ETHIOPIA

Household Energy Status Report

Draft prepared for the 1st IGAD RHEP Kick Off Workshop, Nairobi, Kenya
15-17 February 2000

MGP with the Ethiopian Energy Studies & Research Centre
Addis Ababa, Ethiopia

Inter-Governmental Authority for Development (IGAD)
Regional Household Energy Programme (RHEP)
IGAD Technical Assistance Contract no 7 ACP
RPR 527

11th February 2000

I. An Overview of Political Economy of Ethiopia

1.1 Ethiopian Economy in the Context of Economic Reform

Situated in the horn of Africa, Ethiopia is the tenth largest country with a total land area of about 1.1 million square kilometers. The country supports a total current population of 60 million with an annual growth rate of 3.4%. This makes the country statistically the second most populous in Sub-Saharan Africa. Only 15% of the total population live in urban areas while the rest, 85%, is classified as rural (CSA, 1995). However, urbanization in the country is proceeding at about 7% per annum, reflecting the high rate of rural-urban migration. The per capita income is estimated to US$ 102[1], which makes Ethiopia one of the poorest country in the world (NBE, 1996/97).

The country's economy heavily depends on Agriculture, with 53.1% of the GDP, 80% of the employment and 80.6% of the country's exports (NBE, 1996/97). Services sector accounts 35.5% of the GDP followed by the Industry sector, 10.6%. Although 80% of the population are engaged in agricultural, more than half suffer food insecurity, unemployment is widespread and over 30% of the population have income below the defined absolute poverty level.

Ethiopia's economic and social woes are deeply rooted in rapid population growth (3 per cent per annum), shortage of arable land, rapid environmental degradation, inadequate and crumbling infrastructure, and years of under-investment in human resources. Moreover, the recurrent drought coupled with inappropriate policies and civil unrest have been causes of stagnation of the agricultural sector and hence the economy as a whole for the past several years. While the agricultural sector could not sustain the country's growing population, the industrial expansion has been constrained by the weakness of the domestic private sector.

The massive state control of productive sectors, trade, financial services and infrastructure during the previous regime has severely hampered the country's productive capacity. The macro-economic stabilization and reform program adopted by the new government has improved the fiscal situation and corrected the price distortions. The government's long-term strategy of "Agricultural Development Led Industrialization (ADLI)" aims at increasing the manufacturing sector to absorb labor and meet the increasing demands of the domestic market. Industrial enterprises are encouraged to emerge on the basis of comparative advantage, utilizing labor-intensive technology and, wherever possible, local raw materials. Accordingly, several policies of adjustment and economic growth are being implemented based on the new economic policy framework. Various restrictions previously placed on the private sector have been removed. Hence, the economy has responded positively to these reforms and recovered over the past few years.

---

[1] *The per capita income is calculated using an exchange rate of US $ 1 = Birr 6.43, the average marginal rate set by the National Bank of Ethiopia in December 1996. The first devaluation of the Birr was made on October 1992 from the fixed Etb 2.1 to 4.98 to a dollar. Since the first devaluation, the Birr has grown weaker and current exchange rate is US $1 = Birr 8.2.*

The energy sector of Ethiopia is one of the least developed in the world despite the presence of an enormous energy resource endowment. This is reflected by the low per capita consumption of energy. For example in the year 1994 average per capita of energy consumption was 302 kilogram of oil equivalent (Kgoe) per year. Of this only about 18.12 Kgoe (6%) was derived from modern energy resources (10% electricity and 90% from petroleum products) while the remaining 94% was secured from traditional fuels.

1.2 Policy, Legislative and Institutional Framework

Since 1992, the current government has embarked on abroad economic reform program aimed at reducing gradually the role of the government in the economy, diminishing state control over productive and commercial enterprises, enhancing the development of a market economy, and stimulating the participation of the private sector. The policy initiatives of the current government also included, among others, restructuring of its institutions, separating policy-making functions from operational activities, revising relevant laws and regulations, and liberalizing prices of wide range of commodities. Among numerous sectoral and intersectoral policies issued by the government energy policy and environmental policy are discussed below for they are directly relevant to the issue at hand.

1.2.1 The Energy Policy

In spite of the fact that the nation is endowed with enormous energy resources, only insignificant portion of the potential has been exploited to-date. Obviously, among others, putting appropriate policies and strategies in place is a pre-requisite for development and utilization of energy resource potential. However, despite prolonged prevalence of energy and related problems in the country, there has been no policy guideline for the sector until 1994. In the past, government policy sought to manage the sector through tight controls, to address the fuel wood/forestry problem and to develop the country's power, petroleum and other energy resources. This was done primarily through public sector programmes and projects using public resources, but relying heavily on the contributions of donors. As a matter of fact, the practice of the previous government in the energy sector was ad-hoc and crises management type rather than full-fledged energy sector policy.

As a result, efforts made in the energy sector in the past were far from alleviating problems inherent to the economy for they lacked policy direction and consistence. Therefore, as part of its extensive economic reform program, the current government formulated and issued a comprehensive energy policy with the following major objectives:

- *To ensure sustainable (reliable, affordable and long lasting) supply of energy*
- *To remove bottlenecks inherent to energy resource development and utilization*
- *To provide guidelines and strategies for the faster development and supply of energy*

- *To prioritize the development of energy resources in order to attain self sufficiency*

- *To increase energy utilization efficiency and reduce wastage*

- *To ensure environmental protection association with the production, supply and consumption of energy.*

The energy policy document states the government's intentions in each of the sub sectors. Thus it aims to address household energy problems by promoting agro-forestry, increasing the efficiency with which biomass fuels are utilized, and facilitating the shift to greater use of modem fuels. Furthermore, it states that the country will rely mainly on hydropower to increase its electricity supply but to also take advantage of Ethiopia's geothermal, solar, wind and other renewable energy resources where appropriate. In addition it aims to further explore and develop oil and gas reserves. It also refers to the need to encourage energy conservation in industry, transport and other energy-using sectors, to ensure that energy development is environmentally sustainable and, to provide appropriate incentives to the private sector.

As has been the case in many developing countries, public investment in the energy sector in Ethiopia has focused on the modern energy sector, and to date has largely ignored traditional and new and renewable sources of energy, and particularly, their use in the rural sector. However, it is apparent that this attitude has changed and there is greater awareness of the importance of these sub-sectors, and a realization of their current and potential importance to the economy. As a result some attention is now being paid to investment in the traditional biomass and rural energy sub-sectors.

However, the energy policy has not given a clear glimpse about renewable energies (solar, mini/micro-hydro and wind) development and utilization and hence there is no distinct strategy drafted in this regard. It is well know that the role of renewables is pivotal to rural electrification of countries like Ethiopia. Firstly, these sources are endogenous and hence there is self-reliance. Secondly, those energy sources are fit to remote and small-scale application. Last but not least, they are environmentally friendly. Therefore, for a country like Ethiopia with more than 85% of its population living in the countryside, appropriate policies, strategies and development support mechanisms need to be put in place in order to encourage development and utilization of renewable sources of energy.

