



ETHIOPIAN NATIONAL ENERGY POLICY (2ND DRAFT)

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Acronyms and Abbreviations

ADO	Automotive Diesel Oil
CBO	Community Based Organizations
CDM	Clean Development Mechanism
CRGE	climate Resilient Green Economy
CSA	Central Statistical Authority
E10	Ethanol with 10 Percent Blend
EAPP	East Africa Power Pool
EEPCO	Ethiopian Electric Power Corporation
ESIA	Environmental and Social Impact Assessment
ETB	Ethiopian Birr (1 USD = About 17 Ethiopian Birr)
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gas
GTP	Growth and Transformation Plan
GWh	Giga Watt Hours
ha	Hectares
HFO	heavy fuel oil
ICS	Inter Connected System
ICT	Information Communication technology
IPPs	Independent Power Producers
km	Kilometer
km ²	Kilo Meter Square
kV	Kilo Volt
kWh/m ²	Kilo Watt Hours per Square Meter
kWh/m ² /day	Kilo Watt Hour per Square Meter per Day
LFO	Light Fuel Oil
LPG	Liquefied Petroleum Gas
m ³	Meter cube
MGR	Motor Gasoline Regular
MoWE	Ministry of Water and Energy
MW	Mega Watt
MWh	Mega Watt Hour
NBP	National Biogas Program
NGO	Non-Governmental Organization
R&D	Research and Development
RE	Renewable Energy
RET	Renewable Energy Technology
UEAP	Universal Electric Access Program
USD	US Dollar

RATIONALE FOR UPDATING NATIONAL ENERGY POLICY

Energy plays a driving role in socio-economic development arena; poverty reduction and improvement of the quality of life. Energy links to all sectors of the economy as well as forming a sector itself. To substantiate this fact, agriculture for instance needs energy for irrigation and food processing. On the other hand, Agriculture also provides energy resources in the form of agricultural processing wastes, animal wastes, energy crops and liquid biomass fuels. This intrinsic relationship between energy and economic sectors shows that the decisions being made with respect to energy affects other areas of the economy as well.

The Ethiopian economy, which is non- oil-driven economy, has grown more than **11%** for the last 8 consecutive years. The economy growth is expected to double with a rate of a minimum 11 percent per year, including doubling the agricultural production of the country by the end of 2014/15. The Growth and Transformation Plan (GTP) envisions a major leap in terms of not only economic structure and income levels but also the level of social indicators. The agricultural sector will continue to be the major driver of economic growth. Industrial growth has also been given particular focus. Rapid growth of an industrial sector that increases the competitiveness of Ethiopia's exports and results in import substitution is the major focus.

This continuous economic growth will undoubtedly influence the growth of energy demand. For accelerated development programs: agriculture, industry, transport, health, education, rural development etc, an appropriated and sound energy policy and other implementation modalities appear to be very crucial. The National Energy Policy, formulated in 1994, does not qualify in this respect, on grounds of the fact that there are a lot structural and transformational changes in the country and in global context. This, indeed, calls for the need to revise and update this policy document.

One important rationale for the need to update the policy is to comprehend new energy development related issues and directions which are not stated in the existing policy and to give emphasis to the development and utilization of all renewable energy sources. The policy for example, is silent on bio-fuels development and marketing, which is one of the three pillars of renewable energy development in the country. The bio-fuel policy will help the country reduce its petroleum imports and save foreign exchange. Moreover, the 1994 issued policy did not address new technologies such as: electric rail, electric cars, hybrid cars, flexi-fuel vehicles,, and monitoring and qualifying of smoke and vapor emitted from vehicles. Maximizing the use of modern technologies and renewable energy resources will reduce dependence on imported fuel and the country's carbon footprint.

The other rationale for the need to update the policy is to further emphasis Energy efficiency and conservation from both supply and demand side management. Furthermore,

the current climate change has presented the necessity and opportunity to switch to a new energy sustainable development model.

Another rationale of this policy is to include localization. Due to absence of industries for manufacturing of electric components, such as transformers, turbines, generators etc., there is a heavy reliance on imported technologies that accounts 70% of project cost. This has a huge negative impact on the country's balance of payment.

The policy also needs to be aligned with the recently launched Climate resilient green economy (CRGE) strategy to protect the country against the adverse effect of climate change and to build green economy.

Ethiopia can get economic opportunity from Regional energy interconnection and integration as it is endowed with large hydropower and other renewable energy resources. The power interconnection besides being a source of foreign currency will play a critical role for geopolitical stability in the region. The revised policy has properly addressed this issue.

Atomic energy use in Ethiopia is limited and is applied mainly in the agricultural and health sectors. There is Radiation Protection Agency, to regulate the uses of radiation. In the long term it is envisioned for the country to consider the application of nuclear reactors for power generation as mix to modern energy resources.

Deforestation and forest degradation must be reversed to support the continued provision of economic and ecosystem services and growth in GDP. Fuel wood accounts for more than 80% of households energy supply today. Despite, the economic value and environmental benefit, the country's forest resources are under threat. The growing population requires more fuel-wood and more agricultural production, which in turn creates needs for new farmland both of which accelerate deforestation and forest degradation. The revised policy has thus indicated the actions to be undertaken to change the traditional development path

In general, the task of reviewing the policy is carried out by identifying the gaps between what is stated in the 1994 national energy policy and the current status, as well as anticipated energy resource development. Current technological levels, bottle-necks in the energy development including cross-cutting issues are some of the areas that are considered in the updating process.

INTRODUCTION

The energy sector exhibits a three pronged dominance over all economic sectors in Ethiopia: it siphons nearly all export exchange earnings for importing petroleum fuels; it absorbs the highest share of government investment in the form of power sector development and it is a fundamental enabler of modern economic development.

Ethiopia has undergone substantial changes over the last eighteen years. GDP has been growing by about 11% for the last 8 consecutive years and population growth continued at an average rate of 2.5% annually, both contributing to the substantial level of energy demand created over the corresponding period. The Government Growth and Transformation Plan aims at reaching middle income country by 2025 which requires high energy generation to support all economic sectors development. Moreover, Climate-Resilient Green Economy (CRGE) strategy focuses on enhancing development with minimum carbon emission.

With regard to energy supply, electricity generation capacity has more than doubled while far more generation capacity is within reach. Petroleum fuel import also has increased over the past decade. Demand for biomass energy has also increased exerting pressure on existing forest and woodlands. Projections indicate that unless action is taken to change the traditional development path annual petroleum and fuel wood consumption will rise significantly.

The development of renewable energy technologies, energy conservation and sustainable forest and woodland management practices have not improved over the years, despite being clearly highlighted in the First National Energy Policy document. This could probably be attributed to several factors among which are limited reference made to the policy document, limited practice in developing appropriate energy programs and projects, and translating of the energy policy into action.

Global energy consumption trends are also demanding for climate change adaptation and mitigation measures. New energy efficient and renewable energy technologies are emerging. There is also an opportunity for Regional interconnections that demand high energy generation.

To astride economic development, CRGE has identified sustainable forest management, reduce fuel wood demand, energy efficiency and promotion of Renewable energy technologies as part of its strategy.

To embrace national initiatives into sectoral goals, respond to global recurrences, and support the country's overall development goals, timely updating of appropriate energy policy upon which the sector will be governed is important.

This policy has considered the inter linkage of the rural development, water, industry, environment, science and technology and other policies. Moreover, other countries' energy with policies were referred.

The Revised Policy is divided into five main sections: with **Section One** being an overview of the Ethiopian energy sector while **Section Two** discusses key issues identified in the energy sector. **Section Three** sets the energy policy goals and objectives in more concise and general terms. Supply and Demand side policy objectives are presented in **Section Four** together with available corresponding policy instruments for the sectors of electricity, hydrocarbons, bio-energy, and other renewable energies. The demand side policy objectives and policy instruments are further discussed subdivided into households, transport, industry, service and agriculture sectors. **Section Five** is dedicated to Cross Cutting Energy Policy Issues, namely the energy regulatory framework, energy sector governance, the establishment of strong institution and capacity building, integrated energy planning, energy efficiency and conservation, energy pricing, energy research and development, environment, gender, and Regional & international cooperation.

Vision and Mission

Vision:

The Vision of the energy sector is to be a renewable energy hub in the Eastern Africa Region by 2015.

Mission:

The Mission of the energy sector **IS** to play a significant role for socio-economic development and transformation of the country through provision of a sustainable, reliable, affordable and quality energy service for all sectors in an environmentally benign manner.

1. OVERVIEW OF THE ENERGY SECTOR IN ETHIOPIA

1.1 Status of the Ethiopian Energy Sector

1.1.1 Energy Resource

Ethiopia is endowed with a variety of renewable energy resources including hydro, wind, geothermal, solar and bio-energy. The gross hydro-energy potential of the country is estimated at 650,000 GWh per year of which 25% (160,000 GWh per year) could be economically exploited for power. Woody biomass resources estimate for the standing stock and annual yield is about 1,149 million tons and 50 million tons respectively, for year 2000. This translates into a per capita yield of about 0.79 tons of woody biomass.

The country has huge wind and geothermal energy resource potential estimated about 1,035 Giga watt and more than 7,000 MW respectively. With respect to solar energy, the national average radiation received at ground level is estimated at 5.2 kWh/m² per day. This potential however varies from season to season, with lowest potential being 4.55 kWh/m² per day, and the highest potential being about 6.25 kWh/m² per day .

The country also has natural gas reserve estimated at 112 billion cubic meters. There is 4 TCF natural gas deposit in the Eastern part of the county. Oil shale deposit is estimated at 112 million tons.

Coal resource estimate is 320 million tons distributed in 9 sites mainly located in the Northern, Central and South western part of the country. Resource quality ranges from medium to low grade (sub-bituminous to lignite). Some of better quality coal deposits are located in the high forest areas in the South-Western part of the country where development of sites will potentially have serious environmental consequences.

1.1.2 Energy Supply and Consumption

Despite the presence of a variety of renewable energy resources, the bulk of the national energy consumption is met from biomass sources. Biomass accounts for 92% of total national energy consumption in 2010. Petroleum fuels and electricity met merely 7.6% and 1.1% of the national energy consumption, respectively. Petroleum fuels are mainly used in the transport sector with a smaller share of the demand from the household sector (kerosene for cooking and lighting) and industrial sector (fuel oil for thermal energy). At present the per capita electricity consumption per annum in the country is less than 100KWh, while the sub-Shara Africa is on the average 521 Kwh/capita.

