoves, are now available in the market and their wide adoption may also drive demand. (However, it seems that their adoption is retarded as a result of concerns about their safety.)

Households' choice to use kerosene is driven mainly by its low fuel and stove costs and its wide availability. However, households have some reservations about kerosene cooking mainly on its handling and safety. With increasing incomes households will be willing to move to cleaner and safer fuels and stoves provided they are financially competitive.

Biomass fuels

The number of households cooking on biomass tripled in the past five years after years of gradual decline. Higher kerosene prices are the main reason behind this shift back to biomass. The switch is mainly to fuelwood as the cost reductions are much more substantial with fuelwood than charcoal.

For fuelwood, its continued viability as a major cooking fuel will depend on its supply (availability and price). For charcoal, ownership of the efficient *Lakech* stove has now reached saturation. On the supply side, there is some improvement in charcoal supply as wood species other than acacia are now widely used for charcoal production. In particular, the Prosopis shrub is becoming an important feedstock for charcoal production in the Afar region. These two factors will continue to make charcoal a low-cost cooking fuel for households.

Biomass fuel inflow into Addis Ababa is mainly from the Oromiya (for fuelwood and charcoal) and Afar (for charcoal) regions. The Regional Governments in these regions are implementing different policies with regard to the production and distribution of biomass fuels. The Oromiya Regional State is enforcing a ban on illegal production and distribution of charcoal through direct control (checkpoints) while the Afar Regional State is promoting legal organized charcoal production from the Prosopis Enterprise. On balance, the supply of charcoal is expected to increase because of the limited effect of the ban (which is limited to vehicle traffic on the main roads only) and because of increased legal supplies from Afar and Oromiya.

The structure of urban housing is changing with appreciable growth in the share of low-cost condominium housing in Addis Ababa. This will drive a move from biomass to modern fuels for those moving into the apartments.

LPG

LPG is consumed by high-income households in the cities of Addis Ababa, Dire Dawa and Harar. LPG consumption peaked in 1988/89 at 6714 tons (5275 tons in Addis Ababa) then dropped rapidly reaching a low of 1402 tons in 2001/02 (673 tons in Addis Ababa). The rapid decline was the result of supply constraints and higher prices. The number of consumers and consumption is gradually rising since 2002 due to better availability and price reductions. In 2004 there were more households using LPG as their primary cooking fuel than charcoal (32,000 households for LPG compared to 22,500 households for charcoal).

The LPG market was deregulated in 2002. LPG is now imported and distributed by several companies whereas in the past LPG was imported by the Ethiopian Petroleum Enterprise and distributed exclusively through the then existed four oil companies

(Total, Shell, Mobil and Agip). Since the deregulation supplies have improved, and LPG bottle and fuel prices have dropped (from ETB12/kg to ETB8.25/kg). The deregulation has helped reverse the decline in LPG use but the recovery is attributable to regaining of old customers rather than addition of new ones.

Despite its improved availability and lower prices LPG still remains the most expensive cooking fuel in Addis Ababa (ETB 372/GJ useful). Both fuel and bottle/stove costs are high. Further price reductions are not foreseen for either the fuel or the stove in the near future.

Electricity

Electricity is the cheapest modern cooking alternative for households in Addis Ababa (ETB289/GJ useful for electricity compared to ETB 291/GJ useful for kerosene in November 2006). For low-income households it will be even cheaper since low tariffs apply at lower consumption levels.

The electricity tariff was revised in June 2006 with an average tariff increment of about 20 percent for domestic customers. Several tariff revisions made in the past ten years have recommended substantial tariff rises, a minimum of 50 percent for domestic customers. Further tariff increases are almost certain (to finance the ambitious system expansion plan (doubling of installed capacity in five years) and because it will be impossible to continue subsidies with an extensive customer base (50% access in 2010). Any further tariff rises for electricity will eliminate its small cost advantage over kerosene and ethanol.

Ethanol

There are three government owned sugar factories in Ethiopia with total annual output of 1.5 million tons of sugar. Only one sugar factory, Finchaa, is producing ethanol at present with annual output of 8 million liters. The government plans to expand capacity of existing sugar factories as well as develop new factories at Tendaho and Kesem. Implementation of the plans is underway with factory site preparation and building of the factories. The plan is to produce nearly 130 million liters of ethanol by 2012.

In response to the recent oil price rise, the Government has initiated a strategy for the development of indigenous fuel production to substitute oil products. One of the expected actions is the expansion of ethanol production and use in the country. Ethanol production is therefore expected to increase several fold from production from existing factories and from planned additions.

In the next few years national demand for ethanol will mainly be from three sectors. *The first is that ethanol will be promoted as a **gasoline blend** for the transport sector.* Depending on government's strategy on levels of the blend, 7 to 15 million liters of ethanol will be required as gasoline blend with the demand growing at about 7 percent per year.[12]

[12] Total current consumption of gasoline is about 200 million liters with Addis Ababa and the surrounding areas accounting for about two-thirds of the demand. Ethanol required for blending will be about 7 million liters (if blending level is E5) or 15 million liters (if E10).

*The second demand for ethanol is as **biodiesel** processing feedstock in the oil esterification process.* In the government's other bio-fuel development strategy, that for biodiesel, ethanol will be required as production input for the oil to biodiesel processing technology (esterification). The esterification process requires about 10 percent ethanol by volume for biodiesel production. Therefore, depending on demand for diesel fuel and the prescribed level of blending of biodiesel with petrol diesel ethanol demand will be about 10% of the blend volume[13]. The total annual demand for ethanol as esterification feedstock will be about 1.6 million liters growing 7 percent per year.

*The third demand for ethanol is for **domestic and commercial cooking**.* The demand for this service is mainly in the cities where most cooking fuel supplies are commercial and where biomass fuels are relatively more expensive. With the envisioned expansion, output will surpass local demand from the transport sector (128 million liters output in 2012 with transport demand only 30 million liters). The domestic and commercial cooking market will be the only local outlet for ethanol.

If the expansion plan is realized about 100 million liters of ethanol will be available for the cooking market and for exports in 2012. This volume of supply will meet cooking requirements of 180 thousand households. The technical potential for ethanol is therefore enormous.

[13] The current diesel consumption is about 0.8 billion liters per year. A B2 bio-diesel blend will require 16 million liters of bio-diesel, which will require 1.6 million liters of ethanol as esterification feedstock.

Table 12. Potential ethanol production and demand, 2007-2012 ('000 liters)

Ethanol production	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12
Finchaa	8,000	8,000	17,000	18,600	18,600	18,600
Wonji/Shoa		12,245	17,809	20,836	25,153	25,153
Metehara				17,676	21,301	24,480
Tendaho			23,296	47,508	64,051	60,616
Total	**8,000**	**20,245**	**58,105**	**104,620**	**129,106**	**128,849**
Gasoline demand - total	208,772	219,211	230,171	241,680	253,764	266,452
Gasoline demand - Addis Ababa	139,181	146,140	153,447	161,120	169,176	177,635
Ethanol as gasoline blend (E5/E10)	**0**	**7,307**	**15,345**	**24,168**	**25,376**	**26,645**
Diesel demand	990,486	1,059,820	1,134,007	1,213,388	1,298,325	1,389,208
Biodiesel required for blend (B2/B5)			22,680	24,268	25,967	27,784
Ethanol as Biodiesel feedstock	**0**	**0**	**2,268**	**2,427**	**2,597**	**2,778**
Other uses:						
Export (committed)	6,000	6,000				
Distilleries	1,000	1,000	1,500	1,500	2,000	2,000
	7,000	7,000	1,500	1,500	2,000	2,000
Total Ethanol Demand	**7,000**	**14,307**	**19,113**	**28,095**	**29,973**	**31,424**
Ethanol Available for Cooking	**1,000**	**5,938**	**38,992**	**76,525**	**99,133**	**97,425**
Market potential (Households)	**2,083**	**12,371**	**81,234**	**159,428**	**206,527**	**202,970**
Households in Addis Ababa	564,921	593,167	622,825	653,967	686,665	720,998
Market potential in Addis Ababa (%)	0.4%	2.1%	13.0%	24.4%	30.1%	28.2%

Notes:

- The demand forecast assumes 5% and 7% annual demand growth for gasoline and diesel respectively. These are average historical growth rates for the past ten years.
- The market potential for stoves is estimated based on 480 liters of ethanol average consumption per middle income household. This is based on the Gaia household acceptability survey.
- It is assumed that E10 and B2 blends would be the prescribed blend levels for the next five years. It is further assumed that for the next two years gasoline blending will be limited to Addis Ababa then become national.
- Ethanol required as biodiesel feedstock is 10% by volume. For the next two years no production of biodiesel is foreseen, as at least three years are required for harvesting of oil trees Enterpriseed in 2006.

Sources: Ethanol production data is from Ethiopian Sugar Development Agency; petroleum demand is based on consumption data provided by EPE for 2004.

Ethanol Stove

On the basis of the ethanol fuel demand discussed above, the projected CC stove market is shown in the table below. During the first year, a total of 2,000 single burner stoves will be sold. This will increase to 5000 in the second year and 10000 in the third year. The cumulative number of CC stoves sales at the end of the ten year will reach 180 thousands and replacement sales would start after 10 years.

Table 13. Clean Cook Stove Sales

	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12
Market potential (# of households)	2,083	12,371	81,234	159,428	176,785	176,785
Potential market	2,083	10,287	68,863	78,194	17,357	-
Assumed market penetration	2,000	5,000	10,000	15,000	20,000	25,000
1 Burner	2,000	5,000	9,000	13,500	18,000	22,500
2 Burner	-	-	1,000	1,500	2,000	2,500
Cumulative # Stove sales	2,000	7,000	17,000	32,000	52,000	77,000
1 Burner	2,000	7,000	16,000	29,500	47,500	70,000
2 Burner	-	-	1,000	2,500	4,500	7,000

4.6 Prospects for Local Production of CC Stove

The CC Stove has relatively simple components. It consists of the main stove frame, ethanol container and burner, air controller and a cylindrical perforated cover around the burner and pot-rests. All components has relatively uncomplicated configurations and lend themselves to local manufacturing.

The stove frame provides easy access for placing of the ethanol canister from the bottom. Placing of the canister is a quick fix style procedure and the design also ensures that when burner is not in use the opening of the canister can be easily closed and sealed. All the components are made of stainless steel sheets for the purposes of ensuring durability as well as to increase its esthetic values.

The basic processes involved in the production of components of the stove include basic metal products manufacturing processes. The major workshop units and processes involved are: (a) Sheet metal pressing unit - blanking, piercing and deep drawing operation; (b) Sheet metal fabrication unit - sheet metal cutting, bending, spot welding, drilling; (c) Assembly unit: sub-assemblies, and main assembly bench works, and (d) packing unit - packaging in cartoon box including cleaning, labeling, and inserting of instruction papers. These tasks are typical processes conducted in metal manufacturing industries and metal workshops equipped with basic equipments.

