Ethiopian Energy Authority

Project document

On

Locally manufactured electric stoves

Energy Efficiency Standards and Labeling

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Addis Ababa, Ethiopia

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Annexes

List of Abbreviations

1. CDM Clean Development Mechanism
2. CM Centimeters
3. CRGE Climate Resilient Green Economy Strategy
4. CSA Central Statistic Agency
5. EE Energy Efficiency
6. EEA Ethiopian Energy Authority
7. EEP Ethiopian Electric Power
8. EEU Ethiopian Electric Utility
9. EFY Ethiopian Fiscal Year
10. GC Gregorian Calendar
11. GHG Green house Gas Emission
12. GTP Growth and Transformation Plan
13. GW Gig watt
14. GWh Giga watt hour
15. KW Kilowatt
16. KWh Kilo watt hour
17. MEPS Minimum Efficiency Performance Standard
18. MRA Mutual Recognition Agreements
19. CLASP Collaborative and Standard Program
20. CO_2 e Carbon dioxide equivalent
21. GIZ Deutsche Gesellschaft fur Internationale Zusammenarbeit
22. IEA International Energy Agency,
23. IEC International Electro Technical Commission

24. NPV Net Present Value
25. SNV Netherlands Development Organization
26. TC Technical Committee
27. EAEDPC Ethiopian Alternative Energy Development & Promotion center

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Executive Summary

In developing countries like Ethiopia, residential sector takes the dominant share of the total national energy consumption. The majority of the residential energy is used for cooking or preparation of food. The demand for electrical power has been constantly growing in Ethiopia due to the rapid economic growth, the shortage of fire wood and biomass, and the huge electrification programs underway in the country.

Data at the Ethiopian Electric Utility (EEU) indicates that there about 2,596,800 residential households customers connected to electricity in the year 2007 EFY (2014/15 GC). The households have consumed 4,987.84 Giga watt hours of electrical energy in the same year which constituted about 43% of the total national energy consumption. The consumption of the residential households is more than the energy sold even to the Industries tariff groups within the same year, which was about 29%. Furthermore, as per the Ethiopian Power System Expansion Master Plan Study high case forecast, the demand of electrical energy for the households tariff group increases nearly at an average rate of 9% per year.

The locally manufactured electric stoves, being used mainly for cooking" Wot" (Ethiopian spicy sauce) and baking, are most energy consuming appliances in the households. The energy efficiency of local stove is low based on the tests made by the then Ministry of Mines and Energy and the Ethiopian Energy Authority (EEA). Its cooking efficiency is low due to limited energy conservation behavior of users.

These low efficiencies and limited energy conservation behavior of users affected the electric power supply infrastructure by overloading and effecting frequent power interruptions, outages and voltage drops. Its excessive energy consumption has forced the consumer and the power provider to pay for the wasted energy. The causes of the low energy and cooking efficiencies are: the excessive heat loss from the set during operation, lack of standard on the product, limited research and innovation made on the improvement of the product for decades and lack of awareness creation on the proper use of the product.

Based on the assessment made there are estimated 298,000 and 128,000 single and double cook top type local stoves in Ethiopia in the year 2009 EFY, and the corresponding peak power demand and energy consumption including losses are about 268 MW and 1,189 GWh respectively in the same year. The power and energy demand requires the generating capacity of a big power plant in the country. The projected peak power demand and energy consumption of the local stoves, including losses, in the year 2019 EFY is estimated to be 534 MW and 2,316 GWh respectively.

Improving the efficiency of the locally manufactured electric stoves by developing energy efficiency (EE) standard and labeling program will:

- Reduce demand on power, electric supply interruptions and outages, electrical infrastructure congestion, and capital Investment in energy supply Infrastructure,
- Save energy to the consumer (user) and the nation, thereby enhancing national economic efficiency by reducing energy bills.
- Strengthen market competition among producers
- Encourage research and innovation
- Assist the country in meeting climate change goals and averting regional pollution
- Reduce deforestation in search of fire wood and bio mass fuel.
- Mitigate land degradation and environmental pollution due to the production of clay plates,
- Mitigate the burden on the rural women engaged in the production of clay plates,

The energy efficiency of the locally manufactured electric stoves is estimated to be improved by up to 19%. The projected peak power demand reduction and energy savings obtained in 2019 EFY as a result of the implementation of Energy Efficiency(EE) standard and labeling program on the locally manufactured electric stoves is estimated to be 101 MW and 440 GWh respectively. This has monetized benefit Net present value of 241,048 Mill. Birr If the saving of power is exported and 9,010 Mill. Birr if the saving of power is consumed in the country by providing power to additional residential households. In the case of exporting the power saved, the power demand reduction saves the cost of erecting and running power plant of same size whereas the energy saving has the equivalence of about 2,000 million tons of cumulative carbon saving in the region. This proves the EE program on locally manufactured electric stoves to be an environmental project and that it contributes a lot in reducing GHG emissions as per the Ethiopia's Climate-Resilient Green Economy strategy (CRGE).

The power demand and energy savings obtained as a result of EE standard and labeling of the locally manufactured electric stoves could be used for rural electrification, manufacturing, industrialization, and export programs in meeting the objectives and implementing the strategies for sustained rapid and broad-based economic growth of the Growth and Transformation Plan (GTP) of Ethiopia.

In this proposal, the EE problems on the local stoves and the demand for the project are assessed. EE standard and labeling program is developed. Implementation plan, project inputs, project management and institutional details are proposed. The benefits and justifications and the environmental impact, risks and risk counter measures of the project are analyzed. Electric stove main parameters, test procedures, list of testing facilities, sampling and testing procedures have been prepared.

1 Project background

1.1 Problem analysis

1.1.1 Electric stoves

An electric stoves or electric range is an integrated electrical heating device to cook and bake. Electric stoves became popular as replacements for solid-fuel (wood or charcoal) stoves which have required more labor to operate and maintain. Electric stoves may have single or multiple cook tops and be controlled by a fixed or rotary switch with a finite or infinite number of positions, each of which engages a different combination of electric resistances and hence a different heating power. Some may have a thermostat to switch power on and off and to control the average heating effect of the elements. Electric stoves are widely used in the households and commercial kitchens in Ethiopia.

1.1.1.1 Heat transfer process in electric stoves

There are four heating mechanisms used for food cooking using electric stoves: conduction, convection, radiation and induction. A stove also referred to as a cook top, incorporates one or more distinguishable cooking zones upon which pots/pans can placed. The pots/pan itself can be heated by any of the heating mechanisms (or a mixture) above, before heat is passed to the food via conduction.

Conduction refers to the heat transport from an energy source to the material.

Convection occurs when fluids become less dense on heating, setting up convection currents that physically transfer heat and hot fluid to the material.

Radiation refers to the energy propagation as an electromagnetic wave, which can heat the surface of a material.

Inductive heating involves the induction of a current in a material due to a changing electromagnetic field, which then produces heat due to resistive losses.

In general, cooking processes involve a combination of these mechanisms.

1.1.1.2 Types of electric stoves

There are three basic types of electric stoves based on the physical configuration of stove tops – Iron hotplates, radiant coil, and ceramic. Stoves are also classified based on the technological developments and methods of heat transfer.

1.1.1.2.1 Iron hot plates

The first technology of electric stoves used coils which heated iron hotplates, on top of which the pots were placed. The iron hot plates are believed to have the lowest energy efficiency among electric stoves as they heat up more slowly and usually use higher-wattage elements. This translates into higher energy consumption. The sets are easier to clean up than standard coils. There shall be a good contact between pot and the cook top for cooking. Figure 1 shows single and double cook top iron plate electric stoves.

Figure 1. Iron hot plates

1.1.1.2.2 Radiant coil electric stoves

a) Open resistor type

Most people are familiar with the open resistor type of stove-top. These stoves have exposed heating elements, which pass heat through radiation, and are cheapest electric stoves to buy.

Figure 2. Open resistor electric stove

b) Spiral hollow steel tube resistor type

The spiral hollow steel tube stove, sometimes categorized as solid hot plate stove, has a heating element running through the middle. The tube was wound in a spiral shape and kept at top of the stove. Unlike the earlier iron hotplate the steel spiral was heated to red hot imparting more heat in a form of conduction and radiation to the pan than the hotplate could.

Figure 3. Spiral hollow steel tube electric stove

1.1.1.2.3 Ceramic cook top (smooth-top) stoves

a) Glass-ceramic

Glass-ceramic has very low thermal conductivity, a coefficient of thermal expansion of practically zero, but lets infrared radiation pass very well. Electrical heating coils or infrared halogen lamps are used as heating elements. Heating elements are concealed under a flat, glass surface. Because of its physical characteristics, the cook top heats more quickly, less afterheat remains, and only the plate heats up while the adjacent surface remains cool. Also, these cook tops have a smooth surface and are thus easier to clean, but are markedly more expensive. These have precise and accurate heat control with an almost instant response time but take a relatively long time to cool down once switched off.

Figure 4. Glass ceramic cook tops

b) Induction stoves

Induction stoves also have a smooth glass-ceramic surface. Induction cooking uses electromagnetic technology to heat the cooking utensil and its contents with very little energy wasted on heating the ceramic cooking surface. An electronic circuit supplies power and electronically controls an inductor coil inside the appliance. This coil generates a magnetic field when a pot or pan is placed in contact with the stove's top surface, causing induction currents to flow through the base of the pan. The cook top surface stays cool, and spillages are not baked on, making cleaning easier. Induction cooking provides immediate response and precise temperature control. It is a relatively new technology and is considered to be the most efficient type of electric stoves. Only some types of cookware are suitable for use with induction cook tops. These include cast iron, iron, enameled steel and certain types of glass with an iron-alloy base inset. Standard glass, aluminum, copper based, stainless steel (unless with an iron core) and earthenware cooking vessels are unsuitable. The energy efficiency of inductive is estimated to be the highest of all stove types.[1.]

Figure 5. Induction stove

1.1.2 The locally manufactured electric stoves

In Ethiopia all most all of the locally manufactured electric stoves are open resistor types. There are very few individual producers assembling the spiral hollow steel tube type stove and there is presumably the product of one private limited company in the local market manufactured/assembled in Ethiopia. The locally manufactured open resistor stoves are used in households mainly for cooking ”Wot”, making tea, heating water for washing and re heating of “Wot” purposes. Cafes, restaurants and hotels use these stoves rarely in the absence of kerosene, wood fire and cylinder based gas stoves. Large scale cooking at institutions like universities and hospitals is done using big sized enclosed electric stoves which are electric powered, self contained or centralized steam based cooking pots, and fire wood.

A typical locally manufactured open resistor electric stove, the product type considered under this project document, consists of:

a) A framework predominantly made from mating parts of 4mm thick galvanized iron sheet - a packaging iron sheet for box containers of imported materials. Steel or aluminum sheet metal frame works are also in use.
b) Single or multiple cook tops;
c) Single open coil electric resistor per cook top;
d) Flat or bowl type clay plate weighing about 1.2 to 2.0 Kgs, over/in which the open electric resistor is placed. Groove depth is estimated to vary from 10 to 12mms
e) Round bar pot rest of 4 to 6 mm diameter made in concentric circle style for pot mounting and having height of 10 to 25mm above heating element,
f) Switch or circuit breaker or for turning on or off the unit; cable, connector, and plug.

The power rating of the stoves is set by the corresponding clay plate diameters. Clay plate sizes range from 16mm up to 50 mm having corresponding power rating from 800W to 4000W. The single cook top stove having clay plate diameter of 22 Cms is the most common.

A type of local stove having heat insulation at the bottom and cylindrical shaped convective heat barrier is also being manufactured by a producer. It has been noticed that few producers seal the open resistor of the electric stoves for the sake of safety and to avoid frequent damage to electric resistor due to spillage. A stove type "Karenbola", seemingly named after the Amharic name for Snooker, due to the structural similarity between it and the stove, is being produced locally for the use of large size cook tops. The "Karenbola", stoves have been installed at some university campuses like the Addis Ababa university school of medicine and black lion hospital, Faculty of technology etc..

The electric stoves for households are mainly produced, assembled and distributed from Addis Ababa, Chid Tera. Figures 6 to 13 show types of locally produced electric stoves.

Figure 6. 18 cm and 22 cm diameter single flat type cook tops–Assembled without switch

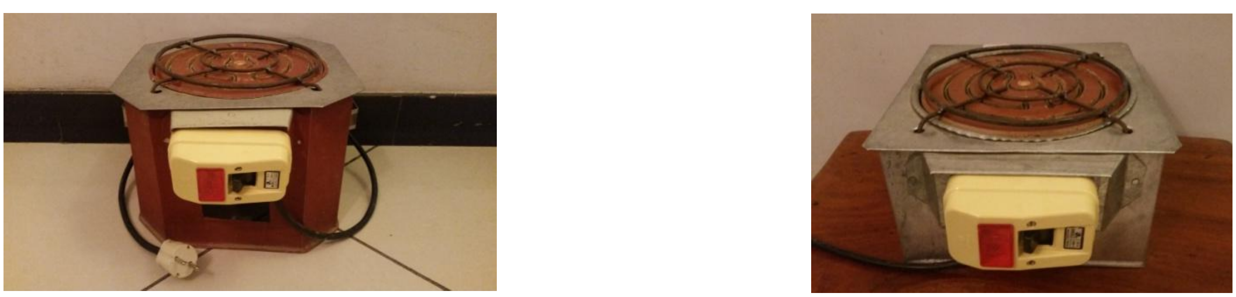


Figure 7. 22 cm diameter single flat type cook top stoves–Assembled with switch

Figure 8. 22 cm single and double semi bowl cook top type stoves

Figure 9. Semi bowel type Coffee boiling pot

Figure 10. 22 cm single spiral hollow steel tube electric stove

Figure 11. Double and Single stoves having bottom insulation and top lateral heat retainers

Figure 12. Clay plate of locally manufactured electric stove sealed using clay material

Figure 13. Locally manufactured "Karenbola" type electric stoves for large kitchens, 21 Kw

Figure 14. Imported electric powered, self contained, steam based cooking pots at Addis Ababa University, Main campus cafeteria

1.1.3 Limitations on locally manufactured electric stoves

The existing electric stove technology is believed to be in the market for many years. The performance efficiency of the stoves is at a lower side and the product has not been standardized so far.

The locally manufactured electric stove is available in most households connected to electricity in Ethiopia. The stoves are also widely used in kitchens for commercial cooking services like hotels, restaurants and cafes. Owing to the fact that stove is turned on for preparation of meals each day in most households for about 3 to 5 hours it contributes to the bulk of the electric power demand and consumption of a typical residential household and the nation.

Based on the test report on open resistor type electric stoves, entitled “Ministry of Mines and Energy and Ethiopian Energy Authority, Cooking Efficiency Improvement and new fuels marketing project - Report on the laboratory test results of electric ring stoves”, prepared by Hiwote Teshome and Hilawi Lakew in March 1994, the minimum energy efficiency of locally manufactured stoves is determined to be 54% while the maximum efficiency of imported stoves is 79%. The core problem of the locally manufactured electric stove is that its energy efficiency is low. The causes of energy inefficiency are mainly attributed to the heat losses and absence of standard in the manufacturing of the product. The electric stoves also exhibit low cooking efficiency due to the limited energy conservation behavior of users during meal preparation, which adds up to the effects introduced as a result of the low energy efficiency of the product.

Other limitations of the locally manufactured electric stoves include:

- Absence of heat insulation
- Lack of heat intensity control mechanisms and switching to control heat level
- Open and exposed heating element and dread of contact for users.
- Frequent burning of heating element due to spillage and poor quality
- Increased gap between cookware base and the heating element.
- Wear of clay plate and fast aging of framework.
- Sub-optimal/poor and inefficient design and workmanship.

The core problem causes and the effects of the locally manufactured electric stoves are indicated in Figure 3, overleaf.

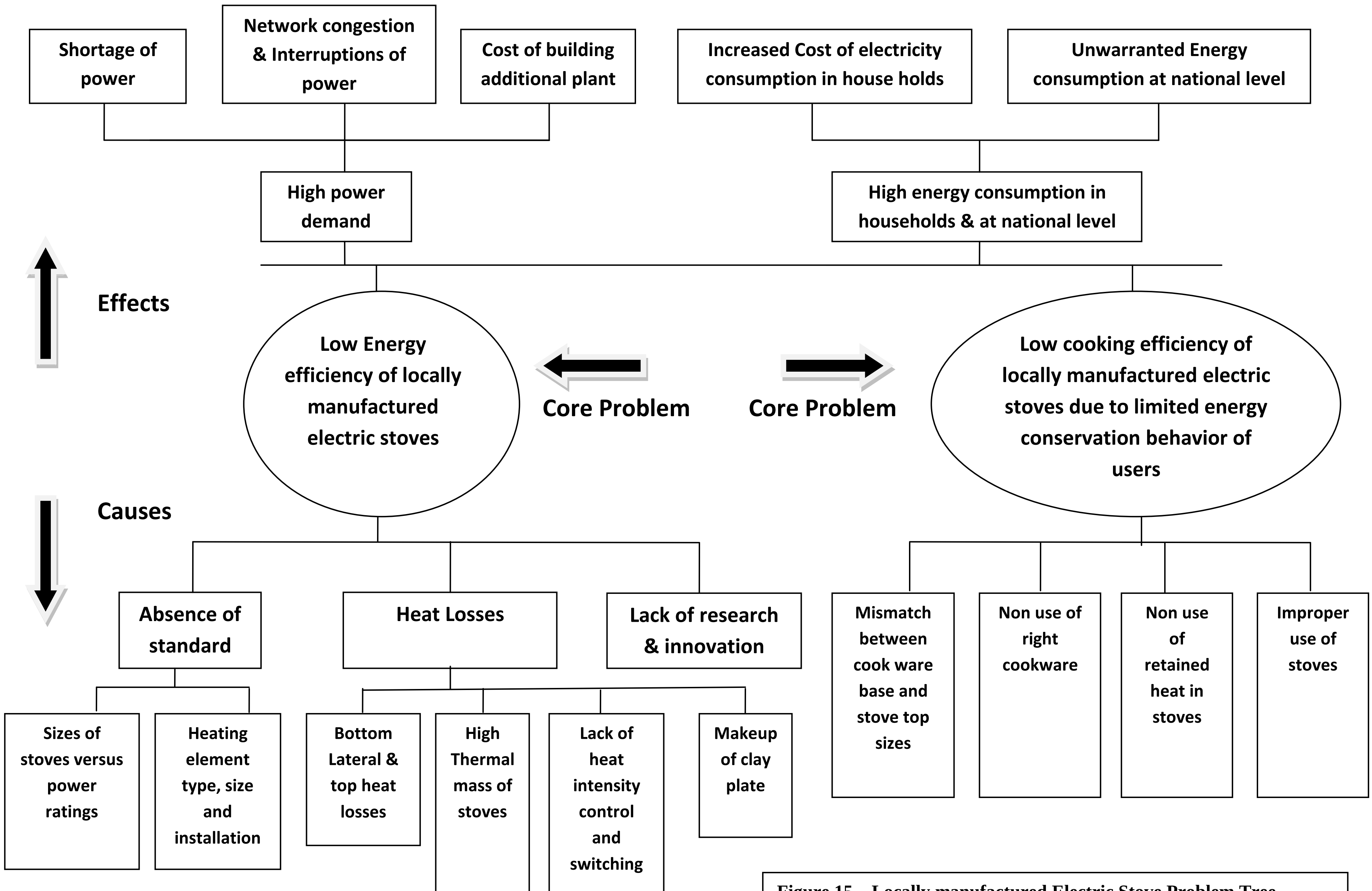


Figure 15. Locally manufactured Electric Stove Problem Tree

1.1.3.1 Causes of low energy efficiency

1.1.3.1.1 Heat losses:

a) From the frame work of the stove

i) From the bottom of the clay plate.

The heat loss at the bottom of the electric in a form of radiation constitutes the major portion of the heat lost. No heat insulation is used between clay plate and body of stoves in the production of the most common size 22 cm diameter. Minimal insulations are used for the 40 to 50 cm diameter types. There are no studies found on the heat loses from the local stoves during cooking process. A study on electric injera mitad (Awash Tekle[4]), which has similarity with electric cooking stove, indicated that about 35% heat energy is lost at the bottom of the stove during the baking process. The injera mitad heats up to about 300 degree Celsius and cools down when batter at room temperature is poured on it. In contrast, electrical stoves operate without bottom insulation and cooling until the food in the cook pot is cooked. Thus the heat loss at the bottom of the local electric stove could exceed 35%.

Figure 16. Bottom side of typical locally produced electric stove –Bottom of clay plate in contact with body of stove

ii) From the side of the clay plate.

Due to the conduction of heat from the clay plate to the support structure and then to the framework, heat is lost at the side of the stove.

iii) From the cook top.

Most of the time the cookware sizes and the outer most diameter of the heating element do not match owing to the use of different sizes of cook pots on electric stoves. In the case when the size of the cook pot is lesser, heat is lost from the stove through radiation and convection.

b) High body mass of the stoves.

Based on the test made by the then Ministry of mines and Ethiopian Energy Authority the energy efficiency of the local stoves was dependent on the body mass of the stoves. Weight of local stoves ranged from 2.5 to 4.0 Kgs whereas imported types which are tested to be more efficient weigh 0.9 to 1.0 Kgs. This implies that heat energy is consumed and lost by the excess weight of the local stoves.

c) Lack of heat intensity control or switching.

The locally manufactured electric stoves use either single or double heating elements. The most common one, the 22 cm diameter stove, is produced using single resistors of 0.6 or 0.7 mm diameter and stretched resistor length of about 130 Cms. The resistor is fitted into the four rounds of grooves in the clay plate. The user has only two options in using the stoves - turn on or off the single resistor. This implies that users do not have the options of slow and medium cooking and will be obliged to use the maximum heat output of the stoves. As a result, excess amount of heat is lost and the cooking process further demands user's attention.

Imported spiral hollow steel tube resistor and iron hotplates stoves types have the options of either discrete or continual heat intensity level selection or selector switches or thermostats for automatic turn on - off at predefined heat levels.

The use of heat intensity control or switching has not been exercised on local stoves due to:

i) The unavailability of short length (to suit the diameter of the clay plate) and lesser diameter (to suite the power rating of the stoves) resistors in the local market. Resistance of a heating element is directly proportional to the resistivity of the material and the length of the resistor, and inversely proportional to its cross sectional area. i.e.

$R = \rho l/A$, where,

R= resistance of the heating element (Ohm)

ρ = resistivity of the heating element (Ohm. m)
l = length of the heating element (m)
A = cross sectional area of the heating element (m^2)

For heat intensity control and switching, multiple thin and shorter length heating elements have to be used instead of the single 0.6 to 0.7 mm and 130 cm long(stretched) resistor currently employed.

ii) The unavailability of selector and thermostats switches in the local market

d) Makeup of the clay plate.

The clay plate of electric stoves is made from sand and clay. Clay plates used for the production of electric stoves are mostly cutaways from those produced for fire wood and electric mitad but rejected due to quality, cracks, and warps except for the bowl type clays. This indicates that inferior quality of clay plate products are used for electric stoves. Production of clay plates for stoves is possible, however, clay plate producers at rural areas do not prefer to do so as the sizing, leveling and firing of the small diameter plates require more time and energy. For the sizes of 22 to 23 cm diameter, the thickness and weight of the clay plate is 2.0 to 2.5 cms and 1.2 to 1.5 Kgs respectively. The thickness, weight and the suboptimal production method of the clay plates make them require more heat energy and break often when the is in use. Clay plates of stoves have poor quality for the following reasons:

i) The clay plate is produced in rural areas in a traditional way. Sand and clay are mixed in under surface pit using hand and legs. There is no defined or accurate measurement as to the proportions of the sand, clay and water either by weight or by volume. Many clay plates got broken or are rejected when brought to the market due to the traditional way of mix proportions, preparation and firing. Disproportional mix of clay and sand result in different level of heat requirement of the clay plate. The Specific heat of sand and clay are different and heat added depends on the mass of the sand and the clay.

ii) The mixture of sand, clay and water is considered to be adequate by the feeling on the bare leg. The mix cannot be judged accurately by the feeling on the leg. These results in inadequate mixing thereby reduce the bonding expected from the sand and clay.

iii) The final sizing of clay plate is not precise. Thickness of plates is not uniform across the plate diameter. This results in the difference in the depth of grooves made while placing of the heating element thereby inducing different level of heat absorption of the plate.

vi) After the mix is baked and dried it is fired on an open air using cow dung as a fire source. When cow dung is burnt away completely the clay plate is considered fired. Because of the prevailing wind, the fire intensity and duration, the firing process is not perfect. There are under firing or over firing instances. This has got an impact on how the clay plate responds to an added heat and its mechanical strength. As a result, the mass (weight) and the strength of the clay plates produced differ from producer to producer. Even though heat is transferred from the stoves is in the form of radiation the clay plate draws some amount of heat based on its makeup.

1.1.3.1.2 Absence of standard on electric stoves

a) Sizes of stoves versus power ratings

Different sizes of electric stoves are produced and the power assigned corresponds to the clay plate diameter. The following table indicates clay plate diameter versus claimed electric power assignments.

No	Clay plate diameter(cm)	Quantity of resistors	Claimed power(Watt)	Claimed resistance diameters used(mm)
1	16-18	1	600 to 1000	unknown
2	22-23	1	1200 to 1500	0.6, 0.7
3	40 cm	2	3300	0.8
4	50 cm	2	3300 to 4000	0.8, 0.85, 0.9

Table 1. Locally produced stoves clay plate size and power assignments.

With same size of stoves power may differ by up to 400w and 700w for 16-18cm and 50 cm diameter stoves respectively. This introduces wastage of power and cooking inefficiencies as buyers are using the stoves for cooking similar food items which may require similar power ratings.

For efficient cooking, the cookware base size shall match to the stove's outer diameter of the heating element. However, assessments on producers have indicated that most of stoves with double cook tops have equal diameters. Thus, the consumer has no choice and uses the big cook tops regardless of the size of cookware.

b) The heating element and electrical connection

The electrical heating element (resistor) used on the stoves are locally wound. Based on the survey made, many of the producers responded that they use the 1200W(0.6mm) or 1500w(0.7mm) mm resistor type for the stoves. However, the resistance measurements on their products during the survey made revealed that the resistance values differ significantly. Different length and resistance values are supplied by various suppliers in Ethiopia. Eg. For 1x 1200w(0.6mm) type, resistance values are like 32.9 ohm, 34.0 ohm, 35.0 ohm, 39.6 ohms corresponding to power levels of 1471W, 1423W, 1382W,1222W at 220V respectively. Resistances are mostly wound locally and the value per resistor depends on the length and diameter. Besides the resistors are labeled as first quality, second quality etc... Very few producers measure resistance using multi meters, instead length measurement of un stretched resistor, which will not indicate resistance at all, is being used to estimate the power ratings.

As electrical power equals the square of voltage divided by resistance (Power =Voltage^2 /Resistance), slight change in the value of resistance changes the power demand. Hence, the electrical stoves currently produced in the country do not have equal and uniform power rating, even within the products of the same producer.

Figure 17. Heating element (Resistor)

It has also been observed that some resistance suppliers and distributors sell resistors of higher rating as a lower rating to justify to producers and assemblers that their resistors are of good quality. Such practices affect power demand.

c) Absence of uniformity in placing electrical resistor in clay plate.

Resistor is placed in spirally made grooves at the top side of the clay plate. There is no uniformity or accepted standard adhered to in fixing the size and depth of the grooves. "U" shaped and about 10 to 15mm deep grooves are used to fix the resistors. The "U" shaped deep groove leads to covering up the resistor and full heat radiation cannot be achieved whereas shallow groove is not employed to avoid the probability of the resistor being raised and contact with the metal pot rest thereby causing electric shock to the user. Similar types of imported stoves are made using the "V" type shaped grooves to maximize the heat radiation from the cook tops.

Figure 18. Groove and gap of cooking pot rest on local stoves.

d) The gap from cooking pot rest to heating element

The gap from the pot rest to the heating element of the local stoves is about 1.5 to 2.5 cm. This is too high as compared to that of imported stoves, which have direct contact with the cook tops. The efficiency of the stoves increases as the pot gets closer to the heating element.

e) Grounding.