The household sector accounts for 89% of total final energy consumption (74% by rural and 15% by urban households). Domestic energy requirements are mostly met from wood, animal dung and agricultural residues. About 81% of the estimated 16 million households use firewood, 11.5% use leaves and dung cakes while only 2.4% use kerosene for cooking.

With respect to sectoral energy consumption, approximately 92% of the biomass energy is consumed by households, 3% by services and 1% by agriculture. Electricity consumption was about 2,400 GWh, which 33% is by households, 40% by industries and 26% by service sector. The transport sector accounts for 6.1% of the total energy consumption, followed by the services sector which consumes about 3.6%. Petroleum fuels are mainly used in the transport sector (80% of the total consumption of petroleum products) with a smaller share of the demand from the household sector (kerosene for cooking and lighting) and industrial sector (fuel oil for thermal energy).

Energy consumption in the agricultural and industrial sectors was merely 0.9% and 0.5% of total final consumption, respectively. The agricultural sector in rural areas relies almost entirely on human and animal power and to a limited extent on commercial sources of energy like diesel. Most rural cottage industries produce food products or household goods such as clothes, woven articles, wooden utensils, handicrafts, pottery and metal products. These industries generally use very little fuel and are largely labour intensive.

Energy supply and consumption trend over the years 1996 to 2010 shows that the share of biomass energy decreased from 96.6% to 92% in 2010, while the share of petroleum fuels and electricity increased from 4.8% to 6% and from 0.6% to 2% respectively, over the same period. Thus, while there is a gradual shift towards modern fuels (petroleum and electricity), biomass energy remains the main source of energy.

Projected demand for 2030 shows that biomass demand will decrease to 71.6 % while, demand for petroleum and electricity increase to 22.6% and 5.8% respectively.

1.1.2.1 Electricity

i. Generation system

Hydropower

Ethiopia is endowed with hydropower resource potential. To-date only 4.8% of this hydropower resource base has been exploited. Yet, hydropower accounts for 98% of the country's electricity production in normal operation.

The national grid or Interconnected System (ICS) accounts for about 99% of the electricity supply. It is predominantly hydro-based, with diesel units serving as backups during generation shortfalls. There are currently 12 hydropower plants with a total installed capacity of 2178 MW, amounting to an average generation capability of 7722 GWh/year. These hydro plants are located within the five major river basins of Abbay, Awash, Omo, Wabi Shebelle and Tekeze. Four major hydropower plants, namely, Gilgel Gibe II, Tekeze, Beles and Fincha Amerti Neshe became operational over the last three years.

Three major hydropower plants, Gibe III (1870 MW), Grand Ethiopian Renaissance Dam (6,000 MW), and Genale Dawa III (265 MW) are under construction.

Wind Energy

Wind power resource potential is emerging to be more promising than was originally thought. Construction has been completed Adama I wind park with 51 MW capacity in Oromia Region. Ashegoda Wind Park with 120 MW capacity in Tigray region is under construction.

Geothermal Energy

Geothermal resource has barely been exploited, with only 7 MW installed at Aluto Langano, of which 3.5 MW is currently in operation with further expansion of 75 MW capacity. There are plans to develop a total capacity of 500 MW by 2020 at various sites in the Rift Valley.

Bio-energy

So far Ethiopia did not use biomass for electricity generation at a commercial level. However, there are small scale activities in some sugar factories. The fact that Ethiopia has biomass resources including agri-residues implies that it could be a source for electricity generation for future use. Since, sugar factories are expanding, baggasse can also be used for electricity generation for commercial applications.

Currently, in the country there is development of bio-fuels particularly that of bi-oil and biodiesel, which could contribute significant share for self contained rural electrification programs.

There is also 100 MW thermal generation plan from biomass (from Gibe III and Grand Ethiopian Rainesance dam). There is a promising opportunity to use urban waste for electricity generation. Co-benefit is also addressed from waste treatment.

Hydrocarbon

Petroleum fuel has been contributing for electricity generation for several years. Still, it is widely used in semi-urban and rural areas operated by the private sector and municipalities. At times of power outages in the grid, it has been used as a backup.

There is modest reserve of coal with low quality for electricity generation. Since, it is not feasible to improve the quality, electricity generation from coal is not environmentally friendly.

Natural gas was discovered before two decades but, so far never been developed including for electricity generation.

Bagasse Cogeneration

In the sugar industry bagasse is an important source of fuel where it is used to co-generate heat and electricity for self use. The combined excess production installed capacity of the three sugar factories is expected to reach 110 MW by 2015 at which time they would be able to sell to the National utility a total of 607 GWh of energy annually.

In addition to the state owned factories, there will be privately owned sugar factories that would start production in the coming years. These factories will have considerable capacity for producing excess power that can be sold to the national utility. The business-as-usual scenario for the existing sugar factories shows that there will be power deficit when they close for maintenance usually for two months annually, at which time they are forced to buy from national grid

Waste- to-Energy

Other biomass resources including municipal solid waste and sewage sludge are now recognized to be potential sources of energy. City administrations are now working with other government and non-government organizations to recover energy from the solid and liquid waste; some are seeking carbon finance to implement projects. The potential to utilize solid and liquid waste is significant in Addis Ababa and other regional capitals and towns. The main application of energy from waste in the urban areas will be electricity production to feed into the grid. There is also a possibility of providing methane gas energy for household cooking purposes.

ii. Transmission

In Ethiopia, transmission lines are operated at 400 kV, 230 kV, 132 kV, 66 kV, and 45 kV, depending on the power transported and distance involved. Now there is a plan to introduce 765KV in transmission system. The length of the existing transmission lines in the country is 12,150 km. The transmission line density of the country per 1000 km² of territorial area thus stands at about 10 km. In some parts of the country, transmission lines are entirely non-existent. In addition, several areas are served by single transmission lines typically radiating from substations or power stations located at the central region. Transmission line rings interconnecting the radial lines, would improve the reliability of power supply by providing alternative supply paths.

In the Ethiopian case, the total capacity of substation transformers with 33 kV and 15 kV outputs stands at about 1,320 MW at 0.8 power factor. This is below the total power generation capacity of 2,178 MW in the national grid. Even, when power export is considered, the mismatch still persists. Thus, substation expansion has to be undertaken to catch up with generation capacity.

The total number of sending-end and receiving-end substations in the national grid is about 150 in number. Out of this total, substations with single transformers are about 50 (i.e. about a third of the total), and they include those in Shashemene, Arba Minch, Jimma, Dabat, Maychew and Semera, among others. Any malfunction in the single transformers can put the whole substation out of action, thereby depriving consumers of power supply for a considerable time. Therefore, there is a need to install additional transformers in such substations.

iii. Distribution

The distribution line is about 126,000 km, and this network currently serves about 1.9 million customers, of which the vast majority is in the ICS. Serving such a large customer population needs a reliable distribution network, skilled and organized workforce, proper planning, implementation and follow-up of network expansion and maintenance, as well as sustained effort to improve customer services.

The on-going Universal Electricity Access Program (UEAP) is a major initiative to address this problem. It is largely based on the grid extension to rural demand centers, and thus presents the rural population with an opportunity for sharing the benefits of the grid electricity of the country.

Universal electricity access, as the name implies, has an objective to promote the socio-economic development of rural areas by expanding the electricity network within a specified maximum distance.

Apart from ensuring electricity access within a specified maximum distance for every prospective customer, the UEAP is also expected to assist the rural customer with actual connection to the supply system. In other words, the UEAP should assist in improving connectivity in rural areas. This can be achieved by designing innovative approaches like covering initial connection costs through installments, community management of the distribution and billing of electricity, other innovative techniques.

In the urban areas, where the electricity supply infrastructure exists, customer service with respect to metering, billing, maintaining the standard supply voltage, etc., needs to be improved. Various alternatives are being attempted to improve customer service. In general, low technical standards and inadequacy of the distribution network are significant challenges of the electricity distribution system.

1.1.2.2 Hydrocarbons

The category of hydrocarbons includes crude oil, natural gas, petroleum fuels, coal and oil shale. Known hydrocarbon reserves in Ethiopia are natural gas, coal and oil shale. So far, none of these resources have been developed. Until recently, consumption of hydrocarbons was solely imported petroleum fuels including diesel, gasoline, kerosene and fuel oil. Since 2007, however, imported coal and pet coke have been added and consumption has been continuously growing over the years. Hydrocarbons constituted about 7.6% of the share in the national energy balance for the year 2010, of which coal and pet coke contributed only about 0.1%.

From 2000 to 2009 petroleum fuel consumption grew by 87% from about 1.1 billion tons to more than 2.0 billion tons. Kerosene and diesel consumption grew by more than double while gasoline consumption, despite an increase in imports of domestic vehicles, remains more or less the same.

i. Hydrocarbon Supply and Demand

Imported Petroleum Fuels

In the past decade, petroleum consumption, on average, has been growing by 8% per year. During this period, imports of petroleum almost doubled and reached 2 million tons in 2009, while price increased by more than seven fold, 1.26 billion USD. Per capita consumption of petroleum fuels grew by about 46% in the last ten years from 17.5 kg in 1998/99 to 25.6 kg in 2009/10. Annual cost of import grew from 157 million USD to over 1.3 billion USD within the same time period using up almost all national foreign currency earnings.

About 80% of petroleum consumption is by the transport sector, which mainly uses diesel fuel. Importation of diesel and kerosene is increasing over the years. Diesel (ADO) accounts for 55% to 60% of total imports followed by kerosene (20% to 25%). Kerosene import is consumed by the household and by the aviation sectors.

Recent study indicated that despite the exemption from VAT and excise taxes in kerosene for household fuel, many households are shifting away from kerosene to other cheaper substitute fuel such as electricity for their daily cooking energy needs.

Much of the kerosene used in the household and business sectors is for cooking. The households that use kerosene for lighting account for about a third of kerosene consumed for non-aviation application (equivalent to 20% of the total annual kerosene import). Kerosene consumption for lighting grew by 14% between 2006 and 2009 from about 75,500 tons to 86,000 tons.

Per capita kerosene consumption for lighting and cooking is about 4 liters while per capita consumption for lighting alone is about 1.3 liters.

Gasoline (MGR) import in general remains the same in the past decade despite the increase in imports of gasoline consuming vehicles. In terms of proportion, gasoline import has continuously reduced in the last decade from 12% to 7.5%.