1.2.2 Environmental Policy

The Overall Policy Goal

The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

Specific Policy Objectives

The Policy Seeks to:

- *Ensure that essential ecological processes and life support systems are sustained, biological diversity is preserved and renewable natural resources are used in such a way that their regenerative and productive capabilities are maintained and where possible enhanced so that the satisfaction of the needs of future generations is not compromised; where this capability is already impaired to seek through appropriate interventions a restoration of that capability;*

- *Ensure that the benefits from the exploitation of non-renewable resources are extended as far into the future as can be managed, and minimize the negative impacts of their exploitation on the use and management of other natural resources and the environment;*

- *Identify and develop natural resources that are currently underutilized by finding new technologies, and/or intensifying existing uses which are not widely applied;*

- *Incorporate the full economic, social and environmental costs and benefits of natural resource development into the planning, implementation and accounting processes by a comprehensive valuation of the environment and the services it provides, and by considering the social and environmental costs and benefits which can not currently be measured in monetary terms;*

- *Improve the environment of human settlements to satisfy the physical, social, economic, cultural and other needs of their inhabitants on a sustainable basis;*

- *Prevent the pollution of land, air and water in the most cost-effective way so that the cost of effective preventive intervention would not exceed the benefits;*

- *Conserve, develop sustainably manage and support Ethiopia's rich and diverse cultural heritage;*

- *Ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities; and*

- *Raise public awareness and promote understanding of the essential linkages between environment and development.*

II. Energy Resources, Supply and Demand[2]

2.1 Energy Resource Potential

Ethiopia is well endowed with variety of energy resources consisting of biomass, hydropower, fossil fuels (especially natural gas and coal), geothermal energy and renewable resources such as wind and solar energy. Despite the presence of substantial energy resources, the country's energy supply mainly depends on biomass fuel. These traditional biomass fuels constitute 94% of the total national energy consumption. The contribution from modern energy resource is only the remaining 6% (10% electricity and 90% from petroleum products) (CESEN, Technical Report, 1986). The fact that modern energy resources are not well developed and utilised, a low per capita consumption of energy is reflected in the country. In the year 1994, the average per capita energy consumption per person was 0.302 toe, of which only about 0.02 toe (6%) was generated from modern energy resources (CSA 1994). When this energy consumption is compared with the 1989 figure of other African countries, their consumption of commercial fuels is well over Ethiopia's level (Table2.1).

Table 2.1: Energy Consumption of Modern Fuels in Selected African Countries (1989)

Country	Per Capita Income (USD)	Per Capita Consumption of Modern Fuel(kgoe)	Traditional fuels as % of total energy
Ethiopia	**120**	**19**	**94**
Algeria	**2170**	**637**	**3**
Cot d'Ivoire	**760**	**118**	**59**
Ghana	**380**	**71**	**67**
Kenya	**380**	**71**	**79**
Senegal	**650**	**141**	**51**
Uganda	**250**	**20**	**87**
Zambia	**390**	**142**	**58**
Zimbabwe	**640**	**472**	**25**
Africa		**283**	**37**

Source: World Resources, 1992-93; A report by the World Resources Institute in Collaboration with UNEP and UNDP; Ethiopia's data adjusted as per World Bank Sources.

[2] **Energy Development Programme, 1996/7 - 2001/2, September1996: Energy Department, Ethiopian Ministry of Mines and Energy.**

Although biomass resources currently dominate Ethiopia's energy supply, other energy resources can potentially offer the nation for major development opportunities. To give a highlight of the country's energy resource potential, Biomass, hydropower, natural gas, coal, geothermal, solar and wind are mentioned below.

2.1.1 Biomass Fuel

The total biomass fuel resources amount about 101.3 millions of toe. Biomass fuels including fuel wood, bagasse and other organic residues like dung and crop residues contributing about 93% of the national energy consumption. From the total biomass consumption fuel wood contributes about 82%. Such a huge dependence on fuel wood coupled with its inefficient and unsustainable utilisation has resulted in a massive deforestation and environmental degradation (World Bank, 1994).

Compared to the 40% forest covered land during the beginning of the century, the forest resources of Ethiopia now covers less than 3% of the territory. Table 2.2 shows the current estimates of the area, growth stock and incremental yield of the major vegetation types in Ethiopia.

Table 2.2: Estimates of the area, growth stock and incremental yields of the major vegetation types in Ethiopia

Forest Resources	Area (10^6 ha)	Growing stock m^3/ha	Annual Incremental Yield	
			m^3/ha	Total (10^6 m^3)
High Forest:				
• Slightly disturbed High Forest	0.7	90 – 120	5 –7	
• Heavily disturbed High Forest	1.6	30 – 100	3 – 4	0.3
Woodland	5	10 – 50	1.2	6.4
Bushland	20	5 – 30	0.2	4
Plantation	0.2	na	9.6 – 14.4	1.6
Farm forestry	na	na	na	2.1

(Source: EFAP, 1994)

2.1.2 Hydro Power Potential

With multitude of streams flowing into a number of major river basins that cross the national boundaries carrying millions of cubic meters of waters and soil from Ethiopian highlands to eventually join the Mediterranean or others, Ethiopia is known as the "Water Tower of Eastern Africa". Ethiopia's plentiful hydropower resources, which are distributed in nine major river basins (where more than 50% of the total potential is in the Blue Nile drainage basin) and their innumerable tributaries are estimated to generate 650 Tera Watt Hour (TWH) (CESEN 1986). Of which, the economically affordable energy and power estimates at 40% of the theoretical potential is about 260 TWh and 26.7 GW, respectively. However, only a minute proportion, around 1%, of the nation's hydro resource is developed to-date.

2.1.3 Natural Gas

The discovery of Gas in the Calub structure was first unfolded by Tenneco in 1973. The recent reserve studies also proved the existence of about 68 billion m^3 of gas in two different reservoirs. Following this the Calub gas field is now being under consideration for small-scale natural gas development by a semi-private share company, to supply the domestic market. Another promising gas field is the Hillala area whose exploitable potential was not justified, but some indications recite this resource is about the same volume as that of Calub field.

Recently, a Chinese company at Calub has completed the construction of ten exploration wells and all of them are ready for extraction.

A detail study on the possibility of extracting kerosene and Liquefied Petroleum Gas (LPG), which can be utilized for households as cooking fuels has been completed. Along with it, different laboratory testes have been conducted by Ethiopian Energy Studies and Research Centre (EESRC) on different types of stoves, which can use these particular fuels. However, since the investment cost of the plant and transportation of the fuel to end-users (pipe transportation) has been identified to be high; the government has not yet decided as to how to proceed. At the moment a couple of proposals have been presented to the government by private investors.

On the other hand petroleum resources in Ethiopia could not be ascertained until now. However, some indications (Ecological and Geomorphologic) have been recorded in the Ogaden, Gambella, the Blue Nile Gorge and Makele area.

2.1.4 Coal

Exploration for coal was started early in the 1930's during the Italian occupation. Some areas had been in use since then for brick factories. The coal occurrences previously reported in Ethiopia estimated to be around 40.65 Million tons.

2.1.5 Geothermal Energy

Geothermal energy is one of the new renewable resources with multiple uses. Surface manifestations of this resource in the form of hot springs and steam were known in Ethiopia for a long time in their applications for medical and recreational purposes. Geothermal resources are concentrated along the Ethiopian rift valley system and adjoining highland zones.

The estimated potential for power generation is about 700 MW with the highest potential in the Danakil depression. In Langano-Aluto area a 7.5 MW back-pressure type generation plant is installed and awaiting for commissioning. An additional 30 MW is expected to be obtained from the same field with seven more production wells (Ethiopian Institute of Geological Studies, MME, 1999).

Other locations in Ethiopia, identified for their geothermal potential are Tendaho area in the Afar Region where exploration drilling is underway for power generation purposes, whereas study around lake Abiyata area of the lakes region is on progress.

2.1.6 Solar Energy

In Ethiopia the average solar radiation is more or less uniform, around 5.20 kwh/m^2. The value varies through time, from a minimum of 4.55 kwh/m^2 in July to a maximum of 5.55 kwh/m^2 in February and March; and with location from 4.25 kwh/m^2 in extreme western lowlands to 6.25 kwh/m^2 in Adigrat area (Tigrai) (CESEN, 1986).

2.1.7 Wind Energy

The Ethiopian Meteorological Agency started wind data collection in 1971 in 39 stations systematically distributed over the territory of Ethiopia. Wind speed is variable in different parts of Ethiopia. Highest speed was recorded at the coastal area of the Red Sea, near the Djibouti border. Wind speeds lower than 3.5 m/sec were recorded in the western part of the country. Medium wind speed between 3.5 – 5.5 m/sec exist over most of the eastern part of the country and the central rift valley zone (CESEN 1986).

