



**The Federal Democratic Republic of Ethiopia**  
**Ministry of Water Irrigation and Electricity**

**National Energy Policy**  
**(Revised)**

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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
EAPP	East Africa Power Pool
EEPCO	Ethiopian Electric Power Corporation
EEP	Ethiopian Electric Power
EEU	Ethiopian Electric Utility
ESIA	Environmental and Social Impact Assessment
ETB	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 <sup>2</sup>	Kilo Meter square

kV	Kilo Volt
kWh/m <sup>2</sup>	Kilo Watt Hours per Square Meter
kWh/m /day	Kilo Watt Hour per Square Meter per Day
LFO	Light Fuel Oil
LPG	Liquefied Petroleum Gas
m <sup>3</sup>	Meter cube
MGR	Motor Gasoline Regular
MoWIE	Ministry of Water Irrigation and Electricity
MW	Mega Watt
MWh	Mega Watt Hour
NBP	National Biogas Program
NGO	Non-Governmental Organization
PPP	Public Private Partnership
R&D	Research and Development
RE	Renewable Energy
RET	Renewable Energy Technology
UEAP	Universal Electric Access Program
USD	US Dollar

## 1. Introduction

The current National Energy Policy was issued in 1994 with assumption of regular revision to incorporate new developments in the environment. However, it was never updated for over two decades although a lot of structural and transformational changes were happening at both national and global levels.

The Ethiopian economy has grown more than 10% over the past decade. The second phase of Growth and Transformation Plan (GTP II) that was launched in 2015/16 anticipated an annual growth rate of 11.2% in the GDP and growth rates in value added of 8.6% in the agriculture sector, 10.2% in the service sector, and 21.4% in the industrial sector (EEA, 2017). GTP II puts strong emphasis on structural transformation, Industrialization, urbanization and export promotion. This continuous socioeconomic growth and the government vision to become middle income country by 2025 will undoubtedly influence the growth and security of energy supply.

The current energy policy needs to be updated to comprehend new energy development related issues and directions which are not clearly stipulated in the policy and to give more emphasis to the development and utilization of all renewable and clean energy resources in a sustainable and environmental friendly manner through participation of both public and private sector. Specifically, adequate affordable and reliable supply to modern energy is vital for enabling structural transformation of Ethiopia's economy and society, including further poverty reduction rates and a shift towards higher productivity rates and industrialization. This revised policy document is divided into five main sections:

- Section I: Overview of the Ethiopian energy sector
- Section II: Energy sector issues.
- Section III: Energy policy goals and objectives
- Section IV: Supply and Demand side policy objectives and policy instruments
- Section V: Cross Cutting Energy Policy Issues,

each with sufficient detail to indicate the direction the Government follows to develop the energy sector in Ethiopia.

## 2. Overview of the Energy Sector in Ethiopia

Ethiopia is endowed with a variety of renewable energy potential including hydro, wind, geothermal, solar and bio-energy. The gross hydro-power potential of the country is estimated at 45,000 MW. The geothermal energy resource potential is estimated about 10,000 MW. There is a significant wind potential greater than 100 GW and solar potential is also massive. The country also has natural gas reserve estimated at more than 8 TCF in Calub, Hilala and Elkuran area. Oil shale deposit is estimated at 253 million tons.

Recently petroleum crude oil is also found at Hilala fields. A groundbreaking trial-production ceremony saw three oil wells spewing 150 barrels. To estimate the amount of reserve further exploration is undergoing. Coal resource estimate is 300 million tons distributed in 9 sites mainly located in the Northern, Central and South western part of the country.

Despite the presence of a variety of renewable energy resources, the bulk of the national energy consumption is met from biomass sources. According to the 2017 National Energy Balance study Biomass accounts for 87% of total national energy consumption in 2017. Modern fuels contributed about 13% of total energy consumption, of which hydrocarbon products constitute 10.4% and electricity 2.6%.

At present the per capita electricity consumption per annum in the country is 100KWh while the sub-Sahara Africa is on the average 521 KWh/capita. The household sector accounts for 88.2% of total final energy consumption and transport sector 8.4% Industry and construction 2.3% and service 1.2%. Household energy used from biomass (88%), electricity and petroleum products together accounted for 12% in 2017.

Industry and construction sector accounted 2.3% of the final energy consumption of which 36.3% petroleum, 42.7% Coal and 21% electricity in 2017. Transportation sector energy consumption accounted for 8% of final energy consumption and 83% of it is petroleum, the remaining being ethanol.

Energy supply and consumption trend over the years 1996 to 2017 shows that the share of biomass energy decreased from 96.6% to 87% in 2017, while the share of hydrocarbon fuels

and electricity increased from 4.8% to 10.4% and from 0.6% to 2.6% 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.

