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Biomass Energy Strategy
Ethiopia

This study has been elaborated (in cooperation with the Ethiopian Ministry of Water and Energy) to develop a Biomass Energy Strategy for Ethiopia.

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Acronyms and abbreviations

ADLI	Agricultural Led Growth
BAU	Business as Usual
BLT	Branches, Leaves and Twigs
CFME	Central Forest Production and Marketing Enterprise
CRGE	Climate Resilience and Green Economy
CSA	Central Statistical Office
EARO	Ethiopian Agricultural Research Organisation
EUEI PDF	EU Energy Initiative – Partnership Dialogue Facility
FUG	Forest User Group
FYGTP	Five Year Growth and Transformation Plan
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Gesellschaft
GoE	Government of Ethiopia
IFPRI	International Food Policy Research Institute
masl	meters above sea level
MDG	Millenium Development Goals
MoA	Ministry of Agriculture
MoE	Ministry of Energy
MoEF	Ministry of Environment and Forestry
MoEPFM	Ministry of Environmental Protection and Forestry Minister
MoFMSE	Ministry of Federal Micro and Small Enterprises
MoIT	Ministry of Industry and Trade
MoWIE	Ministry of Water Irrigation and Energy
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PFM	Participatory Forest Management
PSNP	Productive Safety Net Programme
REDD	Reducing Emissions from Deforestation and Forest Degradation
SME	Small and Medium Enterprises
SNNPR	Southern Nations, Nationalities and Peoples Region
TGE	Transitional Government of Ethiopia
WD	Woina Dega

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1. Introduction

1.1 Background to the Biomass Energy Strategy

As in most sub-Saharan countries, a marked feature of Ethiopia's energy sector is the high dependence on biomass (firewood, charcoal, crop residues and animal dung). The bulk of the national energy consumption is met from biomass sources. It is estimated that biomass energy accounted for 89 percent of total national energy consumption in 2010[1]. Nearly 60 million tons of biomass is consumed for energy purposes with about 81% of the estimated 16 million households using firewood and 11.5% of them cooking with leaves and dung cakes.

The very high degree of dependence on wood and agricultural residues for household energy has impacts on the social, economic and environmental well-being of society. Growing demand for biomass together with increased demand for agricultural output (land for crop production, livestock feed) has resulted in reduced access to wood fuels.

Ethiopia's National Energy Policy (issued in 1994) underlines the critical role of biomass energy.

The successful development of the country's biomass energy resources has been hampered by a combination of factors including poor institutional framework, inadequate planning, and lack of co-ordination. There is no biomass energy strategy to direct and coordinate actions.

Strategies developed previously (the Rural Biomass Energy Strategy Report (2004) developed by the Biomass Technology Group (University of Twente, the Netherlands) and the draft Rural Energy Strategy (2007) developed by the Ethiopian Alternative Energy Development and Promotion Centre) have not led to the required results. The reasons were the lack of ownership by the key institutions and the lack of a comprehensive approach including all related sectors.

It was therefore an important objective that the development of the current Biomass Energy Strategy (BEST) should be strongly process orientated with active involvement of all stakeholders at all stages of its development.

1.2 Approach to Strategy Development

The strategy development followed three phases:

Phase 1: Inception;

Phase 2: Baseline Sub-sector Analysis and Scenario Development;

Phase 3: Strategy Development.

[1] Energy Sector Mapping and Database Development, Draft Ethiopian Energy Policy Framework, August 2011.

Phase 1. Inception Phase

An assessment was made of the national policy framework within which the biomass energy sector is located. This provided an indication of the role and importance of biomass energy within the national development priorities and the degree of political awareness of the sector and its place in the order of national priorities. Also an assessment was made of the regulatory structures within which the biomass energy sector operates.

Stakeholder consultations were held with the Regional Bureaus of Energy and Agriculture to determine the mandates and roles of these institutions in relation to biomass energy. This was important to determine the degree of coordination between the supply of biomass energy and government's role in biomass energy demand. The consultation also examined the resources, expertise and capacity available in the regions. This provided an assessment of the nature and degree of capacity building required to ensure effective implementation of the biomass energy strategy.

Using existing reports a broad assessment was made of the main biomass energy supply and demand levels and the discernible trends both nationally and where possible at the regional level. The desk analysis was supplemented by the regional stakeholder perceptions of these trends in their region.

The inception workshop which concluded the inception phase was useful in a number of respects. Its opening by the state minister indicated a high level of political commitment. The attendance by stakeholders from the regions helped to reinforce the contacts the consultant team had established in the field. Finally it allowed the stakeholders to develop a preliminary vision of the biomass energy sector and indicated to the team the focus for the baseline phase.

Phase 2. Baseline Survey and Analysis and Scenario Development

(i) Baseline Survey

The inception workshop recommended that phase 2 should focus both on supply and demand and on both rural and urban sectors. A review of information on the proportions of biomass energy expended on the four main uses: mitad baking, other cooking, lighting and heating indicated that most biomass energy is used on mitad baking and other cooking.

The main questions to be addressed were as follows:

- What is the current energy supply and demand situation?
- What are the trends and their implications?
- How is the energy situation likely to develop?
- What happens under different assumptions?

Because of the variability of agro-ecological, socio-cultural and economic conditions in Ethiopia and their complex inter-relationships, together with the size of the project area some logical framework for analysis, planning and implementation is required. As the purpose of a strategic plan is to provide the basis for more detailed project planning and implementation it is also preferable that the planning framework is hierarchical and incorporates biophysical, socio-cultural and economic elements. A third requirement is that the framework should have a spatial dimension and that the various levels should be capable of being mapped.

To accommodate this variability livelihood zones identified and used by the Livelihood Integration Unit of the Disaster Prevention and Preparedness Agency Early Warning Directorate were used as a basis for the stratification. Each Livelihood Zone has a defined set of agro-ecological conditions and management practices with respect to crops, livestock and trees.

These have developed over many decades or even centuries in response to natural environmental conditions and socio-cultural and economic factors. As there are some 185 of these, they were grouped into 9 major livelihood zones as follows:

Cereal systems:

- Cereal systems: Dega Zone: Wheat, barley: are found above 2,600masl where growing season temperatures limit cereal crops to wheat and barley.
- Cereal systems on Vertisols: Woina Dega – Wet/moist Zone: Teff, wheat, maize: located in flat plains the heavy black clay soils whilst fertile present considerable problems due to poor drainage and waterlogging. Rainfall is generally adequate and reliable.
- Cereal systems on Non-Vertisols: Woina Dega – Wet/moist: Maize, wheat: soils are freely drained and fertile but highly erodible. Soil erosion is a major problem on slopes above 5 percent. Rainfall is generally adequate and reliable.
- Cereal systems: Woina Dega – Dry Zone: Sorghum, maize. Rainfall is variable and often insufficient for crop production.

Enset-cereal systems:

- Enset is co-dominant with cereals: Enset and root crops provide a major source of food calories. Population densities are very high and land holdings very small (<0.25ha).
- Cereals are the dominant staple and enset and root crops are minor. Land holdings are medium. Coffee is a major cash crop. Soils are freely drained and fertile but highly erodible.

Woody Fallow Cultivation Systems: They are found in the western lowlands. Fields are cropped for 2 to 3 years and then tree fallowed for up to 15 years to enable soils to regain fertility and to suppress weeds. These areas are increasingly being cleared for large-scale commercial agriculture.

Agro-pastoral Systems: Some 50% of livelihoods are derived from cropping and 50% from livestock. In some areas this system is replacing Pastoral systems because households have lost a substantial part of their herd due to drought.

Pastoral: Livestock provide the main source of livelihoods. Sales of livestock are used to purchase cereals. Increasing frequencies of drought and insufficient time to re-build herds is displacing many households from this livelihood system, some turning to agro-pastoralism and some to non-pastoral livelihood strategies (petty trading, herding for remaining pastoralists, fodder production).

There are nine regions and nine livelihood zones to sample. Their distribution is shown in Table 1.

Table 1 Regions, Livelihood Zones and Sample Sites.

Major Livelihood Zone	Tigray	Amhara	Afar	Oromiya	SNNPr	Somali	BSG	Gambela	DD
1. Dega Cereal:barley, wheat, sheep	X	X							
2. Woina Dega: Cereal: Moist	X	X		X	X				
3. Woina Dega: Cereal: Dry	X	X		X	X				X
4. Woina Dega: Cereal: Vertisols		X		X					
5. Woina Dega: Enset (dom.) +Cereal					X				
6. Woina Dega: Cereal+ Enset (minor)				X	X				
7. Woody fallow Cultivation	X	X					X	X	
8. Agro-pastoral			X	X	X	X			X
9. Pastoral			X	X	X	X		X	
Frequency	4	5	2	6	6	2	1	2	2
No.of sample woredas	**1**	**1**		**4**	**4**	**2**	**1**		

The following distribution of livelihood zones was selected to minimise travel but to maximise the number of regions covered.

- Beneshangul-Gumuz region: Woody Fallow LZ (1 woreda, 2 kebelles)
- Oromiya Region: Woina Dega Cereal Moist (2 woredas, 4 kebelles): Woina Dega Cereal Vertisols (2 woreda, 4 kebelles)
- SNNPR: Woina Dega: Woina Dega Cereal- Enset minor: 2 woreda, 4 kebelles): Woina Dega Enset-Cereal minor (2 woreda, 4 kebelles)
- Amhara Region: Dega Wheat-Barley (1 woreda, 2 kebelles)
- Tigray Region: Woina Dega Dry (1 woreda, 2 kebelles)
- Somali region: Agro-pastoral (1 woreda, 2 kebelles), Pastoral (1 woreda, 2 kebelles)

This brings a total of 6 regions and 1 woreda in 5 livelihood zones and 2 woredas in the 4 livelihood zones on Oromiya and SNNP regions. Two kebelles per woreda were sampled in the rural survey (26 kebelles). In each woreda town a household and a small establishment (small cafes, tef bet, etc.) was sampled. In each regional capital and in the same woreda town a supply chain survey for wood and charcoal was conducted.