Several local factories including Akaik Spare Parts and Hand Tools Factory, Selam Vocational Center could be considered by Makobu Enterprises PLC as candidates where the CC stove could be fabricated.

When produced locally, the major cost of production of the stove would be cost of dies and stove materials (stainless steel sheet). Based on our estimates, while the material cost per stove produced would be more or less constant, the unit cost associated cost of dies would be a function of the quantity of stoves produced within the total lifetime of dies employed.

Figure 6–The Dometic Two Burner CleanCook Stove

Considering an annual production of 10,000 stoves, and material cost of ETB 20 per kg of stainless steel sheet metal, as well as other cost such as machine time and labor, the local production cost of the single and double burner CC stoves would be ETB 200, and about ETB 350, respectively.

Assuming 15% producer's gross margin and a VAT of 15%, the producer's unit prices of the single and double burner stoves would be ETB 270 and ETB 470, respectively. This means that local production of the CC stove will bring down to 50% of the import price. The cost components and price build-up of locally manufactured CC stove is given in the table below.

Table 14. Cost components and Price of CC Stoves

		Production cost ETB/Unit)		
Cost components		Single Burner	Double Burner	Share (%)
Material		80.00	140.00	24%
Die and tools		41.00	72.00	12%
Labor		16.00	28.00	5%
Commercial items		55.00	96.00	16%
Overheads		10.00	18.00	3%
Production cost		202.00	354.00	60%
Producer's margin	15%	30.30	53.10	9%
Sub-total		232.30	407.10	69%
VAT	15%	34.85	61.07	10%
Wholesaler's purchase cost		267.15	468.17	79%
Wholesaler's margin	10%	26.71	46.82	8%
Wholesale price		293.86	514.98	87%
Retailers' margin	15%	44.08	77.25	13%
Retail price		337.94	592.23	100%

Note: Assuming FOB prices of US$45 and US$85 for the single burner and double burner CC stoves, respectively; custom duty of 5%; a value added tax of 15%; and wholesale and retail margins of 20% each, the retail price of the single burner and double burners imported CC Stove will be ETB 760 and ETB 1430, respectively.

5 COMPETITION - MARKET ANALYSIS

5.1 Competitors in the Fuel and Stove Market

Domestic cooking fuels used in Addis Ababa include kerosene, LPG, electricity, fuelwood, charcoal and residues (wood workshops, coffee mills). Kerosene and fuelwood are the most important in terms of users (206,000 households for kerosene and 124,000 for fuelwood) with the other fuels each having twenty to 40 thousand users each. Ethanol is a new potential fuel for households in Addis Ababa and other urban areas.

The domestic fuel market in Addis Ababa may be divided into the modern fuel sector constituting kerosene, LPG, electricity and ethanol and the traditional biomass sector consisting of fuelwood, charcoal and residues. The key stakeholders in the modern and traditional domestic fuel market are shown in the following table.

Table 15. Key Actors in the Fuel Market

Fuel	Kerosene	LPG	Electricity	Ethanol	Biomass
Production			EEPCO	Finchaa, other sugar factories	Rural households
Import	EPE	Oil companies, distributors			
Transport	Private/company truck owners	Private/company truck owners	EEPCO	Private/company truck owners	Rural households, truckers
Wholesale	EPE	Oil companies, other companies	EEPCO	Finchaa, other sugar factories	Urban wholesalers
Distribution/ retail	Oil companies	Oil companies, other companies	EEPCO	Makobu, new entrants	Urban traders
Stove	Wick burner, pressurized	Multi burners, single burner	Single burner	Domestic stove, other imports	Open fire, Lakech, metal charcoal
Production	Pressure stoves made in Ethiopia (ECO, Selam)			Dometic AB	Producers in major cities (>20)
Import	Wick stoves from China, pressure stoves from India	Bottles – oil & other companies Stoves – private companies		Makobu	
Wholesale	= Importers			Makobu	Producers
Distribution/ retail	Retailers (>100)	Bottles – Oil & other companies Stoves – private companies	Retailers (>100)	Makobu & others	Retailers (>100)

5.2 Analysis of Competition for Ethanol Fuel and Stove

A. Power of Suppliers

Ethanol fuel

Short term: High. *There is currently only one local supplier for ethanol and the potential demand for its ethanol is high for export, domestic fuel, gasoline blend, and biodiesel process input.* This is in contrast to the situation only a few years ago when the factory itself promoted ethanol as both domestic (K50) and transport fuel (as gasoline blend) and failed. Its effort to promote ethanol as a kerosene blend (K50) was abandoned after only a few months of distribution; and although the government did accept the potential of ethanol as a gasoline blend and drafted a directive for its implementation, no further action was taken and this was also abandoned. The factory is now exporting the bulk of its output through a long-term contract it signed with one customer.

For the next 2 years Finchaa will continue to be the only local source for ethanol. *The ethanol fuel and stove enterprise will need to secure firm fuel purchase contracts with Finchaa for the short term (3 years). It must also reach understanding with the regulatory agency for the sugar factories (the Ministry of Trade and Industry) for long term supplies from Finchaa and new ethanol producers*.

Long term: Low. *In the long term the supplier risk will decline as new ethanol producers come into the market and supply increases*. With the envisioned expansion and new addition of ethanol Enterprises the volume of supply will be higher than the demand for other uses (gasoline blend and biodiesel feedstock) and the domestic and commercial cooking market will be the only local outlet for ethanol producers.

B. Threat of new entrants

Ethanol fuel

High. When ethanol becomes a major domestic fuel all the oil distribution companies as well as others, including the producers, will try to enter the ethanol distribution market. The oil companies in particular have advantages over the new enterprise in their extensive distribution infrastructure.

Ethanol stove

Medium. Once ethanol is established as an alternative domestic cooking fuel, importers and producers will try to get into the stove distribution market. The resource requirements for potential importers will be minimal. Local production of the stove, on the other hand, will require considerable technical and financial resources.

Price reduction for the CC stove is key to sustained development of the ethanol market. The enterprise must therefore develop strategies for price reduction to stay competitive in the stove distribution market.

C. Power of buyers

Ethanol fuel

High. Households in Addis Ababa are accustomed to changing fuel availability and prices and have adopted a risk mitigation strategy of owning and using a variety of cooking fuels and stoves. As the recent switch back to charcoal and fuelwood from kerosene clearly demonstrates households are highly price-sensitive.

Ethanol must be priced competitively with kerosene and prices must be stable. The enterprise will need to secure ethanol supplies and should promote ethanol as a safe, low-cost fuel with dependable availability.

Ethanol stove

Medium. As shown in previous sections of this plan, the price of the CC ethanol stove is high compared to other stoves in Addis Ababa. Where the ethanol fuel is priced competitively with other cooking fuels the price of the stove will determine the extent of the market. If there is any choice in ethanol stoves mid and low-income households will choose low price, lower-quality stoves over the CC stove.

The enterprise must work to reduce the stove price and must promote the high quality of the stove (fuel efficiency, durability, and safety).

D. Barriers to Entry as a New Fuel

Ethanol Fuel

Medium. Each household in Addis Ababa owns and uses several fuels and stoves. In the long term ethanol will compete with fuelwood, charcoal, kerosene, LPG, and electricity. Price for all the substitute fuels has risen substantially in the past five years and further rises are expected in the future. This will improve the competitiveness of ethanol.

Households in Addis Ababa are generally receptive to new domestic fuels and stoves. This has been demonstrated by the smooth and quick adoption of the *Lakech* charcoal stove, the electric *injera* baking and the kerosene cooking. If the ethanol fuel is competitively priced and its safety and economy are well promoted it can easily penetrate the domestic fuel market.

Ethanol Stove

Medium. The decision of households to adopt ethanol as an alternative cooking fuel will depend on the stove price. In the short term where the market is small the barrier will also be small as the enterprise can address special segments of the population (upper income households, apartment housing). In the long term, however, it will need to market the fuel and stove to mid and low-income households as well and the stove price will become a barrier to potential users.

Customers need to be convinced of the safety of the stove and fuel. The enterprise needs to promote the CC stove as having high quality and safety.

E. Degree of Rivalry

Ethanol Fuel

High. In the next two to three years the market for ethanol as cooking fuel will be small due to limited supply and the time it takes to build customer confidence in the ethanol stove and fuel. At this stage few other companies will be interested to develop the market. If the expansion plan for the sugar industries is realized, however, the domestic market for ethanol can reach 40 million liters a year within ten years. This will be a sizable market and the oil companies and other distributors will want a segment of it.

Ethanol Stove

Short term: Low. The ethanol stove market will be fewer than 5000 stove sales per year for the first three years. This level of sales is too small for local production but may be attractive for importers.

Long term: High. In the long-term ethanol becomes a major domestic fuel. As ethanol users rise to 150 to 200 thousand households and annual stove replacements to 15 to 20 thousand, more importers and manufacturers are likely to enter the stove market.

6 STAKEHOLDERS ROLES AND CONTRIBUTIONS

The national energy policy of Ethiopia (1994) promotes sustainable energy supply and use. The policy states six policy objectives, among which three are directly related to household energy supply and use. These are:

a) to give priority to the development of indigenous energy resources with a goal toward attaining self-sufficiency;
b) to ensure and encourage a gradual shift from traditional energy sources use to modern energy sources; and
c) to ensure that the development and utilization of energy is benign to the environment.

Transition from traditional non-sustainable energy sources to modern sustainable fuels for the household sector is a policy priority. In the policy the government commits itself to stabilizing household fuel prices and to increasing alternative energy supplies for the sector.

Large-scale adoption of ethanol as household cooking fuel will help meet the three policy objectives outlined above. Ethanol will displace kerosene and fuelwood, charcoal (in the long-term). Unlike the fuels it will displace, ethanol will be sustainably produced and consumed. This will help mitigate the non-sustainable exploitation of trees for household fuel and reduce GHGs emissions from kerosene combustion.

Ethanol brings Ethiopia closer to the goal of energy self-sufficiency. Energy supply security has now become a major concern because of petroleum supply uncertainties and rising prices. Promotion of ethanol as domestic fuel will reduce Ethiopia's dependence on imported petroleum and frees its meager foreign exchange earnings for productive investments.

Ethanol, as a new household fuel, requires awareness development, promotion, technology development, and regulatory and policy support. Stakeholders engaged in the production-consumption chain; government agencies responsible for policy, regulation and promotion; and non-government agencies involved in sustainable energy development need to work together to promote the national interest as well as their individual missions.