## **2.1. Electricity**

### **A - Generation**

The current generation capacity has reached 4,300 MW with hydropower resource accounting for 92% of the country's electricity production in normal operation. To-date less than 10% of this hydropower resource base has been exploited. Three major hydropower plants, (with a total installed capacity of more than 8.4 GW), the Grand Ethiopian Renaissance Dam at 6,350 MW, Koysa at 2,160 MW) and Genale Dawa III at 254 MW, are all under construction.

Wind power resource potential is emerging to be more promising than that was originally thought. As a result of Adama I, Adama II, and Ashegoda wind parks currently produce a maximum of 324 MW for the national grid.

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 to 75 MW capacity. Furthermore, under the IPP framework, two implementation contracts have been signed to develop 540 MW from each of the Tulumoye and Corbetti sites.

Waste to Energy technology is also in the picture. Recently, the first plant with capacity of 25 mW has been constructed in Addis Ababa Repi site. Other similar plants will be constructed in the major towns of the regions.

### **B - Transmission**

In Ethiopia, transmission lines are mainly at 400 kV, 230 kV, 132 kV, 66 kV, and 45 kV AC systems, although a 500 kV DC is under construction for the Ethio-Kenya power trade. The length of the existing transmission lines in the country is more than 17,000 km. The transmission line density of the country per 1000 km<sup>2</sup> of territorial area thus stands at about 17 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.

The total number of sending-end and receiving-end substations in the national grid is more than 160 in number. Out of this total, substations with single transformers are about 50 (i.e. about a third of the total), Any problem with the transformers can easily get many customers out of service for a considerable time thereby providing unreliable service. Therefore, there is a need to install additional back-up transformers in all substations for improved reliability.

## **C - Distribution**

The distribution line is about 200,000 km, and this network currently serves about 2.9 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) was a major initiative to address this problem. It was 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. With all these efforts, today grid connected household is not more than 30% of the population. Following this the government recently released the Ethiopian National Electrification Program (NEP) implementation Road Map (IRM) for achieving Universal electricity access nationwide by 2025 through both on grid and off-grid schemes.

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 reviewed. 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.

## **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, Petroleum fuels, coal and oil shale. So far, none of these resources have been developed. Until recently, consumption of hydrocarbons was solely imported 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 13% of the share in the national energy balance for the year 2017, of which coal and pet coke contributed only about 1.04%. From 2010 to 2017 petroleum fuel consumption grew by more than double from 2.0 billion tons to more than 4.2 billion tons. Kerosene, diesel and gasoline consumption grew by more than double.

### **A - Hydrocarbon Supply and Demand**

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.

Natural gas was discovered before two decades at present the government is focusing to develop this resource for export market. The country plans to earn an annual revenue of \$ 8 billion from natural gas export which will be made through a pipeline to be installed beginning at middle of 2018.

Petroleum oil is also discovered and is under process to exploit the resource. The Chinese company Poly-GCL Petroleum Investment Limited is responsible for the extraction of both crude oil and natural gas in the Ogaden area, Somali regional state in Eastern Ethiopia.

## *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 4.2 Million tons in 2017, Annual cost of import grew from 1.3 billion USD in 2010 to over 3 Billion USD in 2017 using up most of the national foreign currency earnings.

About 83% of petroleum consumption is by the transport sector, which mainly uses diesel fuel. Importation of diesel, jet fuel and gasoline is increasing over the years. Diesel (ADO) accounts for 67% of total imports followed by Jet fuel (19%) and gasoline 11% Jet fuel import is consumed 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.

Fuel oil accounts for only about 2% 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 way from fuel oil due to high price of petroleum. Coal and Pet coke are increasingly replacing fuel oil. Liquefied Petroleum Gas (LPG) import for 2010 was about 7,650 tons. This import volume increased to 8,297 tons in 2017. Recently, the government is announced that petroleum fuels is found in the country and is in the process to start production. The volume of the reserve is still under investigation. So, in the near future Ethiopia will become one of oil producing countries.

## *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 2017 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 above sugar factories, there are many sugar factories under construction 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.

## *Oil Shale and Natural Gas*

Oil shale and natural gas resources are discovered earlier. 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 526,217 tons and 306,702 tons respectively in 2017.

## *Petroleum Standard and safety*

Until recently there was institutional and legal weakness especially in the area of downstream 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.

## **2.3. Bio-energy**

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

### **Solid Biomass**

Biomass energy accounts for more than 87% of the total final energy consumed in 2017. This makes Ethiopia as one of the most biomass energy dependent countries 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.

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.

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.

**Liquid Bio-fuels**

Ethiopia started 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 6000 m<sup>3</sup> of Ethanol per year from Fincha Sugar Factory alone. In 2010/2011, the annual production capacity of Fincha increased to 8,000 m<sup>3</sup>, while Metahara sugar factory started producing 12,500 m<sup>3</sup> per annum. This increased the annual total National production of Ethanol to 20,500 m<sup>3</sup>.