(ii) Scenario Development

Scenarios build on the current situation and show different pathways of how energy consumption could develop until 2030. Options for development are based on targets and various policy measures such as regulations, subsidies, human capacity building, technology development and awareness creation.

The following scenarios were developed and analysed:

Scenario 1: Baseline Scenario Business as Usual (BAU)

Business as Usual Scenario focuses on the household sector and represents a continuation of the status quo taking into account the phasing out policies, population growth and income effects.

Scenario 2: In Compliance with CRGE

The Climate Resilience and Green Economy (CRGE) Strategies aim at a middle income country status, resulting in an increase in energy consumption. The CRGE reacts to increasing demand by presenting plans to exploit the vast hydropower potential in Ethiopia. Another important plan to secure domestic energy supply addresses the provision of energy efficient stoves for cooking.

Scenario 3: In Compliance with CRGE and the best possible biomass utilisation

This scenario is a variation of scenario 2 and takes additional measures into account. It puts a strong emphasis on the sustainable management of charcoal production. This scenario assumes policies which will ensure a sustainable supply of wood and efficient production and utilisation, and a transparent charcoal production based on a very well managed production chain.

1.3 Structure of the Biomass Energy Strategy

The Strategy Document is structured as follows:

Chapter 1 Introduction: Provides information about the point of departure and the methodological approach.

Chapter 2 Country Context: Outlines the main physical, demographic, administrative, economic development and policy and institutional features of Ethiopia.

Chapter 3 provides a summary of the findings of the baseline and scenario analysis focussing on biomass energy supply and demand in both the urban and rural sectors. The scenario analysis comprises a business as usual scenario with one that examines the impact of implementing the main interventions on biomass energy supply and demand as outlined in the CRGE.

Chapter 4 details the biomass energy strategy in terms of targets and actions required beyond the biomass energy sector.

Chapter 5 details the action plan and sets out actions required on the demand and supply sides.

2. Country Context

2.1 Physical Features

The highlands[2] form a broad plateau between 1,500 and 2,500masl with isolated peaks rising as high as 4,600 masl (see Text Map 2). They cover 43 percent of the total area. The favourable climatic conditions of the highlands sustain 88 percent of the population (see Text Map 3). The highlands account for 95 percent of the cultivated land, and also support 75 percent of the cattle population of 33 million, the highest in Sub-Saharan Africa. Crop cultivation in the highlands has a history stretching over many millennia. Ethiopia is one of the 12 Vavilov centres of crop genetic diversity (term created by the Russian scientist Nikolai Vavilov in 1926), being a main genetic diversity centre for crops such as Arabica coffee, enset, niger seed, sorghum, finger millet, durum wheat, barley and many others. Given the erosion of genetic material elsewhere in the world, this diversity is assuming an increasing global importance.

Surrounding the highlands on all sides are the lowlands. To the east, southeast and south they are semi-arid to arid with an annual rainfall below 600mm. These lowlands are inhabited by pastoralists who herd cattle and sheep (mainly grazers), and goats and camels (mainly browsers). Through skilful herding and differential moving of grazers and browsers they have evolved a very efficient system of livestock productivity given the harsh environment. However, successive droughts over the past two decades leading to catastrophic livestock losses have forced many pastoralists into precarious rain-fed crop cultivation.

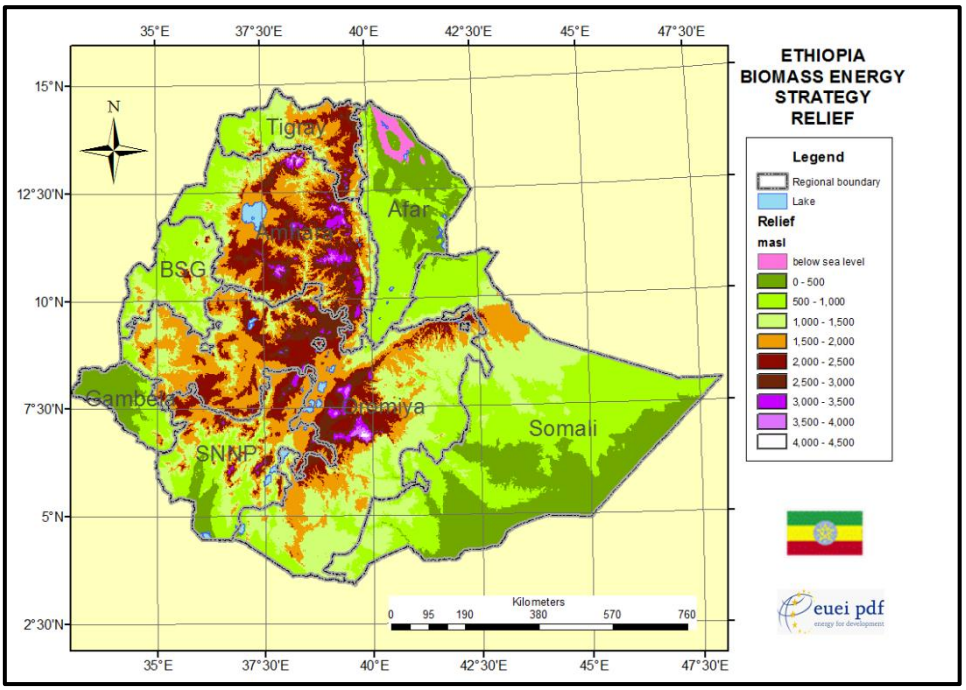
In the western lowlands rainfall is much higher. This factor, together with the prevalence of human tropical diseases not found in the highlands, has meant that until recently these areas were sparsely populated. However, under increasing population pressure in the highlands these areas are now increasingly being settled.

In the high rainfall areas of the southwest and southeast highlands the original vegetation of the highlands was broad-leaved montane high forest. Further north with lower rainfall this changed to a mixed coniferous forest (Podocarpus spp. and Juniperus spp.) and woodland. In the driest parts of the north this in turn gave way to low Juniperus woodland. However, millennia of expanding settlement and clearing for agriculture has left only 3.6 percent of the highlands covered with forest. The semi-arid lowlands of the east, southeast and south support a cover of Acacia-Commiphora woodland and shrubland. Increasingly these lowlands are the source of fuelwood and charcoal for the highland population. In the wetter western lowlands this is replaced by Combretum-Terminalia woodland, with extensive areas of lowland bamboo (*Oxytenanthera abyssinica*).

In the highlands severe population pressure, poor cultivation practices, steep lands and overgrazing by livestock has led to accelerated soil erosion that now affects more than 50 percent of the cultivated area. Some 95 percent of the cultivated area is farmed by smallholder farmers with average holdings of less than 2 hectares. In many areas an increasing proportion of the rural population have no land. With frequent droughts, each year more than 4 million people require food assistance.

[2] "Highlands" in Ethiopia is land over 1,500 meters above sea level.

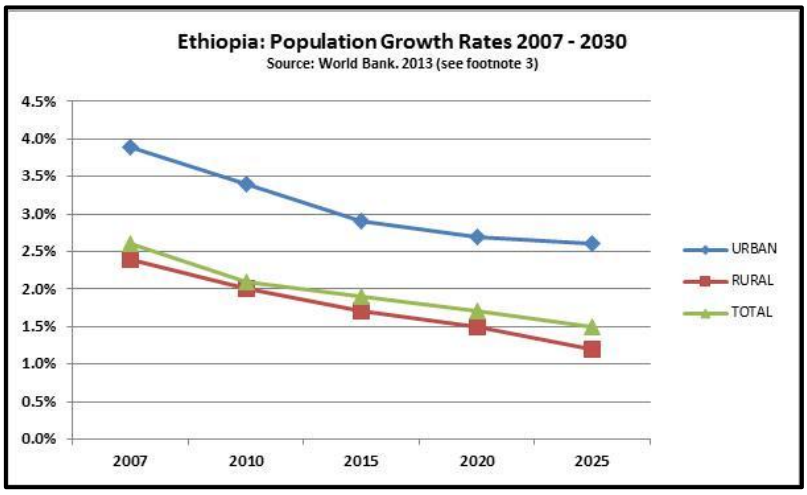
Text Map 1 Ethiopia: Relief Map.



2.2 Rural and Urban Population: Spatial Distribution and Future Trends

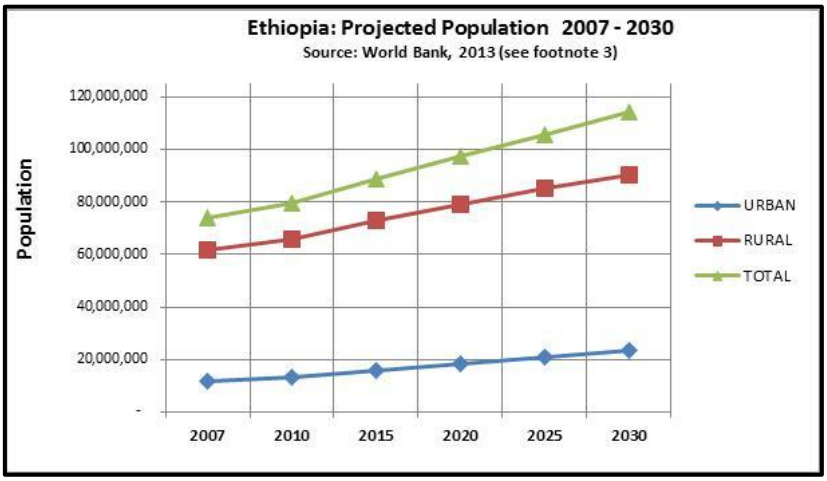
The estimated population in 2010 was 79.8 million, the second highest in Sub-Saharan Africa. Some 84 percent of the population live in rural areas. The estimated total population growth rate (1994-2007) was 2.6 percent per annum. Growth rates are projected to decline between 2010 and 2030 (see figure 1). Nevertheless the total population is projected to rise to 114 million by 2030 (see figure 2)[3].