From the survey conducted, the ground wire, which provides a conducting path to the earth independent of the normal current-carrying path in electrical appliance as a standard, is not provided in most of the locally produced stoves.

f) Switch, circuit breaker, wire and connection.

Stoves with diameters of 18 cm are not provided with switches at all. The user has to plug and unplug to turn the on and off. Electrical household devices shall be provided with a switch or push button to avoid damages at the plug and socket outlet from frequent use and isolate live connection to device when plugged and not in operation.

Circuit breakers of cheap quality are used on significant number of stoves in place of switches to minimize cost. The circuit breaker fail after multiples of switching as it is not designed for this purpose. Circuit breakers are not designed to be used as and in replacement of switches. Electrical stoves shall be fitted with switches.

Figure 19. Local stoves made with circuit breakers instead of switches.

g) The pot rest center eccentric to center of the heating element

When the center of the cooking pot rest does not align with the center of the heating element the cookware shifts to the side and may not receive the intended heat radiation.

Figure 20. A stove's cook pot rest eccentric to the heating element

1.1.3.1.3 Limited research and innovation

Based on the data at the Federal Intellectual Property office, Technology Transfer Team, there are few minor innovations awarded on the improvement of locally manufactured electric stoves. Efforts being made by the innovators indicate that the EE on the existing electric stove could be improved significantly by reducing the heat losses. However, energy efficient products based on innovations and researches are not introduced at large in the market thus far. Besides, there are no technical and financial support for innovations and researches in the country regarding EE works.

1.1.3.2 Causes of low energy conservation of electric stoves due to user behavior

The performance of common cooking appliances varies widely depending on device type, fuel type and user behavior. Studies indicate that with equivalent equipment, user's Improper cooking behavior and cooking style can produce a variation in cooking efficiency and in energy consumption of up to 30% [1].

1.1.3.2.1 Mismatch between cookware base and stove tops.

In addition to different designs, households use different equipment such as pans, pots and so on to prepare their food depending on prevailing customs and culture. Choosing the optimal size of the pot in relation to the size of the cooking top (hobs) is necessary for efficient cooking. For good cooking performance, the diameter of the cookware should closely match the size of the heating area. Cookware that is too small for the heating element can waste energy because heat is lost into the kitchen. Small cookware also increases chances of spill-overs.

Micah Sweeney, Jeff Dols, Brian Fortenbery, and Frank Sharp, Electric Power Research Institute (EPRI), in their research paper “Induction Cooking Technology Design and Assessment”, [3] indicated that the efficiency of conventional electric cooking technology was shown to be highly dependent on the size of the cookware used. The full-power efficiency of conventional electric technology fell from 83% to 42% when testing the electric coil with the small cooking vessel. This demonstrates the impact of contact area on the efficiency of conductive heat transfer between the heating element and cooking vessel. When operated with small cookware, a greater portion of heat created by conventional technologies is radiated outward as losses.

Studies indicate that cookware should not extend more than one inch beyond the heating area. If cookware is too large, the heat is distributed unevenly, cooking time is increased, and more energy is used. Also heat can be trapped under the heating element, causing the element to build up heat. This build-up of heat may shorten the heating element’s life or damage the surface around the element. When a cooking system is thermally limited, a too-large cooking utensil will cause the unit to cycle off and on, reducing the cooking speed and the life of the heating element.

Figure 21. Typical mismatch between cookware base and stove tops

1.1.3.2.2 Non use of right cookware

a) Heat conductivity of cookware material

To work effectively, cookware should be made of a material that conducts heat quickly and evenly. The speed with which a material conducts heat is not only affected by the material but also by its thickness. Thin materials conduct heat quickly while thick materials conduct heat more slowly. Many believe a material's ability to conduct heat quickly is one of the most important considerations in choosing cookware.

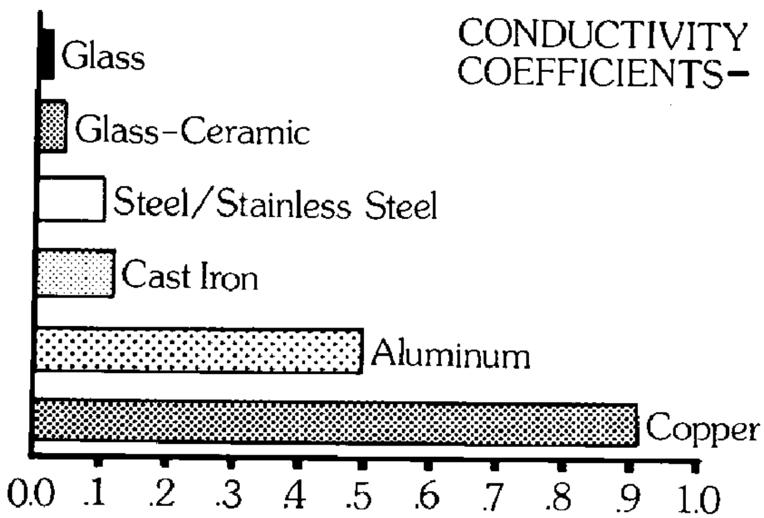


Figure 22. Heat conductivity coefficient of materials of which cook wares are made. (Dr. Leona K. Hawks [2])

This bar graph in Figure 22 shows copper to be the fastest conductor of heat; aluminum is second. Glass-ceramic and heat-resistant glasses are slowest conductors of heat. Copper cookware should be lined with another material, such as stainless steel or tin so the food will not come into contact with the copper. Copper cookware is lined because some foods interact with copper to form toxic substances. Aluminum is considered a fast conductor of heat. Although its conductivity is only half that of copper, it is four times that of iron or steel. Aluminum cookware is made by stamping, drawing, or casting and comes in a variety of gauges (thin, medium, and thick).

b) Thickness of the bottom of the cookware material

Along with the conductivity of the materials used in the cookware, the gauge or thickness of the material is another feature that determines the quality of cookware and cooking performance.

When looking at the gauge or weight of a cooking utensil, the thickness of its bottom is most important. Generally, a thin bottom conducts heat quickly but unevenly. In contrast, a thick-bottomed cooking utensil conducts heat slower, but more evenly, reducing hot spots. The thicker the bottom material, the more heat retained, and the greater the possibility of even cooking performance.

Warped old cook wares do not heat up uniformly and waste heat energy and have to retire earlier.

c) Smooth and flat bottom cookware

Smooth, flat-bottomed cookware is important for good cooking performance and is recommended by all cook top manufacturers. The flatter the cookware's bottom surface, the better it will receive heat from the element and conduct it to the food. Some types of high-quality cookware are not flat until they are heated; otherwise, they are concave. Shorter cooking times and energy savings can be realized when cooking with flat rather than non-flat cookware. A utensil may have a perfectly flat bottom, but if it is improperly cared for, it can become warped. A practice that warps cookware is to run cold water into the utensil when it is hot or by leaving an empty pan on a hot element.

d) Finishing of the cookware.

Some of the most common finishes of cookware are natural metal, fused porcelain enamel, and anodized aluminum, which can influence cooking performance and ease of cleaning. The color and texture of the finish also have some influence on cooking performance and speed. Dark-colored, rough textured cookware absorbs more radiant heat than highly polished cookware.

e) Tight-Fitting Lids.

Lids should fit firmly and snugly. Some lids interlock with cooking utensils and some sit flat on the lips of cookware. Lids that sit flat must be heavy enough to provide a good seal. Tight-fitting lids hold in steam, thus less water and energy are used during cooking.

1.1.3.2.3 Non use of retained heat in stoves

During cooking electric stoves will be heated to high temperature. It is being observed that users turn of power on the local stoves when they have completed the cooking process. The retained heat in the stoves, which could have been used for cooking, is lost to the surrounding. Hence, it is advised to turn off the electric stoves several minutes before the allotted cooking time is up. The heating element will stay hot long enough to finish the cooking without using more electricity.

1.1.3.2.4 Improper use of stoves

a) Spillage problems

Unattended use of stoves often results in spillage of the "Wot", milk and other fluids which shortens the life of electric resistors. The electrical short circuit created as a result also damages the clay plate creating metallic substance sticking to the plate which makes the plate unusable unless it is removed. When spillage occurs at and around the "Woraj"(connecting wire between heating element and cable), fluid inters the electrical connector at the bottom creates short circuit and damages it .

Figure 23. Effect of spillage and short circuit of resistance on clay plate of stoves

b) Use of Charcoal on electric stoves.

Some users burn small amount of charcoal to set a charcoal fire. Charcoal embers when dropped on the clay plate damage the resistances of stoves thereby shortening its service time.

c) Re joining of cut or damaged electric resistances

The resistance wire of stoves is often cut or damaged due to spillage and other reasons. Often users re join the cuts by omitting the damaged parts. This practice reduces the length of the resistance thereby the resistance of the heating element. As a result the stove demands higher power because electric power is inversely proportional to resistance and the duration of service of the resistor shortens further.

1.1.3.3 Comparison between locally produced stoves and imported types.

No	Type of stove	Heat transfer mechanism to cookware	Common heating element diameter	Estimated energy efficiency	Electrical heating element and effect of spillage	Suitable Cookware type	Heating	Heat intensity control and switching option	Surface durability and appearance	Cleaning	Price
1	**Locally produced Open resistor**	Radiation	18Cm	Lower	Exposed and not safe, affected by spillage	All	Fast	Not available	Not durable & good looking	Not easy to clean.	Low
2	**Imported stoves**										
2.1	Hot plate	Conduction	15Cm, 18cm	Lower	Concealed and safe, not affected	All	Slow	Available	Durable & good	Easy to clean.	Medium
2.2	Spiral hollow steel tube resistor	Conduction & radiation	14-15cm	Lower	Concealed and not safe, affected by spillage	All	Fast	Available	Not durable, Good looking	Not easy to clean.	Medium
2.3	Glass-ceramic Coil resistance	Conduction & radiation	Varies	Lower	Concealed and safe , not affected by spillage	Heavy weight flat cookware made from stainless steel or aluminum	Slow	Available with many features	Not durable, Excellent looking	Easy to clean.	High
2.4	Glass-ceramic Halogen lamp	Conduction & radiation	Varies	Lowest	Concealed and safe , not affected by spillage	heavyweight flat cookware made from stainless steel or aluminum	Slow	Available with many features	Not durable, Excellent looking	Easy to clean.	High
2.5	Induction	Electromagnetic Induction	Varies	Highest	None and safe , not affected by spillage	Flat cookware that's high in iron. That includes cast iron—whether enameled or not—and high-iron stainless steel only	Very fast	Available with many features	Not durable, Excellent looking	Easy to clean.	Very high

Table 2. Comparison between locally produced s and imported types

1.1.3.4 Effects of the locally manufactured stoves

The energy inefficiency problems, improper cooking behavior and cooking style of users on the locally produced electric stoves have imposed the following effects:

a) The sets have been unduly rated to high power capacity.
b) Immense pressure on electric generating and distribution networks and the power demand of the country.
c) Frequent interruptions and shortage of power especially during religious holidays.
d) High consumer’s bill and energy consumption at national level.

1.1.4 Efforts made to improve the energy efficiency the electric stove

There have been attempts and studies made by the government, individuals, institutions and firms based in Ethiopia to improve the EE and method of production of the locally manufactured electric stoves**.** The performance efficiency improvements and studies made are briefly presented below. The information has been obtained from the EEA, published materials and the World Wide Web.

a) The then Ministry of Mines and Energy and the Ethiopian Energy Authority(EEA) has made efforts to improve the energy efficiency of electric stoves

A report on laboratory test of open resistor type electric stoves, entitled “Cooking Efficiency Improvement and new fuels marketing project - Report on the laboratory test results of electric ring stoves” was prepared by Hiwote Teshome and Hilawi Lakew in March 1994 [3]. The report indicated that water boiling test was conducted on eight imported and locally produced electric stoves. Table 3 overleaf shows the findings of the test.

Stove type	Pot to resistor distance(mm)	Power rating(W)	Efficiency(%)	Stove's weight(Kg)
Imported type 1	3	948	79	0.6
Imported type 2	3	923	76	1.0
Imported type 3	3	713	75	1.2
Local stove type 1	16	687	58	1.3
Local stove type 2	10	653	58	1.4
Local stove type 3	8	886	60	2.0
Local stove type 4	9	889	69	2.6
Local stove type 5	5	824	54	4.0

Table 3. Laboratory test of open resistor type electric stoves by by Hiwote Teshome and Hilawi Lakew

The following recommendations and conclusions have been given.

i) Pot to heating element (resistance) distance is the most important parameter in electric ring stoves and energy efficiency is inversely proportional to it.
ii) Power rating of the stoves is the second most important to which efficiency is directly related.
iii) Decreasing the body mass of the stove could save energy.
iv) The circular area the resistor covers is a parameter and if it extends beyond the size of the pot, heat will be lost. The project uses 22 cm as a standard of pot sizes in designing stoves.

b) The then Ethiopia Energy Agency has got tested locally manufactured electric stoves by the then Ethiopian Alternative Energy Development & Promotion center(EAEDPC) laboratory section in July 2010. The objective of the test was to evaluate the cooking efficiency of three local stoves (new design) and standard imported stove. Water boiling test (WBT) was adapted to assess the performance of the stoves. The test report concluded that the imported type stove is preferable and recommended that the local stoves shall be labeled and need further modification in design. The following Table shows summary of the test result.

Stove type	Amount of water(lit)	Average time taken to boil(min)	Efficiency(%)
Local stove Code 1	1.8	17	51.34 %
Local stove Code 2	1.8	17	51.86 %
Local stove Code 3	1.8	17	47.35%
Imported type ,1000W	1.8	17	92.72%

Table 4. Laboratory test result of open resistor type electric stoves by EAEDPC

c) The thesis “Energy Modeling in Residential Houses: A Case Study of Single Family Houses in Bahir Dar City, Ethiopia “has been prepared by Netsanet Adgeh Ejigu. The Thesis is submitted for the partial fulfillment of Master of Science in the Sustainable Energy Technology EGI-2010-2014, Division of Heat and Power SE-100 44 Stockholm [4]. The finding shows options to improve household energy efficiency intervention planning and to enhance the effectiveness of policy interventions. The total energy consumption in Bahir dar in 2014 was nearly 330 Giga watt hour per year, and of this value about 83.8% is used for cooking(Electrical Mitad and Stove), and 7%, TV, 4.5%, lighting, 3.5%, refrigerator, and 1% water heater and remaining 0.2% is consumed for other auxiliary appliances.

d) Lejo Aluminum Plc , Addis Ababa, Ethiopia, who are pioneers in electric mitad in Ethiopia, had been granted certificate of innovation in 1993 for 600W and 800 W electric stoves made from stamped Aluminum which has fittings to be used interchangeably as a cook top and for Ethiopian coffee boiling pot (“Jebena”).

Figure 24. Lejo Aluminium Plc , Addis ababa, Ethiopia, stamped Aluminum body electric Stoves

e) Haile Tirkaso had been issued a Utility Model certificate ET/UM/2012/1055, on 17/04/2102, from Ethiopian Intellectual property office, for minor innovation entitled “Alternative energy operating and Multipurpose stove”. The stove uses electric, charcoal, and wood as a source of energy and will be used for cooking food and production of hot water and steam from energy losses of the unit.

1.2 Demand Assessment

Due to the low energy and cooking efficiency of the locally manufactured electric stove, there is a significant electrical energy consumption and power demand in the country. The demand for the product is growing at a high rate due to the rapid economic growth, the shortage and soaring price of fire wood and biomass, the huge electrification programs underway in the country and the expansion and construction of condominium buildings. Besides, the number of stove producers and the production rate is high.

Based on the tests made by the then Ministry of Mines and Energy and the Ethiopian Energy Authority(EEA) shown in Table 3 above, the average efficiency of locally manufactured stoves equals 60% whereas the most efficient imported open resistor type stove has got 79%, an efficiency gap of 19%. From the test result shown in Table 4 the average efficiency of locally manufactured stoves is 50.2% whereas that of imported open resistor type stove is 92.7%, the latter being an optimistic figure in that it exceeds the estimated efficiency of Induction stoves. The test result indicates that the local stoves have lower energy efficiency. Minimizing heat loses and standardizing the manufacturing of the product will increase the energy efficiency of the locally manufactured stoves. Hence, the energy efficiency of the local stoves' could be estimated to be raised by at least 19%.

The Alternative energy technology development and promotion directorate, of Ministry of water, irrigation and electricity had tested the energy efficiency of locally produced electric Injera mitads in June 2016 and confirmed that efficiency of random sample products ranges from 56.8% to 79%, a 22.2% difference. The improved and more efficient Mitads are believed to have been produced with minimized heat loses and better heat insulations. Electric Mitads and the locally produced stoves have similar bottom components and most of the efficiency improvements attained on Mitads could also be attained on the stoves. However, it shall be noted that Mitads differ from locally produced stoves in use, structure, operational mechanism and power rating.

1.2.1 The rate of production of electric stove.

The majority of assemblers and body producers are located at Addis Ababa, Chid tera. About 140 electric stove producers/assemblers in Addis Ababa, willing to fill in questionnaire, have been contacted. There are estimated 45 stove body producers and 50 assemblers at Chid tera only. An assembler / body producer has an estimated minimum production rate of 10 stoves per day. Annual minimum estimated production rate of the local electric stoves will be 50 x 10pcs/day x 24 days/month x12 months=

144,000 per year. A small percentage of this amount goes to replacement of malfunctioned sets.

On the other hand one can see the huge quantity of galvanized local stoves produced, assembled and piled up at Chid Tera, Addis Ababa, and daily being transported to consumers in Addis Ababa and the regions.

Figure 25. Locally produced stoves at assemblers' shops at Chid tera, Addis Ababa

1.2.2 Migration from the use of bio mass fuel to electrical stove

In rural areas there is significant burden on women and children who have to divert their time from education and income generating activities into biomass fuel or wood collection for the fire wood cooking. As it is known, the use of firewood for cooking and baking has been a prime cause of deforestation and environmental degradation in Ethiopia. According to the Energy Balance and statistics report of Ministry of Water, Irrigation & Electricity for the year 20008/2009EC (2014/2015 GC), Household energy use was almost entirely from biomass (98.30 %) in 2015, electricity and petroleum products together accounted for 1.70% of household consumption.

Figure 26. Ethiopian Women carrying fire wood

Currently there are huge rural electrification works in Ethiopia. In addition, the scarcity and soaring price of fire wood and the relatively cheaper electrical energy tariff creates favorable conditions for migration from using biomass fuel to the use of electric stove for cooking. Hence, many stoves will be added to the existing ones at a faster rate. This further creates more demand for electric stoves, thereby power demand and energy consumption.

Table 5 below shows the Calorific values (amount of heat released by a unit weight or unit volume of a substance during complete combustion) of fuels used in Ethiopia for cooking. Comparison will be between calorific value of wood and electricity. The electricity tariff, for greater than 100 KWh range, in which category stove users fall, is set at 0.5 Birr/KWh. From the table, It can be seen that one birr buys 7.2 MJ of electrical energy whereas 7.2 MJ of Calorific value of wood requires 0.4 Kgs of wood which cannot be bought with one birr. The cost per calorific value of electricity is cheaper than that wood.

No.	Fuel	Conversion efficiency %	Calorific Value
1	Wood	15	17.8 MJ/Kg
2	Kerosene	36	36 MJ/liter
3	Electricity	70	3.6 MJ/KWh
4	Charcoal	30	30 MJ/Kg

Table 5. Calorific values of fuel: Assumptions

Studies show that households with higher income or higher level of education have more interest towards shifting to electricity and other clean fuels. Figure 27 illustrates the process of energy ladder which simply shows that when the income of households improves they adopt modern alternatives. Hence, there will be increased demand for electric stoves as the economy of the country grows and higher level of education increases. Electric stove is preferable as it is smokeless, easy to provide, doesn't alter taste of food and user friendly.

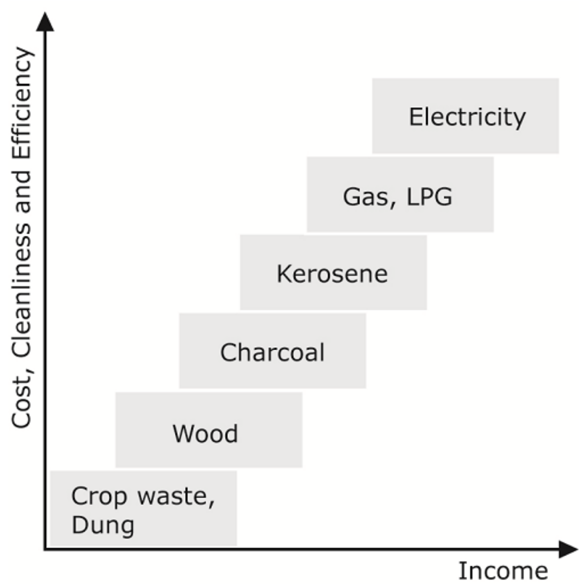


Figure 27 . Schematic representation of the energy ladder (Leach, 1992), (Netsanet Adgeh Ejigu, 2014)

1.2.3 Number of locally manufactured electric stoves in the country

Determining the number of electric stoves requires extensive household survey in the country. Estimates based on the data available from the Central Statistics Agency of Ethiopia, the Ethiopian electric utility and Ethiopian Revenue and customs authority are presented below.

1.2.3.1 Data from the Central Statistics Agency

The Central Statistics Agency Welfare monitoring survey 2011, Vol 2 , Table 9.1(a): Distribution of Household Who Own Asset by Type of Asset and Region - Country Level - 2011 , estimated there were 281,388 electric stoves country wide in

2011. The number of stoves for the year 2017 is projected using the average growth rate of Ethiopian Power system Expansion Master plan Study for the High and Low demand forecast of Domestic customers as in the years 2012 to 2021 – 10.6%, Ethiopian energy Authority, energy efficiency standards and labeling project document for Injera mitad, section 1.2.2, Demand forecast [5]. See Annex 1.

	Year						
	2011	2012	2013	2014	2015	2016	2017
Number of stoves	281,388	312,341	346,699	384,836	427,168	474,156	526,313

Table 6 . Central Statistics Agency Welfare monitoring survey 2011

Based on table 6 above, the number of stoves in the year 2017 could be estimated to 526,000.

1.2.3.2 Data from Ethiopian Electric Utility (EEU) related to number of electric stove users in the country.

Assessment made at the premises of about 150 electric stove producers and assemblers showed that the most commonly produced stove is the single cook top type of 22 cm diameter. The resistance of the heating element used in the stoves was measured during the assessment and it varied from 31.1 ohm to 39.9 ohm which corresponds to power demand ($P=V^2/R$), at 220V of 1.6 Kw to 1.2 Kw respectively. Average power demand of the stoves is estimated to be 1.4 Kw. It has also been noticed that there are stoves of 0.6 to 1.0 Kw in the local market in considerable quantity.

1.2.3.2.1 Duration of cooking.

The major dietary practices of Ethiopian people is Injera and “Wot”(Pancake like bread with spicy sauce). Injera with “Wot”, toasted and boiled whole grains usually are usually consumed as breakfast, lunch and dinner in the injera culture areas.

There are no data as to the time it takes to cook meals in Ethiopia using electric stoves. It requires independent research covering regions in the country having different cultural meals to determine the cooking time. A research has been made by Wudnesh Haile and Belay Tesfaye [6], 1994, entitled “Research on Biogas House Hold consumption, Sample meal combinations and estimated daily time and biogas requirements to feed differing family sizes in Injera staple food areas". The research, even though made on biogas, can be used as a reference for cooking time estimates in Ethiopia. Table 7 below shows the sample meal combinations and estimated daily time and biogas requirements to feed differing family sizes in Injera staple food areas. The table indicates that for a family of three, five and ten persons, the daily cooking time was estimated to be 2.9 -3.3 hours, 3.4 to 4.2 hours and 4.9 to 5.4 hours respectively.

No	Meal combination	Family size					
		Three persons		Five persons		Ten persons	
		Time(hrs)	Gas(m^3)	Time(hrs)	Gas(m^3)	Time(hrs)	Gas(m^3)
1	Tea+ wheat kinche, cracked ater alcha +misir wot and gommen wot	2.9	1.3	3.6	1.6	4.9	2.2
2	Coffee + kolo(barley with chickpeas), meat wot and misir wot			3.4	1.5	5.0	2.3
3	Tea + ambasha, misir wot + atkilt wot (mixed vegetable) and nifro (wheat & peas)	3.3	1.5	4.2	1.9	5.4	2.4

Table 7. Sample meal combinations and estimated daily time and biogas requirements to feed differing family sizes in Injera staple food areas. (Wudnesh Haile and Belay Tesfaye) [6]

For an average family size of five, 3.5 hours per day of cooking time (0.5 hour for break fast, 1 hour for lunch and 2 hours for dinner) is estimated for the energy consumption estimation of the local electric stoves.

The minimum energy consumption for such a family is estimated to be 1.2 KW x 3.5hr/day x 30 days /month = 126 KWh per month. Considering the duration of cooking, the use of other energy sources like charcoal, kerosene and wood, the use of stoves having power rating of 1.0 Kw(consumption = 105 KWh per month), cooking frequency, the different level of energy consumption of families, it is assumed that an electric stove owner would consume above 100 KWh per month. Users having double cook top stove of the 22 cm diameter stove would consume higher than 100Kwh per month.

Data from the Energy management office of the EEU on the consumption of Domestic customers (Residential households including non commercial premises) for more than 100 KWh per month for the year 2008 EFY has been analyzed. The average number of residential house holds consumed more than 100KWh per month is indicated to be 672,348. Detail is presented in Annex 2.

As per the EEU, it is estimated that 95 to 97% of the domestic customers are residential households and 3 to 5% belong to the non commercial premises. Thus, the number residential households consuming greater than or equal to 100 KWh per month and believed to possess electric stove in the country for the 2008 EFY are estimated to be 95% x 672,348 = 638,731.

The data from the EEU will closely estimate the number of electric stoves as it is based on actual electric energy consumption and hence is used as the basis for the estimation of the number of electric stoves in the country.

1.2.3.3 Consideration for imported stoves

Out of the 638,731 stoves estimated above, certain percentage goes to the imported types of stoves. There are no data as to the number of locally produced stoves versus imported stoves in use in the country. Table 8 below shows data from the Ethiopian Revenue and Customs Authority (ERCA), Information management Directorate on the number of imported stoves to the country in the years 2012 to 2016.

Description	**Year (GC)**				
	2012	**2013**	**2014**	**2015**	**2016**
	2004/2005 EFY	2005/2006 EFY	2006/2007 EFY	2007/2008 EFY	2008/2009 EFY
Quantity of imported stoves	196,144	244,288	62,638	120,181	444,925
Average	**213,635**				

Table 8. Quantity of imported stoves- Data from the Ethiopian Revenue and Customs Authority (ERCA) Information management Directorate

The data of the imported stoves include: open resistor, hollow steel tube stoves, hot plates, glass ceramic and induction stoves, and integrated electric and gas stoves. It is not known how many of the imported stoves are installed in the residential households, in stock and used as replacements of old ones in the country. However, the increase in import size indicates there is a considerable demand for imported electric stoves in the country. The imported stoves are also installed in firms and buildings other than residential households. These include cafes, restaurants, hotels, clinics of commercial and business entities and government institutions running cafes, restaurants, hospitals, clinics, universities and the military.

1.2.3.4 Number of locally manufactured stoves in the country

Determining the number and type(single or double cook top) of locally manufactured stoves in the country requires extensive household survey in all regions segregating the imported stoves from the locally produced ones - which cannot be accomplished within the scope of this project document.

Based on the interview made with local stove producers majority of the consumers prefer the local stoves. Reasons are local stoves are perceived to: have higher power, be easily maintained by the consumer, have replacement parts easily available and have longer service life.