Fuel oil accounts for only about 10% of petroleum consumption. It is almost entirely used for thermal applications in the industry sector. However, since 2007 most of the heavy industries are shifting away from fuel oil due to high price of petroleum. Coal and pet coke are increasingly replacing fuel oil.

Liquefied Petroleum Gas (LPG) import for 2009 was about 7,500 tons with a corresponding CIF price of about ETB 50 million. LPG import volume doubled between 2005 and 2009, while import value grew by about three fold CIF price per ton of LPG reaching over USD 6,600 in 2009. This shows an overall increment of 40% in price compared to that in 2005.

Oil Shale and Natural Gas

Hydrocarbon resources so far discovered in the country are oil shale and natural gas. Despite very high and increasing demand for energy in various sectors of the economy, so far, none of these resources have been developed and utilized.

Coal and Pet-Coke

There was no local application of coal or pet-coke prior to 2007. Following the petroleum price hike since 2007, heavy industries, mainly cement factories, started to shift from fuel oil to coal and pet-coke for their thermal energy requirements. Imports of coal and pet coke reached about 42,000 tons in 2009, up from 11,000 tons in 2007.

Import price of coal is higher than pet-coke but seems to decrease as import volume increases. Based on 2009 data, CIF price of coal, on weight basis, is 20% higher than that of pet-coke. However, since pet-coke is of higher energy value per unit of weight, coal becomes even more expensive, about 40% compared to pet coke. Despite such significant import price advantage with pet-coke, import volume of coal continuously grows and exceeded pet-coke in 2009. There is a 30% duty tax on pet-coke while none levied on coal.

Petroleum Standard and safety

Until recently there was institutional and legal weakness especially in the area of down stream petroleum industry. One of the most significant problems in the industry was absence of regulatory body to regulate the standard and safety of petroleum products in the country to curb smuggling and adulteration of products. Recently, there is an attempt to establish the regulatory body and legal framework to address the problem.

ii. Transportation and Distribution of Hydrocarbons

Inland transportation and distribution of petroleum fuels in Ethiopia is done by means of road transportation system. Regional distribution of petroleum filling stations has increased over the past ten years. At the moment there are over 700 filling stations distributed in all regions in the country.

1.1.2.3 Bio-energy

The types of bio-energy used in Ethiopia are wood, charcoal, crop-residues, livestock dung, bagasse, ethanol and biodiesel.

i. Bio-energy Supply and Demand

Solid Biomass Energy

Biomass energy accounts for more than 92% of the total final energy consumed. This makes Ethiopia as one of the most biomass energy dependent countrys in the world. The major use of biomass energy is for household baking and cooking. The amount of wood and charcoal produced and used in the household sector far surpasses the amount used for other purposes. At a per-capita consumption of some 0.7 tons of wood and charcoal, the aggregate amount of wood consumed annually is 55 million tons.

- ***Fuel use by economic sectors***

The household sector uses wood, charcoal, and agricultural residues depending on accessibility and income. Higher income is associated with increased demand for cooking. The income effect is considered more important because as income increases from very low level, the amount of food consumed will increase substantially. Energy required for baking and cooking in households is considerable with per-capita biomass energy consumption of about 1 ton.

Agricultural residue is also important source of fuel for households, where it accounts for 8% of the total biomass fuel supply. In the household sector, crop residues supplement household biomass fuel supplies in the months after harvest where they are mostly used for Injera baking. Cattle dung meets 14% of the total household biomass fuel supply. Cattle dung is an important source of fuel particularly in the Amhara, Tigray and Oromia regional states where it provides 23% of the total biomass energy supplied in Amhara and Tigray and 15% in Oromia. In some zones the dependence on dung as fuel is even higher; for instance, 43% in Arsi and 25% in Debub Wello.

In the year 2000, agricultural residues accounted for 22% of total biomass energy consumed in the household sector at the national level. In some Regional States, such as Amhara region, it accounted for as much as 40% of the total biomass energy consumed by households. Agricultural residues were more important sources of household cooking fuel in some Weredas.

Biomass is also a major source of energy in the service sector. The service sector uses mainly wood but also some charcoal. Wood is still the most widely used baking and cooking fuel in institutions serving large groups of people. In commercial food and beverage catering establishments (restaurants, bakeries, local drink houses) and social institutions including schools, universities, hospitals, prisons and military camps wood is used for preparation of food and drinks. Small and micro enterprises use wood to fire brick and clay products. The industrial sector uses wood for tea processing and bagasse for heat and power in the sugar industry. Tea and sugar agro-industries also use biomass for process heat, power and steam generation.

Service sector biomass energy consumers get their biomass fuels through purchase. Small service establishments such as restaurants obtain wood by retail purchase; whereas, larger consumers such as universities, hospitals and prisons obtain it from bulk purchase.

- ***Rural and Urban consumption***

Rural households depend exclusively on biomass for baking and cooking. A considerable proportion of rural households, particularly in the lowlands, depend on biomass for lighting. Nearly three-quarters of the rural population used kerosene for lighting while about 20% used wood for lighting (CSA, 2004). Wood fuel supply in rural areas is generally by user households themselves. In rural areas wood is collected mainly from commonly accessible forest land and from farmland. Agricultural residues are generally not traded; they are collected by users from their own farmlands after harvest. Agri-residues are collected by household members and carried by themselves or animal back.

Households in urban areas also use biomass fuels for baking and cooking. Wood and charcoal consumed by urban households are obtained from distant peri-urban forests and woodlands. Wood fuel supplies to urban areas are provided by tens of thousands of suppliers. Charcoal is an important urban fuel in Ethiopia where an estimated 0.25 million tons is consumed mainly in households for cooking; about half of this is consumed in Addis Ababa. Charcoal is produced in very small scale, which is about 100 to 300kg of charcoal at a time with yield of a kilogram of charcoal from 6 kilograms of wood using the traditional earth mound kiln.

- ***Trend in biomass consumption***

Biomass energy demand is growing steadily with population growth: whereby, wood fuel is still the most important biomass fuel in Ethiopia. While, the supply base for wood fuel is shrinking, demand for wood fuel is growing rapidly. In more than two-thirds of the Weredas (districts) in Ethiopia wood fuel consumption surpassed sustainable supply in

2002; in a quarter of Weredas wood fuel consumption is more than twice the sustainable supply. The rapid rise in demand for cooking fuels, driven by increased food production and consumption, is expected to have widened this gap further.

Although, national level biomass energy data is available from only two studies over the last thirty years, these and other more frequently available local level studies indicate the continued predominance of biomass as the source of energy in the household and service sectors. The number of consumers of biomass energy has increased at the rate of population growth (2.5%) and the level of biomass energy consumption per consumer has declined slightly. The trend for biomass energy use in the household sector at the national level is therefore, steadily growing at or slightly below the rate of population growth.

Demand for biomass energy in both the service and Industry sectors has increased with increased output, though, the share of biomass energy in total energy supply has not changed significantly over the past three decades. In the service sectors the rate of demand is expected to grow much faster because the main driver for energy requirements is urbanization.

There also appears to be increasing commercialization of wood fuel supplies in rural areas in recent years. More rural households are now using charcoal and in some areas purchasing fuel wood.

Due to the government's Green Growth strategy, the rate of planting trees by rural population and regional development agencies has grown in recent years.

Moreover, crop residue availability has increased significantly because of increased crop production. There is a gradual increase in the use of crop residues and livestock dung particularly in rural areas. Crop production has increased by 6% while agri-residue by 3.4%

annually. Mean while livestock population has essentially remained stable over the past few years.

- ***Energy efficiency and conservation***

The majority of households, particularly rural households, use three stone open fire for cooking and lighting. Most service sectors and small scale industries also use biomass end-use devices with low level of energy efficiency.

In the last couple of decades, an intervention in the development and promotion of energy efficient cooking devices for the household and service sector was made. However, still high degree of energy inefficiency dominates this sector. Attempt was also made to

promote improved charring kiln. The rate of transition to energy efficient end-use devices in urban areas was higher than is in rural areas. A lot has still to be done to achieve broader dissemination level and maintain the standard of energy efficiency of the improved biomass end-use as well as conversion technologies. Moreover, efforts should aim at raising awareness of the sectors and the society at large on energy efficiency and conservation methods.

Energy audit in the industrial sector was another dimension that was once attempted by the government. In the absence of ensuring energy efficiency in the industrial sector, economic disadvantage is an evident fact.

Liquid bio-fuels

Current ethanol production is 20 million liters annually; the short term plan till 2015 is to increase production by nearly ten-fold to 181.6 million liters per annum.

Ethiopia started the blending of Ethanol with gasoline in 2009. Initially, it started with 5% blending [E5] grown to E10 which is being sold at all filling stations within Addis Ababa and its surrounding. When the program started in 2009, the country used to produce 6000m³ of Ethanol per year from Fincha Sugar Factory alone. In 2010/2011, the annual production capacity of Fincha increased to 8,000m³, while Metahara sugar factory started producing 12,500 m³ per annum. This increased the annual total National production of Ethanol to 20,500m³.

Wonji Shoa sugar Factory and the new sugar factory at Tendaho are expected to start production of ethanol in the near future. By 2014/15 nine new sugar factories are expected to start ethanol production while, at the same time the production output of the existing sugar factories are expected to increase considerably. It is anticipated that the total national ethanol production capacity will reach 181.6 million liters per annum. By 2015, the plan is to blend mix of 20 -25% of ethanol [E20-E25] and to expand sales of blended gasoline to regions outside of Addis Ababa. Ethanol is being piloted as a household cooking fuel. Ethanol has been used in refugee camps and a limited number of households in other parts of the country.

Availability of liquid biofuels will increase considerably in the near future with potential production of about 200 million liters (0.16 million tons) of ethanol and vegetable oils by 2015.

Production of biodiesel has not yet started in Ethiopia. However, investors have started to develop bio-fuel plants in large scale farms.

Biogas

Biogas has a dual advantage of providing critically needed energy for rural households such as energy for lighting and for cooking, while at the same time providing high quality organic fertilizer from the slurry produced after the gas is extracted. The organic content of animal refuse is usually wasted or burned, being used for cooking in direct combustion in open fire stoves. Biogas increases agricultural productivity as it provides the necessary organic fertilizer. Biogas further improves quality of life of rural households as it reduces indoor air pollution. Enhanced development of biogas has a considerable impact on the agrarian economy and health of rural households.