Figure 1 Ethiopia: Projected Total, Urban and Rural Population Growth Rates 2007 – 2030.



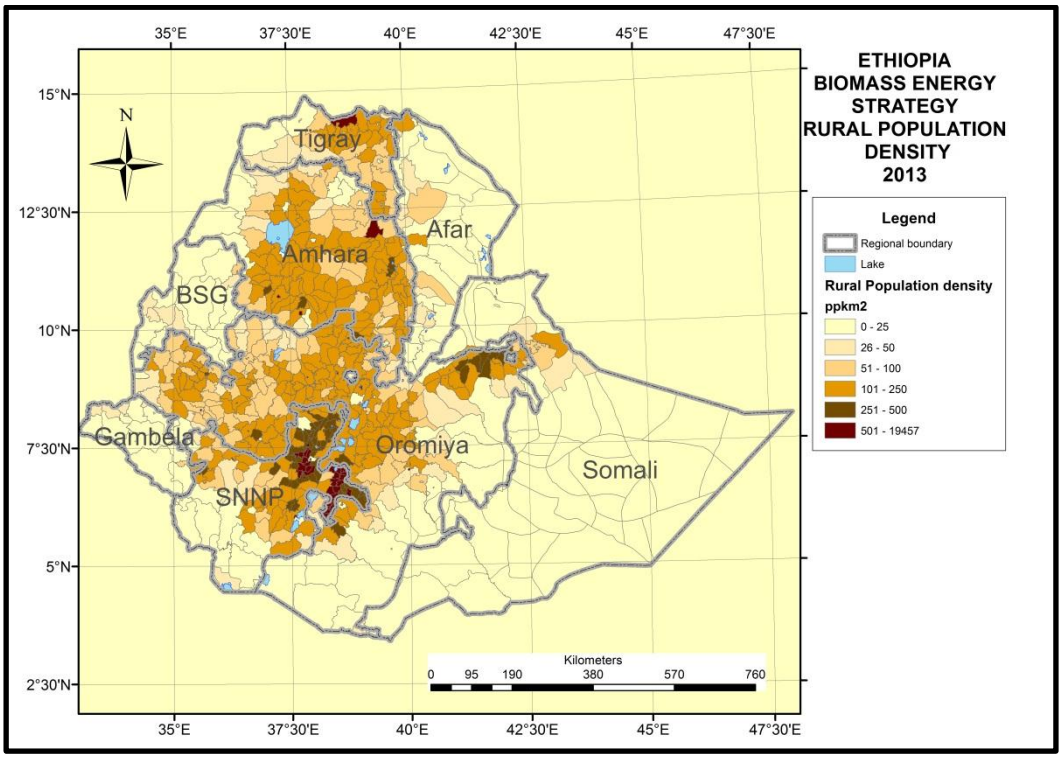
[3] There are no published growth rates 2007-2030 by the CSA. Nor are there any separate rural and urban growth rates published by CSA. National growth rates (2010-2030) are taken from the World Bank data base for Ethiopia (http: \\go.worldbank.org/KZHEKQFAO). Rural and urban growth rates are from CSA (1999) the last published estimates and adjusted to the World Bank national rates.

Figure 2 Ethiopia: Projected Population Increase 2007 – 2030.



The favourable climatic conditions of the Highlands sustain 88 percent of the population (see Text Map 2). The Highlands account for 95 percent of the cultivated land, and also support 75 percent of the total cattle population of 33 million, the highest in Sub-Saharan Africa.

Text Map 2 Ethiopia: Population Densities and Distribution.



2.3 Economic Development

Since 1991, the Government of Ethiopia (GoE) has been implementing its strategy of Agricultural Development-Led Industrialisation (ADLI) that sees agriculture as the engine of growth. Its main thrust has been to: (i) improve agricultural extension services; (ii) promote better use of land and water resources; (iii) enhance access to financial services; (iv) improve access to domestic and export markets; and (v) provide rural infrastructure.

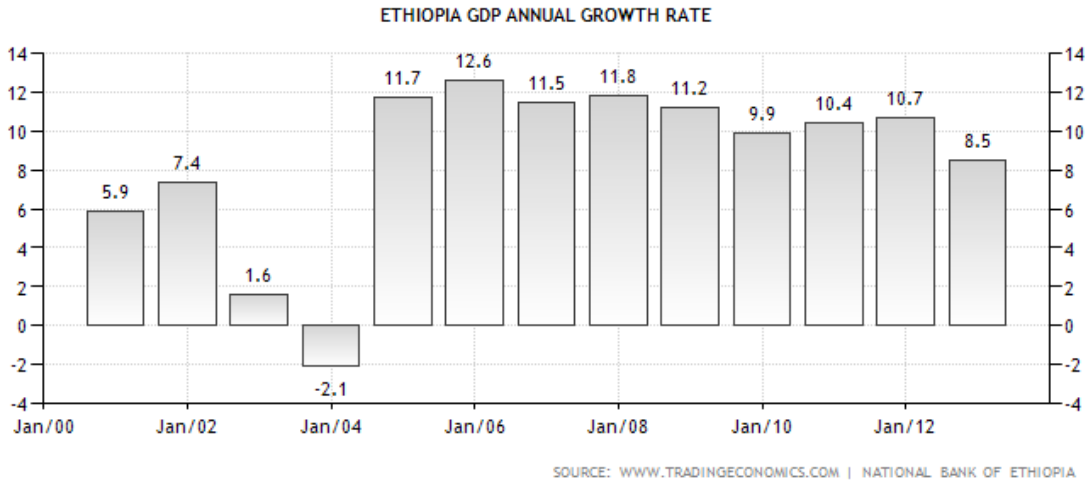
The Five-Year Growth and Transformation Plan (FYGTP) for 2010/11 to 2014/15 was preceded by the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and the previous five-year development plan. The FYGTP, which was unveiled for consultations in August 2010, projects continuing economic growth at a minimum of 10% per annum, and an ambitious best-case scenario of doubling GDP over the five year plan period. The plan aims to reach all of the MDGs and to continue to consolidate democratic governance and institutions and maintain the path towards a stable multi-party democratic system. This will be achieved through balanced participation of the state and private sectors and special support for the emerging states to catch up with the more advanced ones.

The FYGTP has three major goals:

- continuing rapid economic growth;
- expanding access to, and improving the quality of social services; and
- Infrastructure development.

Real Gross Domestic Product (GDP) only grew at 1.2 percent between 1981 and 1991 but accelerated to 5.9 percent between 1991 and 2000 and to 12. 6 percent in 2006 and to 8.5 percent by 2012 (figure 3). Per capita GDP fell by 2 percent per year during the 1980's, rose by 1.3 percent per years in the 1990's and rose by 5.4 percent per year between 2001 and 2009.

Figure 3 Annual GDP Growth Rate 2000 – 2012.



Agricultural growth has made a major contribution to overall growth performance, accelerating from 1.3 per year in the 1980's to 2.9 percent per year in the 1990's to 6.2 percent in the 2000's. The industrial and service sectors grew at an even fast pace with agriculture's share of the GDP falling between 1991 and 2009 from 64 percent to 47 percent.

Up to 2007 Ethiopia experienced considerable economic stability with inflation which was 7 percent in the 1980's fell to 3 percent in the 1990's. But in 2008 inflation surged to 44 percent. Devaluation of the Birr and tight fiscal policies brought inflation down to 33 percent in 2011 and 22 percent in 2012.

There has been a steady decline in poverty levels with the poverty level[4] head count falling from 66.2 percent in 1982 to 60.5 percent in 1995to 55.6 percent in 2000 with an even bigger drop to 39.0 percent in 2005.

2.4 Policy and Institutional Context of the Biomass Energy Sector

2.4.1 Overall policy strategies and planning frameworks

- **Climate Resilient and Green Economy (CRGE) Strategy 2013-2030**

The latest development policy document is the **Climate Resilient and Green Economy (CRGE) Strategy** which Ethiopia launched in Durban on 8th December 2011 during the COP 17. The objective is to achieve middle-income status by 2030 through climate-resilient and green economy development. The green economy strategy has been published and sets out a wide-ranging programme of climate change mitigation projects. The climate resilient part of the strategy is elaborated but has yet to be published.

The green economy strategy has prioritised two programmes that could help to develop sustainable forestry and reduce fuelwood demand:

- Reduce demand for fuelwood via the dissemination and usage of fuel-efficient stoves and/or alternative-fuel cooking and baking techniques (such as electric, LPG, or biogas stoves) leading to reduced forest degradation;
- Increased afforestation, reforestation, and forest management to increase carbon sequestration in forests and woodlands.

The CRGE builds on a series of progressive development strategies that have begun to link economic growth, poverty reduction and sustainability. Since the late 1990s, the Government of Ethiopia has had clear aspirations for broad-based sustainable development and poverty reduction, as evidenced in a series of strategies such as the Sustainable Development for Poverty Reduction Programme (SDPRP, 2000-2004), the Plan for Accelerated and Sustained Development to End Poverty (PASDEP, 2005 to 2009), and the Growth and Transformation Plan (GTP, 2010-2014). The effects on the economy of the first two strategies were judged to be very significant, with strong economic growth, poverty reduced, employment increased, and some exports flourishing (MoFED, 2002, 2005).