Table 16. Key Stakeholders and Contributions

Mission	Stakeholders and contributions
1. Policy, Regulation and Promotion	Development of ethanol as household fuel addresses three of the six energy policy objectives and it is also unique in its diversity of benefits. Translation of these expressed policies into action requires inputs from the Ministry of Mines and Energy (MME) and Ministry of Trade and Industry (MoTI). The MME and the Ethiopian Rural Energy Development and Promotion Center (EREDPC), as energy development and regulation bodies, can help promote ethanol as domestic fuel through awareness development, stove technology development and testing, and regulatory support for tax reduction for the ethanol stove. MoTI's mission includes regulation of petroleum supply and distribution as well as investment promotion. National benefits are maximized when ethanol is adopted by a large segment of the population and consumer benefits are maximized when prices are competitive with existing fuels. This means access of users to ethanol fuel must be enhanced through competitive pricing and long-term supply guarantees. The MoTI can help achieve this through support for fuel tax reductions and provision of ethanol fuels supply guarantees from the producers. Ethanol output is expected to grow to more than ten times current output within five years. Optimization of benefits from this resource depends on careful assessment of costs of benefits of the potential uses of ethanol (household fuel, gasoline blend, non-energy use, and exports). It is the finding of this assessment that application of ethanol as household fuel will be the best alternative use compared to the other applications. Public as well as consumer benefits are maximized with ethanol used as cooking fuel because of reduction of kerosene imports, reduction of government subsidies to kerosene users, lower lifecycle costs to users, and safe and clean cooking for households. The realization of these benefits will require policy and regulatory support from the MoTI and MME. Ethanol has excellent qualities as domestic cooking fuel. The fuel is sustainably produced and burns cleanly. Combined with the high quality and safe CC stove it delivers the best possible service to households. Ethanol reduces indoor, local and global pollutant emissions and for this reason deserves policy and regulatory support from the Environment Protection Authority (EPA). One specific action that the EPA can make towards promoting ethanol would be facilitating international support for the Ethiopian ethanol program. This could be CDM financing and other technical and financial support for the project. Sustainable development of the ethanol domestic fuel program depends on the consistency of quality for the fuel and stove. If quality is compromised in either the stove or the fuel the expected benefits won't be realized. One of the potential threats for the program is the dissemination of low quality and unsafe ethanol stoves into the market.

	The Quality and Standards Authority of Ethiopia (QSAE) should therefore test, set and enforce strict standards for domestic use of ethanol.
2. Ethanol Production	Ethanol producers must realize that domestic use of their output (rather than export) secures their market and benefits. Local use of their output reduces transport and handling costs and makes their product more competitive. The only existing ethanol producer, Finchaa, understood this and was actively pushing for adoption of ethanol as gasoline blend then as household fuel (with the K50). This active engagement must continue with Finchaa and the new ethanol producers in the future.
3. Ethanol Distribution	With the expected rise of ethanol output to more than 128 million liters in five years, the benefits will be substantial for all those in the supply chain. Oil companies and other retailers will have a profitable stake in the distribution of ethanol. Distributors may need to make modest investment in distribution infrastructure in the first few years.
4. Stove Production	One of the promises of the ethanol market development program is the potential for local production of the stove. This is in contrast to other modern cooking devices, which are mostly imported. Total stove sales will reach 150,000 and annual replacements 15,000 stoves in the next ten years. This market can support a few medium scale manufacturers.
5. End use Promotion	Ethanol is a new domestic fuel and for this reason requires active promotion. Although the ethanol fuel and stove have excellent qualities, they can be further improved to fit customer expectation. The Gaia Association and government agencies involved in energy technology development and dissemination should work together to improve the quality of service continually. This involves consumer surveys (to get feedback on access, quality of fuel and stove) and relaying this back to the other stakeholders (fuel and stove producers, wholesaler, distributors and government).

7 AWARENESS AND PROMOTIONAL CAMPAIGNS

7.1 Awareness creation

Public recognition and acceptance of ethanol as a cooking would require extensive public education and promotion campaign through a variety of media and events. This is evident as most households have little or no information on ethanol say on local production capacity, potential uses and its comparative advantage over alternative fuels.

The first and most important step in the process of ethanol fuel market development should therefore be to design an appropriate public education and awareness campaign. Such campaign will involve the use of a variety of media such as radio, TV and newspapers, distributed brochures and posters, posted signs at highways and organized workshops.

and During the early stage awareness campaign should primarily focus on availability and sustainable supply of ethanol for cooking; efficiency and safety of the fuel and the stoves; comparative cooking cost ethanol and competing fuels; and health, social, economic and environmental benefits of using locally produced ethanol.

7.2 Promotional campaigns

Each promotional campaign should be defined by a clear purpose: *to motivate consumers to purchase the CC stove and ethanol fuel and to create brand awareness and understanding*. The following comprise the most important areas on which promotional campaigns should be designed and conducted.

Printed media:

a) Information Leaflets: trifoliate, providing information on product description and why it is being promoted as a domestic cooking fuel. Leaflets could be made available at gas stations, supermarkets, and other frequently visited places such as banks and post offices, and government offices;

b) User's guide: trifoliate, explaining safe and efficient operation of CC stove and safe storage and handling of ethanol fuel. This user's guideline should be distributed to stove retailers and be included in stove pack;

c) Banners and posters: providing brief but clear message on the use of ethanol for cooking, and where ethanol fuel and CC stoves are available;

d) Stickers: introducing ethanol fuel, and distributed where ethanol fuel and CC stoves are sold; and

e) Newspapers: quarter to half page advert on widely circulated newspapers.

Electronic media

a) Radio: short radio adverts on where and at what price ethanol fuel and CC stoves are available; some discussion programs on ethanol as household cooking fuel;

b) TV: advertising the availability and demonstration of safe use of ethanol for cooking; and

c) Short film on CDs: preparation and distribution of short void clips on CDs where use of ethanol is demonstrated, and also contains basic information on ethanol and other cooking fuels (safety, social, economic and environmental issues).

Other means of promotion

a) Bazaars/professional and public meetings: actual cooking demonstration using ethanol, demonstration of safety features, explanation of the benefits of ethanol.

Demonstrations to housing cooperatives

a) Promotional campaign should also directly focus on end-users living in the recently constructed low-cost condominiums through demonstration and distribution of leaflets.

Training of Retail Staff

b) Training of retail staff of CC stove retailers will ensure that they are knowledgeable enough to persuade and inform the end-users at the point-of-purchase. Training may include the comparative cost, health, economic and environmental benefits of ethanol cooking fuel, safety measures in stove operation and fuel handling and storage.

7.3 Design and Execution of Campaigns

Radio and TV campaigns should be designed by experienced advertising agency. The agency should propose different promotional packages. The campaign should be continuous and the agency should supervise the execution of the promotional activities.

At least two radio stations should be used, one of which would be FM Radios and Radio Ethiopia, while TV advertisement would be made on ETV. Promotion would be in the Amharic language and transmitted between 8 to 9:30 pm on Saturdays and Sundays where entertainment programs are transmitted.

The printed media should be designed to have attractive appeal and should be on good quality paper. Banners and permanent road sign posters should also be very appealing and should be placed in places of highly frequented areas. The contracted advertising agency should propose alternative designs and locations where such materials would be displayed.

8 FINANCING STRATEGIES

8.1 Direct Subsidies from Government

As a new entrant into the market ethanol will need supportive public policy. Urban domestic fuel prices do not reflect full costs. Biomass fuel prices do not incorporate replacement costs, kerosene prices are fixed by the government (with special tax exemptions and cross subsidies) and electricity is subsidized up to 50 percent. A new, fully commercial fuel will be disadvantaged in such a distorted market place. On the other hand, the indigenous and sustainable production of the fuel as well as its foreign exchange saving potential should attract the government. Policy and regulatory support should therefore be sought from the Government. The ethanol fuel should at least receive the same promotional pricing support from the Government as it is presently given to kerosene.

The ethanol price build-up starts from the factory gate selling price of ETB 2.25 per liter. Transport cost from the factory at Finchaa to Addis Ababa will add an estimated 10 Ethiopian cents per liter. This price build-up assumes the sale of ethanol from the bulk storage and bottling stations in especially designed bottles and therefore includes bottles, labels, fuel colorants, denaturants and bottling costs. *It should also be noted that the price build-up does not include the promotional price reduction applied to kerosene, which would in this case amount to 90 Ethiopian cents per liter, and give a final retail price of ETB 2.10 per liter.* The retailers' margin is estimated at 15 Ethiopian cents. (This is five times of the current distributor's margin for kerosene.) The final retail price of ethanol in Addis Ababa would thus be ETB 3.0 per liter as shown in Table 17.

Table 17. Price Build-up of Ethanol

			ETB/liter	%
1	Factory gate price		2.25	75.1
2	Transport cost to Addis Ababa		0.15	5.0
3	Losses		0.01	0.4
4	Bottles, labels, colorants, denaturants, depreciation		0.30	10.0
5	Sub-total		2.71	90.5
6	Wholesaler margin	5% of 5	0.14	4.5
7	Wholesale price	5 + 6	2.85	95.0
8	Retailers/Distributor's margin	5% of 7	0.15	5.0
9	Final Retail price in Addis Ababa	7 + 8	3.00	100.0

The factory gate selling price is based on production of ETB 1.87 per liter and gross margin of 20 percent. This is also the current export price of ethanol.

8.2 Opportunities for CDM Financing

As stipulated in the Kyoto Protocol, developed countries have agreed to limit or reduce their GHGs emissions. However, it was also recognized that reduction of GHG in developed countries is more expensive than in developing countries, while at the same time investments in reduction of GHGs emission in developing countries could contribute to social and economic development of these countries. One of the mechanisms adopted under the Kyoto Protocol to meet these objectives simultaneously is the Clean Development Mechanism.

The basic principle behind the Clean Development Mechanism is thus to help reduce GHG emissions at the possible lowest cost while at the same time providing additional source of fund to projects in developing countries with high GHGs mitigation potential. The main criteria for project to qualify for CDM financing is that they are "additional"; that is the project would not be viable without extra revenue from CDM.

This project - ethanol substitution for kerosene to meet household cooking energy demand, provides an opportunity to substitute a non-renewable energy source with one that is renewable that has enormous CO_2 emission reduction pootential. In spite of this, owing to the relatively high cost of CC stove, the Project is not commercially viable. On the other hand, the financial return of the Project gets better with CDM financing.

Based on emission reduction of 0.86 tons of CO_2E per stove per year, and sales value of US$6.5 per ton, the project will generate gross CERs sales revenue of US$1.7 million over ten years and the associated transaction costs would be US$270 thousands or a net revenue of US$ 1.5 million (Table 18).

Table 18. Emission Reduction Potential of CC Stove and Sales of CESs

	2007/8	2008/9	2009/10	2010/11	2011/12	2016/17
Cumulative Stove sales	2,000	7,000	17,000	32,000	52,000	177,000
Emission Reduction, tCO2E/stove/year	0.86					
Emission Reduction, tCO2E/year	1,720	6,020	14,620	27,520	44,720	152,220
CERs value, US$ per ton	6.50					
CERs sales, US$ per year	11,180	39,130	95,030	178,880	290,680	989,430
NPV, 12.5% discount rate	$1,718,644					
Transaction Costs						
Baseline determination & monitoring plan	40,000					
Validation	20,000					
Due Diligence	120,000					
Annual certification	20,000	20,000	20,000	20,000	20,000	20,000
Total Transaction Costs	200,000	20,000	20,000	20,000	20,000	20,000
NPV, 12.5% discount rate	$270,729					
NET CERs Revenue	(188,820)	19,130	75,030	158,880	270,680	969,430
NPV, 12.5% discount rate	$1,447,916					
NPV, 12.5% discount rate						

Notes: Emission reduction and CERs sales and transaction costs are computed based on data from REAP-Canada. These are emission reduction per stove, 0.86 tons; CERs sales price, US$ 6.50.