This resource is a promising potential for water lifting in the rift valley settlements where water is scarce both for irrigation and domestic uses. With continuous effort to locate promising areas, it can also provide a considerable amount of energy for electricity generation.

2.2 Energy Supply and Consumption Pattern

2.2.1 Energy Supply Pattern

Biomass: For the great majority of the population wood and other biomass fuels are the only source of energy. However, the depletion of Ethiopia's forests has put great pressure on fuelwood supplies. Currently woody biomass fuels are supplied by cutting from existing forests without or with little replacement. It claims the largest share (accounting for about 80%) of the total biomass consumed in the country every year.

The total amount of woody biomass supplied in the year 1990/91 amounted 13.5 million toe which is equivalent to 3.9 million ha of forest cover (assuming 10 tonnes/ha production from an average yielding forest). Of which 11.5 million toe or and an equivalent of 3.3 million ha of the forest cover is cleared and supplied for energy purposes. The amount of fuelwood supplied each year indicates an alarming rate of forest clearance every year.

Residue fuels are usually collected freely from farms. Agricultural and crop residues have become important source of fuel for the rural mass, as fuelwood is becoming scarce. For example in 190/91 2.5 million toe of residues fuels are supplied for energy. Using these fuels for fuel contributes for gradual reduction of soil nutrients.

Electricity: The major source of the electricity supplied in the country is hydropower contributing about 92% (378 MW) of the total supply. This amount is, however, only 1.5% of the economically affordable power capacity of the total potential of water resource. The total maximum installed capacity of electric supply comes to be 411 MW, (table1.2). The main interconnected system (ICS) is supplied by five hydro plants with a total capacity of about 371.6 MW and 6.5 MW capacity of thermal plants. Most of the larger population and commercial centers are served by the grid, but many medium size

localities receive only part time, unreliable service from diesel generators operated as part of the self-contained system (SCS), while most towns, villages and rural areas generally lack any access to electricity. Less than 4% of population is believed to have access to electricity. Electric energy consumption per person per year in Ethiopia is estimated to be as low as 20 kWh, which possibly one of the lowest consumption rates among all least developing countries. Recent data shows that there will be electric power deficiency in Ethiopia starting from 1997. Thus, the anticipated growth in power demand calls for additional supply of electric power generation.

TABLE 2.2: EELPA Generation Installed Capacity

SOURCE	ICS		SCS		TOTAL	
	MW	%	MW	%	MW	%
HYDRO	371.6	98.3	6.3	19.1	377.9	92.0
THERMAL	6.5	1.7	26.6	80.9	33.1	8.0
TOTAL	378.1	100.0	32.9	100.0	411.0	100.0

Source: EELPA, Power Sector Development Program (1995/96-1999/2000), Draft Report, April 1996, Addis Ababa, P.I/6

Petroleum products: Petroleum products are the major source of commercial energy accounting for about 90%. Import is the sole source of petroleum products supply to date. Presently, the cost of importing petroleum products, which contributes only 5% the total energy consumption, accounts for about 30% of the total expenditure for import of goods and services. In 1993, the supply of petroleum products amounted to 637,700 tones (WB April 1995:26) of which about 46% is consumed in the transport sub-sector. Almost all of the diesel and gasoline are entirely consumed in the transport sector. Kerosene supply goes to the household sector for cooking (urban) and lighting (rural).

Alternative energy Supply: Alternative energy sources include coal, geothermal, wind, solar and new biomass fuels like briquettes and biogas. The supply of these energy sources is not developed except for the few attempts made to disseminate the briquetting and biogas technologies in the country. All others are in research and development stage.

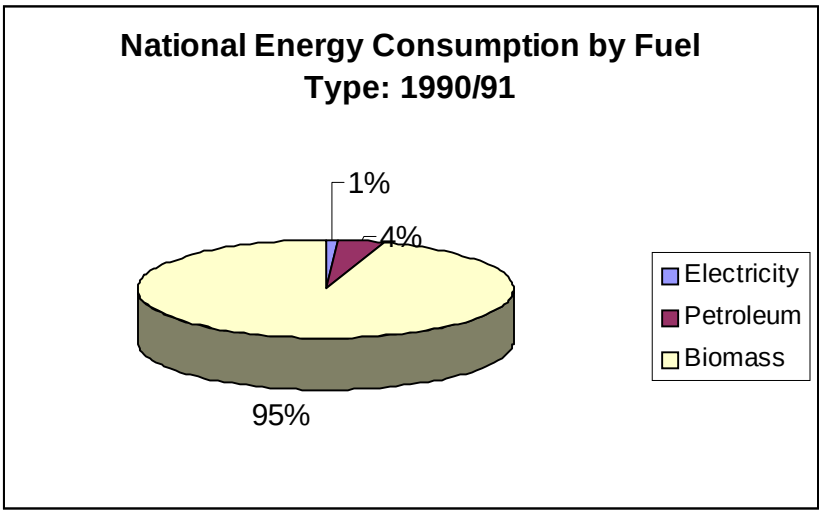
2.2.2 Energy Consumption Pattern

The energy demand of Ethiopia is largely met by traditional fuels. Biomass, which consists of woodfuels and residues contributes the lion share of the total energy consumed each year. The energy balance for the years 1986 to 1993 depicts this fact (Annex Table 7). At present, to gradually overcome the problem of deforestation, which arises from a heavy reliance on biomass fuels, greater effort is being made to develop the modern energy sources.

The total energy used for all purposes in Ethiopia in 1990/91 was 14.8 Million tons of oil equivalent (MTOE). Traditional fuels play a major role in the energy economy of the

country. The breakdown of energy consumption by fuel type for 1990/91 is given in fig 2.1. Wood consists the largest proportion of biomass fuels consumption (81 percent). Followed by dung (9 percent) and agricultural residues (8 percent). Although the share of charcoal is insignificant, a considerable amount of wood us used to make charcoal due to inefficiencies in conversion. Modern fuels, albeit in small quantities are entirely consumed by urban households, except for a small amount of kerosene used for lighting in rural areas.

Figure 2.1- Energy Consumption by Fuel Type-1990/91

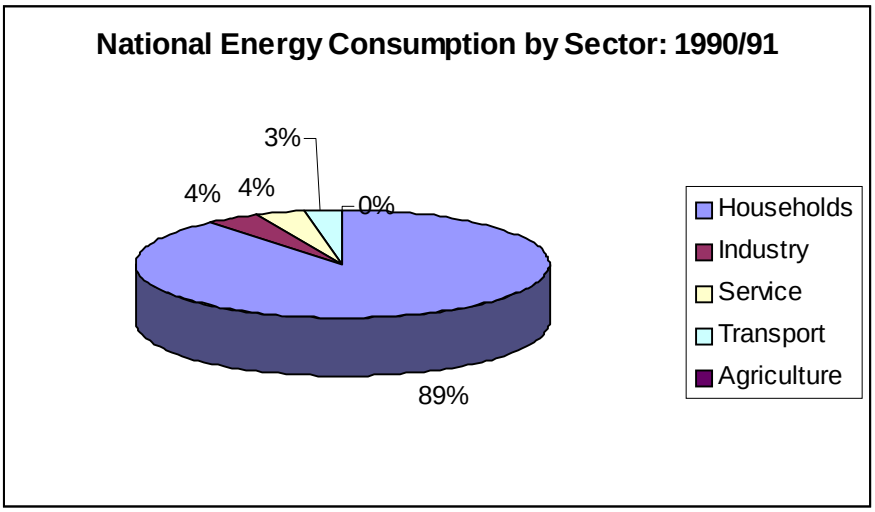


Source: EEA, National Energy Balance, 1990/91, October, 1992.