Ethiopia has a high potential for biogas production with its sufficient resources. Ethiopia's livestock population according to 2009/10 CSA survey is about 150 million. One third of this is cattle, whose refuse can effectively be used for biogas generation. Recent estimates show that about 1.1 million potential owners of household-size digesters exist in the four major regions. The effort to generate biogas from cattle dung started in early 1970s in Ethiopia. Over these past four decades, the progress of biogas digester construction has remained very low.

In 2007, the National Biogas Program (NBP) was initiated with a project target of constructing 14,000 biogas digesters in 5 years. However, it has managed to construct about 3,000 digesters in the past three years, where, the remaining digesters are planned to be constructed in the next two years. While, the progress made in reaching planned targets is very low due to a number of factors, the NBP has managed to introduce appropriate setup for the management of a biogas program at a national scale.

1.1.2.4 Other Renewable Energies

In this section small scale hydro (Mini, Micro and Pico), wind, solar and low enthalpies geothermal are defined as other Renewable Energies. These renewable energy resources are very essential for dispersed rural settlements for the provision of energy access: off grid electrification, water pumping, water heating, milling and other purposes.

Small Scale Wind

Another application of wind energy is for provision of small scale energy that can be used especially in remote off grid areas as a hybrid with other energy technologies for the purpose of rural electrification, potable water pumping, small scale irrigation and milling. Historically, mechanical wind mills have been used for water pumping for livestock in the Rift Valley.

Small-Scale Hydropower

Ethiopia is endowed with considerable hydropower resources. Out of this potential, about 15% is from un-regulated river run-off potential, usually in the category of mini, micro and pico hydropower plants. Data on about 232 small-scale hydropower potential sites have been collected with capacities ranging from 26 kW to 9,840 kW.

The total installed capacity of the entire 232 small scale hydropower plants is estimated to be about 500 MW. Only a small fraction of these small scale hydropower plants has been developed to date.

The small scale hydropower sites developed before 2001 generated about 1522kw. However, most of the sites have ceased operation currently.

Solar

Ethiopia, similar to countries located in the tropics, receives very high solar energy. The average solar energy potential of the country is about 5.2 kWh/m² per day. This potential however varies from season to season, with the lowest potential being 4.55 kWh/m² per day, and the highest potential being about 6.25 kWh/m² per day.

The application of solar energy has grown over the past years for:

- Telecommunications repeater stations,
- Solar home systems mainly for lighting rural households,
- Health centres and health posts for lighting and small power needs,
- Schools for lighting and small power demand,
- Water pumping,
- Water heating.

About 5 MW installed capacity of solar electricity generating units have been put in use (excluding water pumping for which data could not be obtained). Even though, the total exploited solar energy looks insignificant, the energy demand being addressed through these solar installations is vital, serving remotely located rural communities, schools and health centers with badly needed electricity services, that otherwise would not have been served.

Low enthalpy geothermal

There are numbers of hot springs in the country specially, in the Great Rift Valley. Low enthalpy geothermal can be used for direct applications such as: industrial processing, floriculture, therapeutic, swimming, bathing and others.

2. Key Issues in the Energy Sector

2.1 Broad Energy Sector Issues

- **Energy poverty:** Energy poverty is severe in Ethiopia due to insufficient choice in accessing adequate, affordable, reliable, quality, safe, and environmentally benign energy services to support human and economic development. For instance, at present the per-capita electricity consumption in the country is 93 KWh, while the Sub-Saharan Africa is on the average 521 KWh.
- **High dependence and unsustainable use of biomass resources:** Nearly 60 million tons of biomass is consumed for fuel with about 81% of the estimated 16 million households using firewood and 11.5% of them cooking with leaves and dung cakes.
- **Wasteful and inefficient energy production, transportation and utilization:** The household sector is the major energy consumer in Ethiopia with nearly 89% of the energy supplied being utilized by the household sector. About 92% of the energy consumed in households comes from biomass whose utilization is marred with very high inefficiency. There is also wasteful and inefficient use of energy in the transport sector. Moreover, there is high loss in electricity transmission and distribution of the energy itself.
- **Low institutional, human and technological capacity:** One of the major bottlenecks in the Ethiopian energy scene remains to be limited capacity in human, technical and lack of stable institutional arrangement. The development of a vibrant energy sector requires substantial development of energy sector management, investment, technical know-how, and institutional capacity.
- **Low private sector participation:** Private sector participation in the development and supply of energy services remains very limited. Creating the favourable environment for private sector participation in the energy sector will require a substantial effort.
- **High dependence on imported petroleum fuels:** Ethiopia spends large amount of its export earnings for importing petroleum products, putting pressure on foreign exchange reserves. This causes substantial threat on the economy as global oil price hikes. This disrupts security of energy supply where escalating oil prices threaten the country's economy and balance of payment.
- **Big challenge to finance the energy sector program:** The energy sector is highly capital intensive sector in the country, requiring substantial investment for energy sector development and for promoting the transition from traditional solid biomass fuels to modern energy services. While, the large share of government investment is directed to the development of the energy sector, more investment is required, from diversified sources including the private sector, to get the energy sector at the level of development needed to support all economic and household sectors.
- **Climate change:** Ethiopia depends on hydropower for its electricity generation, which is susceptible to climatic changes. The country is prone to recurrent drought and other harsh weather conditions have become common, causing water shortage and high

level of silting on existing and potential hydropower dams. Drought conditions further decrease the regeneration of vegetation cover, affecting availability of biomass.

- **Lack of up-to-date and reliable energy data:** There is a lack of appropriate, up-to-date and reliable energy data vital for integrated energy planning and development.
- **Weak enforcement of Standards and Regulations:** There is a need to strengthen and establish safety and quality standards and enforcement measures in order to ensure safety and efficiency.
- **Inadequate transfer of technology and localization:** Due to insufficient technology transfer and underdeveloped industry for manufacturing, most of the energy technological hard-wares are imported, which leads to high foreign exchange spending.

2.2 Sector Specific Issues

2.2.1 Electricity

- **High capital investment:** The power sector requires huge amount of investment. The participation of the private sector in electricity generation and sales is essential in easing high investment requirements.
- **High system losses and low quality of electricity service:** The power sector in Ethiopia is characterized by low quality of supply such as frequent power outages and interruptions due to poor management and inadequate infrastructure including low technical standard of the existing distribution network as well as high system losses. These call for efficient and effective power sector management.
- **High congestion and inadequacy of power substations:** Power transmission lines in the country were built with lower capacities planned to serve lower loads. As the size of power generation increased and as load demand grew over time, existing substations become congested and failed to deliver sufficient power from point of production to point of consumption. Substation problems are further complicated by the radial nature of the transmission infrastructure and inadequate capacity of substations vis-a-vis the overall generation capacity and load in the system. In many instances, the power system depends on single-transformer substations that could not be relied upon for continuous power supply.
- **Low electricity coverage:** Access to modern energy services, particularly to electricity, has become essential in reducing poverty, promoting rural development, and improving quality of life for rural women. Access rate to electricity services in Ethiopia has remained one of the lowest in the world. Ongoing Universal Electricity Access Program has exhibited very promising results and needs to be further expanded to ensure a universal coverage to all areas and all citizens. More needs to be done towards improving ongoing rural electrification efforts and in overcoming observed weaknesses *such as* sub-standard works in construction.

- **Lack of economies of scale:** Connection to electricity services by rural consumers remains limited even after an area has gained access to electricity supply due to the scattered nature of settlements. In addition consumers remain at very low consumption level after connection has been established, despite a relatively low tariff structure. This result in low power demand density and thus, low economy of scale.
- **Low generation mix:** Hydropower continues to be the most dominant source of electricity supply for the foreseeable future. However, such reliance on large-scale hydro has its own drawbacks such as threats of natural and manmade disasters such as drought, earthquakes, and deterioration of dams. Ethiopia is equally endowed with alternative and localized power generation potential such as wind, geothermal, small-scale hydro and solar energy. Ensuring the variety of generation mix serves better in terms of reliability, cost reduction and security of supply.
- **Inadequate distribution networks:** As in transmission networks, the distribution networks in the country suffer from system inadequacy, failing to meet growing demand of electricity services. Low capacity, low technical standards, and lack of comprehensive plan for the distribution network contribute to continued outage of power at various locations.
- **Use of inefficient devices and appliances:** Due to sub-standard electrical devices and appliances a substantial amount of energy is wasted.
- **Siltation of hydropower reservoirs and inadequate watershed management:** Hydropower dam safety and sustainable dam management are very essential elements of power system management. Soil and water conservation practices at hydropower reservoir catchments remain a lot to be desired.
- **Climate change:** Due to recurrent drought the energy output of hydropower dams becomes highly unreliable. On the other hand, high water run offs threaten water availability and dam life spans.
- **Weak institutional capacity:** The power sector suffers from lack of strong institutions and well-trained personnel to ensure efficient and proactive power system management in the areas of governance, planning, implementation, and regulation.
- **Absence of sufficient information and data:** Absence of well-organized and up-to-date data, on resources, supply, consumption, and finance, remains the main bottleneck for proper planning and management on the one hand and for increased private sector participation in the subsector, on the other hand.
- **Lack of supportive industries (Localization):** Due to low level capacity of industries for manufacturing of electric components, such as transformers, turbines, generators. There is a heavy reliance on imported technologies that accounts for 80% of project cost. This has a huge negative impact on the country's balance of payment.
- **Inadequate dispatch center:** There is inadequate dispatch center for both national and Regional power system integration.