8.3 Stove Financing Methods

The costs of imported CC stoves are relatively high. As a result, a number of households may not be able purchase the stoves. Accordingly, alternative consumer financing methods need to be adopted. The most promising financing methods for the stove include salary withholding schemes, loans through microfinance institutions, and loans from saving and credit cooperative societies. Each method is briefly described in the table below.

Table 19. Financing Methods for the CC Stove

Financing method	Description	Experience
Cash purchase	Purchase of the CC Stove using one payment.	Common. For high and upper middle income group.
Salary withholding schemes	The consumer, a civil servant or member of a company enters a credit agreement with the retailer to have a monthly deduction from his/her salary. The deduction occurs automatically. Loan period may last 6 to 12 months. Interest to be charged on accrued amount.	This is very common among civil servants in Addis Ababa.
Loans through Microfinance institutions	The consumer takes a loan from a saving and credit cooperative society or a Microfinance Institution to buy the CC Stove.	This approach has been used for many micro-enterprise loans in Addis Ababa. The microfinance institutions in Addis Ababa have recently started loans for purchase of consumer goods.
Loans through savings and credit cooperatives	The consumer, a member of a saving and credit cooperative society, takes a loan from his/her society to buy the CC stove. In Addis Ababa, as of November 2006, there were 2852 saving and credit cooperatives with aggregate membership of over 254 thousands. Loans by saving and credit societies typically have lower interest rates than microfinance institutions.	This is very common among civil servants in Addis Ababa.

9 SUPPLY AND DISTRIBUTION OF FUEL AND STOVE

To ensure continuous supply of ethanol it is necessary that well distributed and strategically positioned ethanol sales outlets are established. At the initial phase, the most likely marketing channel to follow is depicted in Figure 7. The envisaged Enterprise will purchase the fuel from the Finchaa Sugar Company and then bottle and distribute the product to retailers. These will include the oil companies, housing cooperatives and other private operators.

Customers served at the retail outlets will exchange empty bottles that were filled and sealed at the bulk storage facility. This of course implies that the bottles used will be standardized, and checked for any physical damage when exchange is made.

One of the potential advantages of this approach is that bulk supply storage would be established as necessary and at locations to meet market demand. The bulk storage facility can also supply various retail outlets. Additionally, retailers can easily adjust stock level based on demand.

The Enterprise will import the CC stove to serve the initial market. However, given that imported stoves would be more expensive, it is important that local production (under license from Dometic AB) is encouraged, capacity developed and manufacturing is started as soon as the beginning of the third year. In this case the local metal manufacturing industries would be the major supplier of the stove and will sell their products to intermediaries in large quantities.

To keep cost of stoves as low as possible it is necessary that the bulk buyers selected - have several outlets through which individual households could purchase. It is also important that ethanol fuel distributors/retailing outlets also stock at least small number of ethanol stoves and hence increase availability of stoves at different locations.

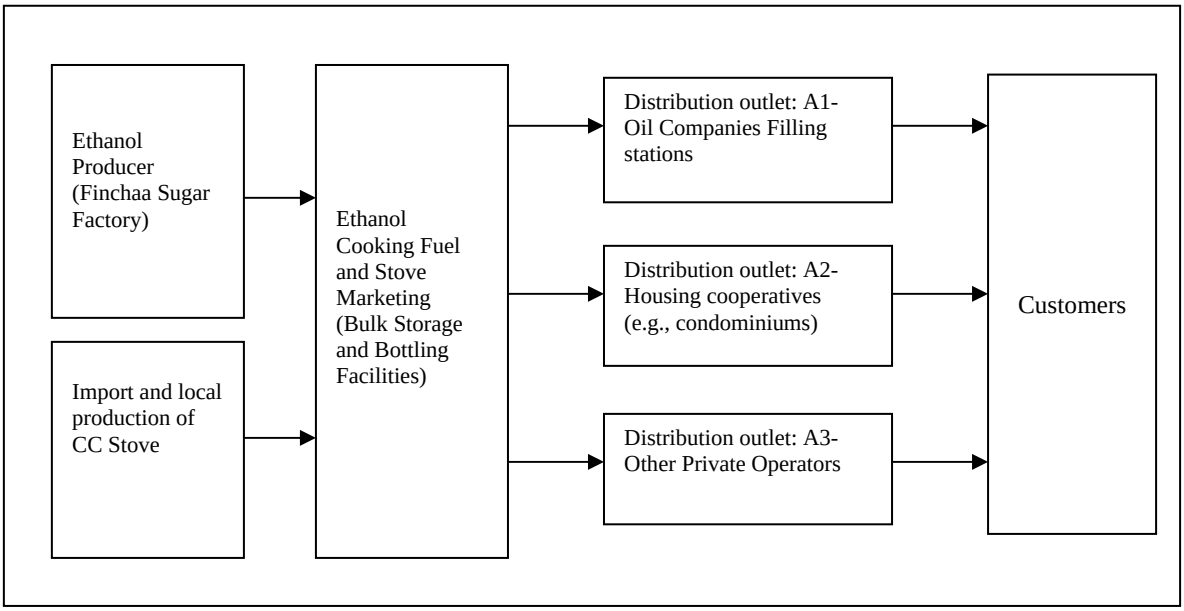

Figure 7. Proposed Distribution Chain for Ethanol Fuel and CC Stove

10 FINANCIAL PLAN

10.1 Assumptions

The basic assumptions for the financial analysis are summarized below. The lifetime of the Project is assumed to be 10 years. All fixed assets will be replaced at the end of their expected economic lives based on their respective depreciation rates. A straight-line depreciation method is adopted for computing annual deprecation charges.

Table 20. Basic Assumptions for Financial Analyses

1. Project Life	10 years
2. Construction period	One year
3. Financing Sources and Terms:	
Equity (Share Capital):	40% of investment cost
Long Term Loan	60 per cent of total capital
Interest Rate	8.75% per annum
Loan Repayment	10 years
4. Depreciation	
Method of Depreciation	Straight Line Method
Annual Depreciation Rates:	
Land and Building Construction	5 %
Machinery and Equipment	16 %
Pre Operating Expenditures	20 %
Office Furniture and Equipment	20 %
Vehicles	20 %
5. Profit Tax	35 %

10.2 Investment Costs and Financing Sources

The total initial investment required for the establishment of the Ethanol Cooking Fuel and CC Stove Marketing Enterprise is approximately ETB 10.6 million as shown in Table 16. This will cover initial investment costs, working capital requirements and project start-up costs. Of this initial investment cost, 90 percent will be for the fuel marketing business and the remaining 10 percent for the stove marketing business.

Of the estimated initial total costs, ETB 3.0 million (28 percent) will be for land lease for the bulk storage and ethanol bottling facility and ETB 1.3 million (12 percent) will be for civil works and building construction. Fuel tankers, metering pumps, manual-operated cupping machines, and fire fighting equipment will cost ETB 840 thousand or 8 percent of the total costs. Vehicles required for transportation of bottled fuels and for office services will cost ETB 1.8 million (17 percent). Working capital requirement is estimated at ETB 3.5 million or one-third of the total initial investment cost.

Table 21. Summary Initial Investment Costs, '000 ETB

Fixed Investment Cost	Total	Fuel Marketing	Stove Marketing	% of total
Land Lease cost	3,000	3,000		28.4%
Construction	1,250	1,250		11.8%
Fuel Tankers	540	540		5.1%
Metering Pumps	100	100		0.9%
Fire fighting equipment	200	200		1.9%
Office Furniture and Equipment	114	72	42	1.1%
Vehicles	1,800	1,400	400	17.0%
Working capital requirement	3,500	3,000	500	33.1%
Organization and Start-up costs	75	50	25	0.7%
Total	10,579	9,612	967	100.0%
Percent	100%	91%	9%	
Financed by:				
Equity Capital	4,231.4	40%		
Long-term loan	6,347.1	60%		
Total	10,578.5	100%		

The sources of finance will be equity capital and long-term loans. It is assumed that the envisaged Enterprise will be capitalized by its owners in an equivalent to 40 percent of the total initial investment amounting ETB 4.23 million and the remaining balance, ETB 6.35 million or 60 percent of total investment, through a long-term loan. It is further assumed that interest rate on the long-term loan would be 8.75 percent per annum and will be repaid over ten years.

10.3 Sales Revenue

The annual revenue of the business is projected based on annual sales volume and unit sales prices. The wholesale price of single burner CC is ETB 530 while that of the double burner is ETB 1000. Similarly, the wholesale price of ethanol fuel is ETB 2.85 per liter. The sales revenue projections also assume a 5% ethanol fuel product loss.

The projected revenue from sales of CC Stove and ethanol fuel marketing during the first year of operation is ETB 3.8 million (ETB 1 million from the sale of the stove and ETB 2.7 million from the fuel sales). The aggregate revenue will increase to ETB 11.7 million and ETB 25 million during the second and third years of operations.

Table 22. Projected Annual Revenue

	2007/8	2008/9	2009/10	2010/11	2011/12	2016/17
CC Stove Sales						
Potential market, stoves	2,083	10,287	68,863	78,194	17,357	0
Market penetration, stove	2,000	5,000	10,000	15,000	20,000	25,000
1 Burner	2,000	5,000	9,000	13,500	18,000	22,500
2 Burner	-	-	1,000	1,500	2,000	2,500
Cumulative # of stove sales	2,000	7,000	17,000	32,000	52,000	177,000
1 Burner	2,000	7,000	16,000	29,500	47,500	160,000
2 Burner	-	-	1,000	2,500	4,500	17,000
Wholesale price, ETB/Stove						
1 Burner	530		294			
2 Burner	1,001		515			
Sales revenue, '000 ETB	1,060	2,650	3,160	4,740	6,319	7,899
1 Burner	1,060	2,650	2,645	3,967	5,289	6,612
2 Burner	-	-	515	772	1,030	1,287
Ethanol Sales						
Cumulative stove sales	2,000	7,000	17,000	32,000	52,000	177,000
Ethanol consumption, liters/hh/year	480					
Annual ethanol net sales, '000 liters	960	3,192	7,752	14,592	23,712	80,712
Ethanol wholesale price, ETB/liter	2.85					
Sales revenue, '000 ETB	2,734	9,090	22,075	41,552	67,522	229,835
Total revenue, stove and fuel' 000 ETB	3,794	11,740	25,235	46,292	73,841	237,734

Note: The Projected ethanol annual sales is net of an estimated 5% product loss.