Sectoral energy is dominated by the non-productive household sector, which accounted for over 80 percent of the total energy consumption each year. For example in 1990/91, 89 percent of the total energy was consumed by the household sector (Fig.2.2), of which over 99 percent was in the form of biomass fuels.

The energy consumption pattern follows the population distribution of the country with 92 percent being consumed by rural households. The share of other sectors, (Industry (4.4%), Service & Others (4%), transport (2.4%); Agriculture (0.13%),) is insignificant.

Figure 2.2 Energy Consumption by Sector: 1990/91



Source: EESRC, National Energy Balance, 1990/91, October, 1992.

The magnitude of energy used annually in Ethiopia has to date been grossly inadequate for the survival and development requirements of its population. The production, conversion and end-use technologies used by all sectors are inefficient. This inefficient utilization of traditional as well as modern fuels by the different sectors has resulted in massive deforestation, devastation of the environment and wasting of the country's meager foreign exchange resource. For instance, the use of three stone (open hearth) stoves in the household sector dissipates nearly 90% of the energy in to the atmosphere. Likewise the useful energy gained using traditional charcoal stoves is not more than 20% of the energy supplied. Moreover, traditional charcoal production methods have very low efficiency. All these contributed to the rapid depletion of the country's forest resources.

III. Profile of Household Energy in Ethiopia

3.1 Background to Household Energy

Despite the fact that the physical environment in several parts of the country has been fragile since sometime and the nation, as one of the poorest in the world, is heavily dependent upon natural resources for most part of its energy and other basic and developmental needs, the issue of sustainable natural resource development and management in general and that of household energy was ignored by its respective governments in the past.

As a matter of fact, woodfuel and energy problems are not new in Ethiopia. For instance, the capital, Addis Ababa, had faced severe woodfuel and construction poles shortage at its formative stage in 1890s. As a result, it was decided to move the capital to Addis Alem, some 30 kms west of Addis Ababa. Later on, however, it was Emperor Menelik's deliberate act of introducing Eucalyptus and Acacia in 1897 that rescued Addis from being abandoned in favour of Addis Alem. Since then policies and development efforts in forestry, woodfuel and energy issues did not receive proper attention. In fact, misguided policies and malfunctioning national institutions of the previous regime have exacerbated environmental and energy crises that manifested themselves since early 1980s.

Studies carried out in the energy sector since early 1980s have clearly identified the household sub-sector as a key issue in the energy sector and the whole economy at large. The studies also indicated several important points that influenced government to respond to household energy realities that were forgotten, or not reacted upon, for several decades. Among some of the most important findings of the studies were:

- *the household sub-sector is the major consumer of energy (94% of the total national energy consumption)*
- *traditional fuels (woody biomass, charcoal, cow dung, agricultural residue) are the major sources of household energy meeting almost entire household energy needs.*
- *household energy use is entirely for subsistence (cooking and lighting)*
- *end-use energy efficiency of household energy use is extremely low (8 to 10%) due to wide spread use of open fire for cooking.*
- *traditional household cooking is highly energy intensive.*

The studies also identified that there is enormous room for cutting down woody biomass consumption in households through improving household energy end-use efficiency; and recommended household energy efficiency improvement as a top priority in the energy sector of the economy.

Although there were some limited efforts made previously to introduce fuel saving stoves in to Ethiopian households, it was as a result of recommendations that arisen from several energy sector studies that the GoE embarked upon some household energy policy measures and implementation of energy efficiency improvement work at household level since mid 1980s. Consequently, a policy decision was made in 1983 to import kerosene stoves in bulk and make both the fuel and the stoves available to households at highly subsidized prices. The intention of the government then was to

buy time in the middle of severe household energy crisis particularly in the capital. However, at present nearly all urban households have owned and are using kerosene stoves and it seems that it would be very difficult for any current or future governments to make a quick shift away from kerosene to other fuels. Secondly, research and development on household cooking energy efficiency improvement was launched in 1989 with an eye on commercial dissemination.

3.2 Impacts of Previous Household Energy Initiatives

Every literature in the area of energy, environment and sustainable development clearly indicated that due to its enormous consumption of energy and heavy reliance on traditional sources of energy, key issue in the energy sector and the economy at large is improving the supply and reducing the costs of household energy. Efforts made to address the household energy problem in the past have yielded remarkable beneficial results both at micro (household) and macro (national) levels. Although much cannot be said about efforts made to increase the supply of biomass fuels, returns on inter-fuel substitution and household energy end-use efficiency improvement efforts made in the past were enormous. Substitution and energy conservation efforts of the past two decades had resulted in:

- massive penetration of kerosene stoves in to urban households,
- enormously growing use of electricity for Injera baking until very recently and,
- massive adoption of improved fuel-saving stoves such as the Lakech charcoal stove and the Mirte Injera stove among urban households

Simple calculation of impacts of the above three household energy interventions reveals that hundreds of thousands of tones of woody biomass was conserved each year due to each measures.

Table 5.1: Annual Impact of Previous Household Energy Interventions (1998)

Fuel	Wood Equiv. (MT)	Savings (ha)	% (ha)
Kerosene	239,480	26,609	21%
Electricity (Addis Only)	280,800	31,200	25%
Improved Stove Lakech	328,500	36,500	29%
Improved Stove Mirte (HH)	31,262	3,474	3%
Improved Mirte (Commercial)	257,400	28,600	23%
Total (1998)	1,137,442	126,383	100%

Assumptions:

- Woody biomass yield 15 cu. m. per ha (**sustainable offset**)
- 1 cu.m. = 600 kg
- Charcoal conversion efficiency 16.67%
- Savings due to Mirte 0.13 kg per Injera baked
- Savings due to Lakech 0.125 kg per household per day
- 1.2 million Lakech in use in1998
- 110,000 Mirte in use of which 70% is domestic and 30% is for commercial use

- Households bake 60 Injeras per week
- Commercial consumers bake 200 Injeras per day for 300 days per year
- 50% of Addis households used electricity for Injera baking in 1998

Policies are powerful instruments. If the right policies are adopted and implemented properly with eyes wide-open to monitor their effect, they can yield desired outcomes effectively in a fairly short period of time. A policy decision made to adopt kerosene as a domestic cooking fuel in this country in early 1980s resulted in massive penetration of kerosene stoves among urban households. In 1998, kerosene displaced nearly 240,000 metric tones of wood equivalent, which is equivalent to 26,609 ha of woody biomass on a sustainable offset basis.

Similarly, in 1998 alone, some 31,000 ha of land with woody biomass vegetation was freed from further anthropogenic disturbance due to use of electricity for Injera baking in Addis alone. The figure could at least double if all urban households using electricity for Injera baking were taken into account. Over 68,500 ha of vegetation were conserved the same year due to various types of improved fuel-efficient biomass stoves disseminated throughout urban parts of the country. Cumulative impact of the household energy measures taken in the past has resulted in a saving of over 126,000 ha of vegetation in the year 1998 alone.

While efforts made so far to improve household energy situation in the country have shown some fruitful results, there are a number of policy issues that need to be resolved. These are:

- *despite the fact that 85% of the population is living in rural areas, efforts have concentrated urban household energy thus far,*
- *despite the fact that biomass fuels will remain important household fuels for majority of the Ethiopian households for foreseeable future, no efforts were made to increase the supply of biomass fuels,*
- *recently, there is a massive shift of consumers away from electric Injera baking due to progressively increasing domestic electricity tariff,*
- *in spite of the fact that the resource base is getting worse by every passing day, prices of biomass fuels have dropped dramatically currently. This could be due to relaxation of control over free trafficking of biomass fuels and prevalence of food insecurity in several rural areas, which forces farmers to cut trees for sale in desperate search for survival.*

It is clear that efforts by the GoE to reduce biomass fuel demand have borne fruit in many urban areas. Improved charcoal stoves and improved woody biomass *injera mtads,* disseminated by the private sector, have achieved impressive market shares in Addis Ababa and other urban centers. In addition, rapid penetration of electric injera mtads and kerosene stoves, along with libralised policy on kerosene imports, are thought to have reduced woody biomass consumption in Addis Ababa considerably.