- National Growth and Transformation Plan (GTP) (2011 – 2015)

Under the National Growth and Transformation Plan (GTP) the National Clean Cook Stove Programme Ethiopia (NCCSPE) addresses the energy demands of rural households, while recognising the reality that wood is likely to continue to be the main source of energy for many. However, rural households that use open wood fires to cook household meals suffer health problems associated with indoor air pollution. As part of the NCCSPE programme, World Vision has been promoting fuel-efficient stoves, known as Tikikil, in Ethiopia. This stove produces little or no smoke and consumes

[4] Measured at the US$ 1.50 per day poverty line.

less fuel wood[5]. World Vision's pilot project in the Oromiya region of Ethiopia disseminated 2,500 Tikikil stoves, and expanded to other regions such as Amhara, using an inclusive approach.

- Country Partnership Strategy (CPS) (2013 – 2017)

The present CAS aims at (i) fostering economic growth, (ii) improving access to and quality of basic services, (iii) reducing vulnerability, and (iv) fostering improved governance. Bottom-up initiatives have been strongly encouraged as a complement to traditionally strong top-down action. The upcoming Country Partnership Strategy (CPS) for FY2013-17 will build upon the achievements of the CAS and support GOE's broader objective for the sector to modernize the sector institutions and build their overall capacity.

- GIZ-Sustainable Land Management (SLM) programme (2005 – 2014)

The Sustainable Land Management (SLM) programme, initiated by the Government of Ethiopia in collaboration with donors (*e.g.* World Bank, Finland, EU and Germany) and other stakeholders to reverse land degradation and improve agricultural productivity. SLM activities in Amhara, Oromiya and Tigray regions already show encouraging results: about 77,000 hectares of land have been rehabilitated; a further 79,000 hectares of forest are being maintained in accordance with participatory forest management principles; and some 50,000 households, have adopted sustainable land management practices. This kind of programme could form the core of any local green economy – protecting the natural assets that underpin development and livelihoods.

Several regional programmes have been initiated by national and international NGOs and bilateral and multilateral donors on sustainable land management, plantation establishment, improved stove dissemination and use of other energy carriers than biomass for cooking (see Inception report, ÖBf 2013)

2.4.2 Energy Sector

In March 1994, the Transitional Government of Ethiopia (TGE) released its energy policy, the first of its kind. As of 2012, this is still in force as the policy of the GoE. It aims to address household energy problems by promoting agro-forestry, increasing the efficiency with which biomass fuels are utilized, and facilitating the shift to greater use of modern fuels. The policy paper states that the country will rely mainly on hydropower to increase its electricity supply, but also take advantage of Ethiopia's geothermal, solar, wind and other renewable energy resources where appropriate. In addition, it aims to further explore and develop oil and gas reserves. It also refers to the need to encourage energy conservation in industry, transport and other major energy-consuming sectors, to ensure that energy development is environmentally sustainable and, to provide appropriate incentives to the private sector.

[5] World Vision, 2012

In February b2013 the Ministry of Water and Energy published the 2nd draft of its national Energy Policy. The policy paper aims to enhance bio energy supply and increase bio energy use efficiency. A major objective is to integrate environmental sustainability into energy production and supply. Specific bio energy objectives include:

- Sustainable forest management
- Enhance diverse and efficient bio-energy production
- Ensure bio-energy security
- Promote availability of end-use devices

The FYGTP stated that disseminating the use of improved alternative (to traditional biomass) energy technologies could minimize deforestation, reduce indoor air pollution that creates health problems and additionally it could contribute on saving working time of women's and children which is caused by searching, collecting and transporting wood fuels. It would support capacity building for regional implementers and other stakeholders to develop alternative energy technologies.

As with the PASDEP there were no specific proposals regarding traditional biomass energy in the rural or urban situation.

2.4.3 Forestry Sector

Previous under the Ministry (and Regional Bureaus) of Agriculture, the forestry sector has very recently (September, 2013) been brought under the new Ministry of Environmental Protection and Forestry.

Forests

Historically forestry rules and regulations have been very restrictive to public access – but not effective in banning people, much more so than with access of lands for agriculture. The new federal Forest Development, Conservation and Utilization Proclamation (542/2007) provides the framework for making fundamental changes to forest resource management across the country. This federal proclamation recognised two types of forest ownership, state and private forest ownership. It is not known if any "private forests" have been designated. However, it seems that the Ministry regards community ownerships as "private" (Damtie, 2008).

Ethiopia has taken successful steps in the devolution of powers to communities. Since the mid-90s, the concept of participatory forest management has been successfully promoted and developed in Ethiopia. It has received support from various donors and organisations, such as GIZ, EC, JICA and Farm Africa. PFM has proven to be effective in the conservation and sustainable management particularly of natural forests. The forest proclamations for Oromiya and SNNPR recognise "community forests". More recently, under a participatory forest management (PFM) project in the Masha and Anderacha woredas of SNNPR "PFM associations" and forest user groups have been legally established as non-profit making organisations with official agreements with the Bureau of Agriculture to manage the forests (demarcated by GPS) within their administrative areas. These are community forests within the meaning of the regional proclamation.

In Oromiya region for example the regional forest products enterprise has rental agreements with forest user groups to manage forest within their administrative area under a system known locally as "*wajib*".

Trees in communal lands

Especially in northern Ethiopia (Tigray and Amhara regions) communal lands are increasingly coming under “enclosure” with livestock exclusion and the prohibition on tree removal. This has resulted in households adopting the following strategies:

- Planting trees on own land (in Tigray not on cropland);
- Harvesting wood and grazing on communal lands not enclosed;
- Using crop residues and dung.

Trees in household lands

The most frequently planted tree species on the farm is Eucalyptus. The two most frequently planted Eucalyptus species are *E. globulus* in the higher rainfall areas, and *E. camuldalensis* in the lower rainfall areas. Prior to 1991 cutting of trees was prohibited and as a consequence very little on-farm tree planting took place under the Derg[6]. With the installation of the transitional government the prohibition on tree cutting was lifted and the tenure and use rights to planted trees were secured. With the accelerating economy and the subsequent building boom, there was a tremendous increase in the demand for construction poles in the entire major and many of the minor centres. This in turn triggered an increase in on-farm tree planting of Eucalyptus.

In Tigray planting of trees on cropland is generally prohibited because of the general shortage of land for crop production.

2.4.4 Status of Charcoal

Charcoal production and marketing has always been almost entirely informally organised and implemented by the private sector. Prior to 1993 the state owned Construction and Fuelwood Production and Marketing Enterprise (CFPME) had in theory the monopoly for charcoal production and marketing. In practice a great proportion of charcoal was produced and marketed "illegally" outside the State monopoly. After 1993 CFPME wound down its operations and was finally disbanded.

In August 1997 all check points for charcoal were removed. It was intended that charcoal production could be better controlled by communities themselves. It was also envisaged that charcoal producers would be licensed and that Bureaus of Agriculture would be able to develop and enforce sustainable forest practices. In practice there have been delays in developing and implementing sustainable charcoal production practices at the field level and instituting a system of licensing and currently there is no nationally implemented charcoal strategy. However, increasingly regions are taking their own initiatives.

Charcoal production and marketing continue to be legally ill defined.

In Amhara region charcoal production and sales are permitted only if Eucalyptus or other exotic species are used. This has been occasioned by the opening up of the timber and charcoal markets in Sudan with the construction of the new road through Metema to Sudan.

6 Although a tremendous amount of tree cutting took place immediately after the economic "U" turn by the Derg in 1990.

In the Afar region in some of the large irrigation farms, charcoal burners are being invited to remove and use the invasive and disturbing tree *Prosopis* for the production of charcoal. Prosopis was introduced to partly reduce soil erosion, partly to produce biomass for feed and as life fence.

Currently, little or no official technical support is given to charcoal production and marketing, which is a legacy of the negative official view on charcoal production as being responsible for deforestation. There is no linkage of woodland and forest management to the production of charcoal, through e.g. 20-30 years rotational harvesting of woodland for charcoal production linked to woodland communities' supervision and licencing.

3. Overview of Biomass Energy Supply, Demand and Energy Balance

For more detailed information in this chapter please see the "Baseline Sub-sector Analysis and Scenario Development Report" (Report Phase 2 of the project)

3.1 Biomass Energy Demand

3.1.1 Rural Biomass Energy Demand: Household Level

(i) Per Capita Annual Fuel Quantities Used

The annual per capita quantities of the various biomass fuels consumed by livelihood zone are shown in the following table. Households tend to use less round wood and more BLT (branches, leaves, and twigs) in the wet season because of the higher price and lower heat value (due to high moisture content) of round wood.

Table 2 Per Capita Annual Quantities of Various Fuels Consumed by Livelihood Zone.

LZ	Fuelwood	BLT	Residues	Dung	Charcoal	Diesel	Kerosene	Electricity
kgs	kgs	kgs	kgs	kgs	litres	litres	kWh	
Dega LZ	609	267	-	202	79	-	11	0.47
WD: Dry	69	124	-	1,147	79	-	2	0.07
WD: Moist	882	534	487	619	183	4	-	1.37
WD: Vertisols	538	758	-	754	22	-	3	-
Cereal: Enset minor	603	285	236	105	17	13	15	-
Enset dominant	1,078	420	435	-	4	4	-	7.28
Woody Fallow	528	379	762	251	48	-	6	-
Agro-pastoral	450	-	-	-	-	-	4	-
Pastoral	605	-	-	51	202	-	7	-

The highest fuelwood consumption per capita can be found in the Woina Dega: Moist, Woina Dega: Vertisols and the Enset Dominant Zones. All these Zones experience the highest rainfall totals and environmental conditions are most suitable for tree growing. The Woina Dega: Dry Zone has a particularly low rate of wood fuel use which reflects the low rainfall and adverse tree growing environment. Energy requirements are met by the heavy use of dung and charcoal. The use of dung precludes its use as a soil ameliorant thus causing soil nutrient deficiencies and low crop yields.