Considering the above quantity of imported stoves, the consumers of imported stoves, the prevalence and the rate of production of locally manufactured stoves, and the preference of locally manufactured stoves over imported ones, it is assumed that 100 % of the average imported stoves for the last five years shown in Table 8, have been installed in the residential households. Hence the number of locally manufactured stoves is estimated to be 638,731 - 213,635 = 425,096 ≈ 425,000.

The actual number of locally manufactured electric stoves in the country is expected to be higher than the above figure. Residential householders who rent rooms in their compound or building possess stoves proportional to the number of rentees. There are also households using more than one local electric stove.

To assess the type of locally manufactured stove which users buy mostly, questionnaire have been filled out by 157 producers. 70% of producers responded the 22 cm diameter single stove is what users buy most often and 30% responded the 22 cm double stove top type. Hence, out of the 425,000 amount, the number of single cook top stoves and double cook top stoves are estimated to be 70%(≈ 298,000) and 30%(≈127,000) respectively.

1.2.4 Power demand and energy consumption of locally produced electric stoves

1.2.4.1 Installed power demand

Based on measurement made on the resistance of the locally manufactured stoves at the workshops of 157 producers, the average power demand for the most common, 22Cm diameter, electric stove is determined to be 1.4 Kw/stove. Hence, the installed power demand at national level in the year 2009 EFY is estimated as follows.

No	Most common stove, 22 cm diameter	Quantity	Average Power demand per stove(Kw)	Total power demand(MW)
1	Single cook top	298,000	1.4	417.2
2	Double cook top	127,000	2.8	355.6
Total				**772.8**

Table 9. Installed power demand of local electric stoves at national level

1.2.4.1.1 Actual power demand

For domestic households, the peak demand for power will occur during holidays and the amount can estimated based on the religious population. From table 10, the census report of CSA, Population by religion in the year 2007GC, the Christian population comprising of Orthodox, Protestant and Catholic religions constitute the maximum percentage - 62.75%.

Population	Religion						
	Orthodox	Protestant	Catholic	Islam	Traditional	Other	Total
	32,092,182	13,661,588	532,187	25,037,646	1,956,647	470,682	73,750,932
% of population	43.51%	18.52%	0.72%	33.95%	2.65%	0.64%	100.00%

Table 10. Population by religion in the year 2007GC, CSA census report.

During peak hour of holidays like New year, Christmas and Easter, it is assumed that 40% of the Christian users turn on their stoves at the same time. Thus, the peak power demand diversity factor would be 62.75% x 40% = 25%. The peak power demand during the Christian religious holidays for the year 2009 EFY could be estimated to be 1,162 MWx 25% = 193 MW. This is equivalent to the generating capacity of a big hydro station in the country.

1.2.4.2 Actual energy consumption

Electricity consumption of electric stove during cooking food depends on the power rating of the set, voltage level, duration of cooking, type of food to be cooked, and the behavior and experience of the user.

Table 11 below shows the estimated electric stove consumption at national level for the year 2009 EFY will be 987 GWh.

Most common stove, 22 cm diam.	Average power (Kw)	Estimated number of stoves(EFY) 2009	Usage hours per day(hr)	Energy consumption per year (GWh), EFY 2009
22cm Single cook top	1.4	298,000	3.5	533
22cm Double cook top	2.8	127,000	3.5	454
Total				**987**

Table 11. Estimated electric stove consumption at national level for the year 2009 EFY

The burden of consumption of electric stoves is being felt by households in Ethiopia. Now days it is getting common for house renters having single electric meter to ask whether a would be rentee possesses electric stove, in order to fix the rent of the rooms to be let. Depending on the locality a rentee having electric stove and electric Mitad is required to pay Birr 50.00 and 100.00 respectively in addition to the rent of the rooms.

1.2.5 Demand forecast

1.2.5.1 Data from Ethiopian Power system Expansion Master plan Study

Data from Ethiopian Power system Expansion Master Plan Study has been used to forecast the power and energy demand for locally manufactured electric stoves.

Data for 10 years period on Domestic tariff group from Ethiopian Power system Expansion Master plan Study, Appendix E, E7 and E8, for the High and Low demand forecast, both for Energy consumption and Power Demand including losses, is presented in Tables 12 to 15 overleaf.

From Tables 12 and 13, average growth of the High and low case energy sales demand forecast will be 8.3%. Whereas from Tables 14 and 15, the average growth of the High and low case Power demand forecast is 9.0%.

Description	Year										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Max demand consumer level	841	929	1,016	1,103	1,195	1,289	1,399	1,532	1,693	1,873	2,081
% growth		10.46%	9.36%	8.56%	8.34%	7.87%	8.53%	9.51%	10.51%	10.63%	11.11%
% Power losses		27.90%	24.60%	22.80%	22.80%	22.70%	22.60%	22.60%	22.50%	22.40%	22.40%
Total Maximum demand supplied (MW)		1,288	1,347	1,429	1,548	1,668	1,807	1,979	2,185	2,414	2,682
Average growth = 9.49%											

Table 12. High Case -Domestic Tariff Group Maximum Power demand and loss consumer level, 2016 - 2026

Description	Year										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Max demand consumer level	712	783	856	927	1,003	1,076	1,160	1,257	1,370	1,490	1,625
% growth		9.97%	9.32%	8.29%	8.20%	7.28%	7.81%	8.36%	8.99%	8.76%	9.06%
% Power losses		27.90%	24.60%	22.80%	22.80%	22.70%	22.60%	22.60%	22.50%	22.40%	22.40%
Total Maximum demand supplied (MW)		1,086	1,135	1,201	1,299	1,392	1,499	1,624	1,768	1,920	2,094
Average growth = 8.60%											

Table 13. Low Case –Domestic Tariff Group Maximum Power demand and loss consumer level, 2016 - 2026

Description	Year										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Consumption (GWh)	3812	4181	4545	4899	5273	5652	6094	6623	7259	7,971	8,795
% growth		9.68%	8.71%	7.79%	7.63%	7.19%	7.82%	8.68%	9.60%	9.81%	10.34%
% energy losses(GWh)		17.00%	14.90%	13.80%	13.70%	13.60%	13.50%	13.40%	13.30%	13.20%	13.10%
Total energy supplied(GWh)		5,037	5,341	5,683	6,110	6,542	7,045	7,648	8,373	9,183	10,121
Average growth = 8.73%											

Table 14. High Case -Domestic Tariff Group Energy consumption and loss forecast, 2016 - 2026

Description	Year										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Consumption (GWh)	3,202	3,495	3,791	4,079	4,383	4,678	5,012	5,396	5,842	6,315	6,851
% growth		9.15%	8.47%	7.60%	7.45%	6.73%	7.14%	7.66%	8.27%	8.10%	8.49%
% energy losses(GWh)		17.00%	14.90%	13.80%	13.70%	13.60%	13.50%	13.40%	13.30%	13.20%	13.10%
Total energy supplied(GWh)		4,211	4,455	4,732	5,079	5,414	5,794	6,231	6,738	7,275	7,884
Average growth = 7.91%											

Table 15. Low case- Domestic Tariff Group Energy consumption and loss forecast, 2016-2026

1.2.5.2 Forecast for the number of electric stoves

Table 16 shows the growth forecast for electric stoves during the next 10 years. Number of Stove is assumed to increase annually based on the average growth rate of Ethiopian Power system Expansion Master plan Study for the High and Low demand forecast of Domestic customers as in the years 2016 to 2026 – 9.0%.

Type of Stove	Year										
	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
No. of Single stove	298,000	321,840	347,587	375,394	405,426	437,860	472,889	510,720	551,578	595,704	643,360
No. of Double stove	127,000	137,160	148,133	159,984	172,783	186,606	201,534	217,657	235,070	253,876	274,186

Table 16. Number of electric stove scenario for the for next 10 years, 2009 to 2017EFY

1.2.5.3 Electric power demand of electric stove

Table 17 presents the forecast power demand including losses for electric stoves during the next 10 years. Demand growth is assumed to increase annually based on the average growth rate of Ethiopian Power system Expansion Master plan Study for the High and Low consumption forecast of Domestic customers as in the years 2016 to 2026, which is 9%. Power loss % data is taken from the Master plan forecast. The peak power demands including losses for the year 2009 EFY is estimated to be 404 MW.

Description	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
No. of Single stove	298,000	321,840	347,587	375,394	405,426	437,860	472,889	510,720	551,578	595,704	643,360
No. of Double stove	127,000	137,160	148,133	159,984	172,783	186,606	201,534	217,657	235,070	253,876	274,186
Installed power demand(MW)	773	835	902	974	1,052	1,136	1,227	1,325	1,431	1,545	1,669
Peak Power demand(MW)	193	208	225	243	262	283	306	330	356	384	415
% Power losses	27.90%	24.60%	22.80%	22.80%	22.70%	22.60%	22.60%	22.50%	22.40%	22.40%	22.30%
Peak Power demand Total (loss and demand) (MW)	268	276	291	315	339	366	395	426	459	495	534
Power loss(MW)	75	68	66	72	77	83	89	96	103	111	119

Table 17. Power demand growth of electric stove scenario for the for next 10 years, 2010 to 2019 EFY

1.2.5.4 Electricity consumption of electric stove

Tables 18 shows the forecast consumption for electric stoves during the next 10 years. Growth is assumed to increase annually based on the average growth rate of Ethiopian Power system Expansion Master plan Study for the High and Low consumption forecast of Domestic customers as in the years 2016 to 2026,which is 8.3%. The energy demand of electric stoves for the year 2009 EFY including losses is estimated to be 1,189 GWh.

Description	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
No. of Single stove	298,000	321,840	347,587	375,394	405,426	437,860	472,889	510,720	551,578	595,704	643,360
No.of Double stove	127,000	137,160	148,133	159,984	172,783	186,606	201,534	217,657	235,070	253,876	274,186
Consumption (GWh)	987	1,060	1,138	1,222	1,312	1,409	1,513	1,625	1,745	1,874	2,013
Energy losses%	17.00%	14.90%	13.80%	13.70%	13.60%	13.50%	13.40%	13.30%	13.20%	13.20%	13.10%
Total Energy loss and consumption(GWh)	1,189	1,246	1,320	1,416	1,519	1,629	1,747	1,874	2,010	2,159	2,316
Energy loss(GWh)	202	186	182	194	207	220	234	249	265	285	303

Table 18. Energy consumption of electric stove scenario for next 10 years, 2010 to 2019 EFY

The energy consumption of Domestic tariff group of EEU in the years 2004 to 2008 EFY is shown in Table 19. The Domestic tariff group which is predominantly residential households consume about 31.4% of the national energy consumption in the year 2008 EFY. Electric stove constitutes about 1,189/2,931 = 40.6% of Domestic customer energy consumption.

	Year(EFY)				
Description	2004	2005	2006	2007	2008
Consumption (GWh)	1,757.92	1,978.24	2,232.77	4,984.87	2,931.00

Table 19. Energy Consumption of Domestic customers of EEU for the years 2004 to 2008 EFY

The energy consumption at national level from 2004 to 2008 EFY is shown in Table 20 below. When compared to the national level consumption of the year 2008

EFY, electric stoves constitutes about 1,189 GWh/9,320.86 GWh = 12.7%. This indicates how energy demanding the electric stoves are.

Description	Year(EFY)				
	2004	2005	2006	2007	2008
National energy cons.(GWh)	4,923.25	6,239.50	6,522.64	11,641.79	9,320.86

Table 20. National electrical energy consumption year 2004 to 2008 EFY

1.2.6 Demand summary

In the year 2009 EFY the total installed power demand of the local electric stoves is estimated to be 773 MW. The peak power demand and peak demand including losses are estimated to be 193 MW and 268 MW respectively. This size of demand requires a big capacity electric generating plant in the country. The energy consumption for the year 2009 EFY is estimated to be 987 GWh. Total energy consumption and losses are estimated at 1,186 GWh. Due to the above, there is a huge power demand and energy consumption imposed on the electric generation and distribution infrastructure.

The rate of production of the sets, the absence of standard on the production, and the shortage of technical skill and knowledge of the stove producers (body producers, clay plate producers, assemblers), lack of standard materials to be used, and the limited energy conservation of user behavior have made the products to have low energy and cooking efficiency. This has created high power demand and energy consumption. There will be peak power demand of 534 MW and energy demand of 2,316 GWh including losses in the year 2019 EFY attributed to the use of the locally manufactured electric stoves.

The finding in the thesis prepared by Netsanet Adgeh Ejigu, "Energy Modelling in Residential Houses: A case study of single family houses in Bahir Dar city, Ethiopia" [8] indicated that about 83.8% of energy supply to Bahirdar city in 2014 has been consumed for cooking(Electrical Mitad and Stove). It indicates the typical energy demand of cooking stoves in urban Ethiopia.

Implementation of EE standards and labeling on the locally produced electric stoves would curb the above problems significantly by encouraging the development, marketing and sale of energy-efficient products. The saving on energy consumptions could be used for electrification of the rural areas, expansion of industries or sold to neighboring countries. It has been seen that the recent replacement of Incandescent lamps by the energy efficient compact fluorescent lamps in Ethiopia had brought 100 MW power demand and energy cost saving to the households and the nation. Hence, production of new and conversion existing stoves to the energy efficient types will have greater impact.

It is the experience of many countries that governments have succeeded in slowing the growth of demand of electricity use and CO_2 emissions from the use of such products through carefully targeted labeling and standardization programs. The labeling and standardization programs can also re-enforce other policies to promote the use of energy-efficient products.

1.3 Stake holder analysis

1.3.1 Major stakeholders

Major stakeholders in the development and implementation of national EE standard and comparative labeling program with their respective roles have been identified and listed in Table 21 below. The stake holders are differentiated as primary, secondary and external based on their interests, their potential impact on the program, and the relative priority of their interest.

No	Stakeholder's Name	Role	Interest	Potential project Impact (+, _, ?)	Relative priorities of interest(1 =high, 5 = low)
1	**Primary**				
1.1	Stove producers (Body builders, assemblers Clay producers and distributors)	Partners in the standardization, comparative labeling	- Better market opportunities for those having trade license	+	1
			- perceived fear of being registered and paying tax for those working without trade license(majority)	_	1
			-cost to be incurred for the program	_	1
			-production methods to continue as used to be	_	1
1.2	Consumers or Residential households(represented by women)	Partners in the standardization, comparative labeling and force manufacturers to produce energy efficient products through informative buying	-reduction on the cost of energy -better efficiency of newer products.	+	1
			- cost of improved products	_	1
1.4	Heating element (Resistor) importers	Partners in the standardization, comparative labeling	- Better market opportunities	+	1
			-Types of heating elements (resistors) to be sold as used to be -decrease in market mix	_	1
1.5	Ethiopian Energy Authority	Partner in the standardization, comparative labeling	-successfulness of the program	+	1
1.6	Ethiopian Electric Utility	Partner in the standardization, comparative labeling	-reduced power demand -reduced energy consumption	+	1
1.7	Ethiopian Electric Power	Partner in the standardization, comparative labeling	-reduced power demand -reduced energy consumption	+	1
1.8	Ministry of Water, irrigation and Electric	Partner in the standardization, comparative labeling	-reduced power demand -reduced energy consumption	+	1

No	Stakeholder's Name	Role	Interest	Potential project Impact (+, _, ?)	Relative priorities of interest(1 =high, 5 = low)
1.9	Researchers/innovators	-Partner in the standardization, comparative labeling -on further improvements of Stove efficiency	- patent rights issues on efficient products -reduction on the cost of energy -better efficiency of newer products.	_ + +	**1** **1** **1**
2	**Secondary**				
2.1	Addis Ababa city Energy bureau(under whose authority majority of Stove body and Assemblers producers lie)	Coordinate project and report the achievements	successfulness of the program	**+**	**1**
2.2	Oromia state Energy bureau(under whose region majority of clay plate producers are found)	Coordinate project and report the achievements	successfulness of the program	**+**	**1**
2.3	Regional states Energy bureaus	Coordinate project and report the achievements	successfulness of the program	**+**	**1**
3	**External**				
3.1	Addis Ababa trade and Industry	Registration of producers	-get producers licensed	**+**	2
3.2	Parliament	Follow up the overall activity of the project	successfulness of the program	**+**	2
3.3	Ministry of Water Irrigation and Energy	Follow up the overall activity of the project	successfulness of the program	**+**	2
3.4	Ministry of Finance and Economic Development	Allocate budget for the project	successfulness of the program	**+**	2
3.5	Regional states Trade and Industry bureau	Registration of producers	get producers licensed	**+**	2
3.6	Ministry of Trade	Registration of producers	get producers licensed	**+**	2
3.7	Ethiopian Standard Agency	Develop Ethiopian Stove Standard and enforcement of standard	successfulness of the program	**+**	2
3.8	Ethiopian Conformity Assessment Enterprise	Avail testing facility as per agreement with EEA, test samples and provide test report	successfulness of the program	**+**	2
3.9	Ministry Science and Technology	Follow up research developments and award best achievements	successfulness of the program	**+**	2
3.10	Intellectual Property Office	Provide intellectual property certificates for best achievements	successfulness of the program	**+**	2
3.11	Donors	Supports the project financially	successfulness of the program	**+**	3

Table 21. List of Major stakeholders

1.3.2 Electric stove producers.

1.3.2.1 Types of producers

Survey on electric stove producers was made in Addis Ababa and Dire Dawa city administrations and the nine regional state capitals. Based on this, electric stove producers in the country are basically classified into two groups.

a. Body producers. This group produces body of the stove is engaged in the retail and whole sale of the body part only.
b. Assemblers. This group purchases the body from body producers above and the clay plate from clay plate producers/retailers, inserts the heating elements, heat insulations, paints, assembles, sells to the customer and handles the repair and maintenance works. The group receives clay plates also from rural area producers and is also engaged in preparing grooves on the clay plates.

1.3.2.2 Assessment made on producers

The number of producers in AA and Dire Dawa city administrations and the regional states city centers has been assessed. Assessment questionnaire has been filled at producer sites. A total of 250 producers and assemblers have been identified and contacted. The questionnaire and list of producers are attached as Annex 3 and Annex 4. About 157 were willing to fill in the questionnaire.

The survey made on the body producers and assemblers in Addis Ababa and the regional capitals indicated the following.

a) Above 74% of producers who filled in questionnaire are not registered by Trade and industry offices and do not have trade licenses and Tax identification numbers. According to the Woreda 01 Revenue and customs representative, the Chid tera assemblers and producers(major producers)do not have licenses for three reasons:
   I. The producers do not have work place rental agreements.
   II. Measurements of work place area were not made by the respective land administration.
   III. The work area has been upgraded from the “Gulit”(a small sales location in an open space) type vendors to assembler/producers working in temporary shades.

b) Of all producers and assemblers, estimated 81% are stove assemblers, and 19% are body producers.

c) Estimated about 95% producers including those not willing to respond are located in Addis Ababa. 5 % are located in the regional states and Dire Dawa city administration. Majority of stove body builders are located at Chid Tera, Addis Ababa. Stove clay plate producers are located in Oromia region at Gewassa(past Lege tafo) and Bishoftu(Debre Zeit). Clay plate whole sellers and retailers are located at Chid Tera, Addis Ababa. Majority of the assemblers are stationed in Addis Ababa. There are clay producers in Mekele and Bahir dar area who supply to the assemblers in the respective cities.

d) 57% of assemblers produce the single cook top type, 14% the double cook top , 28 % both the single and double types equally and 1% the three cook top type. Hence, it is estimated 70% produces the single cook top type.

e) 97% stove assemblers use what they refer to as a one piece 1200 watt electric heating element. They do not measure the resistance of the heating element as they do not have measuring instruments and fix it directly to the clay plate. The assemblers claim that the resistance values are measured by the vendors and they counter check values by seeing the length of the wound resistances. This implies that the assemblers do not know the power of the stoves produced.

f) Resistance value used ranges from 31.1 ohm to 39.6 ohms. Average resistance of heating element used = 34.7 Ohm, corresponding to 1400W. Resistances supplied appear to be higher than what the producers /assemblers needed to buy. Eg. A producer intended to buy 1200 watt resistance unknowingly buys a 1400 watt resistance. Some suppliers, by selling higher wattage resistances in the name of lower rating resistance, think they attract the producers as customers of the producers will be satisfied with the high power stoves.

g) Almost all stove assemblers believe that comparative labeling and standardizing of electric stove will be useful to their business, and the consumers. It may also push to produce quality products and creates completion among producers. There are few, however, who think that the existing local stove technology could not be made more efficient than what it is today.

h) Some producers were not comfortable to respond to the questions related to the volumes of production and the growth rates, because they assume it may be associated with tax issues and income assessments. Some suspect their level of competence may be evaluated through such studies and opted not to volunteer. About 80 producers, included in the 250 above didn't want to respond to the questionnaires.

i) Producers additionally commented on the local stoves and their performances.

- Product, performance and skill related
  - Local stoves are preferred to imported stoves for the speed of cooking.
  - Local stoves are not convenient for slow cooking and need temperature control and switching. If in case it is left turned on, it doesn't turn off and poses danger. Control and switching devices are not available in the local market.
  - The thin galvanized body of stoves is eaten away by the heat intensity.
  - The local stoves' resistances are open and have got risks of contact with live electricity. It was suggested that the live resistances get concealed or covered and power added to compensate for the reduction of radiative heat loss as a result.
  - Maintenance of local stoves doesn't need skilled labour. Users can maintain.
  - Imported stoves easily fail, are not easily maintainable and need skilled labour, and body rusts in a short period.
  - Price of imported steel tube resistance is higher than that of the open type resistances.
  - "Wot" and other fluid enters stove through the gap between body and clay plate and damage the electrical connections.
  - Stoves installed at condominium buildings perform well whereas those at other areas do not due to low voltage levels, usually 160 to 180Volts are received at households. Hence, producers/assemblers increase power of local stoves to compensate for the voltage drop.
  - Majority of producers do not have training on the production and maintenance of the products and this has created quality problems on the product. Most of them work based on learned experiences. Some producers believe that upgrading of their skill is necessary before the EE standards and labeling work is commenced by the Ethiopian Energy Authority. They think a producer shall not be penalized by the EE standards and labeling for producing less efficient product before being supported by the government to improve his/her skill on production.
  - Price of local stoves is affordable by users.
  - Awareness creation shall be given to all producers and consumers
  - They can assemble the imported type stoves if given the chance and opportunity.
  - Few producers have made one smaller diameter and one bigger diameter cook tops on the double cook top type to enable users use proportional sizes of cook wares.

- **Quality of materials related**

  - There are up to three quality levels for the resistance, switches, connectors, and plugs. Many of the components are of low quality. Some assemblers use plugs of rating less than 16 Amper.
  - Resistance melts away simply and upon spillage and further damages the clay plate.
  - There shall be a standard for resistors supplied to producers
  - Circuit breakers at residential households do not protect the high current occurring from over voltage and voltage spikes and stove resistances burn often.
  - Low quality of clay plate materials and hence cracks and breaking occur during use.
  - It has been suggested that heat resistant wires shall be used for wiring inside the stoves.

j) Total number of producers in the country is estimated to be three times the above figure as many of them work at their residence and could not be contacted.

The following can be deduced from the survey.

- There is no a specific license issued for the production and assembly of electric stoves. Producers/assemblers having licenses work under the licenses issued for electric mitad manufacturing and/ or repairing services.
- Majority of the individuals engaged in electric stove are not licensed. This indicates that currently the government has little or no control over the production and producers. This imposes serious problem on the EE standard and labeling program planned as producers are the major stake holders.
- The assemblers play a critical role in determining the EE of the product. Majority of assemblers do not have basic education and the technical skill and knowledge on the electrical aspect of the stove work. However, the decision on fixing the power rating of the products is in the hands of these workers. Training the assemblers on electrical systems and power rating and EE, clay producers, and body producers shall be a pre condition and mandatory requirement for the successfulness of the EE standard and labeling program.
- The production and distribution of electric stove in the country is mainly based at Chid tera, Addis Ababa

- Based on the resistance measurement made majority of electric stoves produced are rated at installed capacity of 1.4 KW at 220V. However, the products of various producers vary in power requirement. i.e from 1200 to 1600W
- Some producers complain that there is a drop of electric voltage level in the country. Due to this, their products do not satisfy the customer's needs and they are obliged to raise the power ratings of stoves they make by cutting the resistances of the heating elements or choosing higher rating resistors. This imposes high power demand.
- There are few producers who started to assemble stoves with imported spiral tube coil resistors.

Electric Stove producers are the main stakeholders of the program. The concerns and interests of the producers are:

- Perceived fear of being registered and paying tax for those working without trade licenses.
- That production methods to continue as used to be. Change in production methods and introduction of new improved products may pull them out of the business and market.
- Cost to be incurred for the program
- Better market opportunities for those having trade license

Producers/assemblers of local stoves shall participate as partners in the development of the EE and labeling program right from the beginning for the project to be successful. There are no formal training institutions in the country giving training on the production of stove and the existing producers acquired the skill and knowledge by working for the senior ones. It has been learned that the producers know each other very well due to the nature of the work. Identifying influential producers and working in partnership with them will be necessary for the successful implementation of the EE program. Recently electric mitad producers, most of whom produce stoves, have formed an association named "Ethiopian Electrical Appliance & Equipment Manufacturers and Service Providers Association", EEAMSPA. It has been understood that majority of the assemblers are happy to have been contacted for answering the questionnaires and think the program would benefit their business.

1.3.3 Consumers

Tens of millions of the Ethiopian population eat injera with "Wot" more than once a day. Consumers buy local stoves for preparing "Wot", different types of meals, boiling coffee and tea, hot water and other cooking needs and are the most concerned in the outcome of this project. The EE standard and labeling program in the future may lead to the use of different sizes of stoves and cooking mechanisms than used to be. What interests the consumers will be that the power and size (diameter) of cook stoves maintained as used to be, cost of the product, reduction on the cost of energy, easier and self maintainable product and better efficiency of newer products.

Consumers need different sizes of local stoves. Many consumers are used to prepare "Wot" using bigger cookware sizes as meals for the whole family for a day or two are cooked once. Other consumers prefer small cook wares to cook different "Wots" for a meal. The 40 to 50 Cms diameter stoves are used for social ceremonies like weddings, and hotels and restaurants.

From consumers' side, women, specifically women maids, shall participate as partners in the EE and labeling program. Women maids are the ones who use electric stoves on daily basis. As mentioned in section 1.1.3, the core problems of the local electric stoves are the low energy efficiency and the low coking efficiency caused by user behavior. Improving the cooking behavior of women maids will have a significant impact in meeting the objectives of the EE standards and labeling.

1.3.4 Heating element (Resistor) Importers

Based on the resistance measurements made during the assessment, different ratings of resistors are in use. Electrical power is the square of voltage divided by resistance. If we consider the nominal voltage of 220V, the power rating of the stoves for the resistance values 31.1 ohm and 39.9 ohm would be 1.6 Kw and 1.2Kw respectively. There is a difference of 0.40 Kw. This difference in power is predominantly due to the variations in the values of resistors imported and distributed.

The interests and concerns of Importers would be on additional markets to be generated and possible decreasing in the mix of products they sale as a result of development of efficient products.

1.3.5 Innovators/researchers

Innovators interest will be to see reduction on the cost of energy, better efficiency of newer products. One of the objectives of EE standards and labeling is to introduce newer products based on innovations and researches. The patent rights issues on the efficient products they develop through innovations and researches would be their main concern.

1.4 Policy context and Implications

The energy efficiency and conservation activities are among the activities prioritized by the government in the national Growth and Transformation Plan (GTP I and II), Climate Resilient Green Economy (CRGE) strategy and the National Energy policy to save huge amount of energy in the country. As the energy loss and power demand in this country are very big, considerable economic, social and environmental benefits can be obtained from the energy and power savings emanating from the implementation of the energy efficiency standards and labeling projects.

In the Growth and Transformation Plan GTP II of the energy sector, prior focus is given to generate sufficient power for both domestic consumption and export. The planning period will see a significant increase in the current low level of domestic per capita annual consumption, and export of electricity export. To this end, the Universal Electricity Access Program will continue to be implemented. In this regard, a decentralized off-grid solar energy supply will be promoted. Since the role of government in the generation, transmission and distribution of electric power is vital, the preparation and implementation of projects that expand energy generation capacity will be given utmost emphasis. The prevailing power supply interruption problem is planned to be addressed fully by upgrading and expanding power transmission and distribution lines.