However, the above interventions have not penetrated significantly into rural area, and as a result have not had a substantial impact on woody biomass demand levels in those areas. It would appear therefore that rural household energy efficiency improvement is an important area of future intervention in the household energy sector.

3.3 An Overview of Current Household Energy Situation: Urban and Rural Context

Although Ethiopia is endowed with a variety of renewable and non-renewable energy resources, its annual per capita energy consumption, at about 13000 MJ (302 kgoe), is among the lowest in the world. Of this total, 93 percent is estimated to be in the form of fuel wood, charcoal, crop residues and dung, while annual per capita consumption of modern energy sources is extremely low at around 900 MJ (21kgoe). Household sector consumption is of the order of 88 per cent of the total, with 99 percent of this being in the form of biomass fuels.

According to the 1996 ESMAP Energy Assessment, Ethiopia's energy resources in terms of natural gas, coal and hydropower, excluding its solar and wind energy potential, are estimated to be in the order of 10.2 million TJ (239 million toe). In principle therefore, the country's present consumption represents less than seven per cent of its potential resources.

In the early 1980s, it was estimated that over 90 percent of final energy consumed in Ethiopia was in the form of biomass fuels used in households. Though this was similar to the patterns found in neighboring countries, what was different about Ethiopia at the time was that certain areas of the country, especially the north and central, already appeared to be confronted by a severe wood fuel crisis. Existing fuel use and grazing practices were depleting the woody biomass resource base and degrading land productivity so severely in certain regions that the basic resources to maintain a subsistence existence were put at risk.

Although no comprehensive recent data exists on household fuel consumption in rural and urban area, it is clear that the woody biomass fuels consumed in rural households continue to dominate Ethiopia's energy balance. As stated earlier, about 85 percent Ethiopia's population lives in rural areas. Rural dwellers collect and consume the vast majority of biomass fuels used nation-wide, namely woody biomass in the form of branches, leaves, and twigs, dung and crop residues. It is clear that in many areas, particularly in the drier northern regions, the situation is critical, and drastic action is needed. With population growth, demand for biomass fuels can only be expected to increase, thus worsening existing biomass fuels scarcities. Furthermore, rural households have little or no access to or disposable income for conventional fuels.

Sections 3.4 to 3.6 to be written up

3.4 Household Energy Sources (Fuels), Technologies and End-uses

3.5 Ongoing or Planned Activities

3.6 Key Issues in the Household Energy Sector: Gaps, Opportunities and Potentials

IV. Renewable Energy Resources and State of Technology

Energy resources are not constraints for technology development in Ethiopia. Resources, particularly renewables, be it biomass, hydro, solar and perhaps wind are quite abundantly available. However, development and harnessing of these resources has not yet been considerably dealt with for lack of technical capacity and economic reasons. Unlike the other alternatives, the biomass resources remain substantial but are inefficiently used with the traditional methods.

4.1. Renewable Energy Resources

4.1.1. Biomass Energy Resources

Biomass energy resources including fuelwood, bagasse, dung and crop residues play an important role in Ethiopia amounting 101.3 millions of toe covering more than 42.3% of the total energy resources. From the consumption point of view, biomass fuels contribute 93% of the total energy supply. Fuelwood (including charcoal) is the largest consumed among these resources contributing 82% of the total biomass supply (World Bank, Feb.1994).

4.1.2. Hydropower Energy Resource

Ethiopia has a vast hydropower resources estimated up to 260 TWh a year. However, only a minute proportion, less than 1%, of which has been utilised to-date. Plentiful rivers are convenient for development of micro-hydro electric or mechanical shaft power generation. Some studies show that there are over 2000 rivers, which are technically potential sites for small hydropower plant development.

4.1.3. Solar Energy Resources

Ethiopia being located near the equator has abundant solar energy potential which can be of great use for solar thermal and electric power generation. The average solar radiation is more or less uniform, around 5.20 kwh/m^2. The values vary seasonally, from a minimum of 4.55 kwh/m^2 in July to a maximum of 5.55 kwh/m^2 in February and March. With location, the radiation varies from 4.25 kwh/m^2 in extreme western lowlands to 6.25 kwh/m^2 in Adigrat area (Tigrai) (CESEN, 1986).

4.1.4. Wind Energy Resource

In general, the range of wind speed in Ethiopia is between 3 to 5 m/sec and is considered as very low. But on the coastal area of the Red Sea, near the Djibouti border even higher wind speed was recorded. Wind speeds lower than 3.5 m/sec having energy value less than 500 Mcal/m^2 were recorded in the western part of the country. Medium wind speed between 3.5 – 5.5 m/sec (energy values between 500 and 1500 Mcal/m^2) exist over most of the eastern part of the country and the central rift valley zone (CESEN 1986).

4.2. Renewable Energy Utilisation

4.2.1. Biomass Energy

Of the total national energy consumption of 16297 x 10^3 Toe, biomass fuels amount 15,168 x 10^3 Toe. Of this the household sector consumes 93% while industries and other sectors consume 7% (EEA, 1992). The household sector overwhelmingly relies on biomass fuels mainly for cooking. Commercial fuels like electricity and petroleum are used only by better off urban households. Electricity is not available in most areas outside larger towns and petroleum products are limited in rural areas.

4.2.2. Hydropower Energy

The total electricity generation capacity of all power plants is 416.02 MW of which 377.75 MW capacity is from hydropower plants. Of the total energy production the share of the hydro resources is 97% while the remaining is obtained from thermal plants using diesel fuel.

There are quite a number of potential sites usable both for big and small hydropower plant establishments. Though the extent of small and micro hydro power development is very limited in Ethiopia, the technology has been practised in the country since the last century. The main purpose of these micro-hydro plants is for grain milling. Electricity generation from small or micro hydro schemes has never traditionally been practised except three small hydropower schemes built by EEPCO altogether generating 6.15 MW.

4.2.3. Solar Energy

Even though solar energy is abundantly available, the domestic market either for thermal use or photovoltaics is not developed. Very few units have been introduced to the country through some NGOs and government organisations for sectors as health, education and water supply or the telecommunications industry in some remote area. Apart from this, they could not make any substantial change by penetrating the private sector for purposes such as lighting.

4.2.4. Wind Energy

The wind energy resource in Ethiopia has been thought to be more suitable for water pumping than for electricity generation. However, according to CESEN, in the eastern part of the country where wind speed up to 5.5 m/s is measured there could be possibilities for generating electricity.

4.3. Renewable Energy Actors and State of Technology Development

Cooking, lighting, grain processing and water lifting are the major end uses that demand energy in most part of Ethiopia. Energy requirements in Ethiopia, particularly in the rural areas are usually met with low grade energy forms such as heat from biomass fuels which is mainly used for cooking and lighting. Modern energy forms like electricity and petroleum are either unavailable or limited to certain areas. The overall coverage of the electricity supply system is only about 500,000 domestic customers in about 370 towns and communities in Ethiopia covering only 4% of the total population. Despite only 4% of the population being connected to electricity, there is no department or division in government offices dedicated to small-scale rural electrification. Electrification of rural areas has been carried out as a continuous expansion program of the existing system of EPPCO.