10.4 Cost of Sales and General Expenses

The annual costs of sales for the CC stove and the ethanol fuel are projected based on annual sales volume and unit purchase prices. The total import price of the single burner and double burner CC is ETB 442 and ETB 834, in their respective orders. However, when the local production of the stove starts during the third year, the stoves purchase prices will go down to ETB267 and ETB 468 for the single and double burner stoves. The purchase price of ethanol fuel is ETB 2.25 per liter.

During the first year of operation, the Enterprise will import and sell 2000 singe burner stoves and purchase 1 million liters of ethanol and the total cost of sales will be ETB3.2 million (ETB 883 thousands for the CC Stove and ETB 2.3 million for ethanol fuel). General and administration expenses during the first year are estimated at ETB 2.2 million. This will bring the total expenses during the first year to ETB 5.4 million.

Table 23. Annual Costs of Sales and general Expenses

	2007/8	2008/9	2009/10	2010/11	2011/12	2016/17
Cost of Sales						
CC Stove						
Cumulative # of stove sales	2,000	7,000	17,000	32,000	52,000	177,000
1 Burner	2,000	7,000	16,000	29,500	47,500	160,000
2 Burner	-	-	1,000	2,500	4,500	17,000
Purchase Price, ETB/Stove						
1 Burner	442		267			
2 Burner	834		468			
Cost of Sales, '000 ETB	883	2,208	2,872	4,309	5,745	7,181
1 Burner	883	2,208	2,404	3,606	4,809	6,011
2 Burner	-	-	468	702	936	1,170
Ethanol Fuel						
Annual ethanol purchase, '000 liters	1,011	3,360	8,160	15,360	36,960	84,960
Ethanol purchase price, ETB/liter	2.25					
Cost of sales, '000 ETB	2,274	7,560	18,360	34,560	56,160	191,160
Total cost of sales, ' 000 ETB	3,157	9,768	21,232	38,869	61,905	198,341
General and Administrative Expenses						
CC Stove Marketing	360	365	371	376	382	411
Ethanol fuel marketing	1,862	2,744	2,974	4,204	5,848	16,148
Total General and Admin. Expenses	2,222	3,110	3,345	4,580	6,230	16,559
Cost of Sales and General Expenses, 000 ETB	5,379	12,878	24,577	43,449	68,135	214,900

10.5 Projected Financial Statements

A complete set of financial projections for the first ten years of operation are provided in Annex I. The projections include balance sheets, income statements, and statement of cash flow. The projections are prepared on an annual basis. Table 17 provides a summary of major balance sheet and income statement and cash flow statement items.

The envisaged Enterprise will generate ETB 12.7 million during its first year of operation and ETB 18.5 million during the second year. The cost of sales is projected to grow from ETB 7.3 million during the first year to ETB 8.4 million during the second year. The projected gross profit during the first and second years of operation will therefore be ETB 5.3 million and ETB 10.1 million, respectively.

The annual general and administration expenses are projected at ETB 3.3 million during the first and second years of operation and will go up to approximately ETB 3.4 million during the third and fourth years.

Included as non-operating expenses is interest payment on long-term loan. It is projected that principal and interest on the long-term loan will be paid over 10 years, starting from the first year of operation. The Enterprise will pay approximately ETB 748.2 thousand in interest on the long-term loan during the first year and ETB 1.6 million during the second year of operation.

Finally, business will generate a net profit of ETB 1.2 million and ETB 5.2 million during the first and second years, respectively, during which profit tax payments are exempted. During the third year of operation, the net profit will be slightly reduced to ETB 4.9 million during which the Enterprise will pay ETB 2.6 million in corporate

profit tax. The net profit to sales during the first, the second and the third years of operation will be 10 percent, 28 percent and 21 percent respectively.

Table 24. Summary of Financial Projections, '000 ETB

	2007/8	2008/9	2009/10	2010/11	2011/12
Balance Sheet					
1. Total Assets	11,393.2	8,993.8	8,371.0	9,752.8	12,311.8
2. Total Liabilities	9,024.8	8,362.3	7,823.8	8,748.6	10,283.2
3. Total Equity	2,368.4	13,335.2	14,803.0	16,521.2	18,244.2
4. Total Liabilities and Equity	11,393.2	21,697.5	22,626.8	25,269.8	28,527.4
Income Statement					
1. Revenue	3,793.6	11,739.4	25,234.3	46,291.8	73,841.7
2. Cost of Sales	3,157.0	9,768.2	21,232.5	38,868.7	61,904.9
3. Gross Profit	636.7	1,971.2	4,001.8	7,423.0	11,936.8
4. General and Admin Expenses	2,222.0	3,109.6	3,345.0	4,580.1	6,230.0
5. Operating Profit	(1,585.3)	(1,138.4)	656.8	2,843.0	5,706.8
6. Other Expenses	277.7	579.7	541.1	499.1	453.4
7. Income before taxes	(1,863.0)	(1,718.0)	115.8	2,343.9	5,253.4
8. Profit Tax	-	-	40.5	820.4	1,838.7
9. Net Profit	(1,863.0)	(1,718.0)	75.3	1,523.5	3,414.7
Cash Flow Statement					
1. Cash Inflow:					
Increase in equity capital	4,231.4	-	-	-	-
Long-term loans received	6,347.1	-	-	-	-
Income from operations	(991.1)	(544.2)	1,251.0	3,437.2	6,301.0
Total Cash Inflow	9,587.4	(544.2)	1,251.0	3,437.2	6,301.0
2. Total Out Flow:					
Land Lease cost	600.0	43.9	43.9	43.9	43.9
Construction	1,250.0				
Fuel Tankers	540.0				
Metering Pumps	100.0				100.0
Fire fighting equipment	200.0				200.0
Office Furniture and Equipment	113.5				113.5
Vehicles	1,800.0				1,800.0
Pre-operation Expenditures	75.0				
Interest payment on loan	-	598.2	561.2	520.9	477.2
Repayment of loan	-	422.8	459.8	500.0	543.8
Profit tax paid	-	-	8.1	87.0	820.4
Dividends paid	-	-	10.6	113.2	1,066.5
Total cash outflow	4,678.5	1,064.8	1,083.6	1,265.0	5,165.2
3. Net Cash Flow	4,908.86	(1,609.02)	167.46	2,172.12	1,135.82
4. Cumulative cash balance	4,908.86	3,299.83	3,467.29	5,639.41	6,775.23

Table 25. Loan Repayment Schedule

Project Year	Loan Receipt	Balance Begin. of Year	Interest due	Loan Repayment			Balance End of Year
				Interest Payment	Principal Payment	Total Payment	
0	6,347,100	6,347,100	277,686	-	-	-	6,624,786
1		6,624,786	579,669	598,165	422,778	1,020,943	6,183,511
2		6,183,511	541,057	561,172	459,771	1,020,943	5,703,625
3		5,703,625	499,067	520,942	500,001	1,020,943	5,181,748
4		5,181,748	453,403	477,192	543,751	1,020,943	4,614,208
5		4,614,208	403,743	429,614	591,330	1,020,943	3,997,008
6		3,997,008	349,738	377,873	643,071	1,020,943	3,325,802
7		3,325,802	291,008	321,604	699,340	1,020,943	2,595,867
8		2,595,867	227,138	260,412	760,532	1,020,943	1,802,062
9		1,802,062	157,680	193,865	827,078	1,020,943	938,799
10		938,799	82,145	121,496	899,448	1,020,943	(0)

10.6 Financial Returns

The financial profitability analyses for the fuel and stove marketing businesses combined indicate that the Enterprise will generate a reasonable rate of return. The internal rate of return (IRR) is 38 percent and the net present value (NPV) at a discount rate of 8.75% (the current commercial banks lending rate) is nearly ETB 23.6 million. The Enterprise will generate a net present value of ETB 20.2 million and ETB 17 million at discount rates of 10.5 percent and 12.5 percent, respectively. On the other hand, when the fuel and stove marketing businesses are treated separately, the stove marketing business will not be financially viable; the IRR is only 6.8%. However, when the CDM financing is included the IRR increases seven fold to over 53% and the NPV to ETB 9 million at 12.5% discount rate. With the CDM financing, the IRR for the fuel and stove marketing business increases to 46%. The financial returns are summarized below.

Table 26. Summary of Project Worth with and Without CDM Financing

Project Worth	Fuel and Stove		Fuel Marketing	Stove Marketing	
	Without CDM	With CDM		Without CDM	With CDM
NPV at 8.75%, '000 ETB	23,647	40,518	23,711	(64)	12,109
NPV at 10.5%, '000 ETB	20,193	35,008	20,304	(112)	10,565
NPV at 12.5%, '000 ETB	16,831	29,633	16,987	(156)	9,052
IRR on Equity	38.1%	45.8%	39.7%	6.8%	53.3%

10.7 Breakeven Analyses

The breakeven point identifies output quantities at which total profits are zero. At that point the volume of activity produces equal revenues and costs and therefore the Enterprise will have no profit or loss at this sales levels; it therefore breaks even. In order to identify the break-even point either the contribution margin approach or an equation approach could be used.

The Enterprise will sell its ethanol cooking fuel and the single burner stove at ETB 2.85 per liter and 530 per stove. Variable costs are estimated at ETB 2.25 per liter for

ethanol and ETB 442 per stove. The gross margin (selling prices less variable costs) therefore equals ETB 0.6 for the fuel and ETB 88.33 for the stove. The gross margins should cover the fixed cost of the fuel marketing and the stove of ETB 1.86 million, and ETB 0.36 million, respectively. Based on these data, the break-even points could be identified for each product using the expression:

Break-even volume	=	Fixed costs/contribution margin		
Fuel	=	1,861,664/0.60	=	3,115,233 liters, and
Stove	=	360,350/312	=	4,080 units

Table 27. Breakeven Determination

	Item		Value
1	**Fixed Costs (ETB)**		
1.1	Fuel		1,861,664
1.2	Stove		360,350
2	**Variable costs (ETB)**		
2.1	Fuel, ETB/Liter		2.25
2.2	Stove, ETB/1 burner stove		442
3	**Selling Prices (ETB)**		
3.1	Fuel, ETB/Liter		2.85
3.2	Stove, ETB/1 burner stove		530
4	**Margin (ETB)**		
4.1	Fuel	3.1 – 2.1	0.60
4.2	Stove	3.2 – 2.2	88.33
5	**Breakeven volume**		
5.1	Fuel, liters	1.1 / 4.1	3,115,233
5.2	Stove, units	1.2 / 4.2	4,080

10.8 Sensitivity Analyses

Sensitivity analyses were carried out to test the sensitivity of the commercial profitability of the ethanol fuel and stove marketing business to changes in basic independent variables such as investment costs, general and administrative expenses, borrowing interest rates, and share of equity capital to total investment requirement. It is assumed that any changes in input prices will be taken care of in product pricing and therefore are not considered in the sensitivity analyses.