(ii) End Use of Biomass Fuels

The main uses for biomass fuels are for mitad baking (njera, ambasha, kocho, etc.) and "other cooking" (wot, coffee, etc.). With respect to round wood in some zones its preferred use is for mitad baking and other zones for other cooking. BLT and crop residues are always preferred for mitad baking and charcoal for other cooking.

(iii) Cooking Devices

(a) Mitad baking

The use of various devices for mitad baking are shown in table 3. The 3 stone fire is most used in all zones except in the Dega and WD: Dry Zones. In Tigray the traditional enclosed clay stove is the most commonly used device (figure 4). The improved biomass mitad is adopted in all zones except the enset and pastoral/agro-pastoral zones.

Table 3 Percent of Households Using Various Devices for Mitad Baking.

Device	Dega LZ	WD: Dry	WD: Moist	WD: Vertisols	Cereal: Enset minor	Enset dominant	Woody Fallow	Agro-pastoral	Pastoral
3 stone open			46%	75%	94%	100%	25%	100%	92%
Traditional mitad							38%		
Traditional charcoal									33%
Enclosed clay stove ("Tigray")	8%	100%							
Improved biomass mitad	92%		19%	25%	6%		38%		

Figure 4 Enclosed Clay Stove Used in Tigray

(b) Other Cooking Devices

Again the 3 stone fire is the most commonly used with the traditional mitad and charcoal stove (Table 4). In Tigray the traditional clay stove is universal.

Table 4 Percentage Households Using Various Devices for Other Cooking.

Device	Dega LZ	WD: Dry	WD: Moist	WD: Vertisols	Cereal: Enset minor	Enset dominant	Woody Fallow	Agro-pastoral	Pastoral
3 stone open	50%		79%	88%	94%	100%	25%	8%	58%
Traditional mitad	17%						38%		8%
Traditional charcoal	8%								42%
Enclosed clay stove ("Tigray")		100%							
Improved biomass mitad			6%	13%	11%		25%		

(iv) Lighting Devices

As with cooking rural households use a wide variety of lighting devices should the main device or its fuel fail. The kerosene lamp is the main device in all zones. "Other lamp" refers to the lamp that uses diesel. Electricity is used in 6 of the 9 zones surveyed. The electric torch is the most common stand by device.

3.1.2 Urban Biomass Energy Demand: Household Level

(i) Per Capita Fuel Use Rates

The survey looked at small towns (population < 50,000) and large towns (population >50,000). The results are presented in tables 5 and 6. The annual amounts of fuel wood consumed are generally less in the large towns. Households in Makele town use large amounts of dung. With respect to other fuels (charcoal, kerosene and diesel) there appears to be little difference between large and small towns. As with rural households urban households use more wood in the wet season. More charcoal is also consumed in the wet season. In rural and urban areas wood fuel prices are higher in the wet season.

Table 5 Large Towns: Per Capita Annual Quantities of Various Fuels Consumed by Region

REGION	Fuelwood	BLT	Residues	Dung	Charcoal	Diesel	Kerosene	Electricity
	kgs	kgs	kgs	kgs	kgs	litres	litres	kWh
Tigray	69	124		1,147	79		2	0.07
Amhara	359	386		178	90		3	
Oromiya	159				114	3	3	20.90
BSG	359	15			103			1.28
SNNP	385	76	135	127	60	.	1	0.01
Somali	334				455		5	1.08

Table 6 Small Towns: Per Capita Annual Quantities of Various Fuels Consumed by Region

REGION	Fuelwood	BLT	Residues	Dung	Charcoal	Diesel	Kerosene	Electricity
	kgs	kgs	kgs	kgs	kgs	litres	litres	kWh
Tigray	41			72	163	-	1	1.92
Oromiya	469	15	202	79	115	-	5	1.79
BSG	482	50	10	114	46	-	66	0.47
SNNP	579	198	198	192	400		2	- 149.0
Somali	511				246		6	1.71

(ii) End Use of Biomass Fuels in Urban Areas

Generally households use preferable wood for mitad baking. Charcoal is always used for other cooking.

(iii) Cooking Devices Used

(a) Mitad Baking

The use of 3 stone fire is very widespread in both large and small towns. The use of the electric mitad is more widespread in the larger towns. The use of the enclosed clay stove is universal in Tigray.

(b) Other Cooking

Again, traditional cooking devices (3 stone fire and charcoal stove) are used by most households in both large and small towns. Electric stoves are becoming widespread in the larger towns.

(iv) Lighting Devices

Electricity is universally used in the urban areas. Backup devices include torches, kerosene lamps and battery lamps.

3.2 Biomass Energy Consumption: National and Regional Levels

3.2.1 Biomass Energy Consumption at National and Regional Levels

(i) Rural Household Biomass Fuels Consumption

Total rural household consumption of wood (including charcoal equivalent of wood) is estimated to be 91.2 million per year with 4.2 million tons per year of charcoal. Total consumption of residues and dung is estimated to be 19.3 million tons per year and 20.7 million tons per year respectively (table 7). Oromiya, SNNP and Amhara Regional shares of total wood (including charcoal as wood) consumption are 38 percent, 26 percent and 24 percent respectively.

Table 7 Total Rural Household Consumption of Biomass Fuels (2013)

REGION	Round wood	BLT	Charcoal as wood	Total wood	Total wood	Residues	Dung	Charcoal
	tons/yr	tons/yr	tons/yr	tons/yr	%	tons/yr	tons/yr	tons/yr
ADDIS ABABA	-	-	-	-	0%	0	0	0
AFAR	667,050	-	1,073,383	**1,740,433**	2%	0	49,364	214,677
AMHARA	8,284,974	6,973,597	5,325,791	**20,676,193**	23%	3,574,559	7,180,842	1,083,524
BSG	367,224	266,544	174,767	**808,535**	1%	424,914	176,495	34,953
DIREDAWA	86,227	54,698	39,206	**180,131**	0%	39,971	29,548	7,841
GAMBELA	143,365	73,643	40,752	**269,794**	0%	53,816	39,783	9,638
HARARI	60,582	38,463	43,281	**142,327**	0%	28,108	21,501	8,656
OROMIYA	16,667,148	11,035,051	7,773,817	**35,476,016**	40%	7,353,173	6,167,744	1,554,763
SNNPR	13,391,328	6,614,107	2,242,178	**22,247,613**	25%	6,781,864	2,026,161	448,436
SOMALI	2,088,070	209,271	2,491,943	**4,789,285**	5%	152,929	220,755	498,389
TIGRAY	484,006	941,441	1,359,979	**2,785,426**	3%	31,256	3,519,733	271,996
TOTAL	**42,239,975**	**26,206,816**	**20,565,097**	**89,115,753**		**18,440,590**	**19,431,926**	**4,132,873**

(ii) Total Urban Household Biomass Fuels Consumption

Total urban household consumption of wood (including charcoal equivalent of wood) is estimated to be 11.2 million tons per year with 1.3 million tons of charcoal. Total consumption of residues and dung are 0.4 million tons per year and 2.1 million tons per year respectively (table 8). Oromiya, Amhara, SNNP and Addis Ababa Regional shares of wood (including charcoal equivalent of wood) consumption are 27 percent, 20 percent, 19 percent and 12 percent respectively.

Table 8 Total Urban Household Consumption of Biomass Fuels (2013)

REGION	Round wood	BLT	Charcoal as wood	Total wood	Total wood	Residues	Dung	Charcoal
	tons/yr	tons/yr	tons/yr	tons/yr	%	tons/yr	tons/yr	tons/yr
ADDIS ABABA	563,136	-	781,124	**1,344,260**	12%	-	39,964	156,225
AFAR	143,304	-	60,778	**204,082**	2%	-	-	12,156
AMHARA	618,952	667,743	919,357	**2,206,052**	20%	345	824,750	183,871
BSG	51,372	4,987	26,827	**83,186**	1%	2,332	11,940	5,365
DIREDAWA	118,155	-	284,406	**402,561**	4%	-	-	56,881
GAMBELA	37,035	984	52,805	**90,824**	1%	13,253	5,183	10,561
HARARI	67,363	-	162,146	**229,509**	2%	-	-	32,429
OROMIYA	945,688	35,584	2,074,212	**3,055,485**	27%	218,277	94,068	414,842
SNNPR	675,666	141,883	1,279,933	**2,097,482**	19%	210,504	203,548	255,987
SOMALI	382,745	1,884	573,925	**958,554**	9%	-	-	88,538
TIGRAY	58,148	104,498	332,876	**495,521**	4%	-	966,603	66,575
TOTAL	3,661,564	957,564	6,548,388	**11,167,516**		444,711	2,146,057	1,283,430

(iii) Total Commercial Services Biomass Fuels Consumption

Total commercial services consumption of wood (including charcoal equivalent of wood) is estimated to be 1.5 million tons per year with 0.16 million tons of charcoal (table 9). Total consumption of residues and dung are negligible. Addis Ababa and Oromiya regional shares of wood (including charcoal equivalent of wood) consumption are 26 percent and 18 percent respectively. Not included in these figures are the very large educational and corrective facilities which have vastly increased in numbers in the past decade.