Energy consumption in the country is forecasted to be doubled or growing even more in the coming years as the number of connected customers increase due to rural electrification and growing individual consumption because of increased urbanization, low electricity tariff, increased life standard, increased industrial customers, e.t.c. Therefore, developing electric supply infrastructure at faster rate to combat the growing consumption and also increasing supply efficiency by reducing technical and non technical loses is a must as stated in GTP II.

1.4.1 Some of the Major targets of GTP II

a. Increase the power generating capacity of the country from 4,180MW in 2014/15 to 17,208MW by 2019/20; of which, 13,817MW is planned to be generated from hydro-power, 1224MW from wind power, 300MW from solar power, 577MW from geothermal power, 509MW from reserve fuel (gas turbine), 50MW from wastes, 474MW from sugar and 257MW from biomass.

b. Increase the energy production capacity of the country from 9,515.27GWH in 2014/15 to 63,207 GWH by 2019/20.

c) Increase electricity coverage from 60% in 2014/15 to 90% in 2019/20.

d) Increase the number of consumers from 2.31million in 2014/15 to 6.955million by 2019/20.

e) Increase the total length of power transmission lines from 16,018km in 2014/15 to 21,728km by the end of 2019/20; out of which, to increase the high voltage 500kv gridline to 1,240km, the 400kv gridline from 1,397km in 2014/15 to 2,137km by 2019/20, the 230kv/132kv and 66kv gridline from 13,383km in 2014/15 to 18,351km by 2019/20. By so doing, the current power interruption and power loss problem will be mitigated significantly.

f) Increase per capita energy consumption from 86KWH in 2014/15 to 1,269KWH by the end of 2019/20.

g) Reduce power loss from 23% in 2014/15 to 11% by the end of 2019/20.

The energy efficiency and conservation activities are also among the activities prioritized by the government in the second national Growth and Transformation Plan (GTP II). According to the plan reduction of power loss from 23% in 2014/15 to 11% by the end of 2019/20 is expected as indicated in the major activities listed above. On the other hand in the **Climate Resilient Green Economy (CRGE) strategy** and the **National Energy policy** also savings of huge amount of energy in the country has been targeted.

In the Climate-Resilient Green Economy (CRGE), The plan: To follow a green growth path that fosters development and sustainability, the CRGE initiative follows a sectoral approach and has so far identified and prioritized more than 60 initiatives, which could help the country achieve its development goals while limiting 2030 GHG emissions to around today's 150 Mt CO 2e – around 250 Mt CO 2e less than estimated under a conventional development path. The green economy plan is based on four pillars:

- Improving crop and livestock production practices for higher food security and farmer income while reducing emissions

- Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks
- Expanding electricity generation from renewable sources of energy for domestic and regional markets
- Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

The energy policy of Ethiopia, section 6, 6.3, Energy conservation Efficiency, states that the government's policy regarding household energy is to increase efficiency in the household sector by instituting conservation and energy saving measures.

The government has authorized the Ethiopian Energy Authority by Proclamation No. 810/2013 to undertake the energy efficiency and conservation activities besides other tasks. The Authority has put in place separate Directorate in its Organizational Structure, which takes care of Energy efficiency and conservation issues. The Authority has also developed **Framework for Strategy Development on Energy Efficiency in Industries, Buildings and Appliances,** which helps it to strategically plan and undertake these activities through different energy efficiency projects. In the Framework document opportunities for improving energy efficiency are clearly described as follows:

- Present in the supply of more efficient models of electric and non-electric appliances, and equipment used in industrial, commercial and residential sectors.
- On the improvement of locally manufactured injera mitad and stoves.

As mentioned in the Framework document, the Ethiopian appliance market is characterized by the locally manufactured electric injera mitad and electric stove and all other major appliances such as refrigerators, washing machines, electric irons ranges and imports from other countries. Therefore, energy efficiency projects shall be prioritized and implemented based on the extent of usage, degree of energy consumption and energy conservation potential of the main equipment and appliances in the household, buildings and industries.

1.4.2 Relationship to other energy programs and policies

Energy-efficiency labels and standards work best in conjunction with other policy instruments designed to shift the market toward greater energy efficiency. Standards typically eliminate the least efficient models from the market. Other energy policies and programs, including energy-efficiency labeling, help to further shift the market toward higher energy efficiency. No one government policy makes an energy-efficient economy. Together, an array of policy instruments can influence manufacturing, supply, distribution, product purchases, and the installation, operation and maintenance of energy-consuming products. When working effectively, these policy instruments accelerate the penetration of energy-efficient technology throughout the market. A rich portfolio of policies is necessary to achieve the stated economic and environmental goals of most of the world's nations. Although energy-efficiency labels and standards are considered by many to be the backbone of a country's program for efficient residential and office energy consumption, the overall energy-efficiency package should also include complementary programs, such as:

- Research and development
- Energy pricing and metering
- Incentives and financing
- Regulation, in addition to information labels and standards
- Voluntary activities, including quality marks, targets, and promotion campaigns
- Energy-efficient government purchasing
- Energy auditing and retrofitting
- Consumer education

An important trend in some countries is to combine policy instruments in ways that selectively support "market transformation"; this results in specific interventions for a limited period that lead to a permanent shift toward greater energy efficiency in the market.

Thus far electric injera mitad and electric motor energy efficiency saving potentials have been studied and project implementation for the former is underway. In the project at hand, a document presenting opportunities for improving energy efficiency of locally manufactured electric stoves will be presented.

2 Project Objectives and rationale

2.1 Project Objectives

Electric stoves are one of the most used household appliances in the country and consume the significant portion of electrical energy in a typical residential house hold.

The core problems of the existing electric stoves are the low energy and cooking efficiencies. The objectives of the project are to reduce the following impacts created due to the high electric power and energy demand of electric stove:

- Existing and future power demand on electric power generating, transmission and distribution networks,
- Existing and future cost of building and operating additional electric power generating, transmission and distribution networks,
- Power outages, interruptions and voltage drops.
- Cost of electricity bill on consumers
- Unwarranted energy consumption at national level
- Environmental degradation of the land from which the raw materials of clay plates are obtained.
- The burden on the rural women engaged in the production of clay plates,
- Environmental pollution due to open air firing of clay plates using cow dung

2.2 Project rationale

The EE problem on the existing electric stoves had not been improved over the decades. Research and innovations made on the product are limited and didn't penetrate the market thus far due to various reasons.

The part of population engaged in the process of the production, distribution and users of local electric stove are significant. This includes clay plate producers in rural areas, body producers, assemblers, sheet metal importers and suppliers, heating element (resistor) importers and suppliers, hotels and restaurants, and households. The purchase cost of local electric stove has thus far been affordable to the users. Other technologies based stoves, even though being imported have not been brought forward as a solution to the consumers' power demand per stove, durability, cost and maintainability. Imported and better quality type stoves require factory based production and would definitely carry high price tags which may not be affordable by the consumer population.

Hence, developing EE standard and labeling on the local electric stoves would be the only option to solve the current problem.

Energy-efficiency labels and standards on local electric stoves:

- Reduce capital Investment in energy supply Infrastructure
- Enhance national economic efficiency by reducing energy bills
- Enhance consumer welfare
- Empower buyers of electric stove to include EE in their choice and decision.
- Strengthen competitive markets
- Meet climate-change goals
- Avert urban/regional pollution

3 Project development, activities and Implementation plan

The development of effective energy-efficiency labels and standards for the locally manufactured electric stove requires certain procedures and steps to be followed. Typical steps in the process of developing energy-efficiency labels and standards (Clasp 2nd Ed.[7]) are defined below. This project document has been organized in accordance with "Appraisal guidelines for public sector projects", Ministry of Finance and economic development, Ethiopia.

a) Decide Whether and How to Implement Energy Efficient Labels and Standards

- Assess Political, Institutional, and Cultural Factors
- Establish Political Legitimacy
- Consider Regional Harmonization
- Assess Data Needs
- Select Products and Set Priorities

b) Develop a Testing Capability

- Establish a Test Procedure
- Create a Facility for Testing and Monitoring Compliance
- Incorporate Testing into Enforcement

c) Design and Implement a Labeling Program and Analyze and Set Standards

- Select Products and Decide on the Labeling Approach
- Conduct Market Research to Design the Label(s)
- Customize a Testing Program for Labels
- Implement the Program

d) Analyzing and setting standards

- Involve Stakeholders
- Gather Data and Forecast Input Parameters
- Categorize Product Classes
- Analyze Using a Statistical Approach (Method 1)
- Analyze Using an Engineering/Economic Approach (Method 2)
- Analyze Consumer, Manufacturer, National, and Environmental Impacts
- Document Data, Methods, and Results
- Set the Standards

e) Design and Implement a Communication Campaign

- Establish Goals and Objectives
- Assess Communications Program Needs and Conduct Research
- Select the Target Audience
- Identify and Recruit Partners
- Develop and Test Messages
- Design the Communications Plan
- Evaluate

f) Ensure Program Integrity

- Assess Options and Competencies for Testing Products
- Assess Accreditation Options for Verifying the Competence of Testing Facilities and Legitimizing
- Assess Certification Program Options for Validating That Products Comply with Standards and Label Requirements
- Establish a Verification Regime for Declaring and Verifying that Manufacturers are Complying with Standards and Label Requirements
- Establish a Compliance Regime for Ensuring that Manufacturers Are Complying with Standards and Label Requirements

g) Evaluating the impact of labeling and standards programs

- Plan the Evaluation and Set Objectives
- Identify Resource and Data Needs and Collect Data
- Analyze Data
- Apply Evaluation Results

3.1 Project Log frame and Activity

Output/Activity	Objectively verifiable Indicators	Means of Verification	External factors Risks and Assumptions
Goal			
To reduce electric power demand and energy consumption of locally manufactured electric stove thereby reducing electric network overloading, frequent power interruptions, GHG emissions and Climate Change problems and saving energy .	Reduced network load and power interruptions, reduced customer complaints, reduced emissions	Survey at EEU/EEP and different categories of customers	Government support and commitment
Purpose			
To make existing and future locally manufactured electric stove energy efficient by reducing power demand and energy losses caused by different models of locally manufactured electric stove through development of Minimum efficiency performance standard and energy efficiency labeling program .	Reduced power demand and energy losses, performance standard set, energy efficiency label developed	Survey at EEU/EEP, EEA and different producers and customers	Full participation and commitment of major stakeholders
Output 1:			
Awareness created on Energy efficiency standards and labeling of locally manufactured electric stove through advertising and promotions and stake holders engagement	Public and stakeholders attitude changed towards locally manufactured electric stove standard and labeling	Evaluations and surveys on stakeholders at workshops and questionnaires from different regions	Successfulness of the promotion program
Activity 1. 1:			
Prepare printed materials and distribute	Number and content of printed and distributed materials	Data from EEA , Public relation and Finance Directorate	Successfulness of the promotion program

Output/Activity	Objectively verifiable Indicators	Means of Verification	External factors Risks and Assumptions
Activity 1.2			
Promote on Tv and Radio	Number and content of TV and Radio spots produced and launched	Data from EEA , Public relation and Finance Directorate	Successfulness of the promotion program
Activity 1.3			
Engage Stake holders and prepare workshops	Number and type of stakeholders engaged	Stake holder participant list and Data from EEA Public relation Directorate	Full participation and commitment of stakeholders
Output 2			
Conducted laboratory testing	Testing laboratory selected	Data from EE and conservation Directorate	Government support
Activity 2. 1:			
Agree with selected testing laboratory	Signed Agreement or MoU	Data from EE and conservation Directorate	Availability of capable testing laboratory and personnel
Activity 2.2			
Collect test samples as per sampling procedure	Number and types of samples collected	Data from testing laboratory	Availability of sufficient samples on the market
Activity 2.2			
Conduct laboratory testing	Number of Samples tested	Data from testing laboratory	Availability testing personnel
Activity 2.4			
Prepare and submit test report	Number of test result delivered to producers	Data from testing laboratory	Successfulness of testing

Output/Activity	Objectively verifiable Indicators	Means of Verification	External factors Risks and Assumptions
Output 3			
Developed locally manufactured electric stove Product Standard			
Activity 3.1			
Standard development request to ESA	Signed Agreement or MoU	Data from partner laboratory	Participation of major producers
Activity 3.2			
Support and follow-up of product standard development	Product National Standards Developed	Data from EEA and ESA Public Relations Directorate, Document produced	Availability of resource materials
Activity 3.3			
Finalized product standard and determined MEPS	Number of Test report prepared, MEPS document produced	Data from ESA	Successfulness of standard development
Activity 3.4			
Introduced the standard to Manufacturers and stakeholders	Number of participants attended the workshop	Participants list from EE and conservation and Public Relations Directorates	Commitment of participants
Output 4			
Developed Labeling logo, grades, levels designed, stake holders comment incorporated			
Activity 4. 1			
Design Labeling logo	Designed label logo	Data from EEA EE and conservation and Public Relations Directorate	Representativeness of the logo

Output/Activity	Objectively verifiable Indicators	Means of Verification	External factors Risks and Assumptions
Activity 4.2			
Design final label logo incorporate stakeholders comment	Comments given on the logo design	Data from EEA EE and conservation and Public Relations Directorate and inspection	Stake holders active participation
Output 5			
Develop Energy efficiency Standard			
Activity 5. 1			
Develop EE Performance standard	Developed Energy efficiency Standard	Information from EEA EE and conservation and Public Relations Directorate	Representativeness of the developed standard
Activity 5.2			
Introducing the EE Performance standard to Manufacturers and stakeholders	Number of trainees attended the workshop	Information from EEA EE and conservation and Public Relations Directorate	Stakeholder’s active participation
Activity 5.3			
Train manufacturers on the developed product and EE performance standards	Number of manufacturers attended the workshop	Information from EEA EE and conservation and Public Relations Directorate	Manufacturer’s active participation
Activity 5.4			
Manufacturers support and follow-up	Number of Manufacturers supported	Information from EEA EE and conservation and Public Relations Directorate	Manufacturer’s active participation

Output/Activity	Objectively verifiable Indicators	Means of Verification	External factors Risks and Assumptions
Output 6			
Monitored & Evaluated project implementation program			
Activity 6.1			
Prepare Monitoring & Evaluation plan	Work schedule prepared	Data from EEA EE and conservation and Public Relations Directorate	EEA's capacity
Activity 6.2			
Measure, Verify and Evaluate the program	Confirmed Producers and consumers abiding by the program	Inspection	EEA's capacity
Activity 6.3			
Preparation of M, V& E Report	Report prepared	Report	EEA's capacity

Table 22. Project log frame

3.2 Energy Efficiency Labeling Program

3.2.1 Benefits of the labeling program

Energy-efficiency labels are informative labels that are affixed to manufactured products and describe a product's energy performance (usually in the form of energy use, efficiency, or energy cost) to provide consumers with the data necessary for making informed purchases.

Benefits of labeling EE labeling are:

- Encourages competition among manufacturers
- Allows consumers to compare the EE of different types of locally manufactured electric stoves available on the market. There are different types of electric stoves imported from other countries and hence there is an international best practice for adoption or reference, which contributes to the development of national standard (as a resource)
- Contributes also for future development and implementation of endorsement labeling program

The government has already laid policy instruments for the implementation of EE and conservation measures to minimize huge amount of energy losses and introduce energy efficient technologies for locally manufactured as well as imported electrical appliances. But to undertake those measures energy-efficiency standards or procedures that prescribe the energy performance of locally manufactured or imported products, which sometimes even prohibit the sale of products that are less energy efficient than the minimum standard, must be available.

The national standard of locally manufactured electric stoves under development will fix Minimum Energy Performance Standard, which is the basis of EE labeling of the product. It prescribes minimum efficiencies (or maximum energy consumption) those producers must achieve in each product, specifying the energy performance but not the technology or design details of the product. It will motivate and also force producers to produce energy efficient models of locally manufactured electric stoves. Those energy efficient products shall be assigned EE labels, whose grades and types will be adopted with specific parameters for stoves from already developed electric injera mitad EE labels and indicate the efficiencies/energy consumption of the product.

3.2.2 Assessment of political, institutional and Cultural factors

The first step in the development and implementation of EE standards and labeling program is to assess the lessons drawn from the implementation of EE standards and labeling program of electric Injera Mitad, because positive lessons from implementation of that project must be carried on and negative lessons must be improved or avoided in order to implement this program successfully.

On the other hand the impacts of this program on the locally manufactured products, imported similar products and their market share shall be assessed, because incase if the energy efficiency of local products is very poor compared to the imported products the market may incline to imported products. In such case local manufacturers may lose their market shares to imported products, which may cause disappearance of many/all local manufacturers from the market. The economical and political impact of such a situation is very big as it touches the lives of local manufacturers, their employees and families.

International experience shows that there may be greater resistance from influential stakeholders to the labeling programs. In Ethiopia the situation can be even worst compared to the International one. Therefore, time and education may be required for people to accept benefits claimed for energy-efficiency comparative labeling program and standards. People must be aware to accept that the programs are economically beneficial to the consumer and for the country in general and do not decrease consumer's choice of products or, even, if designed effectively, energy-efficiency standards and improved products can make local manufacturers more profitable in the long run. Generally in Ethiopia pilot/voluntary programs shall be implemented at least for the first two to three years for smooth implementation of the program.

3.2.3 Harmonization of labels

The labeling program currently focuses only on locally manufactured electric stoves. As we know locally manufactured electric stoves are widely used the country especially by families with lower income, which may not afford the prices of imported stoves. The labeling grades or types used for Injera Mitad may be adopted for stoves by adding stove specific parameters. Those locally manufactured electric stoves may become export products in the near future, when local manufacturers start manufacturing according to the developed product standard. Therefore, harmonization of labels with the international or regional labels is very important and must be taken in to consideration.

Therefore, where products are compared using labels such as stars, numbers, letters or coloured bar charts, algorithms for EE need to be tailored to International, regional or national markets based on currently available test procedures used to determine energy consumption of the labeled appliances. Mutual recognition agreements (MRAs), are useful to implement labeling programs, because common harmonized test procedures and a universal efficiency categorization scheme are also very important to facilitate trade between involved countries and reduce the cost of regulation such as costs of repeated tests.

3.2.4 Comparative Labeling Program

Comparative labels are types of labels that allow consumers to compare performance among similar products using either discrete categories of performance or a continuous scale.

3.2.4.1 Development of comparative labeling program

The energy demand of locally manufactured electric stove is the highest among household appliances. Different models of locally manufactured electric stoves from different producers have definitely different power consumption or varying power ratings. Their efficiencies also differ because there is no common national standard for their production. Even similar models from the same manufacturer can have different power consumption and efficiency just like electric Injera Mitad. Therefore, the urgency of bringing the production of locally manufactured electric stove to common product standard has been given attention by the energy regulator, the Ethiopian Energy Authority.

The Comparative labeling program, which will be carried out by EEA will set **Minimum Energy Performance Standard (MEPS)** as one of the basic parameters. MEPS prescribe the allowable energy consumption producers must achieve and assures in all models of an applicable product. MEPS do not specify the technology or design of a product. It prohibits sales of new products that are less efficient than that minimum level and raise the average EE of the products. The development of locally manufactured electric stoves product national standard will be carried out in collaboration with Ethiopian Standard Agency as discussed in Section 3.3.1 below after the comparative labeling test program sets MEPS.

3.2.4.2 Implementation of comparative labeling program

The implementation of Comparative Labeling program for locally manufactured electric stoves will be used to identify products having both with lower energy consumption and better efficiency which exist in the market. The implementation of this program will definitely bring a course of change in the research, development and production of locally manufactured electric stoves, which has been done on traditional manner without major improvement for a long time.

The comparative labeling can be implemented as mandatory or voluntary program. But for the first phase (first few years) an implementation of voluntary program is preferable. It can be started by attracting manufacturers to the program through continuous communications campaign and awareness creation. The benefits of the program for manufacturers must be announced through media. Direct invitation of major manufacturers to participate in the program should be done in order to increase the probability of program success. Incentives and dissemination mechanisms for better or relatively efficient products must be clearly announced.

For the implementation of this program, basic procedures and guidelines such as product sampling procedure, testing Procedure (test methods), Housekeeping procedure, Testing facility & measuring Devices, locally manufactured electric stoves Main Procedures have been prepared and annexed (Annexes 5,6,7,8).

Various literatures indicate that concerning electric and gas cooking hobs, although several standards have been developed to measure performance and safety of different appliances, adequate test procedures remain a problem. Ethiopian standard ES: 3406, 2007, Electric cooking ranges, hobs, ovens and grills for household use — Methods for measuring performance and Indian standard IS 2994:1992 have been referenced for the test procedures on the local electric stoves.

Testing personnel at the Alternative Energy Technology Promotion Directorate's Testing Workshop (Ministry of Water Irrigation and Electricity) has already developed sufficient experience and capability from testing of electric Injera Mitad. Testing equipment has been already procured and installed by EEA. Therefore, the remaining tasks of the testing laboratory will be sample collection, testing samples, analyzing obtained results and reporting test result to EEA.

The Ethiopian Energy Authority's role in the implementation of this comparative-labeling program includes:

a. Defining the detailed implementation mechanisms in consultation with other stakeholders;

b. Developing and maintaining the legal and/or administrative framework for the program;

c. Ensuring program's credibility; providing information to consumers, including ensuring press and TV involvement in the promotional campaign; and evaluating the program.

In order to achieve these goals a two year program with the budget estimation has been proposed under section 4 of this proposal. The two year program is estimated to suffice as at this time adequate experience have been gained from the EE standard and labeling project of Injera Mitad, which is currently underway.

3.2.4.3 Labels

Major design works of types and grades of labels had been done in the electric Injera Mitad project design phase and they have been already endorsed as a national label for the product. However, for locally manufactured electric stoves, specific parameters must be carefully studied and included. The energy labels convey information in a way that is easy to understand and assist consumer with purchase decisions and it is what consumers actually see when they go to purchase this appliance. The type and grade of the label developed for electric Injera Mitad will be used by adding product specific parameter for all products, which will be considered in the labeling program in the future as consumers will be familiar with the label and grade from electric Injera Mitad project experiences.

The communication campaign for locally manufactured electric stoves efficiency standards and label must be effectively and sufficiently addressed to consumers, producers, government and other stakeholders. The promotion work must be incorporated in to the project development work. To this effect, a separate document entitled “Design and implementing communication campaigns for labeling and energy efficiency standard - setting programs “ has been prepared.

Generally there are two distinct types of energy labels in use around the world: endorsement labels and comparison labels.

3.2.4.3.1 Types of labels

a) Endorsement labels

Endorsement labels (or quality marks), affixed only on models meeting or exceeding a certain efficiency level, indicate by their presence models of superior energy efficiency. They are, by definition, voluntary. The purpose of endorsement labeling is to indicate clearly to the consumer that the labeled product saves energy compared to others on the market. Endorsement labels are a seal of approval indicating that a product meets certain specified criteria. These labels are generally based on a “yes-no” cutoff (i.e., they indicate that a product uses more or less energy than a specified threshold), and they offer little additional information. Typically, endorsement labels are applied to the top tier (e.g., the top 15 to 25%) of energy-efficient products in a market.

Figure 28. Examples of Endorsement labels

b) Comparative Labels

Comparison labels indicate the energy efficiency of a particular model relative to similar models on the market, and are usually, though not always, mandatory. Comparative labels are types of labels that allow consumers to compare performance among similar products using either

- Discrete categories of performance(categorical labels) or
- A continuous scale label.

i. Categorical labels

The categorical labels use a ranking system that allows consumers to tell how energy-efficient a model is compared to other models in the market. The main emphasis is on establishing clear categories so that the consumer can easily tell, by looking at a single label, how energy-efficient it is relative to others in the market. The European energy label shown in Figure 29, b) below is a categorical comparative label.

There are two general formats that are used around the world for categorical labels. Australian-Style Categorical Label (dial) and the European-Style Categorical Label (bars).

Australian-style label

The Australian-style label has a square/rectangular base with a semi-circle or “dial” across the top. The “dial” resembles a speedometer or gauge; the further advanced the gauge indicator is, the better the product. This type of label is used in Australia, Thailand, Korea, and India. In Australia, the dial contains stars (up to a maximum of six stars), and in Thailand the dial contains a one-to-five numbering system. The number of stars or the numerical “grade” on the scale depends on the highest pre-set threshold for energy performance that the model is able to meet.

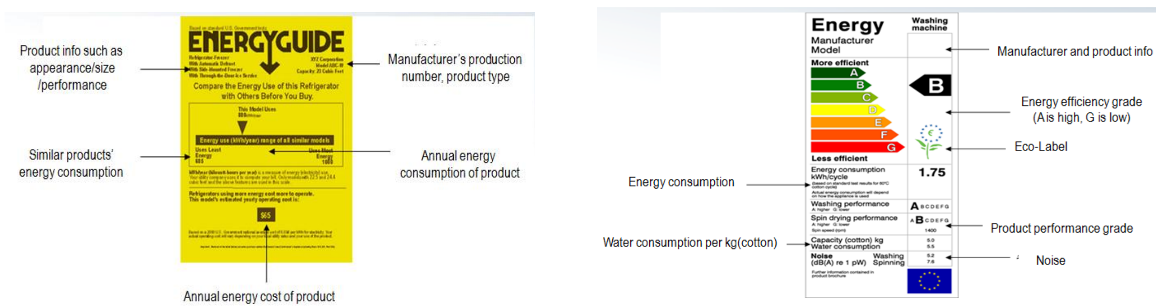
European-Style Categorical Label (bars).

The European-style label is a vertical rectangle with a series of letters ranging from “A” (the best) at the top of the label to “G” (the worst) at the bottom. There is an arrow next to each letter that uses both length and color progression to communicate relative energy efficiency (short and green for “A” and long and red for “G”). All seven graded, colored, and size-varied arrows are visible on every label. The grade of the product is indicated by a black arrow-shaped marker located next to and pointing toward the appropriate bar (e.g., for a “C” grade product, the marker carries the letter “C” and is positioned against the C bar). Because of language requirements of the E.U., the label is in two parts. The right-hand part, which shows the base data common to all products, is not language-specific and is generally affixed to or supplied with an appliance at the point of manufacture; the left-hand part, which gives the explanatory text particular to the model in question, is language specific, and is generally supplied and affixed in the country of sale. This label style is used throughout Western and most of Eastern Europe as well as in Brazil (with a different basis for the A to G category definition than in Western and Eastern Europe). Iran uses a variant of the European-style label that is a mirror image of the European label because Persian script reads right to left, and it uses numerals rather than Roman script letters for ranking: i.e., 1 (best) to 7 (worst). Tunisia uses a European-style label with French on one side of the arrows and Arabic on the other to address the country’s bilingual population. South Africa also uses a European-style label. The international trend is strongly toward adoption of categorical energy labels.

ii. Continuous scale labels

A continuous scale label uses one format as described below. Canada-U.S. both use the Continuous Label (horizontal scale) style. The rectangular Canada-U.S.-style label shows a linear bar scale indicating the highest and lowest energy use of models in a particular product category.

The continuous-scale labels provide comparative information that allows consumers to choose between models, but do not use specific categories. The US energy guide label shown in Figure 29 a) is in this category.



a) US energy Guide – Continuous scale label

b) European Energy label- Categorical label

Figure 29 . The US and European Comparative labels

3.2.4.3.2 Label design

Labels are markings, with supporting promotion and directories, which show products' energy use or efficiency according to a common measure. The steps in developing energy guide labels for household appliances include: Initial Program Design, Conduct Market Research to Design the Label(s), Customizing Testing for the labeling Program and Implementation.

Step 1: Initial Program Design

This task includes study to find which products should be labeled and deciding the labeling approach. Moreover, this includes whether the labeling program should be endorsement or comparative, a voluntary or mandatory, categorical or continuous scale labeling.

In the case of electric stove the labeling approach is proposed to be comparative as there are different levels of efficiency of the product in the market. During the first few years the labeling program is proposed to be voluntary based.