The sensitivity analyses indicate that the financial viability was found to be less sensitive to changes in initial investment costs and interest rates. A 10 percent increase in investment costs would reduce the IRR by only 2.1 percent (i.e., from 38.1 percent to 37.3 percent). Similarly, an increase in interest rate from 8.75 percent (the current commercial bank borrowing rate) to 10.5 percent will reduce the IRR by only 1.6 percent.

The financial viability was relatively sensitive to changes in general and administrative expenses. As can be seen from the table below, a 20 percent increase in general and administrative expenses will reduce the IRR by about 23.1 percent to 29.3 and the Net Present Value will be reduced by nearly 30 percent or by ETB 7 million. Accordingly, it is advised that the management need to be cautious of any increases in general and administrative expenses.

Table 28. Sensitivity of the IRR and NPV to Selected Variables

Variable	IRR (%)	% change	NPV ('000 ETB)	% change
Interest Rate				
8.75%	38.1		23,647.00	
10.50%	37.5	(1.6)	20,192.50	(14.6)
12.50%	36.8	(3.4)	16,830.70	(28.8)
Equity Capital:				
30.00%	36.8	(3.4)	22,794.6	(3.6)
50.00%	39.4	3.4	24,499.4	3.6
60.00%	40.7	6.8	25,351.8	7.2
Investment costs:				
Increase by 10%	37.3	(2.1)	23,135.6	(2.2)
Increase by 20%	36.5	(4.2)	22,624.1	(4.3)
Increase by 30%	35.8	(6.0)	22,111.6	(6.5)
General and Admin. Expenses				
Increase by 10%	33.7	(11.5)	20,159.5	(14.7)
Increase by 20%	29.3	(23.1)	16,663.5	(29.5)
Increase by 30%	25.1	(34.1)	13,167.6	(44.3)

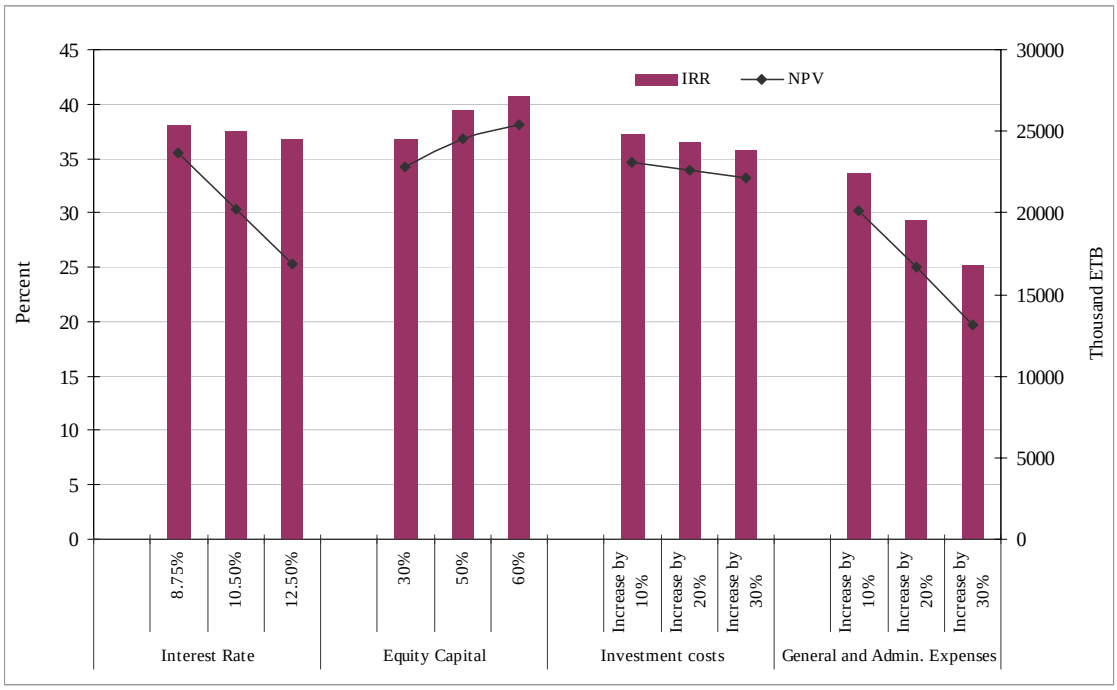

Figure 8- Sensitivity of IRR and NPV to Changes in Selected Variables

11 ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

The ethanol fuel and stove marketing is expected to have significant economic, social and environmental benefits. These include employment generation, saving of foreign exchange through substitution of imports, and earning of foreign exchanges from sale of Certified Emission Reduction.

11.1 Foreign Exchange Savings

Ethanol cooking fuel will substitute imported kerosene and thus saving scarce foreign exchange. As shown in the table below, the present value of the net foreign exchange saving (foreign exchange savings less the foreign exchange requirements for the production and marketing of the fuel and the stoves), is about US$ 51 million. Additionally, the business has the potential to earn approximately US$1.5 million in foreign exchange through sales of CERs.

Table 29. Impact on Foreign Exchange

	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2016/17
Kerosene displaced, '000 Liters	748	2,487	6,039	11,368	18,473	27,354	62,878
Foreign exchange saved, '000 US$	443	1,472	3,574	6,727	10,932	16,187	37,209
Foreign exchange requirement,'000 US$	1,036	501	803	1,455	2,301	3,339	7,196
Ethanol Production,'000 US$	81	270	656	1,234	2,006	2,970	6,828
Ethanol Distribution,'000 US$	863						
Stove Import/Production,'000 US$	92	231	147	221	295	368	368
Net Foreign Exchange Saving,'000 US$	(288)	1,986	5,236	9,912	16,172	(288)	55,681
Present Values @ 12.5% discount rate:							
Foreign exchange saving, '000 US$	64,653						
Foreign Exchange Expenditure, '000 US$	14,124						
Ethanol Production,'000 US$	11,863						
Ethanol Distribution,'000 US$	863						
Stove Import/Production,'000 US$	1,397						
Net Foreign exchange saving, '000 US$	50,529						
Foreign Exchange Earnings sale of CERs							
Sales of CERs, '000 US$	11.2	39.1	95.0	178.9	290.7	430.4	989.4
Transaction Costs, '000 US$	200.0	20.0	20.0	20.0	20.0	20.0	20.0
Net CERs sales Revenue, '000 US$	(188.8)	19.1	75.0	158.9	270.7	410.4	969.4
PV of Net CERs Sales '000 US$	1,448						
Total Net Saving and Earnings, '000 US$	51,977						

11.2 Employment and Social Impacts

The ethanol fuel and stove marketing business will offer employment opportunities to a total of 44 people. In addition, the production of ethanol in large scale in Ethiopia should result in the creation of new employment opportunities in agriculture and agro-industry, providing for considerable and sustainable rural development opportunities. It should also result in reducing urban unemployment through its direct employment creation in the marketing and distribution of the fuel and in the local production of stoves. Furthermore, the business is likely to result in more equitable income distribution as it will employ more low-skilled and semi-skilled laborers.

11.3 Health and Environmental Benefits

The environmental problems associated with household cooking range from the indoor to the global. The effect of indoor air pollutants on health as documented by various researchers and organizations include the following:

a) Carbon monoxide: carbon monoxide exposure will lead to various health problems. Exposure to CO at lower level will cause headache at higher levels may cause loss of conscious and even death. Long term effects of CO exposure include risk to fetus;

b) Non Methane Volatile Organic Compounds (NMVOC). These compounds include various constituents of which benzoapyrene is the most studied and known to cause cancer;

c) Formaldehyde (HCHO): Formaldehyde is a colorless and pungent gas known to cause chronic reparatory diseases. at large dose irritation, pulmonary damage and even death may occur;

d) Repairable suspended particulates (RSP): Respirable suspended particulates are those particulates of size PM10 or less and are part of the total suspended particulates generated when biomass fuel and liquid petroleum fuels are combusted in household stoves. The RSP containing hydrocarbons are known to cause respiratory infections mainly in children exposed to indoor air pollutants; and

e) Sulfur dioxide (SO_2): Sulfur emissions are not major problems for biomass fuels as most biomass fuels (except dung) contain very little sulfur. However it could be generated at higher levels when kerosene or other petroleum fuels are combusted. Sulfur emissions cause irritation of the mucus membrane and of the eye and also chronic bronchitis.

Curbing indoor air pollution will alleviate chronic respiratory problems among women and will prevent child morbidity and mortality.

Annexes

Annex I

The Business Plan Household Energy Sample Survey in Addis Ababa

1. Methodology

The consultant will use the Shell Foundation's ADT business plan (BP) toolkit for the preparation of the Ethanol fuel and stove development plan. At this initial stage, however, standard BP development guidelines are used to determine the data input and analysis requirements. The following seven parts constitute the plan:

a. *Industry analysis*. Places the business in the context of the need for its services and the business environment including the competition. The service to be provided is described and differentiated from those of competitors; comparative advantages are explored; and business objectives are defined.

   Methods
   a. Review and analysis of business concepts
      - Draw lessons from similar business development strategies in developing world markets
   b. Review and analysis of the acceptability survey for ethanol fuel and stove conducted by Gaia in Addis Ababa.
      - Analysis of costs and benefits of cooking with ethanol vs. other urban cooking fuels in selected Ethiopian cities.
   c. Analysis of trends in the urban fuel market in Ethiopia to evaluate the viability of the ethanol business in the future.

b. *Market analysis*. Involves identification and analysis of needs, customers and the Company's competitiveness. The current and projected demand for the service is assessed; the competition is evaluated in terms of profitability, sales, pricing, marketing strategies; a pricing strategy is formulated; and a sales forecast is made.

   Methods

   a. Demand assessment for ethanol
      - Review of the household survey conducted by Gaia (2005)
      - Review of secondary data from the CSA (2004)
      - Review of urban household energy studies from the EREDPC (1994 to 1998)
      - A sample household survey in Addis Ababa.

      Secondly the baseline survey conducted by Gaia doesn't seem to have addressed the marketing aspect either for the fuel or for the stove. There is need to identify strategies for raising awareness and directing marketing information. The baseline survey did not cover these issues.

   b. Assessment of volume and value of business for household fuels in the major cities
      - Review of import and sales data for kerosene and LPG; sales data for electricity; estimate of the charcoal and fuelwood market from the EREDPC.
      - Review of price data for charcoal and fuelwood from the Central Statistical Authority.

c. *Marketing and promotional plan*. Develops strategies to deliver the product to customers. Service delivery channels and promotion strategies are identified.