Table 9 Total Commercial Services Consumption of Biomass Fuels (2013)

REGION	Round wood	BLT	Charcoal as wood	Total wood	Total wood	Residues	Dung	Charcoal
	tons/yr	tons/yr	tons/yr	tons/yr	%	tons/yr	tons/yr	tons/yr
ADDIS ABABA	121,092	-	279,315	400,408	26%	-	-	55,863
AFAR	20,198	-	60,993	81,191	5%	-	-	12,199
AMHARA	111,821	536	71,021	183,379	12%	-	-	14,204
BSG	712	178	1,299	2,189	0%	-	-	260
DIREDAWA	15,448	-	35,634	51,082	3%	-	-	7,127
GAMBELA	1,253	109	2,679	4,040	0%	-	-	536
HARARI	8,782	-	20,258	29,040	2%	-	-	4,052
OROMIYA	199,463	-	73,674	273,137	18%	-	-	14,735
SNNPR	149,887	7,583	22,569	180,039	12%	1,166	134	4,514
SOMALI	49,830	-	137,701	187,531	12%	-	-	27,540
TIGRAY	11,182	-	121,912	133,094	9%	-	-	24,382
TOTAL	**689,668**	**8,407**	**827,055**	**1,525,130**		**1,166**	**134**	**165,411**

(iv) Total National Biomass Fuels Consumption

Total national consumption of wood (including charcoal equivalent of wood) is estimated to be 105.2 million tons per year with 5.7 million tons of charcoal (table 10). Total consumption of residues and dung are 19.7 million tons per year and 22.8 million tons per year respectively. Oromiya, SNNP and Amhara regional shares of wood (including charcoal equivalent of wood) consumption are 37 percent, 25 percent and 23 percent respectively.

Table 10 Total National Consumption of Biomass Fuels (2013)

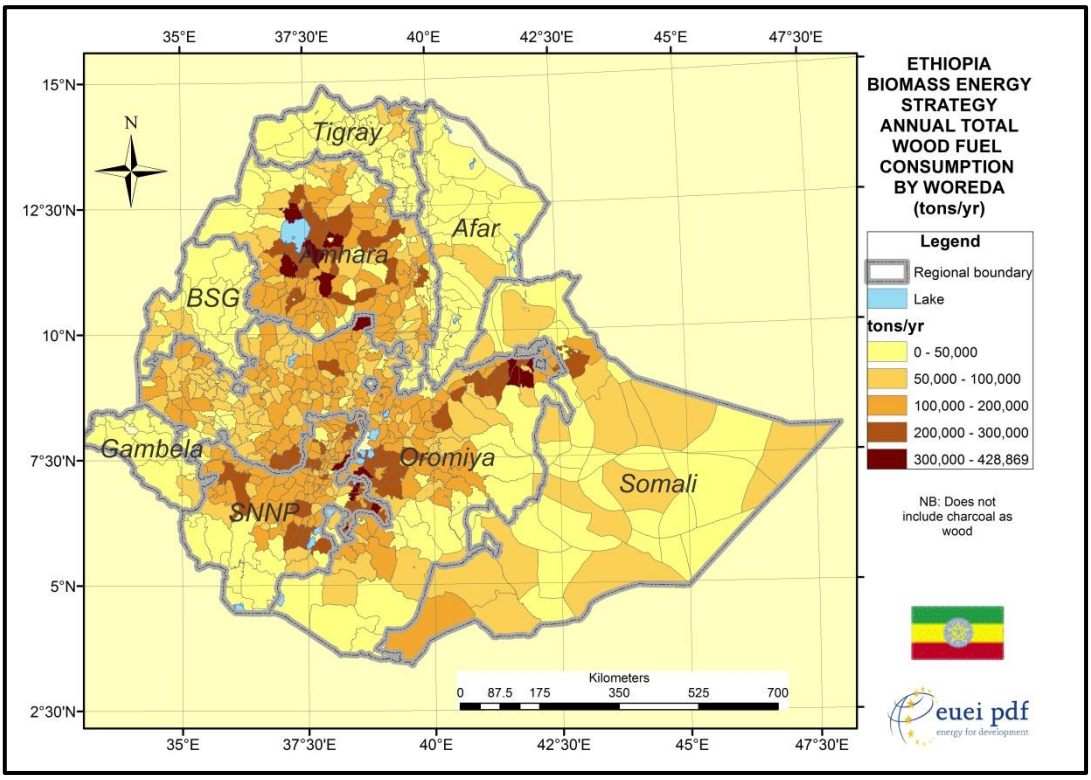
REGION	Round wood	BLT	Charcoal as wood	Total wood	Total wood	Residues	Dung	Charcoal
	tons/yr	tons/yr	tons/yr	tons/yr	%	tons/yr	tons/yr	tons/yr
ADDIS ABABA	684,228	-	1,060,439	1,744,667	2%	-	39,964	212,088
AFAR	830,552	-	1,195,154	2,025,706	2%	-	49,364	239,031
AMHARA	9,549,847	8,042,277	6,603,169	24,287,123	23%	3,867,504	8,221,892	1,339,000
BSG	419,308	271,709	202,893	893,911	1%	427,246	188,435	40,579
DIREDAWA	219,831	54,698	359,246	633,774	1%	39,971	29,548	71,849
GAMBELA	181,653	74,736	96,236	364,659	0%	67,069	44,966	20,735
HARARI	136,728	38,463	225,685	400,876	0%	28,108	21,501	45,137
OROMIYA	17,812,299	11,070,636	9,921,703	38,804,638	37%	7,571,451	6,261,813	1,984,341
SNNPR	15,264,304	7,185,536	3,564,630	26,014,470	25%	7,539,192	2,229,843	712,926
SOMALI	2,520,644	211,155	3,203,569	5,935,369	6%	152,929	220,755	614,467
TIGRAY	614,995	1,284,533	2,167,743	4,067,271	4%	31,256	5,511,309	433,549
TOTAL	**48,234,389**	**28,233,742**	**28,600,468**	**105,172,465**		**19,724,725**	**22,819,390**	**5,713,700**

3.2.2 Spatial Patterns of Biomass Energy Consumption

(i) Wood fuel

This is shown in Text Map 3. The highest wood fuel use occurs around and to the east of lake Tana in Amhara region. High amount of wood fuel use are found along the Hareghe highlands and either side of the Rift Valley in SNNP and Oromiya regions.

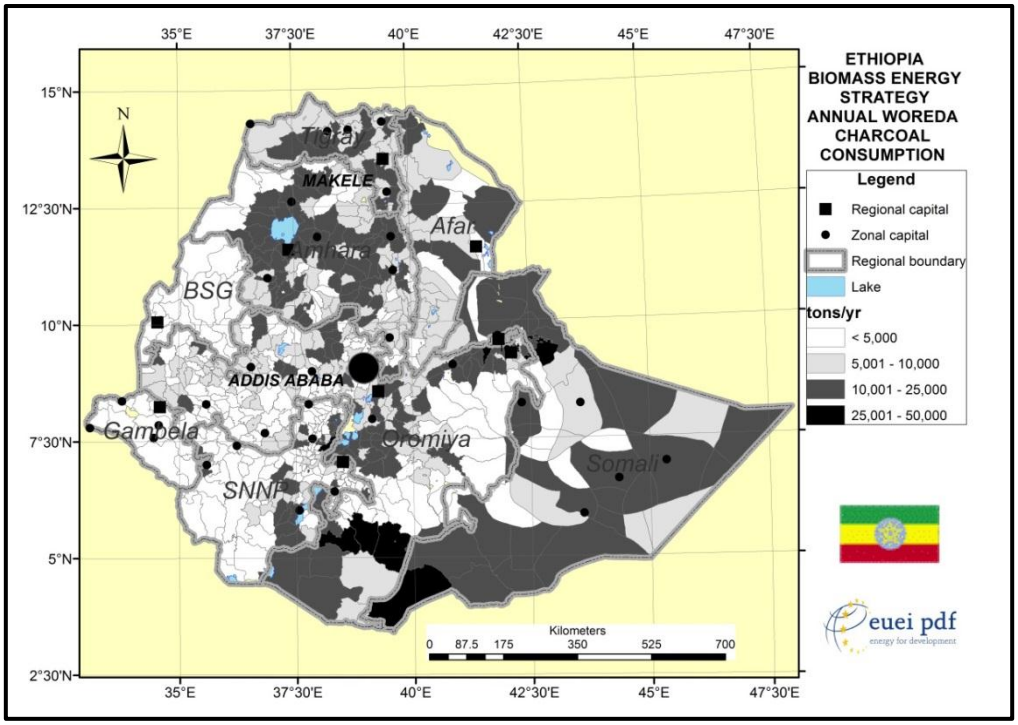
Text Map 3 Annual Total Wood Fuel (excluding wood as charcoal) Consumption by Woreda



(ii) Charcoal

The main charcoal consuming areas are in Afar and Somali regions in the lowlands, and eastern Oromiya, Amhara and Tigray regions in the highlands.

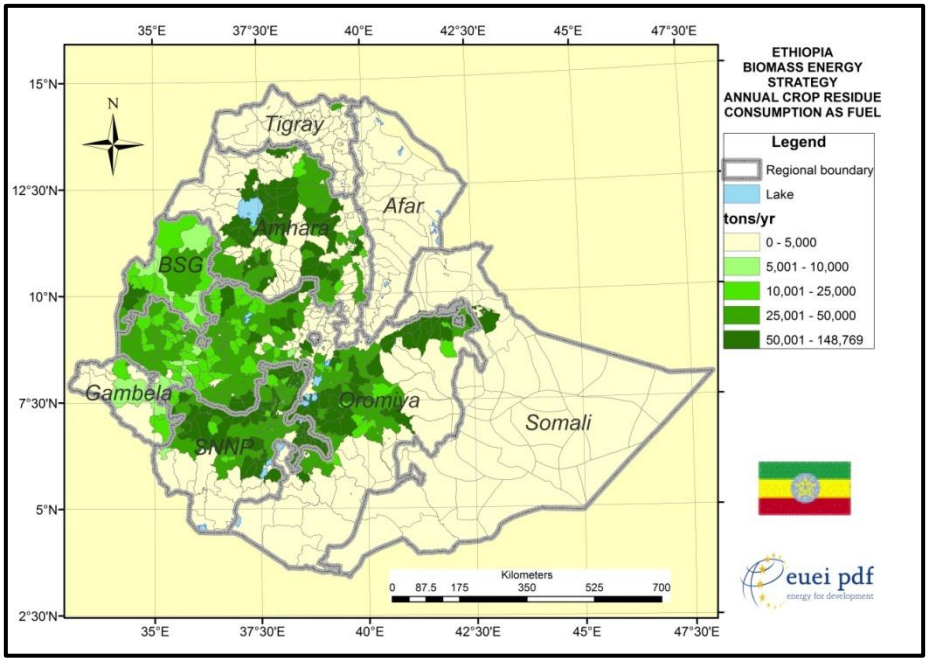
Text Map 4 Annual Total Charcoal Consumption by Woreda



(iii) Crop Residues

Crop residues are used as fuel almost totally in the highlands although the amounts in Tigray are relatively low.