International research and evaluations show that categorical labels are likely to have greater market transformation impact than continuous labels for the following reasons.

- Use of categories enables the efficiency of a product to be determined at a glance as only its category has to be noticed (and recalled) rather than its relative position on a scale;
- It is comparatively simple to remember the efficiency of a product during the shopping process and hence the information is more likely to be used in the final purchase decision;
- Categorical labels have a set of explicit efficiency thresholds that product designers, manufacturers, distributors and retailers can aspire to attain; and
- Promotional and marketing efforts can be targeted at specific high efficiency categories

Step 2: Conduct Market Research to Design the Label(s)

After selecting products to label and the types of labels to use, the next step is to conduct market research on the label design. Market research focuses on the following elements of the label: its visual design, the technical specifications that it will represent non-energy attributes that might be included on it, and any details that will help in outreach/marketing campaigns.

Policymakers are generally concerned that energy labels should mitigate the informational barriers that prevent consumers from taking energy sufficiently into account when purchasing an appliance. Consumers are the primary users of energy labels and so it is appropriate that labels should be designed to present information to them in as useful and accessible a manner as possible. Clearly the format of an energy label is important in communicating this information effectively; however, it is difficult for policymakers to know what format will be most effective without research. Furthermore it can't be assumed that a label design which has been effective in one region and culture will necessarily be effective elsewhere, so successful labels are not necessarily transposable. In addition, if energy labels are to be effective market transformation instruments, they should also be sensitive to the needs of manufacturers and retailers who are responsible for the market offer. Generally, if a label is effective with consumers it will also be influential among suppliers; however, sometimes one of the most effective means of establishing how consumers are likely to respond to a design is to use the experience of those who have been supplying products to them. Lastly, the design of label needs to take into account the goals and concerns of policymakers who may wish to stress particular design elements in order to reflect national policy goals. Accordingly, the label design process should be based on research regarding the most effective design among the key stakeholders: consumers, manufacturers, retailers and policymakers.

The aim of the research approach shall be to:

- Listen to consumers and stakeholders
- Reflect their needs and wants (i.e. particularly their need for getting quick and reliable information about the relative energy efficiency of various appliances in an easily understandable, uncomplicated and simple manner)
- Develop labels accordingly

Figure 30 shows a label design research flow chart which has been employed in countries like China, Malaysia, and India in developing their labels.

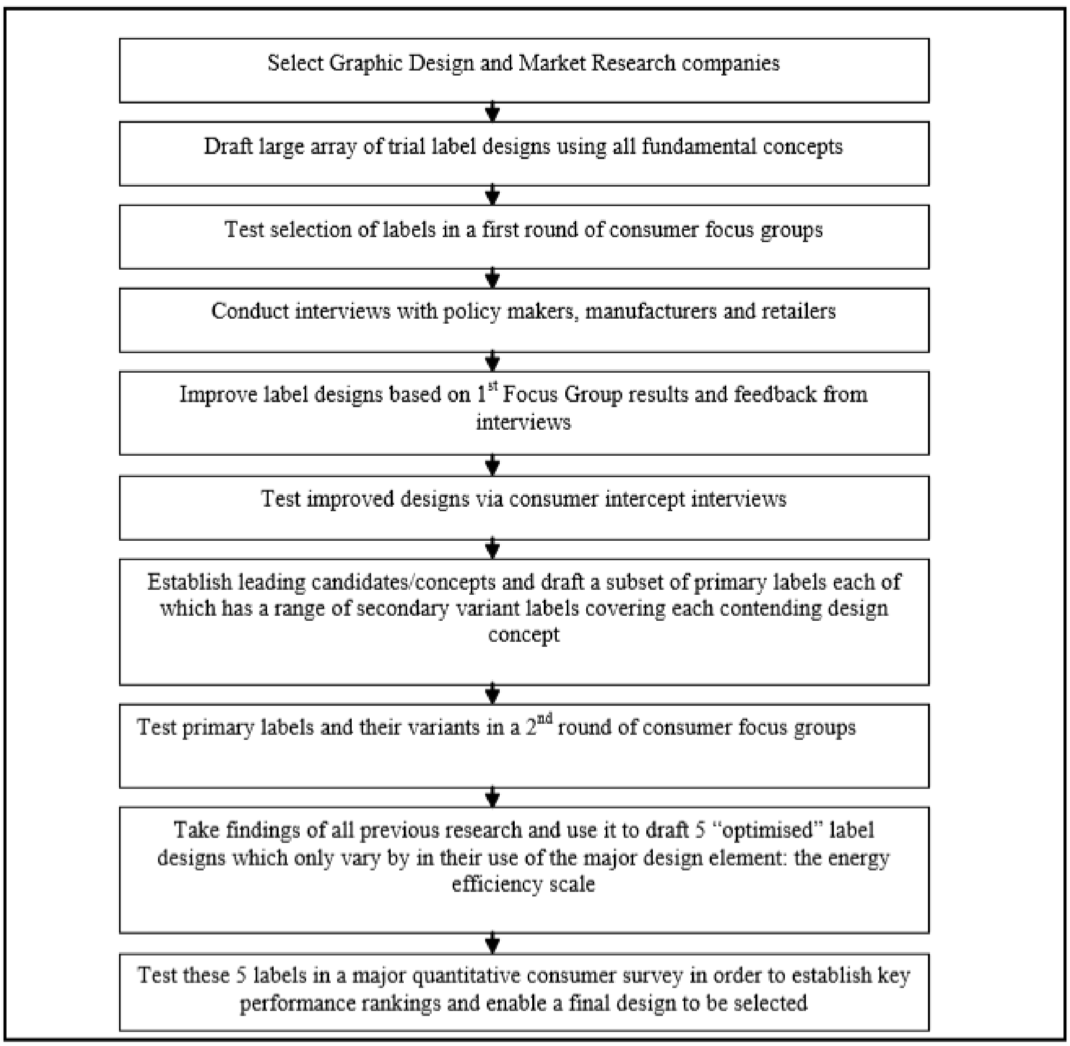


Figure 30. Label design research flow chart

Step 3. Customizing Testing For the labeling Program

Once a system for energy-performance testing is in place, the results of initial testing of a sample of products can be used to:

■ characterize the range of efficiency of models sold in the market

■ estimate the potential savings from the labeling program

■ form the basis for developing the label categories

■ provide the energy-performance results used to label each product

The test data required for an energy labeling program should at a minimum include three essential elements:

■ Energy consumption. The metric of energy consumption will be shown on the comparative energy label or provide the threshold for qualifying a product for an endorsement label. For example, the test might specify energy use per day, per hour, per month, or per cycle.

■ Performance. A description of other measurements or separate tests that must be performed to establish the product's capacity (e.g., kilowatts of cooling capacity for air conditioners, liters of internal volume for refrigerators) or function/performance (e.g., a washing and drying index for dishwashers).

■ Tolerance. Rules specified by regulators to ensure that values reported by tests are within acceptable error bands and to provide for retesting and resolving any apparent differences in results

Certification often but not always involves some form of registration or filing of test reports. Many countries, including Europe, the U.S. and Australia, allow manufacturers to self-certify their products. Self-certification only works, however, if the regulatory agency can effectively monitor and enforce compliance.

Step 4.- Implementation

Once a labeling program is designed, it is important to have a clear plan for implementing the program, including rules and guidelines, marketing and promotion, compliance and enforcement, and regular revision of technical specifications

The label design is critical because it must convey information in a way that is easy to understand and assists the consumer with purchase decisions and it is what consumers actually see when they go to purchase this appliance. It is also important to use the details of energy labels developed for stove for other products, because consumers can learn to understand one type of label to evaluate different products.

Hence, the label design shall be comprehensive and take into consideration products to be labeled in the future.

One of the best ways to make sure that stoves efficiency label will communicate effectively to consumers, producers, government and other stakeholders is to incorporate intensive promotion work into its development. Among the above mentioned stakeholders, manufacturers are key stakeholders. The important idea behind this promotion is that it encourages a wide set of views to be included in the label development process. The final label design must be based on **broad consensus** among those stakeholders.

Sample label types and grades from some countries have been shown in Table 23 below to adopt appropriate label types and grades or develop new ones for Ethiopia.

Country	Type of label	Comments
Australia	Comparative with categories	Six categories range from 1 to 6 stars; 6 stars is most efficient
Brazil	Comparative with categories	Seven categories range from G to A; A is most efficient.
Canada	Comparative with continuous scale	Scale shows range of models in size class; Energy use is the scale metric.
European Union	Comparative with categories	Seven categories range from G to A; A is most efficient
Iran	Comparative with categories	Seven categories.
Philippines	Comparative with categories	Labels for air conditioner only; shows EE ratio (EER) of air conditioner.
South Korea	Comparative with categories	Five categories range from 1 to 5; 5 is most efficient.
Thailand	Comparative with categories	Five categories range from 1 to 5; 5 is most efficient.
United States	Comparative with categories	Scale shows range of models in size class; energy use is the scale metric.

Table 23. Comparison of selected label types from around the World

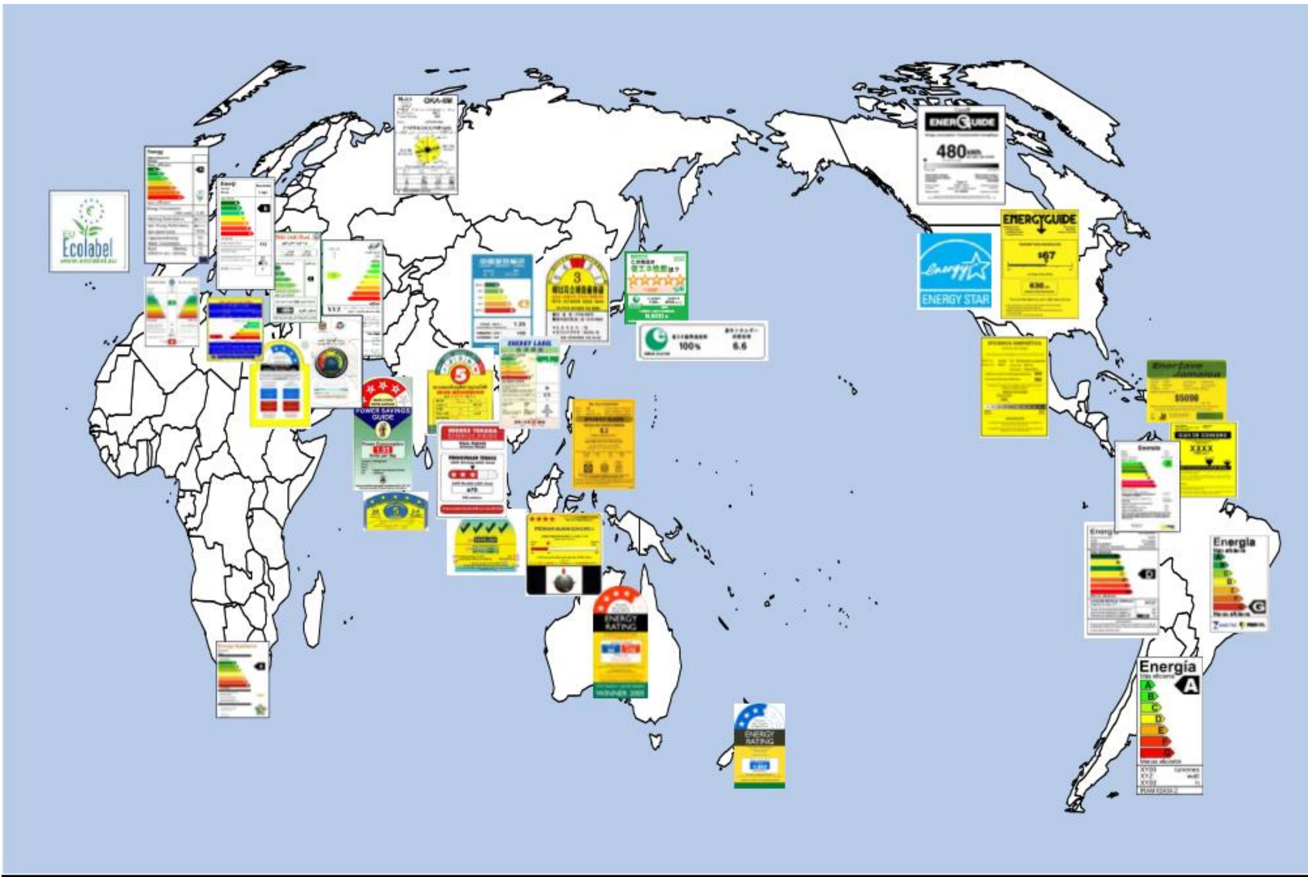
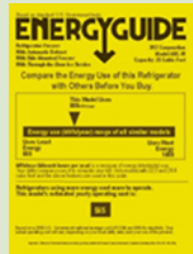


Figure 31. Variety of energy labels around the world.

	KOREA	AUSTRALIA	U.S.A.	EU
Label				
Strength	• Been used for two decades, high awareness •Easy to check consumption efficiency	• Easy to recognize at a glance •High impact of key figures	• Comparison between similar products	• Includes various information besides energy efficiency
Weakness	• Little information for consumers	•Too many colors used, can be improved in terms of design	• All written in text, lower legibility	•Just the grade is emphasized

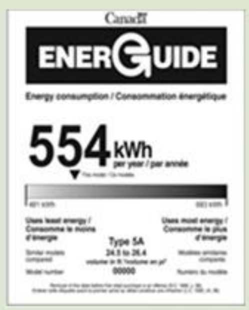
	CHINA	CANADA	JAPAN
Label			
Strength	•Easy to recognize •Simple design	•Comparison between similar products, making it easier for consumers to decide •Easy to recognise energy consumption	• Can check the cost of purchasing the product •eco-friendly image
Weakness	• Limited information provided to consumers	• All written in text, lower legibility •Lack in various information	• Distractive layout

Figure 32. Comparison of energy labels around the world.

There may be number of variants or hybrids of the label types just discussed. It is important to remember that energy label is primarily useful at the point of sale to influence consumer decisions at the time of purchase. Therefore, it must be easily understandable even for customers with low level of education. After a product is purchased, the energy label is normally removed or even has no more benefit.

3.2.4.3.3 Proposed Label and grade design for electric stove

a) Electric stove label Design

Endorsement labels for electric stove can be implemented along with other priority equipment based on the experience gained from the Implementation of comparative labeling. Hence, label design for the Endorsement labels shall be differed until such time.

For the development of types and grades of labels for comparative labeling of electric stove, the discrete category Stars and Coloured bar charts have been considered as options. Some energy efficient household appliances appear on the Ethiopian market especially with European type and grades of EE labeling. Significant numbers of customers have been already informed about the labeling. On the other hand, labeling types and grades with stars and numbers are still not available on the Ethiopian market. Therefore, it may be reasonable to select the labeling types and grades, which have similarities with European type and grades of labeling in order to retain the information which already exists in the minds of many customers.

For the grading or ranking of labels in Ethiopia, alphabets and numbers used at the national and regional states level such as Latin alphabets A,B, C…, Geez alphabets such as ሀ፣ ለ፣ ሐ፣… and numbers 1, 2, 3 or ፩፣፪፣፫፣፬፣ have been considered. But considerations of Geez letters and numbers as options were left out as their applicability is limited to only two regional states of the country. Therefore, the options left to develop the types and grades are from Arabic numbers 1,2,3, Latin Alphabets A, B, C, Stars *, **, *** or colored bar charts like the European labeling types and grades. As most of electric stove buyers may have lower educational level the use of Arabic numbers will be much easier and preferable. The adoption of types and grades of labeling from the above mentioned option may bring also the benefits of harmonization with already existing and internationally recognized labels and colours

Therefore, for the electric stove labeling it is proposed to use the European Categorical Energy label (bars) and colours with bar size modified along with Arabic numbers. Considering the absence of experience of purchase of electric stove based on labeling logo, the more efficient grade is marked with bigger sized Green arrow and number 1. The grade numbers assigned indicate the most efficient or very well product as 1 and least efficient or not so good as 5. The colours assigned are Dark Green (1) which indicates most efficient, green means environmentally friendly and greener product, Light green (2), Yellow (3), light Red (4) and Red (5) least efficient, danger and energy wasting product. Only five grades are proposed as compared to the seven grades used in the EU in order to reduce the volume of work and cost involved in the comparative labeling at the introduction of the program. Latter on the grades could be extended to seven based on the testing capacity and progress on efficiency improvement of the products. The corresponding EE of the specific product shall be indicated by an arrow on the labeling logo. The proposed logo is shown in Figure 33 overleaf.

In addition to the labeling types and grades, other additional information such as manufacturer's Name, Model No, Diameter of stove, annual energy cost of the product (may be calculated from number of days/month and hours/baking used on average), Power rating, and the Energy efficiency, CO_2 emission, vendor's responsibility to protect the labels have been included on the logo.

The size of the labeling logo is proposed to be 5Cm (height) x 3 Cm (width) considering the size of the stove.

The labeling types and grades have been developed by thoroughly assessing the international experiences which best matches for the Ethiopian situation. The Ethiopian Energy Authority sets the labeling standards. Producers may be authorized to fix the label logos appropriate for each model of stove upon fulfillment of the efficiency grades set by the Authority, based on the test result obtained from manufacturer's own laboratory or other laboratory selected by the manufacturer. The manufacturer should ensure correctness of the logos before fixing on the product. The Authority in collaboration with designated laboratory can randomly collect samples of labeled products from the market and check, whether the logos were used appropriately. If, not the Authority can penalize those manufacturers who have fixed wrong logos on their products.

<u>Calculations to be displayed on the labeling logo.</u>

1. Power rating(KW) = 220Volts(V) x Current(A)/1000
2. Annual energy consumption(KWh) = (Power rating(KW) x 3.5hrs/day x 365 days)
3. Annual energy cost of this product(Birr) = Annual energy consumption x Annual operating hours = (Power rating(KW) x 3.5hrs/day x 365 days) x (0.50 Birr/KWh)
4. CO2 emission per year(tone CO_2) = Annual energy consumption (MWh) x Grid Emission Factor(about 0.0034 t CO_2/MWh for Ethiopia)

b) Electric stove grade range

Categories labels (grades) show energy use or efficiency according to pre-defined ranking categories. The width or range of the categories can vary in order to show a reasonable degree of differentiation in the products. The categories should be defined such that there is a fairly even distribution of models falling into the middle and poorer grades (to offer a basis for differentiation) and relatively fewer models falling into the better grades (to challenge manufacturers to build better models). The efficiency grades 1, 2, 3, 4 and 5 can be rated according to the energy efficiency or savings difference between Base energy consumption (BEC) and Comparative Energy Consumption (CEC).

In the case of electric stove, the base energy consumption is assumed to be the maximum power rating of the 22 cm diameter single stove found during the assessment, which is 1.6 Kw multiplied by hours of operation in a year. The average efficiency the local stoves is estimated to be about 60% based on the test made by the then Ministry of Mines and Energy and the Ethiopian Energy Authority(EEA) as indicated under section 1.1.3 above. The 60 % efficiency of the 1.6 KW stove corresponded to the number 5 of the labeling grade. It is estimated that the energy efficiency of the locally manufactured electric stove could be improved to about 79%. Hence, the following example labeling grades along with the corresponding efficiency levels have been proposed. The 79% efficiency level was assigned grade 1.

Stoves are produced with different sizes. In order to assign a labeling grade to the efficiency levels for different sizes of electric stoves, the Energy Efficiency Index (EER) is defined as the efficiency of stoves divided by the respective diameter of the stove. i.e Efficiency Index (R)= efficiency of the stove/ diameter of the stove(M). Details are presented in Table 24 and 25 below.

A	B	C	D	E	F	G	H
Stove type	**Base Energy consumption (KWh) , (Assuming E =1.6 Kw X 3.5hr/day X 30days/month X 12 months)**	**Comparative Power rating (KW)**	**Comparative energy consumption (KWh) energy = C X 2hr/day X 10 times/month X 12 months)**	**% Comparative to Base Energy consumption =(D/B) x %**	**Efficiency assumed to correspond to (E)**	**Stove Diameter (CM)**	**Energy Efficiency Index (R) =(F/G)*100**
A	2,016	1.6	2,016	100.00%	60.00%	22	**2.73**
B	2,016	1.5	1,890	93.75%	64.00%	22	**2.91**
C	2,016	1.4	1,764	87.50%	68.00%	22	**3.09**
D	2,016	1.3	1,638	81.25%	72.00%	22	**3.29**
E	2,016	1.2	1,512	75.00%	76.00%	22	**3.45**
F	2,016	1.1	1,386	68.75%	79.00%	22	**3.59**

MEPS

Table 24. Stove EE labeling - example on Energy efficiency Grade design for 22 Cm diameter stove

Energy Efficiency Index (R)	**Grade**
2.73 < R <= 2.91	5
2.91 < R <= 3.09	4
3.09 < R <= 3.29	3
3.29 < R <= 3.45	2
3.45 < R <= 3.59	1

Table 25. Example on Energy Efficiency Index(R) and Grade for 22 cm stove

The above mentioned range of grades or power saving per grade is not actual data obtained it is presented as an example. The level of efficiency improvements which may be technically achieved for the local electric stove has to be considered in setting of efficiency and grades. Efficiency data for electric stoves can be obtained after the tests under comparative labeling program have been carried out as proposed in this document.

3.2.4.3.4 EE labeling level assignment and application of MEPS

After the label has been developed in consultation with the stake holders it shall be assigned to producers based on the efficiency of their product. The level of energy efficiency of the locally manufactured electric stoves is expected to be different among producers. The test results may also indicate efficiency levels which are closer or having big differences. Thus, there may be a need to assign levels in ranges of energy efficiency. The starting and ending levels and range of efficiency to be assigned to a level shall be determined after samples of products have been tested and efficiencies and MEPS determined nationwide.

Figure 33. Electric Stove EE label - Separate file

3.2.4.4 Monitoring the comparative labeling program

Monitoring the implementation of comparative labeling program is one way of assuring the success of the program. In this process, collecting full information of locally manufactured electric stoves producers, models of locally manufactured electric stoves produced by each manufacturer, number of producers and models fulfilling labeling criteria is very important. There must be clear guideline on the utilization of labeling logo. The Authority shall also assure, whether the labeling logo is properly used. Options to penalize those producers who use the logo illegally shall be in place.

As seen from the data collected during the study, locally manufactured electric stoves producers are spread all over the country, with main production center being Addis Ababa. As obviously seen most electric Injera Mitad manufacturers are also manufacturers of electric stoves. The monitoring activity shall include regional Energy/Trade Bureaus involved in licensing of the producers.

To assess whether energy labels are effective, a policy maker can ask three basic questions:

- Are consumers aware of the label?
- Do they understand it?
- Do they change their behavior because of it?

Placement of an energy label on a product is only the first step in attempting to influence consumers' purchase decisions. Research has shown that education and promotion are valuable aids in making the label effective. Promotional marketing is most effective when consumers are subject to numerous, consistent messages regarding EE, not just as part of the energy-labeling program but also in other related energy programs that may be running in parallel. These repeated messages reinforce a culture of EE among consumers and industry and help to create an energy-efficiency ethics within the country.

3.3 Product National Standard for locally manufactured electric stoves

3.3.1 Development of Product National Standard

Locally manufactured electric stoves technologies vary in their performance and quality from producer to producer. The basic reasons for their differences are due to design, materials type, quality, workmanship or method of production. All the above mentioned parameters have their own effects on the EE of the final product. The research and production community is trying to continually improve the performance and quality of the product. However, the expected breakthrough in the efficiency improvement of this product is not yet achieved. Therefore, government institutions like the Ethiopian Energy Authority and Ethiopian Standards Agency will make joint efforts to develop national standards for this product. The benefits of standardizing of locally manufactured electric stoves are :

- For producers to affirm their product quality and drive innovation;
- For investors, donors, and policymakers to have a credible basis for comparing product performance and quality;
- And for all stakeholders to have a common terminology for communicating, understanding, and improving product performance and adoption

Therefore, to make the energy sector beneficiary from standardizing and labeling of locally manufactured electric stoves, two years program for development and implementation of product National Standard and EE Comparative labeling program has been proposed.

For the development of the National Standard, the Ethiopian Standard Agency is an authorized government organ working on standardization of indigenous products and adoption of international standards for imported products based on international standard development procedures through established Technical Committees. Therefore, the development of locally manufactured electric stove's standard also may fall in this structure and one of already existing technical committees. This technical committee is also working based on a formal consensus-based standards development approach which may take months/years. This approach is definitely very slow and may not be a preferable way for saving huge energy losses caused by inefficient locally manufactured electric stoves widely spread in the country and causing associated climate change problems. Therefore, the two government bodies, the Ethiopian Energy Authority and the Ethiopian Standards Agency can set mechanisms for fast track standard development by setting taskforces specialized in research, development and manufacturing of the product and allocating appropriate budget for the project. The two organizations can setup a joint project committee for the successful completion of the standardization project based on the work plan of the project.

3.3.2 Activities for the development of the Product National Standard

An action plan with budget allocated for standard development along with responsible authorities has been proposed under section 3 and 4 of this document.

3.3.3 Monitoring the implementation of Product National Standard program

The Ethiopian Energy Authority is the body responsible for the promotion, dissemination, and full implementation and follow-up of the developed national standard of locally manufactured electric stoves. It must promote the developed standard to major stake holders specially producers, so that they can take care of further production of substandard products as already done in the electric Injera Mitad project.

The Authority shall not work only on the promotion and dissemination of the Product National Standard, but also on the trainings and supports producers need for the proper implementation of the standards. Sufficient budget and activities are expected from the Authority for the trainings.

In addition to the above mentioned training, the producers may need materials support from the government. The Authority may also be involved in the facilitation of financial supports such as funds or Bank loans, so that the producers can get especially production machineries, testing and measuring instruments they need. Producers may also be organized in group (Small and Medium Enterprises) to simplify access to finance and also they may be provided better plots of land for production and storage of raw materials and finished products. One such arrangement could be to work with the Ethiopian Electrical Appliance & Equipment Manufacturers and Service Providers Association which has been formed during the EE Standards and labeling of Injera Mitad.

The fulfillments of the above mentioned supports by the Government/Authority will speed up the implementation of developed national standard. In this project, experiences obtained from electric Injera Mitad project contributes much for faster and better understanding of the program. An implementation of this program can create opportunity and advantage for Ethiopian locally manufactured electric stoves to become competitive and enter an international market faster than expected.

i. Aligning with Regional Labels

Policy makers should consider regional labeling if the marketplace is more regional than national, in order to take advantage of the collective market power of a larger quantity of appliances. Even slightly different labeling requirements among countries can be disruptive to trade, limit choices, and add to consumer costs. However, if cultural differences within a region would make a single label design ineffective, then customized label designs may be preferable.

3.4 Post standard labeling program

The name “Post standard labeling program” has been used to identify the labeling program in which comparative and endorsement labeling programs will run side by side. As mentioned in Section 3.2.4 above, the comparative labeling of locally manufactured electric stoves sets MEPS for the development of the national standard.

3.4.1 Development of Post standard labeling program

The post standard labeling program, which can include also other prioritized household and industrial equipment labeling, can be developed based on the experiences obtained from the comparative labeling of Injera Mitad. Because, product standards of other prioritized equipment can be adopted from international standards and there may be no need of implementing comparative labeling program.

3.4.2 Implementation of Post standard labeling program

The post standard labeling program for locally manufactured electric stoves can be implemented along with other priority equipment based on the experience gained from the Implementation of comparative labeling. For equipment selected for the labeling program, prioritization of equipment to be labeled, collection of sufficient information on the importers/manufacturers of that equipment, availability of testing facility, personnel and sufficient finance must be ensured. In addition to that intensive promotion and awareness creation program must be done to sufficiently popularize the program. In case of imported products labeling, Mutual Recognition Agreements (MRA) between designated testing laboratory in Ethiopia and laboratory of the products origin countries may be necessary to avoid double test which can incur additional costs on the products. In this case international scenario can be applicable.