2.2.2 Hydrocarbons

- ***Sole reliance on imports:*** The import of petroleum fuels consumes large part of the export earnings of the nation. Sharply increasing demand for petroleum fuels and global oil price escalations have resulted in growing burden on the Ethiopian economy in meeting fuel import bills and maintaining the country's trade balance. Global oil price shocks exacerbate economic uncertainty. Oil importing countries such as Ethiopia suffer the most from oil price induced inflation and economic slowdown.
- ***Limited capacity, mode, and high cost of fuel transport:*** Inland transport of petroleum products is taking place by tanker trucks that are inadequate, inefficient, and more costly than alternative modes of transport. Absence of adequate mode of oil and gas transportation such as pipelines leads to high cost of fuel transportation. There is a strong need for diversifying the mode of fuel transport fleet from trucks to pipes and rails over a transport corridor stretching from port of entry to a central fuel dispatch center and further on to distribution hubs.
- ***Limited capacity of inland depots and strategic reserve:*** Sufficient inland depots and strategic reserves are very essential for easing unprecedented interruption of imports of petroleum fuels. The country needs to further expand petroleum depots and strategic reserves both in terms of quantity and geographic distribution in line with its reserve requirements. On the other hand, there is growing burden on government budget to keep the construction of strategic depots and fuel reserves in pace with increasing demand.
- ***Limited number of retail stations:*** Fuel retail stations remain concentrated in major cities. The distribution of fuel outlet infrastructure needs to be expanded evenly through the country with the objective of serving major future economic growth hubs and population settlement patterns.
- ***Inadequate quality control and loss of the petroleum fuel products:*** Petroleum products are prone to adulteration such as fiddling with retail pump meters, underground leakage and contamination, intentional blending of petroleum products with less costly fuel mixtures and water, and illegal cross-border trading. These illegal practices pose increasing threats to consumers' well-being, public health, and the environment. So far there is no strong regulatory quality standard. Hence, the regulatory body will have to develop a strong quality controlling mechanism to ensure quality control and minimize illegal petroleum product marketing practices.
- ***Inefficient transport fleets:*** Significant proportions of the fleets are on duty for many years without proper maintenance. Besides, the existing regulation does not encourage importation of new and efficient vehicles. Further, this is a challenge for increasing blending rates of ethanol and biodiesel to petroleum fuels.

2.2.3 Bio-energy

- **High Degree of Depends on Biomass:** High degree of dependence on wood fuels and agricultural residues for fuel has an impact on the social, economic and environmental well-being of society. Growing demand for biomass fuels together with increased demand for agricultural output has resulted in reduced access to wood fuels. Users of biomass fuels in the residential and service sectors are spending more time and effort in collecting or purchase biomass fuels, or else have to resort to using less desirable agricultural residues. Demand for wood fuels contributes significantly to forest losses and demand for agricultural residues as fuel reduces what is available as livestock feed and what can be left for soil fertility.
- **Unsustainable use of Biomass:** Biomass is a renewable resource and its use as energy may not contribute to greenhouse gas (GHG) emissions as long as resources are used sustainably. However, when resources are exploited beyond sustainable limits, biomass energy does contribute to GHG. The case for Ethiopia is that biomass energy is generally not sustainably produced and used and thus is not yet carbon neutral.
- **Difficulties in biomass production, transportation and utilization:** There is a huge loss of biomass energy during production, transportation and utilization. Mostly women and girls are involved in the process and are considerably impacted by it.
- **Lack of regulations and standards:** the government has made lots of efforts and has invested a lot to introduce energy efficient devices. However, due to lack of proper regulations, standard and enforcement measures the result is not as anticipated.
- **Lack of reliable and up-to-date data:** Most of the information available on the sector is obsolete. There is a gap in well organized data collection, updating and verification system.
- **Lack of distribution system for ethanol use in the domestic sector:** Ethanol could be used for household cooking through replacing kerosene. The use of ethanol in households faces two major constraints: relatively high cost of ethanol stoves compared with kerosene stoves. Furthermore, there is no network infrastructure in place for storage and supply of ethanol for domestic use throughout the country.
- **Low technological transfer and localization:** Due to low technological transfer and localization, most of the energy technological hard-wares are imported. This has negative impact on foreign exchange.
- **Low participation of investors in biodiesel development:** Even though the government has an interest the number of investors in bio-diesel development is decreasing from time to time.

- **Lack of access to financing:** Low income, lack of access to financing for R&D, promotion and dissemination of bio-energy resources and technologies is a major constraint facing the sector's development.
- **Lack of integrated systematic value-chain approach:** There is gap in establishing the market link between various bio-energy actors. Absence of domestic skill and infrastructure for bio-energy technology development also constrains local production.

2.2.4 Other Renewable Energy

- **High initial capital cost:** Despite multiple applications of renewable energy technology (RET) development remains low mainly due to high initial cost. The cost of other RETs are often beyond the purchasing capacity of ordinary rural households. This also limits involvement of the private sector in their development.
- **Weak institutional and technical capacity:** There is weak institutional set up and support for the development and dissemination of other RETs. Local skill for planning, installation, operation, maintenance, awareness and promotion is also weak.
- **Lack of access to financing and local capacity:** There is lack of access to credit facility for enabling rural communities to use other RETs.
- **Lack of reliable and up to date data:** Reliable data on the potential of other renewable energy resources and technologies of the country lacks.
- **Inaccessibility of sites:** There is lack of infrastructure to mobilize and develop renewable energy resources.

3. Energy Policy Goals and Objectives

The Ethiopian energy policy is specified into main policy goals, broader policy objectives and policy instruments. The policy instruments are presented under each policy objective category for ease of implementation.

3.1 Main Energy Policy Goal

The main energy policy goal is to ensure the availability, accessibility, affordability, safety and reliability of energy services to support accelerated and sustainable social and economic development and transformation of the country.

3.2 Energy Policy Objectives

The Energy policy seeks to meet the following broad objectives:

- Improve the security and reliability of energy supply and be a regional hub for renewable energy.
- Increase access to affordable modern energy.
- Promote efficient, cleaner, and appropriate energy technologies and conservation measure.
- Strengthen energy sector governance and build strong energy institution.
- Ensure environmental and social safety and sustainability of energy supply and utilization.
- Strengthen Energy Sector Financing.

Policy Objective 1 - Improve security and reliability of energy supply

Policy Instruments

- Strengthen the stability and reliability of existing energy supply systems through expansion and strengthening of the supply infrastructure and enforcing quality standards.
- Maximize development and utilization of indigenous energy resources such as bio energy, wind, solar, geothermal, hydro and hydrocarbons.
- Improve energy supply and utilization systems by introducing efficient technologies and sound energy management systems.
- Increase the provision of energy services through encouraging public and private sector investment.

- Ensure energy security through facilitating and encouraging appropriate mix of diversified energy supply.
- Maintain appropriate reserve capacity for electricity and petroleum fuels.
- Improve the effectiveness and efficiency of the energy service providers through capacity building and promoting competition when feasible.
- Ensure ethanol supply by enhancing production.
- Strengthen local R&D

Policy Objective 2 - Increase access to affordable modern energy

Policy Instruments

- Expand electricity service coverage through expansion of grid-based and off-grid electrification.
- Encourage energy cooperatives and societies as well as private sector in energy service delivery.
- Promote local production of energy technologies through facilitating product design to lower production cost, appropriate fiscal and tariff-based incentives and other instruments.
- Support R&D on renewable energy resources and technologies.
- Facilitate adequate financing schemes for RETs by establishing and strengthening sustainable financing mechanisms.
- Enforce technical and performance standards of modern energy services.
- Integrate energy projects with sectoral development programs.
- Achieve greater energy quality and affordability through encouraging competition within the energy markets.

Policy Objective 3 - Promote efficient, cleaner, and appropriate energy technologies and conservation measures

Policy Instruments

- Enhance energy production and delivery efficiency in bio energy production and conversion technologies, electricity production and delivery, and hydrocarbon fuels transport and distribution
- Improve household and service sectors' bio energy utilization efficiencies.
- Facilitate the use of efficient household ,service and industrial sector appliances and technologies for bio energy, electricity and others.
- Introduce industrial energy audits and industrial efficiency measures on the use of electricity, bio energy and fossil fuels.
- Improve transport energy losses by promoting fuel efficient vehicle fleet through conducive taxation measures, availing and encouraging public transport systems and introducing proper vehicle inspection practices.

- Promote public awareness on costs of existing energy losses and associated energy efficiency and conservation benefits and practices.
- Strengthen the institutional basis towards energy efficiency and demand side management practices in the country.
- Enhance the transfer and adoption of efficient and cleaner energy technologies that are appropriate to the socio-economic needs of the society.
- Strengthen energy technology dissemination network infrastructure and institutions.
- Strengthen inter sectoral link for the promotion of energy efficient technologies and services.
- Build local capacities in the areas of research, development, promotion, dissemination, monitoring of improved energy technologies and overall management.
- Enhance R&D infrastructure and institutions towards supporting the development of improved energy supply technologies.
- Establish and enforce standards and quality control.
- Integrate energy technologies and services in the planning, and promote green building design in urban areas.

Policy Objective 4- Strengthen energy sector governance and build strong energy institution.

Policy Instruments

- Strengthen the capacity of energy sector governance institutions in order to better formulate and implement energy policies and improve their operational efficiency and effectiveness.
- Restructure the institutional setup of the energy sector, in order to manage the fast growing demand and development program in coordinated and organized manner.
- Strengthen mandates and delineate roles and functions of the various energy institutions to make their operations effective, accountable and transparent.
- Engage stakeholders (private, non-government, communities, universities and research institutions) in the process of policy formulation and implementation.
- Improve the availability of adequate and up-to-date energy information.
- Integrate renewable energy and modern energy with development programs and urban development master plan.
- Establish and strengthen standard and regulation as well as enforcement mechanisms.
- Establish appropriate measuring, reporting and verification mechanisms(MRV)

Policy Objective 5- Ensure environmental and social safety and sustainability of energy supply and utilization**Policy Instruments**

- Integrate the objective of environmental sustainability into all energy initiatives with respect to the production, transportation and utilization of energy services.
- Subject energy sector projects to proper Environmental and Social Impact Assessment (ESIA) and environmental audit.
- Promote environmentally benign energy technologies and services through a combination of interventions to increase their positive impact on the energy balance and the environment.
- Set-up minimum performance standards and national targets to reduce energy-related emissions.

Policy Objective 6: Strengthen Energy Sector Financing**Policy instrument**

- Support with sufficient finance and search fund for energy technologies development.
- Attract domestic and foreign investments in energy services provision through providing appropriate fiscal and tariff-based incentives.
- Expand regional energy-market integration.
- Establish system to benefit from carbon finance mechanisms.
- Promote energy resource potential to financiers and investors.
- Establish “Energy Fund” by introducing mechanisms such as green tax for sustainability of energy sector development.
- Build local manufacturing capacity of renewable energy technologies through localization strategy.
- Develop technical capacity in negotiation, financial administration, and the like.

4. Sector specific Supply and Demand-Side Energy Policy Objectives and Instruments

This section treats sector specific policy objectives and related policy instruments. These policy objectives and their respective policy instruments are presented in two tiers: supply-side and demand-side. The supply-side policy objectives and associated policy instruments follow energy subsector lines while the demand-side policy analysis follow sectoral categories: households, industry, services, transport, and agriculture.