   Methods

a. Marketing channels
   - Assessment of the marketing channels employed for kerosene and LPG
   - Review of the marketing strategy employed for K50
   - Assessment of distribution costs (the price building up), and legal requirements
     - Consultation with key stakeholders (Ministry of Trade and Industry, Investment Commission)

b. Promotion
   - Sample survey to identify best strategies for promotion of ethanol (households interviewed in the stove acceptability survey may be used)
   - Review of the promotion strategies used for efficient stove dissemination (by the EREDPC)

d. *Service processes*. This explains the processes involved from wholesale ethanol purchase to delivery to the final user. It will also show the ethanol stove import (or local assembly) and marketing process. The objective is to evaluate resource requirements (including finance, human, and institutional) for the establishment and operation of the business.

Methods

a. Determination of short and medium range supply availability and costs.
   The level of demand (determined in step 2) and the volume of ethanol supply from Finchaa (or other sources) determine the volume of business for the enterprise. The potential supply of ethanol in the short and medium term will be estimated through discussions with management of Finchaa and other sugar estates. The Ministry of Mines and Energy will also be consulted on the viability of methanol production from natural gas.
   - Determine cost of supply (wholesale purchase, transport, marketing, retailing)
   - Evaluate risks, alternative sources of ethanol supply
   - Assess legal and technical requirements for ethanol purchase, storage, distribution

b. Policy, regulatory and technical support issues
   a. Review of policies, regulations and proclamations in place

e. *Institutional analysis*. The organizational structure of for the business and its human resource requirements (management and staff) are assessed.

f. *Financial plan.* This plan shows the financial risks and benefits of the enterprise. It will be a key requirement from partners and bankers. Investment and operation costs are shown as well as returns on investment.

g. *Risk analysis*. The risks to the business will be assessed in terms of market demand, resource availability and costs, and the competition. Sensitivity analysis will be carried out to evaluate the profitability of the business with different resource costs, prices, sales volume and other sensitivity parameters. Strategies will be formulated to minimize adverse impacts and to exploit benefits.

Checklist for the market survey (the draft household questionnaire is attached)

a. General household characterization
   - Household size
   - Type of employment, education, age
   - Type of house, ownership of house
   - Water supplies, electricity access, and bills
   - Ownership of phone, radio, TV, other electronic media
   - Water heating for bathing (what do they use, how much, frequency)
   - Refrigeration
   - Who makes purchase decisions in the household? For major purchases, for food, and for fuel and stove?
   - Monthly expenditures for the household

b. Market and promotional information
   - How to reach potential customers (media = press, radio, TV, other)
     - Type of media, specific papers and programs, hours attended
   - Food and fuel purchases
     - Where, when, volume, value
     - Reasons for choices for places, times
   - New product purchase habits
   - Payments (credit, cash)

c. Fuel use (fur each fuel)
   - Food preparation (who buys the ingredients, prepares meals, buys the fuel)
     - Cooking done by employed maid (resident, non-resident), woman of the house, female children, man of the house, other
     - Who makes the decision to buy stoves, fuels, etc
   - Fuelwood, dung, charcoal, kerosene, electricity, LPG
   - Types of stoves owned, used, expenditure, life
   - Frequency of use
   - Baking, cooking (wat, coffee, tea, water heating)
   - Frequency of purchase, volume of purchase, value of purchase
     - Stove purchases = who makes the decision? How are they bought (cash, credit)? If credit, how (ikub, work place, ikub, other)?
   - Place of food preparation (separate kitchen, inside main house)?

d. Preferences
   - What are the drawbacks of existing fuels and stoves
   - What do you appreciate most in existing fuels and stoves (cost of fuel, cost of stove, cleanness, speed, easy access to fuel/reliability, ease of use, safety, tradition, taste of food, durability of stove, other
   - What are the drawbacks (cost of fuel, cost of stove, hard to obtain/not reliable, smell, smoke, break down, other)
   - Comparative cost of cooking
     - Which fuels and stove are the cheapest for cooking, second, third?
     - Which fuels and stoves are the cheapest for baking, second?

Ethanol fuel and stove market development

SURVEY OF THE URBAN COOKING MARKET
QUESTIONNAIRE FOR HOUSEHOLDS

Enumerator identification		**11.3.1**
Interview date		A
Enumerator identification		B
Supervisor identification		C
Area and sample identification		
Region		D
Zone		E
City		F
Wereda		G
Kebele		H
Introduction of purpose of survey to households		
House number or name of head of household		I
Name of respondent to interview		J
Contact phone		K
Household characteristics		
Number of persons in the household		L
Adult men – older than 15 years		M
Adult women – older than 15 years		N
Children – 15 years or younger		O
Household head and spouse details		
Details about the head of household		
Sex	Male 1	P
	Female 2	
Age		Q
Educational attainment—grade		R
Main occupation	Government employed 1	S
	Self employed (incl. trade) 2	
	Private/NGO salaried 3	
	Retired 4	
	Other 5	
	Specify _____	T
Details about the spouse		
Sex	Male 1	U
	Female 2	
Age		V
Educational attainment—grade		W
Main occupation	Government employed 1	X
	Self employed (incl. trade) 2	
	Private/NGO salaried 3	
	Retired 4	
	Other 5	
	Specify _____	Y

Fuel consumption, expenditure, stove use	KEROSENE			
Do you use kerosene in the home?	Yes	1		A
	No	2		
How often do you use it for cooking?	More than once a day	1		B
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for reheating?	More than once a day	1		C
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		D
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use kerosene for other purposes?	Water heating (bathing)	1		E
	Lighting	2		F
	Space heating	3		G
	Other	4		H
	Specify			I
How many liters of kerosene do you buy per month? *(enumerator helps with computation)*				J
How many purchases do you make per month?				K
What type of kerosene stove do you use?	1 burner wick stove	1		L
	2 burner wick stove	2		
	1 burner pressure stove	3		
	2 burner pressure stove	4		
	Gravity pressure stove	5		
What do you like about kerosene cooking?	Fuel is inexpensive	1		M
	Good fuel availability	2		N
	Stove is inexpensive	3		O
	Stove is durable	4		P
	Clean to work with	5		Q
	No smoke	6		R
	No smell	7		S
	Fast	8		T
	Safe	9		U
	Food tastes good	10		V
	Other	11		W
	Specify			X
What don't you like about kerosene cooking?	Fuel is expensive	1		Y
	Fuel availability low	2		Z
	Stove is expensive	3		Aa
	Stove is not durable	4		Ab
	Dirty	5		Ac
	Smoke	6		Ad
	Smell	7		Ae
	Slow	8		Af
	Not safe	9		Ag
	Food tastes bad	10		Ah
	Other	11		Ai
	Specify			Aj

Fuel consumption, expenditure, stove use	CHARCOAL			
Do you use Charcoal in the home?	Yes	1		A
	No	2		
How often do you use it for cooking?	More than once a day	1		B
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for reheating?	More than once a day	1		C
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		D
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use Charcoal for other purposes?	Water heating (bathing)	1		E
	Lighting	2		F
	Space heating	3		G
	Other	4		H
	Specify			I
How many kg of Charcoal do you buy per month? (Enumerator helps in computation)				J
What type of charcoal stove do you use?	Mostly traditional metal	1		K
	Mostly Lakech	2		
	Equally (Lakech+Trad)	3		
What do you like about Charcoal cooking? Rank!	Fuel is inexpensive	1		L
	Good fuel availability	2		M
	Stove is inexpensive	3		N
	Stove is durable	4		O
	Clean to work with	5		P
	No smoke	6		Q
	No smell	7		R
	Fast	8		S
	Safe	9		T
	Food tastes good	10		U
	Other	11		V
	Specify			W
What don't you like about Charcoal cooking? Rank!	Fuel is expensive	1		X
	Fuel availability low	2		Y
	Stove is expensive	3		Z
	Stove is not durable	4		Aa
	Dirty	5		Ab
	Smoke	6		Ac
	Smell	7		Ad
	Slow	8		Ae
	Not safe	9		Af
	Food tastes bad	10		Ag
	Other	11		Ah
	Specify			Ai

Fuel consumption, expenditure, stove use	FUELWOOD			
Do you use Fuelwood in the home?	Yes	1		A
	No	2		
How often do you use it for cooking?	More than once a day	1		B
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How many times per week do you bake injera/bread with it? (0 = None)				C
How often do you use it for reheating?	More than once a day	1		D
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		E
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use Fuelwood for other purposes?	Water heating (bathing)	1		F
	Lighting	2		G
	Space heating	3		H
	Other	4		I
	Specify			J
How many **kg** of Fuelwood do you buy per month? (Enumerator helps in computation)				K
What do you like about Fuelwood cooking? Rank!	Fuel is inexpensive	1		L
	Good fuel availability	2		M
	Stove is inexpensive	3		N
	Stove is durable	4		O
	Clean to work with	5		P
	No smoke	6		Q
	No smell	7		R
	Fast	8		S
	Safe	9		T
	Food tastes good	10		U
	Other	11		V
	Specify			W
What don't you like about Fuelwood Cooking/baking? Rank!	Fuel is expensive	1		X
	Fuel availability low	2		Y
	Stove is expensive	3		Z
	Stove is not durable	4		Aa
	Dirty	5		Ab
	Smoke	6		Ac
	Smell	7		Ad
	Slow	8		Ae
	Not safe	9		Af
	Food tastes bad	10		Ag
	Other	11		Ah
	Specify			Ai

Fuel consumption, expenditure, stove use	**LPG**			
Do you use LPG in the home?	Yes	1		A
	No	2		
How often do you use it for cooking?	More than once a day	1		B
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for reheating?	More than once a day	1		C
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		D
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use LPG for other purposes?	Water heating (bathing)	1		E
	Lighting	2		F
	Space heating	3		G
	Other	4		H
	Specify			I
How many **kg** of LPG do you buy per month? (Enumerator helps in computation)				J
What type of LPG stove do you use?	1 burner (or screw tops)			K
	2 burners			
	More than 2 burners			
What do you like about LPG cooking? Rank!	Fuel is inexpensive	1		L
	Good fuel availability	2		M
	Stove is inexpensive	3		N
	Stove is durable	4		O
	Clean to work with	5		P
	No smoke	6		Q
	No smell	7		R
	Fast	8		S
	Safe	9		T
	Food tastes good	10		U
	Other	11		V
	Specify			W
What don't you like about LPG Cooking? Rank!	Fuel is expensive	1		X
	Fuel availability low	2		Y
	Stove is expensive	3		Z
	Stove is not durable	4		Aa
	Dirty	5		Ab
	Smoke	6		Ac
	Smell	7		Ad
	Slow	8		Ae
	Not safe	9		Af
	Food tastes bad	10		Ag
	Other	11		Ah
	Specify			Ai