Seeing the need for energy in most part of the country, there is a huge potential market for renewable energy technologies provided enough promotional works being done.
In some rural areas there are private business men who initially bought small gen-sets to generate electricity for their own consumption. Most of them now found it a lucrative business to sell electricity to domestic households, small bars and restaurants for

lighting. Use of car batteries for playing tap recorders is not uncommon in rural areas. Rural people found that use of car battery for tap players is extremely cheaper and convenient than using dry cells. Battery charging stations in rural areas are usually at private gen-set owner. In areas where there is no private gen-set, people take their batteries to the nearest town on donkey backs to get it charged from grid electricity. Had DC bulbs for household lighting been widely available, use of car batteries for lighting would be highly acceptable in the rural areas. Except the initial capital required to purchase the battery, the charging cost as observed is happily paid by the customers.

Corp processing is another end-use that demand energy. In areas where electricity is not available crop processing is done manually using one fixed and one sliding mill stones. It is laborious and time-consuming activity for rural women. Now, diesel mills are penetrating the country-side and people are very happy because the service is available. In other areas where such service are not available, they walk over 10 km distance carrying heavy loads of grain to the nearest available milling service.

Potable water is one of the major problems in rural areas. It is the major cause of water born diseases observed on the country people. Water is usually obtained from near by rivers, wells and springs and is consumed directly. In some areas if the ground water level is shallow they dig wells by hand and fetch water from there. Shallow well water is not always free from bacteria but is much better than river water. In some areas solar and wind pumps are used to provide clean water for certain communities. But compared to the demand only very few of these systems are distributed in the country owing to lack of sufficient and appropriate promotional activities.

4.3.1. Biomass Energy Technologies

Since biomass fuels are the main energy resources in Ethiopia, heavy dependence and inefficient utilisation of the resources have highly depleted the resource base. Conversion technologies (stoves of different types) having efficiencies of 6 - 10%) contribute to this phenomenon widely. Apart from this the inefficient technologies used during charcoal production (with 16% efficiency) is also another factor worth mentioning. For this matter, the government has devised supply augmented and demand management strategies in order to alleviate the problem and bring about sustainable utilisation of forest resource. The demand management strategies included improved efficiency in household energy utilization especially for cooking, through introduction of improved cooking stoves. In this regard, a number of governmental and non-governmental

institutions involved in stove design, production, dissemination as well as information assessment and compilation, whether directly or indirectly (through financial and technical contributions), as early as 1970s in the history of Ethiopia.

The primary institution that should be mentioned in the promotion and dissemination of cooking stoves (regardless of thermal qualities) is the 'Informal Sector'. This sector as far back to the beginning of the 19th century until the present is contributing to the cook stove market of traditional as well as improved stoves of different size and dimension. Although, a single figure, which quantify the penetration rate of these stoves is not available, it is been evident that this sector plays a big role in the supply of conversion devises in the country at large.

As studies indicated, prior to the 1970s the Ministry of Agriculture (MoA) was promoting improved stoves as a part of community development along with other stakeholders. However in the 1970s, according to the demand side strategies recommended, the Ethiopian National Energy Committee (ENEC) under Ministry of Mines and Energy (MME), to deal with the assessment of energy in country, was established. In this respect, to have the first hand information and data, the ENEC along with the Central Statistical Office -CSO (the present Central Statistical Authority -CSA) conducted the first household energy studies.

However since detailed information on energy situation which encompass the different sectors and sub-sectors energy demand and utilization was found mandatory, the first comprehensive energy assessment by its type and nature was conducted throughout the country. The study was conducted again by ENEC with the help of Italian consulting firm called CESEN and the analysis and results were fully published in 1986. The study gave the first highlight of the energy situation in different sectors and sub-sectors and wax taken as a primary input in drafting of the energy sector policy and strategy. Although these studies are out of date and need to be updated, they are still the background information and guideline at present as well.

The demand management strategies suggested by the various studies were mainly focused on household cooking efficiency programs. Since the potential for immediate returns was found to be high, the studies recommended that cooking efficiency programs should focus on Addis Ababa, whose large urban population constitutes a heavy burden on the surrounding peri-urban plantations. The first phase of a cooking

efficiency program was launched with a prior pre-investment project which undertook a baseline survey of household fuels.

Executed by International Labor Organization (ILO), this project on Cooking Efficiency Program Planning in Ethiopia (CEPPE) is addressing household cooking options. The study identified a major intervention in improving the use of biomass efficiency in the households, specifically wood and charcoal. Portable metal wood and charcoal stoves were designed and tested with an ultimate aim of massive dissemination of the stoves after undertaking field tests and acceptability assessment. Although marginal, the field tests showed improvement over the traditional open fire stove, which gave the go ahead for a large scale production and dissemination plan devised in 1987 for the next phase of the project. However, a number of changes occurred in Addis Ababa household energy economy between the two phases of the projects.

Other than this, the Ministry of Agriculture also continued to promote improved stoves programs in different places. The Rural Technology Promotion Centers (RTPCs) under the MoA developed and promoted improved charcoal, wood and confined stoves in different regions of the country. Side by side, the Ministry of Education (MoE) funded by UNICEF has also promoted improved mud stoves through Burayu Basic Technology Center. The German Development Service (DED) has also promoted improved mud-stoves in the Ambo area.

Accordingly, the Cooking Efficiency Improvement and New Fuels Marketing Project (CEINFMP), under the Energy I project of MME financed by World Bank, was initiated to implement plans of the Cooking Efficiency Program Planning in Ethiopia (CEEPE) to disseminate improved wood stoves in Addis Ababa. Surveys undertaken to update the findings of the previous survey in 1989/90 revealed the dynamics of the Addis Ababa households' energy economy. The introduction of kerosene[*] and increasing importance of electricity for cooking changed the consumption pattern with wood being the least important

---

[*] **The government policy towards importing of kerosene in mid 1980s made some 90% of the Addis Ababa households' and household in other major urban towns users of kerosene stoves. In fact, in 1980s kerosene was not a cooking fuel in Ethiopia but electricity was used by as many as 10% of households in Addis Ababa to prepare *'Injera'* on Electric *'Mtad'* (WB/ESMAP, 1995). This was a measure as a temporary relief for forests mainly focusing on Addis Ababa.**

fuel in most households. Therefore, any effort in improving the use of wood efficiency was believed to have little impact. However, charcoal assumed greater importance in the households, which suggested room for improvement in charcoal use in the households. On the other hand, although electricity increased in importance for '*Injera'* baking, there were still the majority of households utilizing biomass for *'Injera'* baking. Therefore, improvement of the efficiency of biomass use or reduction in its use was found necessary either by improving the biomass stove or introducing a low cost electric '*Mtad'* for low-income households.

The aim of the second phase of the project was introducing improved charcoal stove for other cooking and biomass stoves for '*Injera'* baking and the development of a low cost electric '*Injera' 'Mtad'*.

The Cooking Efficiency Improvement and New Fuels Marketing Project (CEINFMP) of Ministry of Mines and Energy succeeded in developing and commercialising an improved charcoal stove named *'Lackech* Charcoal Stove" which has an overall efficiency improvement of 25 per cent (tested in the households) compared to the traditional charcoal stove in Addis Ababa. In 1994, 22% of households in Addis Ababa owned a *'Lackech'* improved charcoal stove thereby showing a penetration rate of 18% as compared to other charcoal stoves.

The rapid payback plus the fact that the stove is attractive and fit well for the traditional coffee ceremony are the two main reasons behind its rapid dissemination in Addis Ababa. An '*injera*' baking biomass stove known as 'Mirt' is also one of the successful household technology developed by CEINFMP. 'Mirt' has showed an overall efficiency improvement of over 50% compared to the traditional open fire stove. This rapid dissemination which is driven entirely by consumer demand met by private sector producers can be characterized, as no less than a stunning success relative to most stove programs that never attain double-digit penetration rates even after many years effort.

4.3.2. Hydropower Technologies

Since electric power generation, distribution and sales was totally monopolised by the government, there was no initiative left for the private sector except for developing micro-hydro schemes for mechanical shaft power use. Unlike the availability of the

resource, the development of the small and micro hydro technology has remained traditional and limited only to grain processing.