4.1 Supply Side Policy Objectives and Policy Instruments

4.1.1 Electricity

Policy Objective 1 – Provide adequate, reliable and affordable electricity supply to meet growing power demand for socio-economic development

Policy Instruments

- Expand the electric power generation capacity through public investment.
- Diversify energy generation mix based on cost, efficiency, environmental considerations, appropriate technologies and competitiveness.
- Encourage independent power producers, small-scale private power producers and co-generators through creative incentive mechanisms.
- Expand power transmission infrastructure and distribution network.
- Establish regulations to promote affordable pricing.
- Support local manufacturing of power generation, transmission and distribution equipment and materials.
- Implement proper competency certification system for electricity contractors and develop standards and code of practice.
- Promote R&D on electricity generation, transmission and distribution.
- Enhance regional cooperation and power market integration.
- Create a favorable environment for electricity cogeneration from bagasse, and electricity generation from urban solid and liquid waste.
- Establish appropriate infrastructure for energy provision to gain economy of scale.

Policy Objective 2 – Increase access to electricity services**Policy Instruments**

- Expand grid-based Universal Electricity Access Program through public investment.
- Expand off-grid power supply to rural areas through creating incentive mechanisms to attract private investment.
- Improve tariff structure considering the competitiveness of the industry and affordability for low income households.
- Design and implement appropriate support mechanisms to electricity contractors, small and micro enterprises (SMEs) and end-users to increase connectivity.
- Integrate power sector development with sectoral development programs and projects such as education, health, rural water supply, road access etc.
- Promote productive use of electricity services to enhance rural employment and income generation.
- Encourage the use of renewable energy for off-grid electricity supply

Policy Objective 3 – Ensure continuous improvements in electric power efficiency and conservation**Policy Instruments**

- Introduce regulation and standards for acceptable limits of electricity production and delivery system losses.
- Implement internationally acceptable quality standards for electricity end-use devices and appliances.
- Enforce and monitor supply-side management practices.
- Strengthen appropriate institutional capacity to implement energy efficiency and conservation measures.
- Promote electricity supply efficiency and conservation through effective support of training programs, information dissemination and continuous communication.
- Ensure regular inspection of facilities and implement maintenance and rehabilitation.

Policy Objective 4 – Improve power sector governance**Policy Instruments**

- Improve the government's capacity to institutionalize strong and efficient power system management structure and governance processes.
- Clarify the roles and functions of electric power governance institutions.
- Ensure accountability and transparency of operations of the institutions.
- Improve managerial and technical capacity of utilities.
- Establish and implement suitable electric power sector information, statistical and database system.

- Enhance the capacity of private sector, local communities and cooperatives in electricity service provision.

Policy Objective 5 – Strengthen environmental and safety management practices

Policy Instruments

- Enforce environmental rules and regulations that reduce environmental pollution during power generation and transmission.
- Enact and enforce internationally acceptable safety standards.
- Integrate environmental and social impact assessment in all power system investment projects and environmental audits.
- Minimize siltation and deterioration of reservoirs of existing and new hydropower dam catchment areas through soil and watershed management practices.
- Maximize the use of financing facilities which encourage investments in renewable energy technologies.

4.1.2. Hydrocarbons

Policy Objective 1 – Ensure the availability, accessibility and affordability of hydrocarbon fuels

Policy Instruments

- Encourage domestic and foreign investment for exploration and development of hydrocarbon reserve.
- Assess the feasibility and establish an inland refinery.
- Expand fuel handling facilities at ports of entry.
- Improve capacity of fuel transport from ports of entry to inland depots.
- Diversify mode of fuel transport from ports of entry to inland depots from fleets of road tankers to a pipeline and rail.
- Expand the capacity of inland depots.
- Expand the number and geographic spread of fuel retail outlets.

Policy Objective 2 – Reduce dependence on imported petroleum fuels

Policy Instruments

- Enhance bio-fuels development as substitute for imported petroleum fuels.
- Enhance oil and gas exploration and use of natural gas as a transport fuel and domestic fuel supply to reduce dependence on fuel imports.

- Gradually reduce petroleum imports through replacement of mode of passenger and freight transport from petroleum based systems to other systems like electric, flexi fuel and hybrid.
- Increase availability and efficiency of mass transport service.
- Encourage use of cheaper fuels such as coal and pet-coke for industrial applications and thermal power generation in environmentally sound manner.
- Promote the substitution of kerosene for lighting with low cost, cleaner and brighter lighting alternatives such as renewable energy systems.
- Provide incentives for investments that reduce the consumption of petroleum fuels through fuel substitution and efficiency measures.

Policy Objective 3 – Improve the efficient use of petroleum fuels

Policy Instruments

- Enact and implement regulations to encourage and enforce energy efficiency measures particularly in industry and transport sectors.
- Introduce fiscal and other pricing incentives on energy efficient practices.

4.1.3 Bio Energy

Policy Objective 1 - Ensure sustainable forest management

Policy Instruments

- Promote integrated management of forest resources.
- Promote plantations by private owners and communities.
- Improve the management of public owned plantations.
- Promote multi-purpose tree planting around homesteads in rural areas.
- Promote tree planting in degraded areas.
- Encourage social institutions to develop plantation for energy use.
- Promote farmers education to integrate agriculture with forestry.
- Set standards for management of existing forest areas for large commercial farms.
- Conduct periodic inventory of forests.
- Improve the monitoring of forests with remote sensing and other techniques.
- Seek carbon and other environmental financing to support forest management.
- Strengthen R&D for fast growing energy trees.
- Strengthen the establishment of centre of excellence for forest management.

Policy Objective 2 - Enhance diverse and efficient bio-energy production**Policy Instruments**

- Promote improved bio-energy conversion technologies including agro-industrial waste for thermal and power applications, biogas from urban, livestock and poultry waste.
- Enact and enforce appropriate charcoal regulations and strategy.
- Introduce small, medium and large scale bio fuel processing technologies.
- Build local capacity in production and generation techniques.
- Provide a favorable environment for private investors working in bio-energy production such as land, tax, infrastructure, security, and legislative support.
- Encourage the development of local capacities for bio energy equipment and appliance manufacturing.
- Involve all stakeholders including NGOs and CBOs in small and large biodiesel development activities in rural villages and in remote locations.
- Strengthen and promote market based private sector participation in biogas development.
- Enhance technology transfer for bio energy technologies including second generation bio-fuel processing.
- Support private sector involvement in productions of bio energy technologies.
- Facilitate the establishment of centre of excellence for bio energy system production and know-how.
- Strengthen R&D in the bio energy sector.
- Introduce attractive biodiesel pricing and widen biodiesel market infrastructure for investors and actors involved in biodiesel development.

Policy Objective 3- Ensure bio energy supply security**Policy Instruments**

- Promote the sustainable exploitation of wood resources.
- Develop and strengthen standards to increase bio-energy production.
- Develop awareness for commercial farms and homesteads to grow and use their own bio-fuels.
- Regulate the distribution of bio-energy.
- Diversify and promote use of indigenous energy resources such as bamboo.
- Expand the production of ethanol to ensure security of supply.
- Promote use of bio energy by establishing processing, distribution, transportation and marketing infrastructure.
- Promote modern cattle rising for better biogas production.
- Promote the construction and effective utilization of biogas digester.
- Promote bio oil and bio diesel for household energy use

- Provide financial support, such as loans, and seed money for potential bio energy developers.
- Incorporate bio energy promotion with the overall rural development package.
- Promote alternative fuels for rural areas: bio-fuels, biogas, solar cookers, and electricity.

4.1.4 Other Renewable Energy

Policy Objectives

- Promote and enhance renewable energies such as solar, wind, small scale hydro power and low enthalpy geothermal for small scale applications.

Policy Instruments

- Promote wide application of solar, wind and small scale hydro energy to meet decentralized electricity demands in the rural areas.
- Promote solar water heating for both domestic and institutional applications.
- Ensure favorable import duties for imported input material for manufacturing and assembling of renewable energy (RE) technologies and imported RE equipments and appliances.
- Encourage domestic production of RE technologies, accessories, and appliances.
- Develop data collection and estimation capacity for RE resources assessment.
- Encourage the participation of the private sector and enhance investment for exploiting RE resources.
- Encourage development and use of RE for own consumption.
- Build the skills and technical capacity on the production, installation, operation and maintenance of RE technologies.
- Create favorable financial, fiscal and pricing policies in favor of RE development, and provide financial support such as loans and seed money.
- Support the development of appropriate institutions working for RE development such as rural communities, Independent Power Producers (IPPs), and local administrations.
- Incorporate RE development with the overall rural development package.
- Encourage wide participation of IPPs in renewable energy development.

4.1.5 Atomic Energy

Policy Objective

- Consider peaceful application of atomic energy for power generation through adoption and adaptation of international basic safety standards and related treaties.

Policy Instrument

- Adopt and implement the new Atomic Energy Legal Framework.
- Adopt and implement the regulatory framework.
- Build human resource capacity and professional skills through universities on nuclear energy technology.
- Draw up medium and long term national plan on nuclear energy applications.
- Establish an appropriate laboratory to enhance quality assurance and control programs.

4.2 Demand Side Policy Objectives and Instruments

Major energy consuming sectors are household, transport, industry, agriculture and service. In this policy document hotels, restaurants and social institutions like hospitals, universities, refugee camps, prisons and the like are considered as service sectors.

4.2.1 Household Sector**Main Issue**

- Lack of access to reliable, affordable and clean energy.
- Poor end-use efficiency of locally produced and imported sub-standard energy appliances.
- Exposure to indoor pollution causing health hazards, especially for women and children.

Policy Objectives

- Improve access to clean and affordable energy technologies.
- Ensure and promote availability of efficient end-use devices.

Policy Instruments

- Accelerate dissemination of efficient end-use devices.
- Introduce diverse household energy alternative fuels and technologies such as improved and efficient lighting technologies, domestic biogas, electricity, biofuels, solar cookers, and kerosene end-use devices.
- Promote increased use of electric stove for Injera baking in both rural and urban areas.
- Expand and strengthen financial support mechanism to increase affordability of modern energy service technologies.
- Enhance R&D to develop more efficient, low-cost and appropriate end-use and conversion technologies and appliances.
- Promote awareness on energy efficiency, conservation and related health issues.