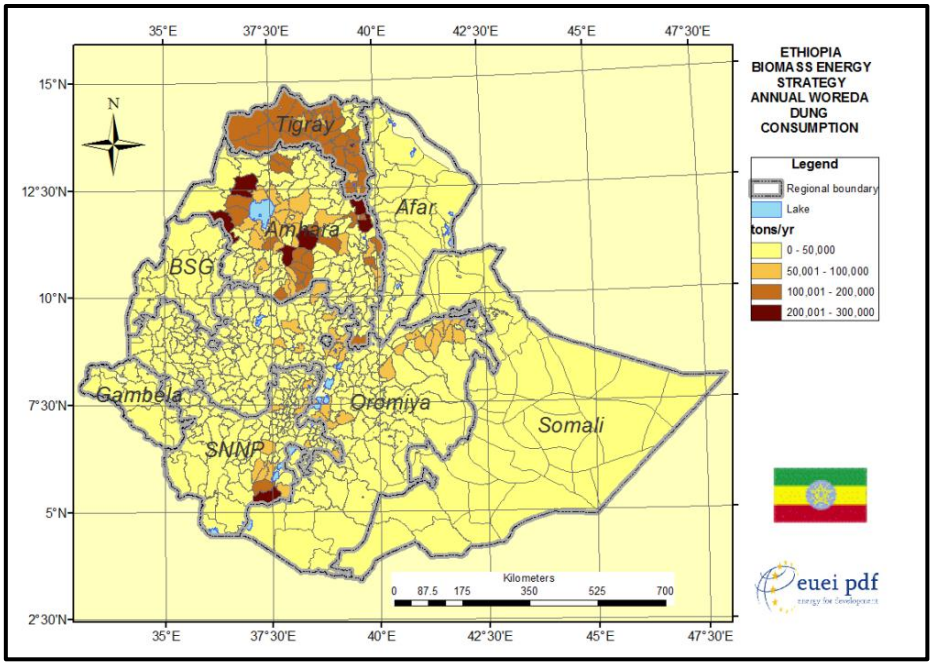
Text Map 5 Annual Total Residues Consumption by Woreda



(iv) Dung

The main areas of high dung use as fuel are the highlands in Tigray, Amhara (around lake Tana), eastern Oromiya (Hareghe) and the southern Rift Valley in SNNP region.

Text Map 6 Annual Total Dung Consumption by Woreda



3.3 Biomass Energy Supply

Supply of all biomass energy fuels is shown in table 11. The table is elaborated on below.

Table 11 Annual Supply of Woody Biomass Energy Fuels (tons/yr)

REGION	Natural stock	Natural yield	HH Stock	HH Yield	Total Yield	BLT	Dead wood	Wood clearing	Sustainable yield	Sustainable wood yield
	tons	tons/yr	tons	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	%
ADDIS ABABA	503,009	83,835	-	-	83,835	16,767	-	-	100,602	0.1%
AFAR	15,639,133	909,141	-	-	909,141	181,830	312,783	-	1,403,754	0.7%
AMHARA	111,210,009	5,870,207	296,872,394	26,718,515	32,588,722	1,987,401	2,224,203	-	36,800,326	18.7%
BSG	76,613,747	3,529,603	7,648,653	688,379	4,217,982	705,920	1,532,275	-	6,456,177	3.3%
DIREDAWA	565,621	34,427	2,943,252	264,895	299,322	7,240	11,313	-	317,875	0.2%
GAMBELA	69,150,099	3,319,332	3,958,970	356,307	3,675,639	664,316	1,815,641	-	6,155,597	3.1%
HARARI	15,708	1,037	2,067,722	186,095	187,132	-	-	-	187,132	0.1%
OROMIYA	348,563,457	17,983,736	519,072,363	46,726,583	64,710,319	3,851,003	6,935,040	1,611,088	77,107,450	39.2%
SNNPR	226,831,897	9,264,276	362,786,103	32,658,977	41,923,253	2,120,243	4,995,391	-	49,038,887	25.0%
SOMALI	261,209,171	7,949,673	14,605,082	1,314,457	9,264,130	1,589,931	5,224,183	-	16,078,245	8.2%
TIGRAY	30,508,605	809,615	14,410,347	1,296,931	2,106,546	177,089	610,170	-	2,893,805	1.5%
TOTAL	**1,140,810,456**	**49,754,882**	**1,224,364,885**	**110,211,141**	**159,966,022**	**11,301,740**	**23,660,999**	**1,611,088**	**196,539,850**	

3.3.1 Natural Wood

Between 1990 and 2002 the Woody Biomass Inventory and Strategic Planning Project[7] (WBISPP) mapped the landcover and inventoried the woody biomass in all land cover types. To date, neither the landcover mapping nor the inventory has been repeated. In the high population density regions of Tigray, Amhara, Oromiya and SNNP regions land scarcity has meant that cropland expansion has all but ceased. Thus there has been no significant reduction in the non-cropland areas. In many of these areas "area closure" has been implemented with livestock exclusion, recovery of the herbaceous and woody vegetation.

Thus, it is considered that the natural woody biomass supply estimates of the WBISPP are still valid. It is known that considerable expansion of cropland has taken place in the past 10 years in northern Somali region, caused by the considerable loss of livestock and the change from pure pastoralism to agro-pastoralism. In the western lowlands of Ethiopia there has been considerable (but not mapped) expansion of commercial agriculture, which has resulted in loss of woodland/shrubland vegetation. In the southwest there has been a reduction in forest cover caused by the expansion of agriculture.

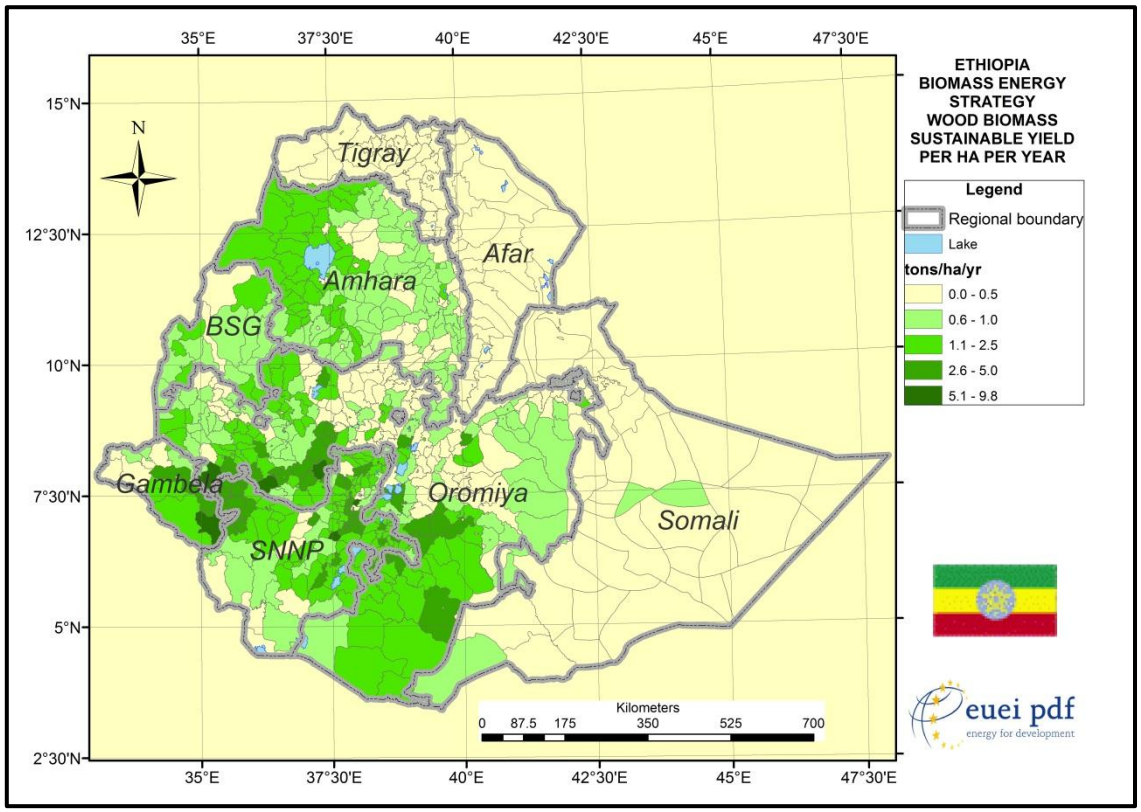
Notwithstanding these cases of reduction in woody biomass the WBISPP woody biomass stock and yield estimates are still valid over large areas of densely populated Ethiopia and are therefore retained in this strategy.

Total sustainable natural woody biomass yield is estimated to be 49.7 million tons (air dried weight). Oromiya, SNNP and Amhara regions have the largest sustainable supplies having 35 percent, 29 percent and 19 percent of the national total.

The sustainable yield per ha of natural woody biomass is shown in Text Map 8. The highest rates are found in the southwest and southeast high forests and in the woodlands of the western lowlands. The lowest sustainable supply rates are located in the arid and semi-arid eastern and south-eastern lowlands.