Currently, it is estimated that there are over 500 traditional micro-hydro schemes in rural areas for grain milling purpose and most of them are privately owned. These schemes have vertical axis turbines with very poor performance. However, recently few NGOs and church groups have stepped in to revive the technology by introducing new and efficient machines.

Since 1989, Ethiopian Evangelical Church Mekane Yesus (EECMY) has been working in installing modern micro hydro schemes in rural areas for the purpose of grain milling. In the last ten years EECMY has installed over 30 micro-hydro schemes which operate using locally made cross flow turbines.

The design of the turbines was initially brought from Nepal by EECMY. They were then copied and have been produced locally by an NGO known as Selam Technical Vocational Centre (STVC) and a local metal workshop known as Paradizo. Of the thirty schemes not more than two are for electricity generation. At present for lack of repair and maintenance these schemes are not functioning.

There are two other Francis turbine micro-hydro schemes built by missionaries. One of the schemes has 50 kW capacity and is used for supplying electricity for a clinic in a place called Walga. The other unit is a 30 kW capacity and is used for grain milling purpose. The problem the owners are facing is lack of spare parts for the turbines.

The limitation of micro hydro schemes is that they are located some distance away in a valley that people have to carry their grains all the way down to get it processed. Customers consider this less convenient compared to its diesel motor competitor which is placed right at the centre of the village. In addition to this, unfortunately the flow of water in the river is reduced to the minimum during harvest time when it is needed most. These are the two limitations of the technology from the customers point of view.

From the investment point of view, since the market for the technology is not well developed the capital and installation cost required is much greater when compared to the cheap Chines made diesel motor alternatives that are available in the country today. This and the limitations of the technology mentioned above, micro hydro units for crop

grinding business do not attract business people much for the pay back period will be longer. However, there is still a huge market in very remote areas where transportation of diesel fuel is almost impossible.

For electricity generation however, hydro scheme would be highly viable than any other alternatives. Lack of local technical capacity for the installation of micro-hydro power generation schemes and the fact that regulations for private power generation are not clear, investment in the field could not yet be possible.

4.3.3 Solar Technologies

The domestic market for solar technology both for thermal and electricity generation is not developed. BP through Michel cots, Nestle and Siemens are the existing suppliers and installers of PV systems in the country. They, however, not taken any action to invest on the promotion of the technology. They concentrate only on marketing to donor led sectors as health, education and water supply or the telecommunications industry. Equatorial Business Group (EBG) is a huge company which under its energy unit supplies and installs photovoltaic systems. In the future when the market is well established it has a plan to set a factory that will have the capacity to produce the panels locally.

Direct Ethiopia is a small company which is specialised in installations of solar energy technologies. The owner, Mulugeta, got his training by Siemens in Germany. The total number of employees are five. Up to now Direct Ethiopia has installed solar electric systems of about 100 W for twelve schools, which are located in Tigray, Ormomia, Amhara (Barhir Dar), and Southern Peoples (Konso & Gidole) regions. Moreover, they have installed a solar electric powered security systems and solar water heaters for Sheraton Hotel in Addis Ababa, where solar water heaters were supplied from Israel. As Direct Ethiopia is a small company the price it quoted for all works were cheaper than that of Mitchell Cotts, Nestle or Siemens.

Recently a new enterprise known as Tena Trading Company has also started providing services in supplying and installation of photovoltaic systems.

4.3.4. Wind Energy Technologies

Since the wind resource in Ethiopia is limited only for water pumping purpose, no one unit is installed for electricity generation. All units installed in the country are for the purpose of water pumping.

An international NGO known as Lay Volunteers International Association (LVIA) as part of its food security activities in Ethiopia installed about 73 wind mills for water supply in rural areas in the Rift Valley since the year 1980. The tower is 16 meters high and the diameter of the rotor is 6 meters. The wind mills deliver 20 to 65 cubic meters of water in a day from a depth of 35 to 85 meter.

EBG has recently started promoting similar types of wind turbines in rural areas along with solar technologies. EBG at present is focusing on production, promotion and distribution of wind turbines for water pumping.

The model of the windmill that is selected for local production by EBG is based on Tozzi and Bardi's Italian design. The design employs both casting and welding technology. The mill post guide and the thrust bearing housing are made of cast iron. The other components are manufactured from locally available materials. EBG has locally assembled and installed one such type of wind mill for water pumping in the rift valley for demonstration.

The diameter of the rotor is 6 meters with 18 sheet blades made up of sheet metals. Depending on the wind speed of the site and the dynamic head of the bore-hole, the pump size is determined. The parts will be manufactured mostly by sub contracting to five mechanical workshops in Addis Ababa.

V. Household Energy Stakeholders

5.1. Private Sector

The primary institution that should be mentioned in the promotion and dissemination of cooking stoves (regardless of thermal qualities) is the 'Informal Sector'. This sector as far back to the beginning of the 19th century until the present is contributing to the cook stove market of traditional as well as improved stoves of different size and dimension. Although, a single figure, which quantify the penetration rate of these stoves is not available, it is been evident that this sector plays a big role in the supply of conversion devises in the country at large.

5.2. Public Sector

5.2.1. Ethiopian Rural Energy Development & Expansion Center (EREDEC)

The Ethiopian Rural Energy Development & Expansion Center (EREDEC) previously the Ethiopian Energy Studies & Research Center (EESRC) is restructured according to the government's long-term strategy of "Agricultural Development Led Industrialisation" facilitating rural based socio-economic development in the energy sector.

The major duties of the Centre are to assess and evaluate the energy resources of the rural areas and conduct feasibility studies for their development; study the energy demand, supply and consumption pattern of rural areas and compile data periodically; study the production, distribution, utilisation and conservation of affordable and efficient energy resources and technologies with due regard to the protection of the environment and promote them to rural communities via private, pubic and other appropriate sectors as the case maybe. The Centre also studies the social, economic and environmental impacts of various energy resources and technologies and raise awareness of the rural communities. At present, the center is planning to launch household energy efficiency improvement project with World Bank funding.

5.2.2. Ethiopian Electric Power Corporation (EEPCO)

The Ethiopian Electric Power Corporation (EEPCO) previously the Ethiopian Electric Light and Power Authority (EELPA) was reformed as a public Enterprise by Council of Ministers Regulations No. 18/1997 (7th July 1997).

The purpose of the corporation is to engage in the business of producing, transmitting, distributing and selling electricity (in accordance with economic and social development policies and priorities of the government) and to carry out any other related activities that would enable it achieve its purpose.

The rights and obligations of EELPA have been transferred to EEPCO, which is the dominating Corporation involved in generation, transmission, distribution and selling of electricity nation wide. A Power Sector Development Program for the period 1995/96 – 1999/2000 was prepared by EELPA.

5.2.3. Ethiopian Petroleum Enterprise (EPE)

The Ethiopian Petroleum Enterprise (EPE) is the sole responsible body for petroleum products import, refining and distribution in the country. It is an autonomous body reporting directly to Prime Ministers Office.

5.2.4. Ethiopian Electric Agency (EEA)

The Ethiopian Electric Agency (EEA) was established as a regulatory body for electric Council of Ministers Regulations No. 86/1997 (7th July 1997). The objective of the agency is to promote the development of efficient, reliable, high quality and economical electric services. A body designed by the government, Electric Agency, is the Supervising Authority of the Corporation.

The Electric Agency is an authority body for issuing supervising, and ensuring the generation, transmission, distribution, sales, import and export of electricity. In accordance with the electricity proclamation, regulation and directives, the Agency: issue certificates for professional competent electric contractors and study and recommend tariff and supervise its implementation.