3.4.3 Monitoring Post standard labeling program

Monitoring of post standard labeling program is similar to that of the comparative labeling program of Injera Mitad, but shall involve measurement, verification, and evaluation. In this process proper utilization of labeling logo must be validated by the regulator and if not appropriate legal measures shall be taken to protect abuse practices.

3.4.3.1 Measurement and Verification

The integrity of energy-performance information for locally manufactured electric stoves covered by standards is a primary requirement for a successful standards-setting and labeling program. All standards-setting and labeling programs rely on measuring and accurately declaring the energy consumption and energy efficiency of locally manufactured electric stoves. Without a means of measuring locally manufactured electric stove's energy performance, it is impossible to launch a meaningful standards-setting and labeling program. It is also essential that locally manufactured electric stove's energy performance be measured in a consistent way and that the values reported within the program are accurate. Following are major steps to be accomplished during the measurement and verification process.

1. Assess options and competencies for testing Products
2. Assess accreditation options for verifying the competence of testing facilities and legitimizing test results
3. Assess certification program options for validating that products comply with standards and label requirement
4. Establish a verification regime for declaring and verifying that producers are complying with standards and label requirement
5. Establish a compliance regime for ensuring that manufacturers are complying with standards and labeling requirements

3.4.3.2 Evaluation

Program evaluations quantify impacts and benefits in concrete terms, which can be the main evidence of the need to support the programs. Measuring impacts can justify allocation of resources to the program and demonstrate the need for funding that is sufficient to make the program effective. Steps to be followed are:

1. Plan the evaluation and set objectives
2. Identify resource and data needs and collect data
3. Analyze data
4. Apply evaluation results

4 Project Work plan and costs

4.1 Project Work plan

Outputs	Year	First year												Second year											
	Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Outputs 1	**Activities**																								
Awareness created on Energy efficiency standards and labeling of locally manufactured electric stove through advertising and promotions and stake holders engagement																									
	Activity 1.1																								
	Prepare printed materials and distribute																								
	Activity 1.2																								
	Promote on TV and Radio																								
	Activity 1.3																								
	Engage Stake holders																								

Outputs	Year	First year												Second year											
	Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Output 2																									
Conducted laboratory testing																									
	Activity 2. 1																								
	Agree with selected testing laboratory																								
	Activity 2.2																								
	Collect test samples as per sampling procedure																								
	Activity 2.3																								
	Conduct laboratory testing																								
	Activity 2.4																								
	Prepare and submit test report																								

Outputs	Year	First year												Second year											
	Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Output 3																									
Developed locally manufactured electric stove Product Standard																									
	Activity 3.1																								
	Standard development request to ESA																								
	Activity 3.2																								
	Support and follow-up of product standard development																								
	Activity 3.3																								
	Finalized product standard and determined MEPS																								
	Activity 3.4																								
	Introducing the standard to Manufacturers and stakeholders																								

Outputs	**Year**	**First year**												**Second year**											
	Months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Output 4																									
Developed Labelling logo, grades, levels designed, stake holders comment incorporated																									
	Activity 4. 1																								
	Design Labeling logo																								
	Activity 4.2																								
	Design final label logo incorporate stakeholders comment																								
Output 5																									
Developed Energy efficiency Standard																									
	Activity 5. 1																								
	Develop EE Performance standard																								

Outputs	Year	First year												Second year											
	Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	Activity 5.2																								
	Introducing the EE Performance standard to Manufacturers and stakeholders																								
	Activity 5.3																								
	Train manufacturers on the developed product and EE performance standards																								
	Activity 5.4																								
	Manufacturers support and follow-up																								
Output 6																									
Monitored & Evaluated project implementation program																									

Outputs	Year	First year												Second year											
	Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	Activity 6.1																								
	Prepare Monitoring & Evaluation plan																								
	Activity 6.2																								
	Measure, Verify and Evaluate the program																								
	Activity 6.3																								
	Preparation of M, V& E Report																								

Table 26. Project Work plan

4.2 Project Cost

Outputs	Activity	First year	Second year
Outputs 1			
Awareness created on Energy efficiency standards and labeling of locally manufactured electric through advertising and promotions and stake holders engagement			
	Activity 1.1		
	Prepare printed materials and distribute	500,000.00	
	Activity 1.2		
	Promote on Tv and Radio	750,000.00	
	Activity 1.3		
	Engage Stake holders	1,200,000.00	250,000.00
Output 2			
Conducted laboratory testing			
	Activity 2. 1		
	Agree with selected testing laboratory	20,000.00	
	Activity 2.2		
	Collect test samples as per sampling procedure	800,000.00	
	Activity 2.3		
	Conduct laboratory testing	175,000.00	
	Activity 2.4		
	Prepare and submit test report	55,000.00	

Outputs	Activity	First year	Second year
Output 3			
Developed locally manufactured electric stove Product Standard			
	Activity 3.1		
	Standard development request to ESA	5,000.00	
	Activity 3.2		
	Support and follow-up of product standard development at ESA	12,000.00	
	Activity 3.3		
	Finalized product standard and determined MEPS	5,000.00	
	Activity 3.4		
	Introducing the standard to Manufacturers and stakeholders (covers all regional states)		1,250,000.00
Output 4			
Developed Labelling logo, grades, levels designed, stake holders comment incorporated			
	Activity 4. 1		
	Design Labeling logo		30,000.00

Outputs	Activity	First year	Second year
	Activity 4.2		
	Design final label logo incorporate stakeholders comment		200,000.00
Output 5			
Developed Energy efficiency Standard			
	Activity 5. 1		
	Develop EE Performance standard		50,000.00
	Activity 5.2		
	Introducing the EE Performance standard to Manufacturers and stakeholders (covers all regional states)		500,000.00
	Activity 5.3		
	Train manufacturers on the developed product and EE performance standards		750,000.00
	Activity 5.4		
	Manufacturers support and follow-up		600,000.00
Output 6			
Monitored & Evaluated project implementation program			
	Activity 6.1		
	Prepare Monitoring & Evaluation plan		5,000.00

Outputs	Activity	First year	Second year
	Activity 6.2		
	Measure, Verify and Evaluate the program		250,000.00
	Activity 6.3		
	Preparation of M, V& E Report		10,000.00
Year Total		3,522,000.00	3,645,000.00
Contingency 15%		528,300.00	546,750.00
Grand Total		4,050,300.00	4,191,750.00
Total Project Cost		**8,242,050.00**	

Table 27. Project cost

5 Project management, organizational and Institutional context

EEA is the implementing agency for the EE standards and labeling program of the locally manufactured electric stoves. The organizational and institutional setting of EEA is assessed as follows.

5.1 Institutional setting and legal frame work

a. The EEA is mandated by the Proclamation on Energy, proclamation No. 810/2013, on EE regulation and conservation works in Ethiopia. Article 19, 2, of the proclamation states that Energy efficiency and conservation activity may be regulated through the application of anyone or more of the following, as may be appropriate: a) minimum energy efficiency standard; b) energy efficiency labeling codes. Article 20 also states that under National Energy Efficiency and Conservation Strategies and Programs: the Authority shall develop and implement national energy efficiency and conservation strategies and programs. The draft energy regulation operation directive derived from the proclamation is on the process of ratification.
b. The implementation of the locally manufactured electric stove EE standards and labeling program are within the mandate of EEA. However, the implementation of the program necessarily needs the ratification of the energy regulation operation directive. Even though it is proposed that the EE standard and labeling program commences with voluntary participation of the producers, it eventually proceeds to mandatory participation and compliance requirement to the standards to be developed. The energy regulation directive is required to enforce the implementation of the program and is assumed to be ratified soon.

5.2 Organizational capacity assessment

5.2.1 Organizational structure of EEA

EEA is established under Ministry of Water, irrigation and Energy and headed by a Director General and its deputy. According to the Human Resource Directorate of EEA, a new organizational structure and salary scale has been approved and ready for implementation. There will be fourteen directorates, one office and one unit under the new structure of the EEA. Figure 14, overleaf, shows the new organizational structure of EEA

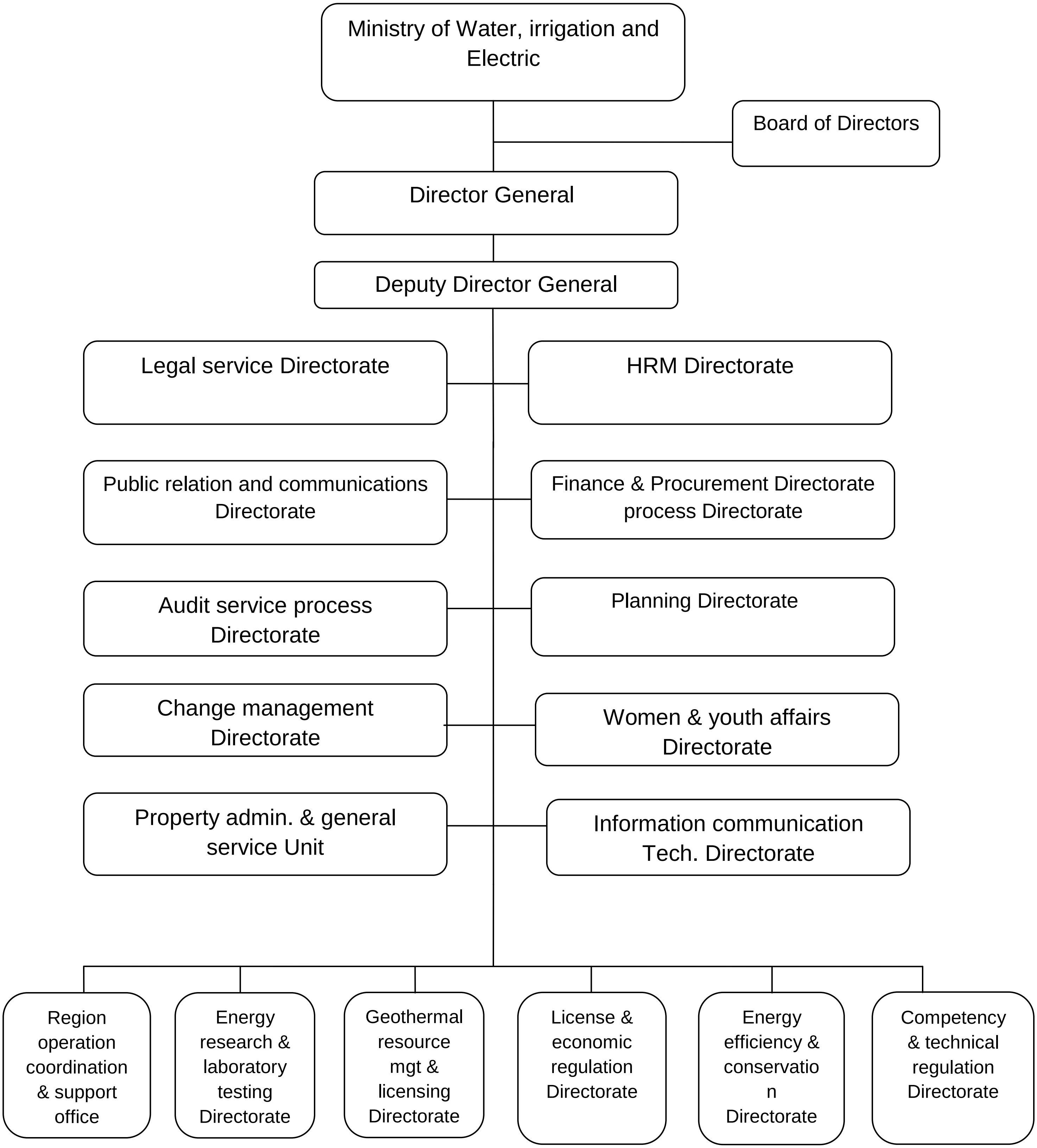


Figure 34. The new Hierarchical structure of Ethiopian Energy Authority

5.2.2 Proposed organization for the implementation of the EE standards and labeling program of locally manufactured electric stove.

As indicated in earlier sections of this project proposal, the EE program involves the development of efficiency standards and labeling and engages different types of stake holders including producers, consumers, importers, government institutions, and regional state bureaus. Lots of activities are expected to be carried out with the stakeholders to achieve the desired goals of the program.

Under the new structure the EE and Conservation Directorate, being one of the core directorates, will be tasked with the responsibilities of regulating EE and conservation activities in the country. There are going to be two teams under the directorate: Energy audit and Standards, labeling and promotion teams. The new structure envisages forty two staffs to be assigned to the directorate. The EE and Conservation Directorate is the appropriate department to execute the EE efficiency program on the locally manufactured electric stoves effectively once the proposed staff experts under the new structure are in position.

As indicated under section 3, It is proposed that the development of standards and the development of and implementation of comparative labeling of EE program on stove takes about two years. Thereafter, the post standard labeling program shall take place.

5.2.3 Capacity building activities.

The EE program on electric stove is proposed to be accomplished by hosting the program within the new EEA structure.

Training on EE standards and labeling shall be given to the staffs of the EE and Conservation Directorate in order to enhance their capacity for the post standard labeling program and future projects. Energy bureaus of Addis Ababa and Diredawa cities and regional states are expected to implement and coordinate the program and hence need basic training on EE standards and labeling works.

6 Project benefits and justifications

Improvement in the EE of an electricity consuming product like the locally manufactured stove reduces the amount of power demand energy that the product uses. If the product consumes electricity and operates at times of peak power demand, the improvement on efficiency reduces demand for new power plants. The investment that would be required for new power plants is vastly more expensive than the increased cost of designing and manufacturing energy-efficient components for the energy-consuming products that these power plants service. Studies and analysis showed that improvements in EE avert projected energy demand and capital investments in power plants, transmission lines. At the time, these efficiency improvements could have cost little. In other words, efficiency labels and standards are a highly cost-effective way to reduce future investments in expensive power plant construction, freeing capital for more economically advantageous investments in the energy sector, or basic health and educational services.

6.1 The benefits of the EE standards and labeling

The benefits of the EE standards and labeling of locally manufactured electric stove include:

- Power demand reduction and reduction of capital investment in energy supply infrastructure.
- Reduction on power supply infrastructure overloading, frequent power interruption, outages and voltage drops
- National economic efficiency by reducing energy bills.
- Reduction of deforestation in search of fire wood and bio mass fuel.
- Mitigation of the burden on the rural women engaged in the production of clay plates
- Strengthening of market competition among producers
- Encouragement of research and innovation
- Assist the country in meeting climate change goals and averting regional pollution

6.2 Power demand reduction

6.2.1 Power demand reduction at national level

Tests made earlier on existing electric stove of the 22 cm diameter (the most common stove size) shows that EE of stoves could be improved by at least 19%. Table 28 overleaf indicates the peak power demand including loss, demand saving and forecast for the next 10 years if EE standards and labeling is implemented. For the year 2009 EFY it is estimated that 19 % of 268 MW = 51 MW of power saving could be obtained.

If the consumers' energy conservation behavior in using the local stoves is improved there could be a huge power demand and energy saving too. This could be achieved through the activities carried out in the standards and labeling program.

6.2.2 Power demand reduction at consumer level

For the commonly used 22 cm diameter single stove, there could be up to 0.27 KW (1.4 Kw x 19%) reduction of installed power per consumer.

6.3 Energy savings obtained

6.3.1 Energy savings at consumer level

For the commonly used single cook top 22 cm diameter stove, there could be up to 0.27 KW x 1 stove x 3.5hrs/day x 365 days = 345 KWh energy saving per year per consumer. Whereas for the double cook top type the saving will be 690 KWh.

6.3.2 Energy savings at national level

For the 22 cm diameter single and double cook top stoves, there could be up to 1,189 Gwh energy demand including losses in the year 2009 EFY. Energy saving of 19 % including that of losses in the 2009 EFY is estimated to be 226 GWh at national level. Based on the above, the energy saving for the next 10 years was forecast as shown in Table 29 overleaf.

The power demand and energy saving indicated in Tables 28 to 29 below could be used for electrification, manufacturing and export. There will be significant CO_2 savings in the case of which the energy saved is sold to neighboring countries where electricity generation is oil based.

Ref.	Description	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/2026	2026/2027
A	No. of Single stove	298,000	321,840	347,587	375,394	405,426	437,860	472,889	510,720	551,578	595,704	643,360
B	No.of Double stove	127,000	137,160	148,133	159,984	172,783	186,606	201,534	217,657	235,070	253,876	274,186
C	Installed power demand(MW)	773	835	902	974	1,052	1,136	1,227	1,325	1,431	1,545	1,669
D	Peak Power demand(MW)	193	208	225	243	262	283	306	330	356	384	415
E	% Power losses	27.90%	24.60%	22.80%	22.80%	22.70%	22.60%	22.60%	22.50%	22.40%	22.40%	22.30%
F	Peak power demand plus loss (MW)(D/(1-E))	268	276	291	315	339	366	395	426	459	495	534
G	Power loss (MW) (F-D)	75	68	66	72	77	83	89	96	103	111	119
H	Power demand saving(MW) (F x 19%)	51	52	55	60	64	70	75	81	87	94	101

Table 28. Power demand saving scenario for 22 cm diameter electric stove for the next 10 years, 2009 to 2019EFY

Ref.	Description	2009 EFY 2016/17	2010 EFY 2017/18	2011 EFY 2018/19	2012 EFY 2019/20	2013 EFY 2020/21	2014 EFY 2021/22	2015 EFY 2022/23	2016 EFY 2023/24	2017 EFY 2024/25	2018 EFY 2025/2026	2019 EFY 2026/2027
A	No. of Single stove	298,000	321,840	347,587	375,394	405,426	437,860	472,889	510,720	551,578	595,704	643,360
B	No. of Double stove	127,000	137,160	148,133	159,984	172,783	186,606	201,534	217,657	235,070	253,876	274,186
C	Consumption (GWh)	987	1,060	1,138	1,222	1,312	1,409	1,513	1,625	1,745	1,874	2,013
D	Energy losses%	17.00%	14.90%	13.80%	13.70%	13.60%	13.50%	13.40%	13.30%	13.20%	13.20%	13.10%
E	Total Energy losses and consumption (GWh) (C/(1-D))	1,189	1,246	1,320	1,416	1,519	1,629	1,747	1,874	2,010	2,159	2,316
F	Energy loss(GWh) (E-C)	202	186	182	194	207	220	234	249	265	285	303
G	Energy saving (GWh) (E x 19%)	226	237	251	269	289	310	332	356	382	410	440

Table 29. Energy saving scenario for 22 cm diameter electric stove for the next 10 years, 2009 to 2019 EFY

6.4 Reduction of deforestation in search of fire wood and bio mass fuel.

In the rural part of Ethiopia domestic households have no option and use fire wood for cooking. Some urban domestic households still prefer using fire wood and charcoal due to the belief that cost of using electric stove will be much higher. Based on the survey made, even premises like public universities still use fire wood stoves due to the frequent interruption of electricity and the down time of the cooking process. As indicated earlier the Energy Balance and statistics report of Ministry of Water, irrigation & electricity for the year 20008/2009EC(2014/2015 GC) shows Household energy use in 2015 GC was almost entirely from biomass, which constituted 98.30 %

EE standard and labeling is believed to reduce the electric bill of consumers and interruptions during peak power demand as mentioned under the sections 6.2 and 6.3 above. If consumers believe that the cost of using electric stove is lesser, significant number of them would migrate from the use fire wood stove to electric stove.

6.5 Mitigation of land degradation due to the production of clay plates

The power demand of electric stove is partly affected by the quality and weight of the clay plate. That is, as the weight decreases, power requirement decreases. The existing electric stove clay plate's weight of 1.5 to 2.0kgs could be reduced to 1 Kgs. Large quantity of clay plates, which partly are used for electric stoves, arrive at Chid Tera, Addis Ababa, every Wednesdays and Saturdays. Thus, the sand and clay dug from the rural areas could be reduced significantly as a result of the EE standards and labeling.

6.6 Mitigation of the burden on the rural women

Stove clay plates are produced solely by women. In the rural areas it is considered traditionally that making clay plates is the work of the women. This misconception has put the hardship of the production of all the clay plates on the shoulder of the women. The preparation of clay plates involves mixing of clay and sand in under surface pit by hand, kneading of the mix by bare foot, baking the clay plate, drying, leveling, smoothening, and firing. Introduction of EE would definitely bring changes on the hardship the women clay producers are facing by the use of electrical driven devices like mixers, leveling devices, and firing kilns.

6.7 Strengthening of competition among producers

Energy-efficiency standards and labeling on electric stove lead to the production of improved products and make local businesses more profitable in the long run and more competitive in the local market place.

6.8 Encouragement of research and innovation

EE standards and labeling will attract researchers and innovators of electric stove as introducing new and more efficient product will have market and will be rewarding under the program.

6.9 Assist in reducing environmental pollution and averting regional pollution

There are pollutions arising from Bio mass fuel cooking and the production of clay plate. Avoidance of emissions could be achieved in the regionally due to the savings from the standardizing and labeling of the local stoves.

6.9.1 Mitigation of environmental pollution due to Bio mass fuel cooking and clay plate firing.

According to the Energy Balance and statistics report of Ministry of Water, irrigation & electricity, for the year 20008/2009EC(2014/2015 GC), traditional fuels /Biomass energy sources (primary and derived)/ are the predominant, representing 90 percent of total energy sources in 2015 GC. Household energy use was almost entirely from biomass (98.30 %). Migration from using biomass to the use of electric stoves would bring about significant carbon emission reduction in the country.

Clay plate for electric stove is fired (burned) in an open air using cow dung as a fire source. Clay plate firing with cow dung releases carbon di oxide and creates a difficult work environment due to the prevailing wind.

Clay plate firing could be accomplished by using modern kilns produced for this purpose. It is possible to design and build kilns in Ethiopia. One of the benefits that EE standards and labeling program induces will be research and innovations on the production of such equipment which mitigates environmental pollution due to clay plate firing.

There are no data and studies found to quantify the amount of carbon emission reductions obtained from possible migration from using biomass to electric stoves for cooking and from that of clay plate firing.

6.9.2 Averting regional pollution due to electricity generation

Ethiopian electricity generation is mainly based on the hydro – electricity and CO_2 releases are limited to the relatively smaller Diesel power plants. However, Ethiopia is exporting electricity to neighboring countries and the energy savings in Ethiopia increase the potential to export where it replaces mainly oil based power generation like in Sudan, Djibouti and Kenya. The CO_2 savings in these countries is considered as Ethiopia's contribution to the reduction of regional pollution. The saving of electrical energy due to EE standards and labeling of electric stove at national level could be exported. In such cases, the CO_2 savings for the regional countries will be a sizable amount. Table 30 shows the estimated annual and cumulative CO_2 savings assuming that the energy saved is exported to the neighboring countries. The CO2 savings is calculated based on the base line emission data of the Ethio-Kenya power interconnection project which is 5.71x10-4 metric tons CO2 /KWh.

Description	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
	2016/17	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	**2023/24**	**2024/25**	**2025/2026**	**2026/2027**
Energy saving (GWh)	226	237	251	269	289	310	332	356	382	410	440
Annual CO_2 savings(tons)	129,046	135,327	143,321	153,599	165,019	177,010	189,572	203,276	218,122	234,110	251,240
Cumulative CO_2 savings(tons)	129,046	264,373	407,694	561,293	726,312	903,322	1,092,894	1,296,170	1,514,292	1,748,402	1,999,642

Table 30. Estimated annual and cumulative CO_2 savings of the 22cm electric stove assuming that the energy saved is exported to the neighboring countries.

6.10 Monetized benefits of the EE standard and labeling program

Benefits from EE standards and labeling could be quantified and monetized to determine the cost effectiveness of the program.

6.10.1 Framework for Cost - Effectiveness Evaluation

The typical approach for quantifying the benefits of energy efficiency is to forecast long-term “avoided costs,” defined as costs that would have been spent if the energy efficiency savings measure had not been put in place.

6.10.2 Choosing which benefits to include

There are two main categories of avoided costs:

a. Energy-related and,
b. Capacity-related avoided costs.

Energy-related avoided costs involve market prices of energy, losses, and other benefits associated with energy production such as reduced air emissions (for diesel power plants) and water usage. Capacity-related avoided costs involve infrastructure investments such as power plants, transmission and distribution lines, dams, and tunnels. Environmental benefits make up a third category of benefits that are frequently included in avoided costs. Saving energy reduces air emissions including GHGs, and saving capacity addresses land use and site related issues such as new transmission corridors and power plants.

6.10.3 Net Present Value

A significant driver of overall cost-effectiveness of energy efficiency is the discount rate assumption. Cost-effectiveness test compares the Net present Value (NPV) of the annual costs and benefits over the life of an efficiency measure or program. Typically, energy efficiency measures require an upfront investment, while the energy savings and maintenance costs accrue over several years.

The benefits from the EE standards and labeling are monetized as shown in Table 31 – Scenario 1. The following equivalences and assumptions have been employed.

a. Peak power demand saving – 1100USD/Kw or 24,731.63 Birr/KW for Hydro power station, including costs of power plant erection, transmission and distribution based on Ethiopia's Climate-Resilient Green Economy Green economy strategy (CRGE)-GHG emissions Baseline.

b. Energy saving (If used for export) – 7 USD/KWh or 157.38 Birr /KWh, based on Ethiopian Power system Expansion Master plan Study - Volume 5, Financial Assessment and Tariff Impact
c. The benefit accrued due to EE standards and labeling program is assumed to materialize in the year 2012EFY, after the full implementation of the program.
d. The operating costs after 2 years of the program would continue at 0.5 mill birr per year.
e. Discount rate of - 10%

Table 32 -Scenario 2, shows monetized benefits assuming energy saving is used for domestic consumption at the rate of 0.5 Birr/KWh, other assumptions in Table 31 remaining the same.

No.	Cost/Revenue (Mill Birr)	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/2026	2026/2027
1	**Cost**											
1.1	Fixed assets	-										
1.2	Operating costs	4.05	4.48	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Total cost	**4.05**	**4.48**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
2	**Revenue**											
2.1	Peak Power demand saving				1,483.90	1,582.82	1,731.21	1,854.87	2,003.26	2,151.65	2,324.77	2,497.89
2.2	Energy saving (If used for export)				42,335.22	45,482.82	48,787.80	52,250.16	56,027.28	60,119.16	64,525.80	69,247.20
	Total Revenue	**0**	**0**	**0**	**43,819.12**	**47,065.64**	**50,519.01**	**54,105.03**	**58,030.54**	**62,270.81**	**66,850.57**	**71,745.09**
3	**Net Revenue**	**(4.05)**	**(4.48)**	**(0.50)**	**43,818.62**	**47,065.14**	**50,518.51**	**54,104.53**	**58,030.04**	**62,270.31**	**66,850.07**	**71,744.59**
4	**Discount rate**	10%										
5	**Net present value**	**241,807.53**										

Table 31. Monetized benefits of the EE standard and labeling program – Scenario 1.

No.	Cost/Revenue (Mill Birr)	2009 EFY	2010 EFY	2011 EFY	2012 EFY	2013 EFY	2014 EFY	2015 EFY	2016 EFY	2017 EFY	2018 EFY	2019 EFY
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/2026	2026/2027
1	**Cost**											
1.1	Fixed assets	-										
1.2	Operating costs	4.05	4.48	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Total cost	**4.05**	**4.48**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
2	**Revenue**											
2.1	Peak Power demand saving				1,483.90	1,582.82	1,731.21	1,854.87	2,003.26	2,151.65	2,324.77	2,497.89
2.2	Energy saving (If used for export)				134.50	144.50	155.00	166.00	178.00	191.00	205.00	220.00
	Total Revenue	**0**	**0**	**0**	**1,618.40**	**1,727.32**	**1,886.21**	**2,020.87**	**2,181.26**	**2,342.65**	**2,529.77**	**2,717.89**
3	**Net Revenue**	**(4.05)**	**(4.48)**	**(0.50)**	**1,617.90**	**1,726.82**	**1,885.71**	**2,020.37**	**2,180.76**	**2,342.15**	**2,529.27**	**2,717.39**
4	**Discount rate**	10%										
5	**Net present value**	**9,029.82**										

Table 32. Monetized benefits of the EE standard and labeling program – Scenario 2.