Fuel consumption, expenditure, stove use	ELECTRICITY			
Do you use Electricity for baking?	Yes	1		A
	No	2		
How did you buy the electric mitad?	Cash	1		B
	Credit	2		
	Ikub	3		
	Other	4		
	Specify			C
How many times per week do you bake?				D
Do you use Electricity for cooking?	Yes	1		E
	No	2		
How often do you use it for cooking?	More than once a day	1		F
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for reheating?	More than once a day	1		G
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		H
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use Electricity for other purposes?	Water heating (bathing)	1		I
	Ironing	2		J
	Other	3		K
	Specify			L
What is the monthly electricity bill (ETB)?				M
What type of electric **stove** do you use?	1 hot plate	1		N
	2 or more hot plates	2		
What do you like about Electricity cooking? Rank!	Electricity is inexpensive	1		O
	Good fuel availability	2		P
	Stove is inexpensive	3		Q
	Stove is durable	4		R
	Clean to work with	5		S
	Fast	6		T
	Safe	7		U
	Food tastes good	8		V
	Other	9		W
	Specify			X
What don't you like about Electricity Cooking/baking? Rank!	Electricity is expensive	1		Y
	Stove is expensive	2		Z
	Slow	3		Aa
	Not safe	4		Ab
	Food tastes bad	5		Ac
	Other	6		Ad
	Specify			Ae

Fuel consumption, expenditure, stove use	OTHER FUELS			
Other cooking or baking fuel used in the home:				A
How often do you use it for cooking?	More than once a day	1		B
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How many times per week do you bake injera/bread with it? (0 = None)				C
How often do you use it for reheating?	More than once a day	1		D
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
How often do you use it for coffee/tea?	More than once a day	1		E
	Once a day	2		
	Less than 3 times a week	3		
	Never	4		
Do you use the fuel for other purposes?	Water heating (bathing)	1		F
	Lighting	2		G
	Space heating	3		H
	Other	4		I
	Specify			J
How much do you spend per month on fuel?				K
What stove is used for the fuel?				L
What do you like about this fuel? Rank!	Fuel is inexpensive	1		M
	Good fuel availability	2		N
	Stove is inexpensive	3		O
	Stove is durable	4		P
	Clean to work with	5		Q
	No smoke	6		R
	No smell	7		S
	Fast	8		T
	Safe	9		U
	Food tastes good	10		V
	Other	11		W
	Specify			X
What don't you like about this fuel? Rank!	Fuel is expensive	1		Y
	Fuel availability low	2		Z
	Stove is expensive	3		Aa
	Stove is not durable	4		Ab
	Dirty	5		Ac
	Smoke	6		Ad
	Smell	7		Ae
	Slow	8		Af
	Not safe	9		Ag
	Food tastes bad	10		Ah
	Other	11		Ai
	Specify			Aj

Fuel and stove preferences					
		Now	2 years ago		
What is the cheapest & second cheapest fuel for cooking? (1=cheapest, 2=second cheapest)	Kerosene			A	G
	Charcoal			B	H
	Fuelwood			C	I
	LPG			D	J
	Electricity			E	K
	Dung/BLT/other residue			F	L
		Now	2 years ago		
What is the cheapest & second cheapest fuel for baking? (1=cheapest, 2=second cheapest)	Fuelwood			M	P
	Electricity			N	Q
	Dung/BLT/other residue			O	R
Food preparation in the home					
Who cooks for the household, mostly?	Hired cook/maid	1			S
	Woman of the house	2			
	Woman & fem. children	3			
	Man of the house	4			
	All members equally	5			
Who bakes injera for the household, mostly?	Hired cook/maid	1			T
	Woman of the house	2			
	Woman & fem. children	3			
	All members equally	4			
Purchase decisions					
Who makes the decision to buy major items for the household?	Husband	1			U
	Wife	2			
	Husband & wife	3			
	All members equally	4			
Who decides if the household needs to buy a new stove?	Husband	1			V
	Wife	2			
	Husband & wife	3			
	All members equally	4			
Marketing information					
At what times do you watch TV?					W
What TV program do you like most?					X
At what times do you listen to the radio?					Y
What radio program do you like most?					Z
What newspaper do you read often?					Aa
Would you be interested in a new fuel?					Ab
What do you look for in a new fuel supply? Rank!	Cheap fuel				Ac
	Dependable availability				Ad
	Cheap stove				Ae
	Clean and convenient				Af
	Safe				Ag
	Speed of cooking				Ah
	Other				Ag
	Specify				Ah

Housing and utility				
Housing	Detached house	1		A
	Semi detached	2		
	Apartment	3		
	Other	4		
	Specify			B
Kitchen	Detached modern	1		C
	In house modern	2		
	Detached traditional	3		
	In house traditional	4		
	Cooking inside house	5		
	Other	6		
	Specify			D
Water supply	Taps in rooms in house	1		E
	One private tap in compound	2		
	Tap shared	3		
	Communal tap	4		
	Other	5		
	Specify			F
Electricity supply	Own electric meter	1		G
	Shared electric meter	2		
	No meter (from land lord)	3		
	No electricity	4		
	Other	5		
	Specify			H
Household assets and expenditure				
Household equipment	TV			I
	Radio			J
	Refrigerator			K
	Electric iron			L
	Electric water heater			M
What is the household's monthly expenditure?	Less than ETB 200	1		N
	ETB 200-500	2		
	ETB 500-1000	3		
	ETB 1000-2000	4		
	More than ETB 2000	5		

2. Survey Results: Statistical Tables

Cooking Fuel

The sample household energy survey in Addis Ababa conducted as part of this business plan indicated that 98% of households use kerosene while charcoal is used in 91%. However, there is also considerable variation of both kerosene and charcoal consumption across expenditure groups[14]. Households in the highest two expenditure categories use kerosene, while charcoal consumption is 100% among the lower expenditure groups and 70% among the highest expenditure groups. Fuelwood is used by about half of the households.

Monthly consumption of kerosene is 27 liters per households per month in the high expenditure group but only 6 liters in the lowest expenditure category. Similarly households in the higher expenditure category use 44 kilograms of charcoal per month while the corresponding figure for lowest group is 28 kilograms. Fuelwood ranges 62 to 88 kilograms per households per month.

Frequency of use

Kerosene is used more than once a day for cooking in 90% of the households, while charcoal is used by 31% and wood by 7%. A higher percentage (69%) of households also use kerosene for tea and coffee making while only 32% use charcoal for similar purpose.

Table 1
Cooking fuel use by expenditure class

Expenditure class (ETB/month)	N =	Kerosene	Charcoal	Wood	LPG	Electricity
Total	170	98%	91%	49%	15%	2%
<200	5	100%	100%	60%	0%	0%
200-500	39	92%	95%	56%	0%	3%
500-1000	72	99%	92%	54%	10%	3%
1000-2000	44	100%	89%	34%	27%	0%
>2000	10	100%	70%	50%	60%	0%

[14] The five expenditure categories used are, households spending each month – less than Birr 200; between Birr 200 to 500; over Birr 500 to 1000, between Birr 1000 to 2000 and over Birr 2000.

Table 2
Monthly fuel consumption by expenditure class

Expenditure class (ETB/month)	N =	Kerosene Liter/month	Charcoal kg/month	Wood kg/month	LPG kg/month	Electricity kWh/month
Total	170	17	12	76	9	280
<200	5	6	28	88	-	-
200-500	39	12	32	66	-	3,806
500-1000	72	17	31	62	5	6,148
1000-2000	44	21	39	84	12	-
>2000	10	27	44	86	8	-

Table 3
Monthly fuel expenditure by expenditure class, ETB/month

Expenditure class (ETB/month)	N =	Kerosene	Charcoal	Wood	LPG	Electricity
Total	170	72	41	27	53	90
<200	5	25	34	31	-	-
200-500	39	49	39	23	-	1,218
500-1000	72	70	37	22	20	1,967
1000-2000	44	86	47	29	45	-
>2000	10	110	52	30	28	-

Table 4
Stove ownership and use

Kerosene	N =	1 burner wick	2 burners wick	1 burner pressure stove	2 burner pressure stove	Gravity pressure
	167	98%	2%	0%	0%	0%
Charcoal		Lakech	Traditional metal	Lakech & traditional		
	129	40%	60%			
LPG		1 burner	2 or more burners			
	20	5%	95%			
Electricity		1 hot plate	2 or more plates			
	3	33%	67%			

Table 5
Frequency of cooking

	Kerosene	Charcoal	Fuelwood	LPG	Electricity	Other
More than once a day	89%	31%	7%	48%	1%	6%
Once a day	9%	31%	10%	22%	1%	6%
Less than 3 times a week	2%	23%	42%	30%	3%	28%
Never	0%	16%	41%	0%	95%	61%

Table 6
Frequency of use for coffee and tea making

	Kerosene	Charcoal	Fuelwood	LPG	Electricity	Other
More than once a day	68%	32%	3%	13%	1%	0%
Once a day	26%	45%	0%	26%	1%	0%
Less than 3 times a week	2%	17%	1%	26%	0%	0%
Never	4%	6%	96%	35%	98%	100%

Table 7
Major advantages of household fuels and stoves

	Kerosene	Charcoal	Fuelwood	LPG	Electricity
Fuel is inexpensive	2%	27%	25%	0%	0%
Good fuel availability	48%	19%	14%	0%	0%
Stove is inexpensive	12%	10%	6%	0%	0%
Stove is durable	4%	27%	25%	0%	0%
Clean to work with	1%	1%	0%	0%	0%
No smoke	1%	0%	0%	0%	
No smell	0%	0%	1%	0%	
Fast	31%	2%	25%	0%	0%
Safe	1%	2%	2%	0%	0%
Food tastes good	0%	12%	1%	0%	0%
Other	1%	1%	0%	0%	0%

Table 8
Major disadvantages of household fuels and stoves

	Kerosene	Charcoal	Fuelwood	LPG	Electricity
Fuel is expensive	73%	44%	38%	86%	0%
Fuel availability is low	1%	2%	1%	14%	
Stove is expensive	0%	0%	2%	0%	0%
Stove is not durable	0%	3%	0%	0%	
Dirty	2%	1%	14%	0%	
Smoke	11%	35%	32%	0%	
Smell	9%	5%	6%	0%	
Slow	1%	7%	0%	0%	0%
Not safe	4%	3%	5%	0%	0%
Food tastes bad	0%	0%	0%	0%	
Other	0%	2%	1%	0%	0%

Table 9
Cheapest cooking fuel

	Today		2 years ago	
	Cheapest	2nd cheapest	Cheapest	2nd cheapest
Kerosene	29%	36%	69%	21%
Charcoal	40%	37%	18%	52%
Fuelwood	20%	21%	6%	10%
LPG	4%	3%	4%	6%
Electricity	1%	1%	3%	10%
Dung/BLT/other	5%	2%	1%	0%

Table 10
Cheapest baking fuel

	Today		2 years ago	
	Cheapest	2nd cheapest	Cheapest	2nd cheapest
Fuelwood	42%	49%	45%	38%
Electricity	42%	32%	47%	48%
Dung/BLT/Other	16%	20%	8%	13%

Table 11
Interest in a new fuel

	Total
N	165
Yes	**99%**
Cheap fuel	79%
Dependable availability	2%
Cheap stove	8%
Cleanness and convenience	2%
Safety	8%
Speed of cooking	1%
Other	0%

Annex II

Projected Financial Statements