- Establish standard and regulation for household energy end-use and conversion technologies.
- Encourage technology transfer and localization.

4.2.2 Transport Sector

Main Issue

- Dependence on petroleum driven vehicles.
- Poor energy efficiency of transport fleets.
- Poor transport infrastructure.
- Lack of diversified and shortage of mode of transport.
- Inadequate mass transportation.
- Exhaust emission from inefficient transportation systems.

Policy Objectives

- Reduce the share of petroleum dependent transportation system.
- Encourage fuel efficiency in transportation.
- Expand and improve transport infrastructure.
- Increase and diversify mode of transportation and mass transportation.

Policy Instruments

- Increase the blending ratio for ethanol and biodiesel to the maximum feasible extent.
- Encourage mass transport, and establish system for electric trains, trams and buses for freight and passenger transport over long corridors and for urban mass transit.
- Encourage local manufacturing and assembly as well as import of fuel efficient vehicles such as hybrid, electric and flex-fuel.
- Create incentive mechanisms to retire old and inefficient vehicles.
- Improve and expand road transport infrastructure with due consideration of energy efficiency.
- Incorporate in urban development master plans pedestrian and pedal cycle transportation side roads.
- Facilitate use of pedestrian and pedal transportation means.
- Raise awareness on energy efficiency and conservation.
- Encourage technology transfer and localization.
- Formulate fiscal policies (taxation) and transport policies to promote energy conservation and efficiency on the transport sector.
- Develop standards for efficiency of motor vehicle engines and enforce stringent vehicle inspection.

4.2.3 Industrial sector

Main Issues

- Use of old and low energy efficient machineries and processes.
- Importation of sub-standard machineries.

Policy Objectives

- Replace outdated machineries with new technologies.
- Improve the energy efficiency of systems and operations.
- Provide adequate energy for industrial zones

Policy Instruments

- Promote the use of energy efficient and conservation practices.
- Encourage replacement of energy inefficient machineries and systems.
- Encourage self energy generation especially from REs.
- Utilize heat recovery system and technology in medium and large scale industries.
- Encourage technology transfer and localization.
- Establish appropriate energy infrastructure in industrial zones.
- Establish regulations for energy audit, build capacity and conduct periodic energy audits.
- Collaborate with industries and energy efficiency audit agencies in identifying energy efficiency and conservation options.
- Enact enabling legislation and efficiency standards requiring the manufacture and use of energy efficient equipment and goods.
- Facilitate credit enhancement mechanism to finance a large number of clean energy and energy efficiency projects.

4.2.4 Service Sector

Main Issues

- Poor efficiency of locally produced and imported energy equipments and end-use devices.
- Lack of awareness on alternative energy resources and technologies.
- Indoor air pollution and health hazards caused by use of energy inefficient end-use devices.

Policy Objectives

- Ensure use of efficient modern energy technologies.

Policy Instruments

- Encourage development and use of modern energy technologies and RETs.
- Promote and disseminate energy efficient end-use devices.
- Establish standard and regulation for energy end-use devices and equipments.
- Create awareness on energy efficiency and conservation.
- Replace and encourage use of RET for social services areas and street light.
- Regulate switch to alternative fuels such as electricity, LPG and liquid bio-fuels for medium and large-scale service establishments.
- Design appropriate incentive mechanisms to encourage energy efficiency and conservation.

4.2.5 Agricultural Sectors**Main Issues**

- Dependence on animate power and traditional agricultural implements.
- Lack of awareness on modern energy technologies and services.

Policy Objectives

- Employ modern energy technologies.
- Diversify energy use in agriculture.

Policy Instruments

- Educate farmers on availability and benefit of appropriate modern energy technologies.
- Increase self sufficiency through promotion of liquid bio-fuels and agricultural waste and other RETs to run agricultural machinery and for power generation.
- Adopt and promote agricultural technology transfer.
- Increase awareness and promote utilization of modern energy.
- Increase access to modern energy technologies through credit facility.

5. Cross-Cutting Issues

5.1 Energy Regulatory Framework

The presence of a strong regulator and the development of a strong regulatory framework are very essential to ensure the delivery of reliable, efficient, cleaner, affordable modern energy services for all citizens and the economy at large. Ethiopia has established a regulatory agency, Ethiopian Electric Agency, under the auspices of the Ministry of Water and Energy. The agency is mandated to regulate only electricity subsector. There are gaps in the regulation of other subsectors.

The Ethiopian energy regulatory body will have to focus on regulatory functions and needs to avoid shouldering non-regulatory responsibilities to ensure its effectiveness and efficiency. The regulatory body may have appropriate divisions within it that specialize in regulating various energy agencies as well as private and public partners playing a role in the production, delivery and utilization of energy services. These may include regulations on power sector, biomass and other renewable energy, fossil fuels, energy efficiency and conservation, energy markets and pricing, and sectoral energy utilization regulations such as households, industry, services, and agriculture.

Main Issues

- Weak institutional capacity of existing regulatory bodies.
- Absence of regulatory bodies for some energy sub-sectors.
- Weakness in enacting and enforcing energy laws and regulations.

Policy Objectives

- Strong institutional capacity of the regulatory bodies.
- Enact and enforce stringent proclamations, regulations and directives.

Policy Instruments

- Provide full power to discharge responsibilities for the existing regulatory bodies.
- Build institutional capacity.
- Work in close collaboration with organizations that have close linkage with the energy sector.
- Put in place relevant legal and regulatory instruments covering all sectors, sub-sectors, energy resources and technologies.
- Regular monitoring and inspection of imported and locally produced energy devices.

5.2 Energy Sector Governance

The energy sector encompasses multi-faceted objectives that need to be balanced. These are secured and adequate supply, economic efficiency, financial self-sufficiency, access to modern energy services for the low income population and environmental sustainability. Managing a vibrant energy sector thus requires the presence of well organized and balanced energy sector governance that is founded upon sound legal framework.

Main Issues

- Weak energy governance.
- Non-comprehensive legal framework.

Policy Objective

- Improve and institute energy sector governance backed by a sound legal framework for the realization of appropriate reforms.

Policy Instruments

- Critically review existing legal instruments and promulgate appropriate legislations so as to meet social, economic and environmental sectors' governance requirements.
- Introduce a legal framework that balances the interest of all parties and provides sufficient room for participatory actions and cooperation of all stakeholders at local, national and international level.
- Strengthen the capacity of energy sector governance institutions in order to better formulate and implement energy policies and improve their operational efficiency and effectiveness.
- Put in place relevant legal instruments that would define the roles and functions of the various energy governance institutions to make their operations more accountable and transparent.
- Provide the enabling environment and rooms for decentralized decision making and actions.
- Establish a consultation process that would engage stakeholders such as private, communities, academia, civic societies, government and non-government organizations in policy formulation and implementation (Energy Forum).

5.3 Building Strong Energy Institution and Capacity

The presence of well organized and credible energy sector institution is essential for the efficient and effective management of the sector towards meeting core energy sector objectives. Institutional development needs longer lead-time and commitment of financial and human resources. A successful energy sector program is dependent upon very clearly defined mandates together with commonly perceived and agreed targets. Strong communication between institutions, well-founded work ethics, and transparent operations all contribute to the effective functioning of energy sector institutions.

Energy sector management demands high level technical and managerial capacities, which are currently lacking. There is thus, a strong need for capacity building of those working in the energy sectors in order to improve their efficiency and effectiveness. There is also strong capacity building needs at regional and local levels including energy management, planning, demand and supply analyses, resource assessment, market opportunity studies and renewable energy promotion and technical back stopping.

The capacity for energy technology adaptation, system design, installation and service is inadequate. There are very few institutions capable of replicating RET products. There is inadequate capacity for adaptation and innovation for RETs. The technology adaptation and service capability currently available is concentrated at the ministry in some limit. Thus, capabilities must be enhanced and decentralized for accelerated and more effective implementation.

Main Issues

- Lack of strong energy institution that coordinates, organizes and manages overall energy activities.
- Limited skilled human power in the market.
- Limited hardware infrastructure.

Policy Objective

- Develop strong energy sector institution that is equipped with well trained human power and sufficient resources with clearly defined role.
- Strengthen energy institute with full authority and resources.
- Develop the skills and knowledge of human resources, and equip with adequate hardware at all levels.

Policy Instruments

- Establish strong energy institution that coordinates, organizes, manages and oversees the activities of all energy organs.

- Establish appropriate energy organs and define roles of the various actors.
- Provide the enabling environment and rooms for decentralized decision making and actions.
- Ensure the motivation and commitment of personnel and staff retention mechanisms through provision appropriate incentives.
- Enhance the cooperation, exchange of information, and transparency between energy sector institutions.
- Continually enhance energy sector management and technical capacity through short- and long-term training and experience sharing visits.
- Ensure the necessary human and financial resources and introduce timely training and skills upgrading programs regularly.
- Support the establishment and strengthening of training institutions and centres of excellence which will serve as a catalyst for technology research and development and training of RET developers and promoters.
- Introduce courses related to the various energy sub-sectors into educational curricula at education levels.
- Equip all energy organs with the necessary hardware: Information Communication Technology (ICT), machineries, transport, field equipment and others.

5.4 Integrated Energy Planning

The energy sector is the core player in ensuring sustainable development as it is highly related with the environment by way of the resources it utilizes and the pollution it creates in the process of producing, delivering, and utilizing its services. On the other hand, the demand for energy services are derived from all sectors, signifying the need for high level of integration of energy plans and programs with that of all the sectors and the environment. It is equally important that energy sector development is fully rooted in social, economic, and environmental dimensions.

The energy sector is amenable to local, national, regional and global concerns such as:

- Sustainable local resource management practices.
- Maintaining the balance between food production, energy utilization, and environmental management in such a way they work towards supporting each other.
- Global energy price changes (especially oil prices) and growing regional power markets.
- Global and regional environmental threats, mainly global warming and greenhouse gas emissions.

Thus, the coordination of all sectors and interest groups needs to be ensured through adopting integrated energy planning practices.

Main Issues

- Weak integration with other sectors.
- Duplication of efforts and wastage of resources.

Policy Objective

- Develop integrated energy planning system.