7 Assessment of environmental and social impact.

7.1 Environmental advantages of the project

The EE standards and labeling of electrics stove is an environmental project. As mentioned under Section 2 and Section 6 of this project document the objectives and benefits of the project include:

- Encouraging the migration from the use of bio mass and wood fuel to electricity for cooking thereby reducing deforestation.
- Mitigation of environmental degradation of the land from which the raw materials of clay plates are obtained.
- Mitigation of environmental pollution due to the use of biomass fuel for cooking, open air firing of clay plates using cow dung, and due to clay plates taken out from damaged or worn out stoves.
- Averting regional pollution due to electricity generation

As presented under section 6.3.2 above, the energy savings from the implementation of EE standards and labeling of electric stove at national level would result in the saving of large amount power demand energy. The saving on energy could be used for rural electrification, manufacturing, education, health and export.

Ethiopia currently exports power to neighboring countries. As indicated under 6.9.2 above, the export replaces the demand for electrical energy which could have been generated by oil power plants.

7.2 Social values of the project

- EE standards and labeling on electric stove could enhance the welfare of the consumers. As Implementation of EE strengthens, competition among producers, the price of stove will go down. The product will be produced with additional and enhanced features.

- Introduction of the EE program would bring saving of electrical energy which could be used to supply electricity to more and more rural areas. This leads to the migration from the use of fire wood and biomass stove types to the electric stove. Cooking using electric stove reduces the significant burden of collecting the fire wood and biomass fuels on women and children who have to divert their time from education and income generating activities. This will also provide clean cooking fuel to the community. Women do not have to cook in smoke-filled kitchens.

- There are consumers who believe that the energy consumption of electric stove would be costly than the price of fire wood and bio mass fuel. The EE program will reduce the electricity consumption for a consumer and encourage the fire wood stove users to use electric stove. This will reduce deforestation and the burden on women and creates additional jobs.

- Right from the beginning of the production of electric stove women carry out the difficult work of clay plate preparation and finally cooking is done almost all by women either for households or commercial activities. The project introduces better ways of producing stove clay plates, encourages the transition from fire wood to electric stove relieving women from the hard work and fume related health problems. Women benefit a lot from the outputs of the project.

8 Financial plan

The possible sources of finance for the program are:

a. Equity capital. The government, represented by the primary stake holders: Ethiopian Energy authority, Ethiopian Electric power and Ethiopian electric utility shall outlay capital project budget.
b. Recurrent revenue or grant. From Clean Development Mechanism (CDM) financing where industrialized countries with greenhouse gas reduction are committed to invest in projects that reduce emissions in developing countries as an alternative to more expensive emissions reduction in their own countries or donations obtained from NGOs working actively in the energy sector like GIZ, SNV or other NGOs involved in the carbon trade.
c. Service charges. Collected from producers for labeling services in the post standard – labeling program.

The project is priority for the nation and might be scheduled to start sooner. As searching for donors may take years to get appropriate funding, it is suggested that the government shall allocate sufficient capital budget for the project. In the mean time supports of external donors can be sought for further financing of the program..

The equity capital from the government and possible grant from CDM finance shall cover the initial cash outlay required for the EE and standards program. EEA shall execute the program within the existing structure. The operating costs could be covered by the government and recurrent revenue sources and the service charges collected from producers. Considering the schedule above, it is anticipated that there will be positive cash flow throughout the implementation period.

The financial viability of the EE standards and labeling program for electric stove requires that the cash balance shall meet all financial commitments of the program from creating public awareness up to monitoring and evaluation for two years.

9 Arrangement for project Hand over

As indicated under section 5.2.2, It is proposed that the project is carried out by the EEA. The development of standards and the development and implementation of comparative labeling of EE program takes about two years. It is proposed that the EE and Conservation Directorate manage the project operations during the project period. After having worked on the stove EE program for two years, the EE and Conservation Directorate would be able to manage the operations and monitoring of the post standard labeling program.

10 Assumptions, risks, and risk management.

10.1 Assumptions

Important assumptions to achieve project purpose are:

- Stable economic growth of the country is maintained
- Appropriate amount of budget is allocated for the program
- Appropriate number of staff is allocated to the EE and conservation Directorate of EEA.
- Effective public awareness creation, specifically to women, is made on the importance of standardizing and labeling electric stove. It has been indicated that cooking efficiency improvement by consumers could save up to 30% energy on electric stoves. Based on the survey made, the majority of producers have the impression that EE standards and labeling would benefit their business. However, there are number of producers having negative attitude to the program.

- Training the producers/assemblers of stove on electrical systems, power rating and EE is a pre condition and mandatory requirement for the successfulness of the EE standard and labeling program.

10.2 Risks and risk management

The risks identified their impact and probability and the counter measures to be taken are indicated in the Table 33 below.

No.	Risk description	Impact & probability	Counter measure/Management response
1	Producers not willing to implement the EE program	The implantation of new regulations resulting in additional costs and skill requirements to producers is usually a great concern and a central issue in the discussions between the implementing agency and the producers. However, the proposed project will take into account the financial situation and training requirement of the producers and will be designed to move forward with the development of EE labels and standards	A comprehensive awareness raising plan to allow the full participation of the private sector in the project implementation
2	Consumers not interested in purchasing stoves with a high initial cost	End users do not understand the EE process and avoid purchasing Energy efficient models owing to their higher initial costs. While the project can not eliminate the potential higher initial costs of energy efficient stoves for consumers who prefer to spend less money for less efficient models, label development will be accompanied by substantial efforts in information dissemination, consumer education, retail - directed educational materials, and other activities to both raise awareness of the labels and to educate consumers on the benefits of EE purchasing.	Awareness campaign during project implementation by public and private sector partners.
3	Low technical capacity	Successful implementation of the project requires increase in the technical capacity of EEA staff, and capacity in the private sector. The project will seek to mitigate this risk by providing sufficient capacity building support to EEA staffs in developing the necessary in – house technical skills and by providing specific training.	A series of capacity building activities to help remove technical barriers to the development and implementation of EE

4	Cultural and societal attitudes on the size of stoves	Traditionally many Ethiopians favor bigger sized stoves. Introduction of the EE program could introduce smaller sized electric stoves due to the benefit of efficiency and reduced demand on power. This part of the consumer could revert to the use of bigger sized stoves demanding more power and energy	Awareness raising plan to allow the full participation of the consumer.
5	Increase of electricity tariff	Currently the price of electricity is relatively cheaper and hence consumers prefer electric stoves. In the event of tariff increase and depending on the amount of increase consumers may shift to the use of wood and bio mass fuel stoves for cooking.	Awareness raising campaign to allow the full participation of the consumers. EE standards and labeling would reduce the bills of consumers.

Table 33. Risks, impact and probability and counter measures

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Annex 1: EEU Domestic tariff group Master plan forecast- High and low case Domestic forecast- Maximum demand consumer level(MW)

Description	Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Max demand consumer level(MW)	453	570	661	751	841	929	1,016	1,103	1,195	1,289
% growth		25.83%	15.96%	13.62%	11.98%	10.46%	9.36%	8.56%	8.34%	7.87%
	Average growth =11.20%									

Domestic tariff group Master plan forecast- High case domestic forecast-Maximum demand consumer level (MW)

Description	Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Max demand consumer level(MW)	418	500	569	640	712	783	856	927	1,003	1,076
% growth		19.62%	13.80%	12.48%	11.25%	9.97%	9.32%	8.29%	8.20%	7.28%
	Average growth =10.02%									

Domestic tariff group Master plan forecast- Low case domestic forecast-Maximum demand consumer level (MW)

Annex 2 : EEU customer count data for 2008 EFY

REGION/PERIOD	2008 - 1	2008 - 2	2008 - 3	2008 - 4	2008 - 5	2008 - 6	2008 - 7	2008 - 8	2008 - 9	2008 - 10	2008 - 11	2008 - 12	Grand Total (per year)
ADDIS ABABA EASTERN	85431	111352	82976	93781	93175	94971	94789	100913	95518	93225	98986	92702	**1,137,819**
ADDIS ABABA NORTHERN	70606	97861	62043	80163	82490	76014	71913	84378	73672	73183	74906	75784	**923,013**
ADDIS ABABA Original(for reports)	15	16	15	14	16	16	15	17	14	12	16	16	**182**
ADDIS ABABA SOUTHERN	82911	108220	70540	82316	88417	77668	90031	93337	86869	79694	91593	80726	**1,032,322**
ADDIS ABABA WESTERN	84940	117355	80706	95478	100016	89657	100232	96865	98021	91843	99641	96290	**1,151,044**
ASOSA REGION	3293	2591	3641	3549	4143	3367	4208	4474	4373	3576	3659	2835	**43,709**
EASTERN (DIRE DAWA)	33705	31461	33996	34900	34978	34038	33412	34029	35210	31904	34033	36410	**408,076**
GAMBELA REGION	753	413	956	876	1026	867	1117	1092	920	767	1061	873	**10,721**
JIJIGA REGION	4840	4734	4333	4682	4608	4404	4609	4518	5078	4884	5395	5612	**57,697**
NORTH-EASTERN (DESSIE)	37244	32926	38796	38402	37941	38142	37716	42634	41500	40016	42398	43107	**470,822**
NORTHERN (MEKELE)	56255	53954	64253	61560	62269	62747	64992	66035	67865	65775	66784	68410	**760,899**
NORTH-WESTERN (BAHAR DAR)	42127	39511	44575	47204	47157	48335	49661	50802	50772	49204	51070	48278	**568,696**
SEMERA REGION	4533	3901	4099	4458	3973	3990	4037	3866	4455	3970	4822	4800	**50,904**
SOUTH EASTERN	45095	45684	50280	47854	48206	47100	50558	49041	50955	50250	52027	50393	**587,443**
SOUTHERN (AWASA)	47160	40146	45926	48051	46652	48307	48213	47417	49206	47143	50870	48893	**567,984**
WESTERN (JIMMA)	23301	22724	24921	25492	23967	25263	26931	25152	25210	22211	27963	23705	**296,840**
Grand Total (per cycle)	**622,209**	**712,849**	**612,056**	**668,780**	**679,034**	**654,886**	**682,434**	**704,570**	**689,638**	**657,657**	**705,224**	**678,834**	**8,068,171**
Average						**672,348**							

Annex 3: Questionnaire on manufacturers of locally produced electric stove

1. Name of the producer: ______________________________

2. Trade name : ____

3. Address: Region _____________________,Subcity_____________________,Woreda ________, H.NO_________ , Tele.________________

4. Does the producer posses Tin No? a) Yes ☐ b) ☐ No
   If yes , TIN no_____________________________

5. Which part of electric stove is produced by the producer.
   a. Stove set (Body of Electric stove plus Clay plate)
   b. Body of Electric stove only
   c. Clay plate only
   d. None, only assembling

6. If the producer doesn't produce the body(enclosure and stand) of the electric stove, from where does he/she gets it?
   a. Same city he/she is working or nearby towns
   b. Addis Ababa
7. What is the body of the electric stove made of:
   a. Sheet metal
   b. Galvanized sheet
   c. Aluminum sheet
   d. Other materials

8. If the producer doesn't produce the clay plate of the Electric stove from where does he/she gets it?
   a. Same city he/she is working or nearby towns
   b. Addis Ababa

9. Which diameter of electric stove does the producer/assembler produce most often?
   a. 16-18 Cm
   b. 22 -24Cm
   c. 40 Cm
   d. 50Cm
   e. Other diameters=_________Cm.
10. Which number of stove units is produced /assembled per stove set often?

a. One
b. Two
c. Three

11. What is the diameter and value of the resistor used for the electric stove most of the time?
    a. 16-18 Cm = _______mm ______Ohms
    b. 22 -24Cm = _______mm ______Ohms
    c. 40 Cm =_______mm ______Ohms
    d. 50Cm =_______mm ______Ohms
    e. Other diameters=_______mm ______Ohms

12. Does the producer/assembler measure the resistance of the resistors used ?

    a) Yes ☐ b) No ☐

13. Does the producer/assembler know the power rating of the electric stove he /she produces?

    ☐ a) Yes ☐ b) No

14. Does the producer know the energy efficiency of his/her electric stove?

    a) Yes ☐ b) No ☐

15. How many electric stoves does the producer/assembler produce in a year?
    a. Less than 100
    b. 100 to 1000
    c. > 1000
    d. Not known
16. Annual growth rate of the production and sales. __________per/yr
    a. Less than 100
    b. 100 to 200
    c. Above 200
    d. Not known
17. Does the producer/assembler believe that energy efficiency standards and labeling of electric stoves is useful to his/her business?
    a. Yes
    b. No
    c. Indifferent
18. What other related items are produced by the producer/assembler?
    a. Injera Mitad
    b. Bread baking oven
    c. None
19. What is the opinion of the producer/assembler regarding the improvement on the locally produced electric stoves in comparison to imported types?

Annex 4: List of local electric stove producers/assemblers

No	Name	Fathe Name	Region	K.Ketema	Woreda	H.No	Tel.No	Tin.No
1	Hayiredin	Husen	A.A	Bole	7		913191931	
2	Mifta	Keder	A.A	Bole	7	274	912670342	3305133
3	Temesgen	Getachew	A.A	Bole	9	549	911466803	509429
4	Shemsu	Akmel	A.A	Yeka	9	345	911447260	1098789
5	Germa	Selemon	A.A	Yeka	9	511	911984460	
6	Eskender	X	A.A	Yeka	X	X	911752766	
7	Meles	Asefa	A.A	Yeka	9	188	939594026	51137355
8	Yesuf	x	A.A	Bole	7		979940102	
9	Germa	Tadele	A.A	Bole	7	228	925383940	
10	Yeshitela	Adamu	A.A	Bole	7	1018	911652121	
11	Kemam	Muri	A.A	A/K	1	324	911428920	10003101152
12	Aweti	G/meskel	A.A	A/K	9	35	910697736	
13	Muhamed	Ahmed	A.A	A/K	1	448	9117325924	
14	Amarech	Sahlem	A.A	A/K	13	631	9113192281	
15	Dawit	Sisayi	A.A	A/K	4		911195147	
16	Kalid	Eliyas	A.A	A/K	1	7658	911450277	
17	Kibrom	X	A.A	A/K	13	1142	913193257	
18	Shimeles	T/berehan	A.A	A/K	9		911637122	
19	Tesfayo	X	A.A	A/K	14	Adis	924341583	
20	Faris	Redu	A.A	A/K	11		921381505	
21	Temesgen	Kbede	A.A	A/K	14	Adis	912744653	
22	Yordanos	Aga	A.A	K/KERA	9	589	910053547	
23	Tesfayo	Gezahegn	A.A					
24	Senayit	X	A.A	Kirkos	10		932249960	
25	Behayilu	Kasa	A.A	Kirkos	4	65	911647454	
26	Amare	Ayalew	A.A	A/K	3	258	911606974	1618391
27	Abdurazak	Chemsu	A.A	Arada	11			
28	Temesgen	Kebede	A.A	K/KERA	14	Adis	912744653	
29	Tesfayo	X	A.A	K/KERA	14	Adis	924341583	
30	Shimmeles	T/berehan	A.A	K/KERA	9		911637122	
31	Muluwerk	Etseyi	A.A	K/KERA	13	1142		
32	Tamerat	Mengestu	A.A	A/K	10	12	911198519	
33	Fekadu	Eregasa	Oromiya	Adama	2	11		1790681
34	Taji	Aiu	Oromiya	Adama	2	B14		4051488

No	Name	Fathe Name	Region	K.Ketema	Woreda	H.No	Tel.No	Tin.No
35	Muzeyin	Alo	Oromiya	Adama	11		913267076	
36	Ferid	Kemam	A.A	A/K	1	Adis	962456024	
37	Kemal	Abdu	A.A	A/K		1485	920624006	
38	Dereselgn	Geta	A.A	K/KERA	13	1425	912177652	
39	Tariku	Tadese	A.A	K/KERA	13		911716103	
40	Fantu	G/meden	A.A	Ldeta	7	1056	911686639	
41	Husen	Muhamed	A.A	A/K			929014511	
42	Hamru	Akmmel	A.A	Kirkos	21	53	911420311	
43	W/senbet	Debebe	A.A	Lafto	6	43	910832398	
44	Tesfayo	Chala	A.A	Kirkos	10		911658885	
45	Asrat ena Hlawi	Enginering	A.A	Yeka	10		911897926	37088663
46	Selemon	Admasu	A.A	Gulele	8	Adis	913580441	
47	Mezmur	Afewerk	A.A	Ldeta	10	665	911210990	3340261
48	Leji	Almurazem	A.A	Ldeta	10	664	911211860	42769
49	Biniyam	Alebachew	A.A	A/K	8-Jan		921344889	
50	Bertukan	Duma	A.A	A/K	1	452	911132185	
51	Mengeste	Abe	A.A	Kirkos	88	595	911141887	
52	Dese	Gebeyehu	A.A	Arada	10	447	91807456	113673
53	Beyene&Freands	Par/sh	A.A	Yeka	9		911732852	38977314
54	Yohanes	Tadese	A.A	A/K	10	572	911434923	2052951
55	Rsom	Chehayi	A.A	Ldeta	10	501	911306490	2957063
56	Mulugeta	Yilma	A.A	Arada	5	465	91182209	
57	H/mariyam	Gebeyehu	A.A	A/K	8	72	912608852	
58	Negatu	Belayi	A.A	Gulele	4	15	913142667	
59	Muhamed	x	A.A	Gulele	2		936513466	
60	Teshome	Getachew	A.A	Gulele	1		911389822	
61	Tesfayo	Lema	A.A	Arada	4	1001	913681709	
62	Yigermal&Freands	Par/sh	A.A	Gulele	1	413	913788089	48430224
63	Hbtom	G/meskel	A.A	Kirkos	8	209	911484604	
64	Webeshet	Demse	A.A	Gulele	8	Adis	911483858	21109495
65	Werku	x	A.A	Kirkos	8		911430658	
66	Alemaw	Teshome	A.A	Kirkos	8		911693843	
67	Mengesha	W/mikael	A.A	A/K	10	596	912477965	1331565
68	Alemahu	Dula	A.A	Kirkos	5	606	913491564	
69	ZENABU	Negese	A.A	Gulele	7	34	911895718	
70	Zeleke	Bayisasa	A.A	Akaki/Kality	6	Adis	912147379	31390029
71	Germa	Mengestu	A.A	N/Lafto	9		911311494	
72	Aragew	Deka	A.A	N/Lafto	9	1578	912120462	

No	Name	Fathe Name	Region	K.Ketema	Woreda	H.No	Tel.No	Tin.No
73	Mubarek	Jemal	A.A	Yeka	8	1514	116635866	
74	Behayilu	Alemayehu	A.A	Yeka	9		911880626	
75	Behaftu	Telahun	A.A	Yeka	4	161	913141780	
76	Shimeles	T/berehan	A.A	K/KERA	9	2	911637122	
77	Germa	Tadele	A.A	Bole	7	228	925383940	
78	Meaza	x	A.A	Yeka	7		939872686	
79	Yohanes	Engedawerk	A.A	Gulele	7	387	911344285	
80	Mesayi	Bekele	A.A	Yeka	2		913039528	
81	Abebaw	Shitaye	A.A	Yeka	2		911153982	
82	Yonas	Belachew	A.A	Yeka	2	1187	946665843	
83	Alemu	x	A.A	Yeka	2	Adis	920719918	
84	Tesfa	Feker	A.A	Yeka	2		912664425	
85	Netsanet	Tabor	A.A	A/K	2	79		
86	Eyasu	Hayile	A.A		6	511	921809705	5582969
87	Germa	Deti	A.A	Yeka	10		911373701	
88	Mekonen	Werkneh	A.A	A/K	1	606	911430732	
89	Helen	Kefle	A.A	A/K	3	23	932081742	
90	Zenebech	Ayele	A.A	A/K	3	746	911198019	
91	Dereje	Mamo	A.A	Ldeta	9	279	911174083	
92	Dawit	Selemon	A.A	Ldeta	7	54	937918806	
93	Dereje	Abereham	A.A	Bole	14	24	913661944	
94	Merem	Beshir	A.A	Bole	24	135	925557598	4711233
95	Selemon	Hayile	A.A	A/K	5	1366	926791809	
96	Zebiba	Mustifa	A.A	A/K	5	8	912401526	
97	Yared	x	A.A	A/K	1		920663100	
98	Abdulber	Shekur	A.A	A/K	1	598	912125745	
99	Asnake	Adamu	A.A	Yeka	6	Adis		2986658
100	Temesgen	Asefa	A.A	Bole	14	418	912142028	1150015
101	Metaferiya	Mulugeta	A.A	Bole	4	289	911631082	27353738
102	Ermiyas	Hayile	A.A	Bole	6	179	913161896	
103	Wendwesen	Hayile	A.A	Bole	6	5	912093914	26862442
104	Tsedale	Tezera	A.A	Bole	4	127	911131915	
105	Teramaji	Terefe	A.A	Yeka	2	B1222	911868159	5684819
106	Husen	Muhe	A.A	Gulele	3		912368576	
107	Hayilu	Tesfaye	A.A	Yeka	5	1969	939174319	
108	Shiga elec Metad	Sera	A.A	N/Lafto	4	1837	911216030	295714
109	Aklok	W/lehul	A.A	Ldeta	10	20	913191503	

No	Name	Fathe Name	Region	K.Ketema	Woreda	H.No	Tel.No	Tin.No
110	Mestawet	Bekele	A.A	Ldeta	10	13	912072006	
111	Abereham	Tesfayo	A.A	Ldeta	10	690	913666568	
112	Yakob	Muse	A.A	K/KERA	1	84	911747060	
113	Nebil	Gezmu	A.A	Kirkos	11	213	925002472	
114	Danel	Asefa	A.A	Kirkos	11	216	911102630	14539437
115	Abdul	Feta	A.A	Kirkos	11	218	909537279	5286013
116	Yonas	Getachew	A.A	Bole	14	Adis	911464267	
117	Ana	Miliwen	A.A	Bole	14		9366859	
118	Eyerus	Bezuneh	A.A	Bole	14	6328	911466875	
119	Raju	Ahmed	A.A	Bole	14	6329	923518610	
120	Dina	Husen	A.A	Bole	13		913092460	
121	Hayile	x	A.A	Bole	11	Adis	910531861	
122	Tedi	x	A.A	Bole	11	Adis	912964053	
123	Samson	Berehanu	A.A	Bole	11		912964053	
124	Surafel	Ayele	A.A	K/KERA	22	731	913552722	54500036
125	Marko	Melese	A.A	K/KERA	2	56	911652254	15346436
126	Zerihun	Tegegne	A.A	K/KERA	3	Adis	911379723	
127	Esayas	Bade	A.A	K/KERA	3	244	911117174	5665270
128	Abdurazak	Shemsu	A.A	A/K	1	847	911632675	
129	Yohanes	Afewerk	A.A	A/K	1	101	911675572	
130	Bhayilu	Seum	A.A	A/K	10	49	911694587	37929762
131	Samuel	Badebo	A.A	Ldeta	1	7	912902313	
132	Hasen	Muhamed	A.A	N/Lafto	11	Adis	9430234245	
133	Yonas	Hayilu	A.A	K/KERA	1		921544238	
134	Mudin	Jehar	A.A	K/KERA	1	Adis	911647199	43229964
135	Mengesha	x	A.A	N/Lafto	1		911792646	
136	Abdil	Awel	A.A	N/Lafto	1	Adis	920157165	
137	Danel	Asrat	A.A	Arada	9	1045	920717137	525881
138	Admasu	Abiola	South N	Tabor			927819523	
139	Belachew	Awoke	South N	Batote			916580054	
140	Elias	Yohannes	South N	Batote			911014575	
141	Tinsae	Filimon	South N	Tabor			932686723	39470442
142	Yisak	Yoseph	South N	Tabor			926990929	
143	Nigussie	Habte	South N	Medhani			911734528	

No	Name	Fathe Name	Region	K.Ketema	Woreda	H.No	Tel.No	Tin.No
144	Zelalem	Frew	South N	Leku			911745174	22421690
145	Workineh	Frew	South N	Batote			910200867	
146	Mintesionot	X	South N	Piassa			911681163	
147	MiKael		Diredawa	Fiderale	X	3712	911069975	302370484
148	Mamo	Tefra	Tigray	Mekele		X	914122396	41592488
149	Eden	Zeray	Tigray	Mekele		X	914708149	487503
150	Meher		Tigray	Mekele		X	X	X
151	Daniel	Nigussu	Amhara	Bahir Dar		X	918353931	4949774
152	Abebe	Tebbu	Amhara	Bahir Dar		X	918765008	8817190
153	Tewodros	Akalu	Amhara	Bahir Dar				37611431
154	Yonas	Tarekegn	Amhara	Bahir Dar			918-762453	
155	Tomas	Bekele	Gambela	Gambela		237	0475510218	
156	Zewedu	T/Ghiorgis	Beneshangul	Assosa			0921528309	39544489
157	Aragaw	Seid	Beneshangul	Assosa			0917856263	

Annex 5: Main parameter identification and test methods

1. Introduction

Electrical Cook stoves have a long history dating back almost to 18th century when first ever fabricated. Today there are over 60 major designs and more than 100s of varieties. However, the Electrical stoves have not caught the imagination of the people in Ethiopia, except in places where shortage of conventional fuel like fire wood and the like has become very acute. This days almost all urban dwellers are egger have imported or locally fabricated electrical stoves, depending on their income. Due to its price affordability and easy maintainability people prefer having locally fabricated electrical cook stoves.

Thus, due to its fast growing market requirement government authorities are obliged to question its safe and efficient performance. In order to have safe and efficient electrical stoves have been subjected to several types of tests to rate its performance. Some of the tests conducted have been inter related to acceptable international standards adopted from IEC-Standards as stated in the reference stated below. As presented a set of tests procedures to assess the thermal performance of the stove has been forwarded in this document. These recommendations will be used during the development of standards for locally fabricated electrical stoves

2. Electrical Stove testing procedure

Product technical requirements and test methods are interrelated elements of standards and should always be considered together. Wherever possible, the standards should contain test specifications for completely and clearly checking compliance with the technical requirements. It should be easy to recognize which test methods apply to each technical requirement. This Procedure covers the general safety and performance requirements for locally electrical stoves. The tests should be performed at the ambient temperature, humidity and atmospheric pressure described in the technical description.

In some cases, a compliance statement such as 'visual inspection', 'manual testing' or similar is adequate for this purpose if such a method gives an accurate assessment.

Appropriate headings should designate the appropriate test and a reference should be made to the clause containing the requirement.

This also applies for references which are made to other relevant test standards. In developing the test Procedures, reference should be made to the ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, highlights the need for requirements of “Type Tests” and are required for verifying the basic safety requirement of the product design.

When testing the sample, relevant information provided in the instruction for use should be taken into account. Before commencing the test, special precautions should be taken to prevent harm to the personnel performing the tests and/or other individuals who might be involving in the test process. While preparing this procedure assistance have been derived from the following documents

3. Relevant Reference Standards

3.1	IEC 60311	Electrical Appliances -Safety-requirements
3.2	IEC 60335-1	Household and similar electrical appliances — Safety requirements
3.3	IEC 60335-2-6	Safety of household Cooking ranges, ovens and Similar appliances
3.4	IEC 60335-2-12	Safety of household warming plates
3.5	IEC 60335-2-14	Safety of household Kitchen machines
3.6	IEC 60335-2-36	Safety of household electric cooking ranges, and ovens

3.7	IEC 60335-2-64	Safety of household Commercial electric kitchen machines
3.8	BS 115:1995	Metallic resistance materials for electrical heating purposes
3.9	BSEN 60350	Methods for measuring Electric Appliance performance
3.10	IEC 60068-2-2	Environmental testing procedures
3.11	IEC 60083	Plugs and socket-outlets for domestic and similar general use
3.13	IEC 60227	PVC insulated cables of rated voltages up to 450/750 V
3.14	IEC 60245	Rubber insulated cables – Rated voltages up to and including 450/750 V
3.15	IEC 60529	Degrees of protection provided by enclosures (IP Code)
3.16	IEC 60906-1	Plugs and socket-outlets for household and similar purposes
3.17	IEC 60990	Methods of measuring touch-current and protective conductor current
3.18	IEC 60999-1	Safety requirements for Connecting devices– clamping units
3.19	IEC 61010	Safety requirements for electrical equipment for measurement control, and laboratory use(all parts)
3.20	ISO/IEC 17025	General requirements for the competence of testing and calibration Laboratories

3.21 CEE11-1954		Electric cooking and heating appliances for domestic and similar purpose. International Commission on Rules for the Approval of Electrical Equipment.
3.22 SABS:153-1958		Electric stoves and hot plates, South African Bureau of Standards.
3.23 BS3456: Section A-l: 1961		Heating and cooking appliances, Section A-l General requirements. British standards Institution.
3.24 *IS No. Title 302-2-202 (* 1992)		Safety of household and similar electrical appliances: Part 2 Particular requirements, Section 202 Electric stoves 302-I (1979) Safety of household and similar electrical appliances: Part 1 General TYPE TESTS are performed on a single representative sample of the item being assessed. Multiple samples may be utilized simultaneously if the validity of the results is not satisfactory.