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 bio-fuels 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.

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. 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 8,161. Recently, with National Biogas program the total installed biogas digesters reached 21,735 and the NBP has managed to introduce appropriate setup for the management of a biogas program at a national scale.

## **2.4. Small Scale Renewable Energy**

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 1522 kW. However, most of the sites have ceased operation currently.

#### *Small Scale 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/m<sup>2</sup>/day. This potential however varies from season to season, with the lowest potential being 4.55 kWh/m<sup>2</sup>/day, and the highest potential being about 6.25 kWh/m<sup>2</sup>/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 centers and Schools for lighting and small power demand such as water pumping, and heating.

About 10 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.

### 3. Key Energy Sector Policy Issues

#### 3.1. Broad Energy Sector

- ❖ **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 structural transformation, industrialization and urbanization. At present the per-capita electricity consumption in the country is about 100 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 18 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 88% of the energy supplied being utilized by the household sector. About 88% 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 favorable 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 largely 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 of energy production, transportation and usage.
- ❖ **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.

## 3.2. Energy Sub Sector

### 3.2.1. *Electricity*

- ❖ High capital investment: The power sector requires huge amount of investment. The participation of the private sector through Public Private Partnership (PPP) or through Independent Power producer (IPP) 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 and upgrading.
- ❖ 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. Although there are some efforts to make redundant some of the substation transformers and transmission infrastructure, in many areas, the power system depends on radial nature transmission infrastructure and 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, connection rate to electricity services in Ethiopia has remained one of the lowest in the world which is not more than 30%. The current launched National Electrification Program Implementation Road Map (NEP- IRP) with the moto of "Light to All" should address the country's wide connectivity

problem.

- ❖ Lack of economies of scale: Connection to electricity services through grid-based technology to some of rural consumers remains limited even after an area has gained access to electricity supply due to the scattered nature of settlements. This needs other off-grid or stand alone technology to supply electricity.
- ❖ 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 Power transformers, turbines, generators switchgears etc. There is a heavy reliance on imported technologies that accounts for more than 60% 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.

### **3.2.2. 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 mostly 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.

### **3.2.3. 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 hardware is imported. This has negative impact on foreign exchange.
- ❖ 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.

### **3.2.4. *Small Scale Renewable Energy***

- ❖ High initial capital cost: Despite multiple applications and the trend for cost reduction of renewable energy technology (RET) development remains low mainly due to still high initial cost compared to conventional technologies. 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 some renewable energy resources.

## 4. Energy Policy Goals, Objectives, and Instruments

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.

### 4.1. Broad Energy Sector

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

The Energy policy seeks to meet the following broad objectives:

- Improve the security and reliability of energy supply and be a regional export power hub for renewable energy.
- Increase access and connectivity to affordable modern energy.
- Promote efficient, cleaner, and appropriate energy technologies and conservation measures.
- 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 through the involvement of the private sector.

**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 additional 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 and connectivity to affordable modern energy

**Policy Instruments:**

- ❖ Expand electricity service coverage through expansion of grid-based and off-grid technology.
- ❖ 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 and clean 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.
- ❖ 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
- ❖ 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 private investors in energy sector production and services provision through providing appropriate legal framework 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 and financial administration.

## 4.2. Energy Sub Sector

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 follows sectoral categories: households, industry, services, transport, and agriculture.

### 4.2.1. Supply Side

#### 4.2.1.1. *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 and private sector involvement either through PPP or IPP arrangement.
- ❖ 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 and connectivity 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 local private sector, 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.
- ❖ Increase private sector participation in power generation

#### **4.2.1.2.        *Hydrocarbons***

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

**Policy Instruments:**

- ❖ Accelerate the production of hydrocarbon reserves for local and foreign market.
- ❖ 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.
- ❖ Accelerate the production of oil and gas reserve for local and export market to reduce dependence on fuel imports
- ❖ Gradually reduce petroleum consumption 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.

### ***4.2.1.3. 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.

**4.2.1.4. *Small Scale Renewable Energy Resources***

**Policy Objective**

- ❖ 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.

### ***4.2.1.5. 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 Instruments:**

- ❖ 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.

## **4.2.2. Demand Side**

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.

### ***4.2.2.1. 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, bio-fuels, 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.

### **4.2.2.2. *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, tramps 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.

### ***4.2.2.3. 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.

### **4.2.2.4. 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.

### **4.2.2.5. 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.

### **4.2.3. Cross-Cutting Issues**

#### **4.2.3.1. 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.

#### **4.2.3.2. 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).

#### **4.2.3.3. 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.

#### **4.2.3.4. 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.

#### **4.2.3.5. 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.

#### **4.2.3.6. 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.
- ❖ Absence 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).

#### **4.2.3.7. 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.

### **4.2.3.8. 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.

#### **4.2.3.9. 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.

#### **4.2.3.10. 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.