Policy Instruments

- Incorporate energy in the higher level plans and programs of the country.
- Integrate energy into the plans and programs of all economic sectors.
- Coordinate national and lower level energy plans in such a way that rural energy development would be integrated into the rural development plans, programs and practices.
- Develop inter-sectoral energy planning where agriculture, environmental and water management and social services plans are fully coordinated towards supporting each other's actions.
- Ensure that energy planning is based on reliable, well organized and updated database where a continuous updating of the country's energy database is carried out.
- Develop and maintain well organized and networked database with regional energy organs, other government and non-government bodies and the private sector.
- Avail updated energy database, plans and information to energy stakeholders and wider public using online service.
- Collaborate and establish favorable environment, communication and networking among sectoral institutions, energy developers and consumers.
- Develop networked plan and performance exchange system among the federal and regional energy institutes.

5.5 Energy Efficiency and Conservation

Increasing the efficiency of energy supply and use yields substantial economic and environmental benefits. Energy efficiency and conservation have multiple and multi-level gains. It reduces growing energy demand, improves energy security, and reduces emissions of greenhouse gases. Energy efficiency and conservation must be addressed in all sectors.

Main Issues

- Lack of awareness on energy efficiency and conservation.
- Production, importation and utilization of energy inefficient technologies.

Main objectives

- Improve energy efficiency and conservation.

Policy instruments

- Increase awareness of energy efficiency and conservation using different promotional media.
- Develop standards and codes for energy efficiency.
- Integrate energy efficiency and conservation in the planning and implementation of all sectors.
- Include energy efficiency and conservation in education curricula.
- Incorporate energy efficiency in designing of buildings.
- Use incentive mechanisms in the form of tax reduction, reward and the like.
- Set standard and regulatory frame work that discourages production, import and use of energy inefficient technologies.
- Apply stringent measures to discourage energy wastage.

5.6 Energy Pricing

Energy pricing policy plays a crucial role in mainstreaming energy markets such that certain preferred energy forms and services could be used in lieu of other less preferred options. Energy production and utilization efficiency, energy transition, access to modern energy services, expansion of renewable energy technologies, carbon neutrality in energy utilization, competition and investment decisions in the energy sector could all be influenced through the application of appropriate pricing instruments. The most desirable pricing policy is to follow market prices whenever the conditions exist for competitive markets. However, market imperfections prevail in energy markets requiring pricing policy interventions to reflect true costs of energy services that internalize financial, economic, social and environmental costs.

Main Issues

- Imperfection of energy market in reflecting true costs of energy services.
- Modern energy prices and costs are unaffordable by the majority of the population.
- Unrealization of feed-in-tariff.

Policy objectives

- Introduce appropriate pricing policies, whenever market mechanisms fail to provide sufficient pricing instruments to achieve certain energy sector objectives.

Policy Instruments

- Allow market mechanisms to play central role as long as the presence of market imperfections do not obstruct the realization of certain basic energy objectives and principles.
- Apply basic principles of longer-term cost-effectiveness and financial viability, economic efficiency, income distribution/ social well-being, and sustainable development as main drivers for energy pricing intervention.
- Introduce targeted and time-bound subsidies and pricing instruments in areas where market mechanisms fail to promote access to certain energy services for low income groups, and when certain energy forms fail to compete until bottlenecks are removed.
- Provide clear signal to energy consumers and producers through pricing mechanisms.
- Keep updated pricing information for biomass and other fuels (at key geographic areas).

5.7 Research and Development

The energy sector demands the application of new and advanced technologies in the production, delivery and utilization of energy services. Countries like Ethiopia need to shift their excessive dependence on biomass fuels that are inefficient, less clean, and less conducive for advancing accelerated growth. Transition towards modern energy services will have to be met with the application of green growth where environmental sustainability is given sufficient attention. Introduction of robust research and development (R&D) capability is a key element of energy sector development.

Main Issues

- Less attention on basic adaptive energy R&D.
- Lack of strong institutions that undertake R&D on energy.

Policy Objective

- Strengthen energy R&D institutions towards facilitating the development of the sector and expansion of modern energy service.

Policy Instruments

- Encourage academic institutions to promote energy R&D as centers of excellence specializing in certain specific energy areas.
- Promote the transfer, adoption, and development of renewable energy technologies.

- Conduct research in development and dissemination of efficient energy conversion and end-use technologies such as efficient stoves and appliances.
- Enhance the prototype production of energy equipment, machinery parts, and appliances.
- Expand policy research in the energy field on a continuous basis to ensure timely adaptation of legislative, pricing and regulatory adjustments.
- Create the forum and enhance cooperation, consultations, and exchange of information on energy research among R&D institutions.
- Encourage inclusion of energy aspects in education curricula for schools, vocational training centers colleges and other relevant learning institutions
- Facilitate the availability of sufficient fund for the promotion of energy related R&D.

5.8 Environmental and Social Impact

Energy and environment are like two sides of the same coin. Energy depends on the environment for extracting its resources. The production, transportation, and utilization of energy releases pollutants that pose the bulk of the environmental threats at local, national, regional, and global levels which has an impact on the society. It is therefore vital that energy sector development is subject to scrutiny for its adverse implications on the environment and the society. Introduction of environmental and social impact assessment for new investment projects and environmental audits for existing ones are necessary. This encompasses both specific energy development projects and all other investment projects on their energy utilization and emissions of pollutions thereof.

Main Issues

- Environmental degradation due to energy utilization, production and delivery.
- Pollution of soil, water and air a result of energy utilization, production and delivery
- Climate change through release of GHG energy utilization.
- Threat on the well being, health and safety of society.

Policy Objective

- Ensure energy production, delivery, and utilization poses minimum threats on the environment and society.

Policy Instruments

- Introduce mandatory environmental and social impact assessment on new energy and non-energy investment projects to assess the level of emissions of pollutions and determine whether the project will have to be realized and on the type of necessary mitigation measures to be adapted.

- Introduce environmental audit for existing polluting establishments (mainly industrial, service and transport sectors) to assess the level of pollution being released and introduce necessary mitigation measures.
- Promote green and carbon neutral development through wider utilization of renewable energy sources and technologies.
- Arrest biomass energy related environmental and social impacts such that the relationships of biomass energy utilization, agriculture and the environment are improved through introduction of improved land use, forestry/ woodland, animal husbandry and agricultural management practices.
- Commit sufficient finance and introduce greater investment in reducing existing environmentally polluting practices and introducing efficient energy production and utilization options.
- Promote project funding through the CDM, GEF, and green growth funding options.
- Minimize in-door air pollution through introduction of energy efficient end-use devices and cleaner fuels.
- Promote awareness on maintenance of transport fleet for minimizing notable GHG emissions.
- Decrease transport related emissions in major cities through introduction of vehicle emission test and inspection and promotion of cleaner vehicle fleets.
- Switch mode of urban mass transit from petroleum based fuels to that of electricity based light trains and trams.
- Ensure environmental and pollution mitigation in mining areas such as damage to landscapes and in the extraction of other energy related minerals such as coal.
- Comply with global initiatives and treaties towards a cleaner global environment such as reduction of GHG emissions and global warming.
- Ensure the participation and benefit of local communities from energy development programs and projects.

5.9 Gender

Energy development and utilization is highly intertwined with gender such that the conditions and positions of women tend to be compromised in the process of energy procurement and use. Women shoulder household responsibilities that subject them to long distance trips for the collection of cooking fuels such as wood, shrubs, branches, leaves, dung, and agro-residues from the field. They are exposed to indoor air pollution more than their men counterparts as they are subjected to household chores. Their conditions are further worsened by the fact that they are required to fulfill reproductive functions in raising children and in sharing workloads in the field at the same time. Women are more likely to be subjected to occupational environment hazards in industries and service sectors. It is, therefore, necessary that energy policies address gender issues

such that the conditions and positions of women are improved at household, community and occupational levels.

Main Issues

- High workload, abuse and harassment on women due to long distance walk, fuel collection and transportation.
- Health impact due to exposure to indoor air pollution and fuel transportation.
- Deprived to get education and high dropout rate.
- Lack of time to be involved in productive activities.
- Low participation in energy planning management and decision making.
- Low financial capacity to access modern energy.

Objective

- Ensure the participation and benefit of women from energy sector programs and projects.

Policy Instruments

- Enhance access of women to modern energy services that are cleaner and more convenient to use and reduce workloads for women minimizing fuel collection chores.
- Collaborate with various government and non-government institutions and community groups in improving the participation and benefit of women in all energy related programs and projects.
- Facilitate the participation of women at all levels of decision making on energy planning and management.
- Introduce efficient and convenient energy appliances in households to minimize exposure of women to in-door air pollution.
- Collect gender disaggregated information and conduct gender research to improve the working and living conditions and positions of women.
- Facilitate credit mechanisms to enhance production capability, and usage of modern energy.
- Make aware of women on the benefit and availability of energy efficient technologies.

5.10 Regional and International Cooperation

The energy sector more than any time before is coming under regional and global influence in a number of ways. This calls for cooperation and collaboration regionally and internationally. Countries endowed with energy resources could share the surplus with countries with deficit resources. Countries that are technologically advanced could play important role in the transfer of energy technologies.

Main Issues

- World oil price hikes and associated economic shocks have repercussions on low-income developing countries.
- Global warming due to anthropogenic activity and climate change.
- Increasing global and regional electricity demand.
- Limited transfer of technologies and exchange of know-how.

Policy Objective

- Enhance regional and global cooperation in the energy field to ensure exchange of know-how, information and transfer of technologies
- Strengthen cross border energy trade.

Policy Instruments

- Set regional and global energy cooperation and engagement frameworks and protocols.
- Play a substantial role and formulate strategies to maximize benefits from growing global energy markets by way of benefiting from newly opening market opportunities such as the East African Power Pool, bilateral cross-border power trade and petroleum fuels trade.
- Demonstrate in global energy forums that Ethiopia has the resource potential to emerge as a regional (sub-regional) renewable energy hub by harnessing its renewable energy resources in a sustainable way.
- Expand the horizon of Ethiopia's presence in Regional and Global energy and environmental forums and energy markets.
- Facilitate the exchange of information, skills and know-how as well as transfer of energy technologies through benefiting from ongoing Regional and Global energy forums.
- Expand the scope of global development and facilitate acquisition of Climate Change mitigating funds from Regional and Global funds.
- Ensure greater economy of scale and market competitiveness through enhancing sub-Regional and Regional cooperation in Global energy markets.
- Work towards creating a favorable domestic investment climate to attract the inflow of international investment funds in energy sector development.
- Ensure greater security of energy supply via neighboring country ports, through diversifying ports of entry and forming greater cooperation with neighboring states.