- TERMINOLOGIES

  3.1 to 3.9 Clause of 60335-1 shall apply.

- GENERAL REQUIREMENTS

  4.1 Clause of IEC 60335-1 shall apply.

- GENERAL NOTES ON TESTS

  5.1 to 5.18 Clause of IEC 60335-1 shall apply.

- RATINGS

  7.1 Clause 5 of IEC 60335-1 shall apply.

4 GENERAL REQUIREMENTS

4.1 Test and Measuring equipment

- The measuring and test equipment should comply with requirements of the IEC 61010 series of standards.
- In Normal use of the measuring equipment should not expose the person doing the testing or other individuals to unacceptable RISKS.
- The accuracy of the measuring functions within the range marked or declared by the measuring equipment manufacturer should be specified in test data sheet.
- The measuring equipment used for the tests should be tested and calibrated according to the reference standards (e.g. voltage, current, impedance) used by the equipment for calibrating measuring and test equipment should be certified and traceable national standards. This ensures that the integrity of calibration accuracy and compliance with IEC/ISO 17025 is respected
- For the tests, protective earth connections may be interrupted in the measuring devices, if protection against electric shock is guaranteed by another means of IEC 61010-1.
- It is recommended to use dedicated test equipment (e.g. dielectric withstand tester, ground bonding and continuity tester, etc.).
- The test equipment should be capable of providing all voltages and currents needed

  Note: IEC 61010 *Safety requirements for electrical measuring equipment, for measurement, control, and laboratory use*

4.2 Preliminary conditions of Test facilities or devices

The users of the laboratory equipment must understand how important laboratory personnel checks are. Some equipment and environments may demand special needs, thus the following checklist should be respected.

1. Check the overall condition of the equipment,

2. Check the supply cable, connection devices, etc.

3. Check if they have valid label indicating it has been formally inspected and calibrated
4. Check the facility is suitable for the environment.
5. Check the plug and make sure the cable is securely gripped and there is no mechanical damage.
6. Check that the ground connecters have not been removed.
7. Check the socket outlet to make sure there are no signs of damage or overheating.
8. Check that the facility is working correctly as expected.

If the standard test precondition is not fulfilled, then following test should not be continued, then

1. Switch off the power and disconnect the sample from the supply.
2. Clearly label to identify that it must not be used.
3. Report to the appropriate responsible person.

This type of inspection should only be carried out by a competent person as defined by the laboratory instruction manual before starting active tests.

4.3 SAFETY REQUIREMENTS

The electric stoves shall comply with the requirements as given in clause 8 to clause 32 of IEC 60335-1 except for clauses 9, 14, 17 and 32. The measurement and test equipment should be selected so that the test operator cannot be accidentally subjected to hazardous voltages and currents such as those used for a dielectric strength test, and protective earthing continuity test. It is recommended to use measurement and test equipment which includes safety interlocks which provide protection by automatically shutting down the VOLTAGE whenever a safety or emergency switch is ON.

5. Testing

5.1 General testing condition

The following general testing conditions should be applied:

a) After the sample has been set up for normal use, tests are carried out within the range of environmental conditions specified in the technical description.

c) In cases where ambient temperatures cannot be maintained, the test conditions are to be consequently modified and results should be adjusted accordingly.

d) The tests should be performed with qualified personnel, who have the knowledge, experience, and acquaintance with the relevant technologies and regulations. The personnel should be able to assess safety and be able to recognize possible consequences and hazards arising from non-conforming samples.

f) All tests are to be performed in such a manner that no unacceptable risk arises for testing personnel, or other individuals.

g) If not otherwise stated, all values for current and voltage are effective values (r.m.s.) values as appropriate.

h) All tests performed should be comprehensively documented. The documentation should contain as a minimum the following data:

- identification of the testing laboratory (e. g. company, department);
- names of the persons, who performed the testing and the evaluation(s);
- identification of the sample (e. g. type, serial number, inventory number);
- measurements (measured values, measuring method, measuring equipment);
- date and signature of the individual, who performed the evaluation;
- If applicable, the sample tested should be marked / identified accordingly.

5.2 Type Tests

The tests specified in Table 1 shall constitute the type tests and shall be carried out on two samples of electric stoves of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the electric stoves shall be visually examined and inspected for obvious visual defects in respect of components parts and their assembly construction, stability, marking, provision of suitable terminals for supply connection, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

5.3 Sequence of tests

Unless stated otherwise, the tests are to be sequenced in such a way, that the results of any test do not influence the results of other tests. Tests should, if applicable, be performed in the sequence, unless otherwise stated by this particular standard.

- 5.3.1 Durability and legibility of marking
- 5.3.2 Mains Terminal Cord physical dimension
- 5.3.3 Impedance of PE connection
- 5.3.4 Dielectric strength of mains leads cable
- 5.3.5 Creepage distances and Air Clearances
- 5.3.6 Heating Element parameter Determination
- 5.3.7 Power requirement of the Electrical Stove
- 5.3.8 Determination of working voltage, current or energy
- 5.3.9 Earth Leakage Current
- 5.3.10 Protective Conductor/Touch Current measurement
- 5.3.11 Load test performance
- 5.3.12 Operational temperature parameters determination

5.4 Procedures for testing, including Test arrangements

The following subclasses describe the framework for performing tests that are required by relevant sample by using test procedures followed by above stated standards for particular routine tests.

5.4.1 The electric stove shall be mounted 200 mm above a wooden supporting surface (test table) on heat insulated supports. It shall be shielded by a suitable antidraught screen which should be of a height extending from the test table to the top of test vessel. The screen should not be allowed to induct the draught by acting as a chimney, the supports shall be arranged to provide maximum of free air space under the stove.

5.4.2 The test vessel containing 1.5 litres per kilowatt rating of the appliances, of water shall be placed centrally on the stove. The initial temperature of the water shall be noted. The stove shall be connected to the source of Supply, the circuit having been adjusted to give rated input.

5.4.3 During the heating up period, water shall be continuously stirred and its temperature measured. When the water temperature is nearly 50°C above the initial temperature of the water, its temperature $T\ ^{o}C$ just prior to the addition of an extra quantity of water shall be accurately noted.

5.4.4 A quantity of water equal to 0.75 litre per kilowatt rating of the appliance whose actual mass M in kg and initial average temperature $T_1\ ^{o}C$ are accurately known, shall then be poured into the test vessel, and the heating continued, measurement of electrical input energy in kilowatt-hours having began from this instant. The heating and stirring shall be continued till the whole mass of water again reached the temperature $T_2\ ^{o}C$ when the measurement of input energy shall be discontinued. The electrical energy consumed during this period E in kilowatt-hours is noted.

5.4.5 The test shall be repeated with the test vessel rotated through 180^{o} relative to the position in the first test.

5.4.6 ENDURANCE TEST

Electric stoves shall be so constructed, that in normal use, there shall be no electrical or mechanical failure that might impair compliance with this standard. The insulation shall not be damaged and contacts and connections shall not work loose as a result of heating, vibration etc. The electric stove shall be connected to the supply under conditions of adequate heat discharge such that the input is 1.15 times the maximum rated input which shall be maintained for 96 hours.

5.5 THERMAL EFFICIENCY

5.5.1 When tested in according above stated notes**,** the thermal efficiency shall not be less than 60 percent.

5.5.2 In case the efficiency marked on the electric stove is higher than 60 percent, a tolerance of - 10 percent shall be allowed on value subject to the provision that the actual efficiency shall in no case fall below 60 percent.

5.5.3 The thermal efficiency, which is the ratio of heat absorbed by water to the equivalent of electrical energy supplied expressed as a percentage shall be computed as follows:

$$\text{Thermal efficiency} = \frac{MS\,(T_2 - T_1)}{860 \times E} \times 100$$

Where

M= Mass of water added in kg,

S= Specific heat of water in cal/deg C,

T_2 = Final temperature of the water,

T_1= Initial temperature of the water,

E= Electrical energy input, and

860 = Heat equivalent to 1 kWh of electrical energy.

6 RATINGS

6.1 Power requirements for tests

Unless otherwise specified by alternative Technical Report, sample is tested at favorable rated voltage within the predetermined voltage range. It may be necessary to perform some of the tests more than once in order to establish confidence with the result obtained during previous tests.

6.2 Supply Mains

SUPPLY MAINS used for testing the sample should be assumed to have the following

Characteristics: The electric stove shall be connected to the supply under conditions of adequate heat discharge, such that the input is 1.15 times the maximum rated input which shall be maintained for 96 hours.

- voltage dips, short interruptions and voltage variations on the Supply mains as described in the general test condition
- No voltage application in excess of 110 % or lower than 90 % of the Nominal value (i.e. according to the Ethiopian National standard the nominal voltage value is 230V ±10%) between any of the conductors of the system or between any of these conductors and earth. For Stoves having rated voltage other than 230V ±10% volts, no voltage application in excess of the rated voltage ±10% shall be made.
- Voltages that are practically sinusoidal and forming a practically symmetrical supply.
- protective measures as described in relevant standards

6.3 *Criteria of Acceptance*

Test samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If any of the samples fails in any of the type tests, the testing authority, at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the tests(s) in which failure(s) occurred. No failure shall be permitted in the repeat test(s).

Annex 6: Testing facility and existing relevant standards

1. Purpose

This document is set forth the information required by Inspection, Verification, and Test Laboratories, the availability of **testing facility** for inspection and test of sample electrical stoves by using existing **relevant standards** including the testing stages in accordance with the procedure and recommended standards by recognized consulting firm.

2. Scope

This document deals with standards prepared by regional and international standard institutions for the performance and safety tests of electrical appliances similar to Electrical stoves for household and commercial services, their rated voltage being not more than 250 V for single-phase 50Hz electrical supply line.

The purpose of this document is to state and define the principal performance characteristics of electric measuring devices and facilities to monitor the performance parameters of heating appliances and give guidelines for the evaluation of test results.

This document defines main devices and facilities required to check the passive and active performance characteristics of electrical stoves which are of interest to the user and specifies relevant standards to set testing methods and procedures to carry out tests within locally set-up testing facility or under Ethiopian conformity assessment laboratory

Relevant Appliance Standards referred for comparison purpose within the scope of this document are:- bread makers; - contact grills (griddles); - cookers; - hotplates; - baking ovens; - roasters; - waffle irons;

3. Relevant Reference Standards

3.1	IEC 60311	Electrical Appliances -Safety-requirements
3.2	IEC 60335-1	Household and similar electrical appliances — Safety requirements

3.3	IEC 60335-2-6	Safety of household Cooking ranges, ovens and Similar appliances
3.4	IEC 60335-2-12	Safety of household warming plates
3.5	IEC 60335-2-14	Safety of household Kitchen machines
3.6	IEC 60335-2-36	Safety of household electric cooking ranges, and ovens
3.7	IEC 60335-2-64	Safety of household Commercial electric kitchen machines
3.8	BS 115:1995	Metallic resistance materials for electrical heating purposes
3.9	BSEN 60350	Methods for measuring Electric Appliance performance
3.10	IEC 60068-2-2	Environmental testing procedures
3.11	IEC 60083	Plugs and socket-outlets for domestic and similar general use
3.12	IEC 60085	Thermal evaluation and classification of electrical insulation
3.13	IEC 60227	PVC insulated cables of rated voltages up to 450/750 V
3.14	IEC 60245	Rubber insulated cables – Rated voltages up to and including 450/750 V
3.15	IEC 60529	Degrees of protection provided by enclosures (IP Code)
3.16	IEC 60906-1	Plugs and socket-outlets for household and similar purposes
3.17	IEC 60990	Methods of measuring touch-current and protective conductor current
3.18	IEC 60999-1	Safety requirements for Connecting devices –clamping units
3.19	IEC 61010	Safety requirements for electrical equipment for measurement control, and laboratory use(all parts)
3.20	ISO/IEC 17025	General requirements for the competence of testing and calibration Laboratories

4. Testing facility and devices

It is often possible to build performance checks – system suitability checks – into test methods (e.g., based on the levels of expected detector or sensor response to calibration standards, the resolution of calibration standards in separating systems, the spectral characteristics of calibration standards, etc). These checks are completed before the equipment is used.

The standardization of instruments is performed using reference standards when these are available, or against certified standard instruments when they are not. This is done before the instrument is used.

Calibrations are conducted under the same instrumental conditions as those that will exist during the measurement process. The frequency of calibration depends on the accuracy requirements of the investigation and the stability of the instruments. Calibration checks are performed immediately prior to a series of measurements at other times. For unstable instruments, the calibration is checked prior to each series of measurements, in between measurements, and after the last measurement.

The calibration process is vital to all measurement programs and is governed by a calibration plan. The calibration plan provides for:

- calibration procedures and record forms
- stated calibration frequencies
- appropriate sources for obtaining certified and high quality standards,
- a list of all calibration standards
- specifications of environmental conditions
- range of validity Calibration procedures include information on the following:
- groups of equipment to which the procedure is applicable
- a brief description of the scope, the calibration method (an example and a reference may also be included)
- calibration specifications, such as the number of calibration points, environmental requirements, and precision and accuracy requirements
- a list of the calibration standards and accessory equipment needed to perform an effective calibration, manufacturer's name, and instrument model number
- a complete, clear, concise, step-by-step written calibration procedure
- specifications for calibration facilities, equipment, temperature, and humidity, and physical protection for calibration standards
- specific instructions obtaining and recording the test data (includes data collection forms)

Item	Item Description	Price in USD	Price in Birr
1	Constant Temperature & Humidity Climatic chamber	$13,000.00	
2	Digital Multi-meter	$544.64	
3	Current clamp meter	$513.50	
4	Portable Insulation tester	$1,163.50	
5	Resistance measuring device	$2,600.00	
6	Integrated Appliance Tester	$6,110.00	
7	Power measuring meter	$15,723.50	
8	Energy Analyzer	$3,516.50	
9	Digital timer	$130.00	
10	Infrared Temperature measuring facility	$3,250.00	
11	Calibrated Linear meter	$195.00	
11	Calibrated caliper	$226.20	
12	Calibrated Micrometer	$236.60	
13	Weighing scale	$780.00	
14	Stabilized power source with appropriate setting devices with setting facility	$5,323.50	
15	Primary Current injection facility	$4,764.50	
16	volume measuring buckets	$45.50	
17	Low pressure metering device	$201.50	
18	Sample preparation tools	$2,860.00	
19	Custom made Laboratory Test bench with complete accessories	$65,388.57	
	Total	**$126,573. 01**	**Birr 2,400,00.00**

The bench-top appliance tester for testing the safety of electrical heating appliances by performing a ground bond test, an insulation test, specific ground leakage tests and operational VA tests according international standards. Among the issues that can arise during this processes are safety precautions to be taken by the lab technicians like:

- Exposure to live, conductive parts due to damage to the outer casing of the equipment.
- Worn and/or frayed power cord.
- Defective, loose or missing earth/ground connections.
- Failure to identify and correct problems such as those listed above can result in the electrical equipment becoming a shock hazard or a fire risk.

Many of these problems can be identified visually, but still often go unreported. Internal faults often go undetected. Appliance testing involves performing a series of tests identify faults or product defects that would otherwise not be detected.

In addition to protecting personnel, regular safety checks of electrical equipment tend to increase the operational life of that equipment. An appliance tester allows the lab technician to make a number of safety tests with a single instrument, including:

5. Purpose of Testing facility and devices

5.1 Earth Bond and Continuity Tests device

To verify the integrity of exposed metalwork on grounded appliances.

5.2 Insulation Test device

To check that equipment conductors are isolated from earth.

5.3 Touch Current Test device

To check that the equipment case and all exposed metal parts are isolated from earth/ground.

5.4 Differential Leakage Test device

To measure the difference in current between live and neutral conductor during operation.

5.6 Alternative Leakage Test device

To check that the equipment case and all exposed metal parts are isolated from earth/ground, by use of a safe test voltages as an added protection against seriously faulted test items.

5.7 Functional Load Test device

An operational test to ensure the asset works as it should without drawing excessive current from the supply.

5.8 Power Cord Tests device

To check cords and line cords for safe operation. In addition to these standard tests, some instruments will perform a flash test (hipot or dielectric strength test) to test breakdown voltage levels. This test is normally done on new equipment, articles that have had a major overhaul, or equipment in the rental industry.

5.9 Earth resistance test device

This test shows the resistance offered by the earthing rods with the connection leads. Various testing instruments are available for earthing resistance tests. The earthing resistance should be less than 1Ω.

5.10 Earth continuity test device

The equipment shall have a measured resistance of the protective earth circuit, or the earthing conductor of the appliance cord set, which does not exceed 1Ω.

5.11 Current injection test facility

This test requires specialized test equipment, knowledge and training;

- A current, equal to the rated tripping current, shall be “suddenly” applied between active and protective earth and the operating time measured with maximum trip time 40ms for Type I and 300ms for Type II.

6. Testing facility and devices performance examination

Visual examination is vital and always precedes electrical testing. It often reveals major defects that would not be revealed by testing alone.

6.1 Isolation of equipment: in normal circumstances, lab technician must be able to reach the plug/socket without difficulty and disconnect/ isolate. Isolation is simplest when the equipment is connected via a plug and socket. Not all equipment will be connected in this way and isolation may be achieved via a main switch or removal of a fuse.

Caution must be exercised when inspecting equipment without the usual plug/socket arrangement. When inspecting equipment, permission from the equipment operator should be gained before disconnecting from the supply. Failure to do this could result in serious loss of data. It should also be noted that equipment might need to be powered down in the correct manner before isolation.

6.2 Equipment condition: before beginning any equipment inspection, lab-technician or the client should be asked if they are aware of any faults and whether the equipment is functioning as expected.

6.3 The power supply system

Facility containing appropriate regulated and stabilized power supply system,

Facility in good condition and free from physical damage, wear and tear,

Facility is suitable for the intended testing process,

Facility have adequate self protection and is insulated from external hazard.

6.4 power outlet or wall-socket

Is it free from cracks or damage,

Is there any sign of overheating.

6.5 The standard plugs

- Power cable incorporates a continuous protective conductor (earth/ground),
- This could be caused by a faulty or loose connection in the plug or the socket outlet,
- On a non-rewirable type, the cable grip can be tested by firmly pulling and twisting the cable.
- Cable core terminations tight and the plug correctly wired,

6.6 Environment

- Equipment suitable for the environment in which it is being used,
- Equipment being used for the correct purpose.

Annex 7: None-Standardized Electrical Stove Sampling Procedure

Purpose

To outline the sampling plan and procedures for sampling of **Electrical Stove** or products for subsequent testing. This procedure shall be adapted for **Electrical Stove** from household heating appliances

Scope or Field of Application

This procedure covers all **Electrical Stove** producers, while the item is not yet standardized. Due to dimensional, capacity, performance and other physical features of the baking plate, there is no sampling exclusion. Sampling will be taken from all producers in agreement that will be set between the regulatory body and producers.

Sub-sampling performed in the test laboratory is carried out according the tests in standard operating procedure or test method set for the sample **Electrical Stove**

Representative sample

Representative Sample – There must be a minimum of 2- samples in each sampling steps that is taken from the whole product, or production lot. The destructive test of the sample will be the last steps to be carried out. For the characteristics identification of the heating element, one pair of new heating element will be taken with the main sample.

Responsibilities

The individual authorized by the regulatory body or the laboratory taking samples is responsible for:

a. sample contents and history
b. taking a representative sample from product
c. integrity of the sample

Materials Required

Sampling equipment and ambient conditions (proper tools, transport handling frame).Sampling containers and packing (essential to prevent damage during transport or storage).

- ✓ Tamper proof seals (for legal samples)
- ✓ Support letter and Sample submission form
- ✓ Chain of custody form (for legal samples)

Procedure

Sampling Plans:- Each sampling plan must fulfill the following criteria:

Administrative arrangements

- sampling personnel: EEA representative or delegated authority
- Representation of stakeholders concerned: EEP, **Electrical Stove** Producers, & users, and etc.
- safety, and security precautions: As per the safety precaution stated in the product standard document

- Identification and inspection of the lot prior to sampling (important in survey sampling for identification, condition of the lot, and selection of the method of sampling).

- Sampling procedures (as agreed by the regulatory body and the laboratory performing the test)
  - sample size: Minimum of 2 –samples plus one pair of heating element
  - how taking of the sample: Samples will be collected by the EEA or an organ delegated by EEA
  - selection of samples : As per the agreement reached between EEA and the producer

- Packing, and marking of samples and sample containers (identification of units)
  - sealing of sample containers
  - marking
  - packing samples for storage or transportation, type of container used

- Precautions during storage and transportation of samples, expected danger on the collected samples, (fragile, transport handling position)

- Sampling report
  - administrative details
  - details of unit packs or enclosure containing the samples
  - marking and sealing of samples

Key Activities for Sampling: *Sample Contents and History*

1. Thoroughly complete the sample submission form.
2. Record visible signs of potential alteration.
3. Record identity of product, lot # / code dates, time of sampling, and any other information as necessary.
4. Label sample with indelible marking pens.

Representative Sample

a. Obtain clear guidelines for the sampling to be done.
b. Choose proper units to be sampled, suitable number of samples (may be based on agreement between the producer and the regulatory, if it is on purchase based sampling, there must be at least three randomly selected samples from the periodical lot), and choose the right area to sample.

Sample Integrity

1. Consider the necessary handling, storage, and transportation arrangements involved after sampling.
2. Ensure samples are transferred to the appropriately labeled sample storage area.
3. Pack samples to prevent breakage.
4. Transport to the test laboratory by the most rapid method so samples can be examined as soon as possible to minimize rescue. .

Documentation

Completed sample submission forms are received at sample reception and forwarded to the laboratory.

Reference Procedures

Specifications set out in individual sample plans

Code # – Handling of Test Items

References

"Household Electrical Appliance Standard Method of Sampling from a Lot," ISO Catalog, International Organization for Standardization,

Revision History Revision 1

Annex 8: Electrical Test Laboratory House Keeping Standards Operating Procedure

Contents

c) PURPOSE

The purpose of this work instruction is to ensure that house keeping activities are undertaken as per the documented procedures detailed herein.

d) SCOPE

The house keeping activities given in this work instruction are to be adhered to by laboratory personnel while working in the electrical testing laboratory.

e) TERMINOLOGY / REFERENCES

The definitions ISO/IEC/17025 and ISO 1400 P APPLY & Test Laboratory Quality Manual

f) PRINCIPAL RESPONSIBILITIES

It is the responsibility of the Laboratory to ensure that this work instruction is adhered to. Personnel working in the Laboratory and shall ensure that the defined house keeping activities are followed.

g) PROCEDURE

Safety Precautions: Cleaning activities shall only be done at the time when test sample is not on test and taking care of any warning signs placed at designated locations.

The working environment plays a major part in the selection of appropriate testing equipment. Selecting the wrong equipment can have a detrimental effect on the test result obtained from the test.

Special consideration should be given to equipment for use where it will be exposed to natural hazards, extreme temperatures, high or low pressure, wet, dirty , mechanical or physical damage.. Thus the following checks should be checked before starting the test:

- Set room temperature and humidity monitoring devices at appropriate positions and keep the record.
- Easily accessible means of disconnection/isolation from the supply.
- The equipment is operated with all protective covers
- There are no unprotected cable runs.

h) Operation Follow-ups

e.1 House keeping activities shall be carried out in accordance with the testing laboratory procedure for security, and confidentiality.

e.2 Cleaning of testing facility shall be done once a week according to the duty roster shown in Appendix. Maintenance of test facility shall be done periodically prior to calibration with maintenance activities

e.3 The Laboratory technician is responsible with the assistance of the cleaner carrying out the dusting and arrangement of test facility before starting the testing process.

e.4 Laboratory technicians and helpers shall ensure that they keep their working area clean and tidy at all times. Measuring instruments, tools and other equipment shall be kept in an orderly manner during use and returned to their respective locations immediately after use.

e.5 If the floor becomes dirty or wet as a result of any testing activity, the testing technician informs the cleaner and ensures that cleaning is done to his satisfaction.

e.6 Equipment manuals and standards are kept in appropriate files that are kept in the laboratory closed shelves. Any retrieved manual or standard for use shall be returned by the user to the appropriate file.

e.7 Every laboratory personnel shall remove from the working tables any files, books, and equipment manuals which they have finished using and return them to their respective locations in the cabinet.

e.8 Custody of laboratory keys shall be kept according to the roster agreed on.

e.9 Only authorized personnel shall be allowed to enter to the laboratory.

e.10 The lab-personnel in custody shall be responsible for opening and locking the laboratory at the beginning and the end of working hours.

e.11 At no one time shall the laboratory be left open and unattended by at least one of the laboratory personnel. No visitors shall be left in the laboratory alone.

v) APPENDICES

v.1 Appendix a = Duty Roster for cleaning of test equipment
v.2 Appendix b = Duty Roster for arrangement of working documents
v.3 Appendix c = Duty Roster for custody of keys
v.4 Appendix d = Personnel authorized to operate test equipment
v.5 Appendix f = Test Method /Procedure and Document Control

vi) ASSOCIATED DOCUMENTS

Appendix a = Duty Roster for cleaning of test equipment. A duly filled and up to dated duty roster in the format shown below shall be displayed on the laborartory notice board.

Month	Name of Responsible Technician	
	Testing Laboratory I	Testing Laboratory II
Hamle		
Nahase		
Meskerem		
Tikmet		
Hidar		
Tahisas		
Tir		
Yekatit		
Miazia		
Ginbot		
Sene		

Signed:______________________ Date:________________________

Appendix b : Duty Roster for arrangement of working documents

A duly filled and up to date duty roster in the format shown shall be displayed on the laboratory notice board.

Month	**Responsible Technician**
Hamle	
Nahase	
Meskerem	
Tikmet	
Hidar	
Tahisas	
Tir	
Yekatit	
Megabit	
Miazia	
Ginbot	
Sene	

Note: When a technician is on leave the technician responsible the following month takes over.

Signed:______________________

Date________________________

Appendix c : Duty Roster for custody of keys

A duly filled and up to date duty roster in the format shown below shall be displayed on the laboratory notice board.

LABORATORY	RESPONSIBLE TECHNCIAN		
	Responsible	Alternative I	Alternative II
Laboratory I			
Laboratory II			

Signed:_________________________

Date:__________________________

Appendix d : Personnel Authorized to operate Test equipment

The following laboratory personnel are authorized to use to Test equipment

____

____

Other laboratory staff may operate to said equipment ONLY under supervision of any of the above listed personnel.

Appendix E = Test Method /Procedure and Document Control

Test Method /Procedure

SOP TITLE	Doc. No.
House Keeping in the Laboratory	ETS/___________________
	Issue: / Rev
	Date:
	SOFT Copy Ref.____________
Issued by:	
Signed:	Date:
Audited by:	Date:
Signed:	
Authorized by	
Signed	Date

Document Control

Copy No:
Issued to:
Issued Date:
Controlled/Uncontrolled
Location of Copy

Note: Controlled copies of this standard operating procedure may not be copied.

1. Do not deface SOPS, 3,
2. Write amendments on the page provided,
3. Keep this SOP Secure.