5.2.5. Energy Operation Department (EOD)

The Energy Operations Department (EOD) is a responsible body for undertaking policy matters, monitoring development activities and developing energy administration systems (the energy development perspectives, the energy laws, codes and standards). In cooperation with other energy institutions, regional energy bureaux and other economic sectors, the ED establishes energy database, which will be accessible to all sectors.

5.2.6 Ministry of Agriculture (MoA)

The Ministry of Agriculture plays the key role in supply augmented strategy to alleviate the problem of biomass resource base depletion and bring about sustainable utilisation of forest resource.

Other than this, even though it is not its mandate, MoA also involved in promotion of improved stoves as part of its natural resource conservation programs. The Rural Technology Promotion Centers (RTPCs) under the MoA develop and promote improved charcoal, wood and confined stoves in different regions of the country.

5.2.7 Regional Bureaux of Water, Mines and Energy

Water, Mines and Energy bureaux are the responsible bodies to conduct household energy studies and programs in the regions. However, almost in all regions all activities of bureaux are only of water development projects. The energy sector is not given much emphasis. The activities carried out by the energy sectors of some bureaux are mostly donor initiated.

5.3. Donors

5.3.1 German Technical Cooperation for Development (Gtz)

Gtz with MoA as a local counterpart conducts household energy programs involving assessment of household energy supply and consumption patterns and promoting

improved fuel saving stoves in a number of regions in the country. A three-years GTZ Household Energy Project is underway since 1997 in three regions of the country. Activities of the project include organizing workshops and seminars for regional government offices, household energy studies, training of improved stoves producers, and promotion of improved biomass Injera stove known as the Mirte.

While the first phase of the project is due to phase out around the end of this year, there is a possibility of continuing the second phase based of achievements of the first phase.

6. Summary and Recommendation

6.1. Summary

Ethiopia has vast energy resource potentials consisting of biomass, hydro, coal, geothermal, solar and wind. However, it is only on the biomass resource base that heavy reliance is seen. This is mainly because of lack of technical capacity and economical problems to harness such resources that could potentially offer the countries development opportunities. The hydropower resource potential developed to date is only about 1% of the total potential. Apparently, there exist several rivers, which can be developed to big and small hydro purposes. On the other hand the solar energy resources are of great importance in rural electrification. Power from wind resources can also be utilised for water pumping.

In this regard, a number of institutions (both governmental and non-governmental) have played key roles in assessing and compiling the resources, introducing, developing and disseminating improved energy converting technologies. Since energy consumption in the household sector is the major portion of the total national energy consumption, special attentions were given in coping the problem faced through improve cook stoves development and dissemination. On the contrary, the government has not given a due attention for the development of other renewable energy technologies mainly solar, wind energies and small hydropower schemes. These area has been left to-date to the private sector.

6.2. Recommendation

- The energy policy has not given a clear glimpse about renewable energies (like solar, wind, and small hydro) development and utilisation and hence there is no distinct strategy drafted in this regard. It is well know that, renewable energy resources can play significant role to enhance the country's energy supply in different ways. Firstly, these resources are indigenous and hence there could be self-reliance. Secondly, these energy sources are fit to remote and isolated small-scale applications. Last but not least, they are environmentally friendly. Subsequently, an aggressive program is essential regarding renewable for a country so vast like Ethiopia with more than 85% living in the countryside.

- Development and proper utilisation of energy resources being one of the major constraints of development in the country, less or no emphasis is given to the energy sector particularly in regional Water, Mines and Energy bureaux. Due emphasis should be given in developing small and isolated energy generating units preferentially from renewable resources in order to bring about rural based development. The household sector should also be dealt seriously with special emphasis given to cooking devices.

- Following the government's policy of Agricultural Development Led Industrialisation (ADLI), development of small and micro hydro schemes plays important role to bring socio-economic development in rural Ethiopia. The role of small and micro hydro schemes for agricultural products processing such as grinding mills and oil expellers could be substantial. The outcome of such technologies would make changes in the life style of peasants by reducing drudgery which otherwise be the case and alleviating poverty by adding values to their processed agricultural output.

- One of the reasons for biomass resource depletion beside other factors is the inefficiency of energy conversion technologies used by the households as well as devises used during charcoal production. Developing and dissemination of improved stoves (both in urban and rural areas) and charring kilns will highly contribute in alleviation deforestation and the impact of energy production and utilisation on the environment. In addition to this, charring kilns, through increasing the recovery rate of the charcoal produced, improve the life style of farmers who are involved in charcoal production.

- Lighting in rural areas where electricity is not available is mainly by wick torches with kerosene or diesel. Apart from the health problem that emanate from the smoke and insufficient luminosity, unavailability of electric energy for lighting curtails the amount of working hours that women could spend in the household course. This also limits the effort that students could spend on their study during night time, hence affecting the teaching-learning process. In order to solve such problems, solar powered small battery charging units should be promoted.

REFERENCES

1. Central Statistical Authority, Population Statistics, 1994.
2. CESEN, Technical Report, 1986.
3. A proclamation to Provide for the Establishment of the Ethiopian Rural Energy Development and Promotion Center (Draft), Nov. 1999.
4. Ethiopian Petroleum Enterprise, Imported Petroleum Products form January 1995 to June 1999.
5. World Bank, Calub Gas Development Project, SAR, February 1994.
6. Ethiopian Forestry Action Program, Synopsis Report, Addis Ababa, Dec. 1994.
7. Ethiopian Energy Authority, Ethiopian National Energy balance, July 1992.
8. Environmental Protection Authority, Environmental Policy of Ethiopia
9. Ethiopian Energy Authority, Ethiopian National Energy Policy
10. Energy Department, Energy Development Programme 1996/7 - 2001/2

Annex 1: Sectoral and Cross Sectoral Environmental Policies

7. Sectoral Environmental Policies

7. Soil Conservation and Sustainable Agriculture

- Soil Husbandry and Sustainable Agriculture
- Forest, Woodland and Tree Resources
- Genetic, Species and Ecosystem Biodiversity
- Water Resources

2. Energy Resource

The Polices are:

- To adopt an inter-sectoral process of planning and development which integrates energy development with energy conservation, environmental protection and sustainable utilization of renewable resources;

- To promote the development of renewable energy sources and reduce the use of fossil energy resources both for ensuring sustainability and for protecting the environment, as well as for their continuation into the future;

- To make institutions and industries which consume large amounts of wood fuel established their own plantation or make contractual arrangements with plantations to meet their wood requirements;

- To encourage Government leases for private entrepreneurs to plant fuel woodlots in peri-urban areas;

- To ensure that feasibility studies for hydroelectricity facilities and other significant generating facilities include rigorous environmental impact assessments to allow informed decision-making that maximizes benefits to the community and to the country at large and eliminates or at least minimizes damages to the natural resources base and/or to environmental well-being;

- To review current institutional, pricing and regulatory arrangements in the energy sector to suggest reforms that will better meet community energy needs and maximize the opportunities for private commercial and

community sector initiatives to develop and market environmentally sound energy sources;

- To recognize that water resources play an important role to meet Ethiopian's energy demand and that, by generating power cause no pollution on the environmental;

- To focus extension programmes on farm and homestead tree planting to ensure that each homestead grows enough trees to satisfy its wood requirements; and

- To locate, develop, adopt or adapt energy sources and technologies to replace biomass fuels.

3. Mineral Resource
4. Human Settlement, Urban Environment and Environmental Health
5. Control of Hazardous Materials and pollution From Industrial Waste
6. Atmospheric Pollution and Climate Change
7. Cultural and Natural Heritage

B. CROSS-SECTIONAL ENVIRONMENT POLICIES

- Population and the Environment
- Community Participation and the Environment
- Tenure and Access Rights to Land and Natural Resources
- Land Uses Plan
- Social and Gender Issues
- Environmental Economics
- Environmental Information System
- Environmental Research
- Environmental Impact Assessment (EIA)
- Environmental Education and Awareness