[7] WBISPP Phase 1 was funded under the GoE/World Bank Energy I Project and Phase 2 funded under the GoE/World Bank Energy II Project

Text Map 7 Annual Natural Sustainable Supply of Woody Biomass by Woreda (tons/ha/yr)

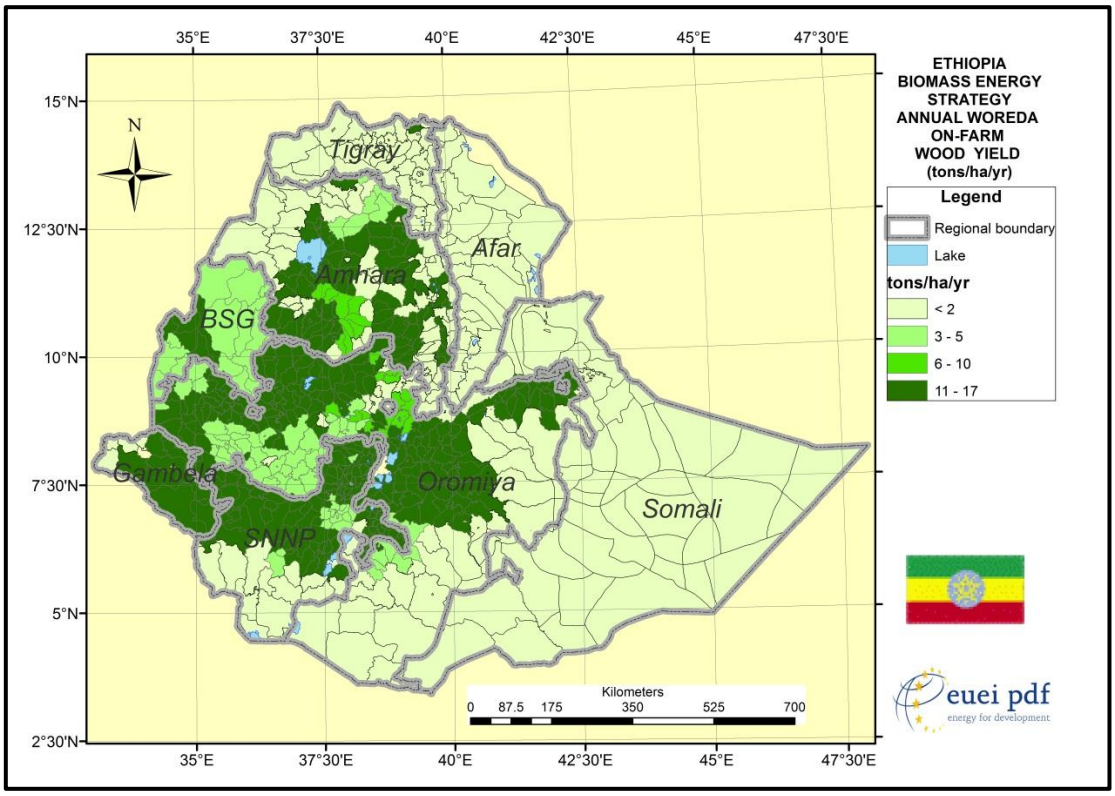


3.3.2 On-Farm Trees

The WBISPP undertook a very detailed and comprehensive survey of household biomass energy consumption rates and also of on-farm tree planting. By obtaining the numbers of trees planted at successive time periods and knowing the tree growth rates (mainly of Eucalyptus) it was possible to estimate the woody biomass in terms of stock and yield of the on-farm trees as at 2000.

The on-farm trees survey was conducted in 2013 as part of the baseline survey enabling a new estimate of the woody biomass stock and yield of on-farm trees as at 2013. The national estimate of on-farm woody biomass sustainable yield was 58.3 million tons. The estimate for 2013 is 110.2 million tons. The near doubling is caused by the fact that many of the on-farm trees enumerated in the 2000 survey have matured in the intervening years and these been supplemented by additional plantings since 2000.

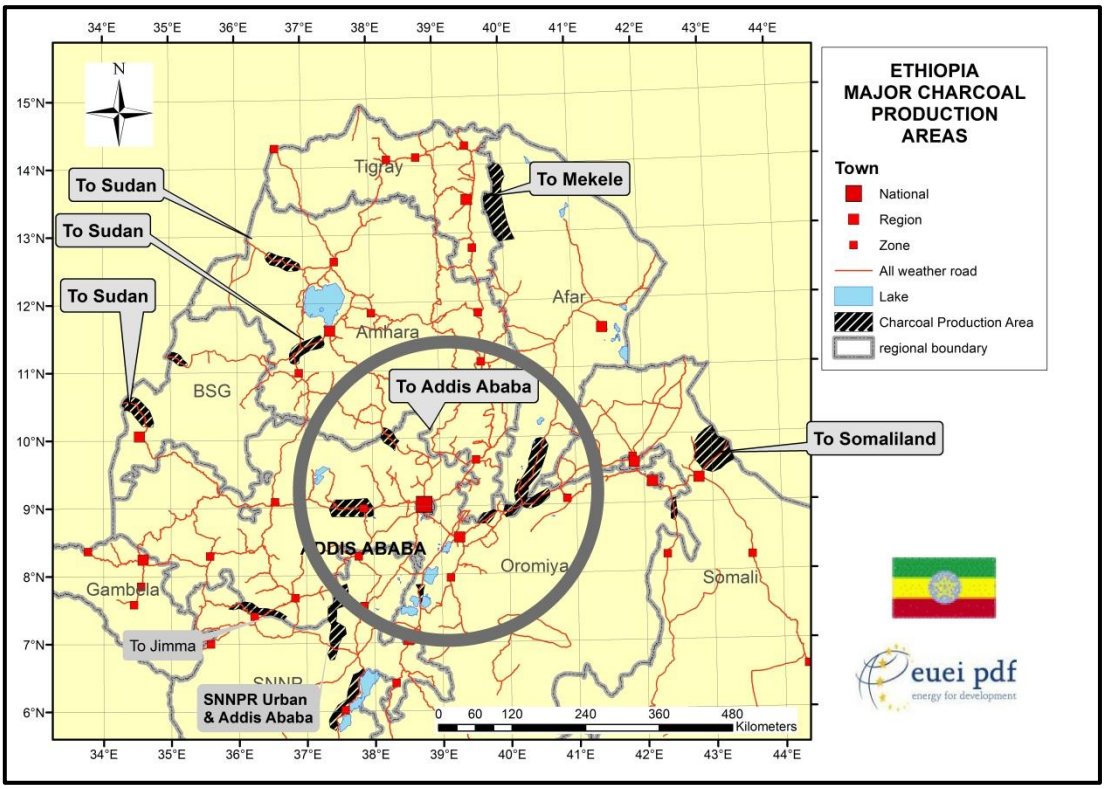
Text Map 8 Annual On-farm Sustainable Supply of Woody Biomass (tons/ha/yr)



3.3.5 Charcoal

The main remote producing areas are in the Afar region within close proximity to the Djibouti-Addis Ababa main road, and in the Oromiya region along the same road between Metahara and Nazereth, and in the central rift valley lakes area in East Shewa zone along the Shashamene to Mojo road. Other more remote areas are the Abay Gorge area along the Addis Ababa to Gojam road and parts of West Shewa zone along the Addis Ababa - Nekempte road. Relatively smaller amounts are produced around Addis Ababa up to a radius of about 50kms. MPG (2003) reports a loosely organized arrangement among suppliers who hire trucks to collect and transport the charcoal, the truck owners and the main charcoal wholesalers.

Text Map 9 Ethiopia: Main Locations of Charcoal Production



3.3.3 Crop Residues and Dung

The potential supply of crop residues was estimated from the WBISPP farming systems survey and the WBISPP Livestock Feed Balance Survey. Total potential supply of residues has been estimated to be 22.4 million tons per year of which 10.3 million are used as fuel.

The potential supply of dung is 33.0 million tons per year of which 22.8 million tons per year is used as fuel.

Table 12 Annual Supply of Woody Biomass Energy Fuels (tons/yr)

REGION	Residues	Dung
	tons	tons
ADDIS ABABA	-	-
AFAR	121,808	2,644,408
AMHARA	7,372,259	10,668,086
BSG	211,207	175,310
DIREDAWA	-	-
GAMBELA	39,866	35,488
HARARI	7,878	2,724
OROMIYA	13,099,548	10,315,518
SNNPR	456,038	3,978,169
SOMALI	316,834	3,046,804
TIGRAY	782,439	2,093,812
TOTAL	**22,407,877**	**32,960,319**

3.4 Past Regional and National Trends in Biomass Energy Supply

3.4.1 Wood Fuel, Residues and Dung

The picture with round wood is mixed. In the following zones it has decreased: Pastoral, Agro-pastoral, Woody Fallow, Cereal: Enset Minor, WD: Vertisols and WD: Dry (6 out 8 zones). In the remaining two zones WD: Moist and Enset Dominant it has increased. In these two zones environmental conditions for on-farm tree growing are optimal and the increase in consumption has come from the increase in supply from these trees.

In areas where BLT is used, a steady increase in consumption of BLT coincides with the decline in round wood consumption. It is not clear why this has happened but it may be due to the increase in use of round wood for construction and poles for sale. Similarly, there has been an increase in the use of residues and dung where these fuels are used. This has important implications for the supply of livestock feed and the maintenance of soil fertility.

3.4.2 Charcoal

(i) Trends

The most significant change that has taken place in the past 15 years has been the massive increase in the consumption of charcoal in all regions. The increase far surpasses the increase in population. These changes are shown in table 13. In 2000 charcoal was only consumed in significant quantities in Tigray and Somali regions and hardly at all in all the other regions. In the intervening years there has been a massive increase in charcoal consumption by rural households in all regions.

Table 13 Ethiopia: Changes in Rural Household Consumption of Charcoal: 2000 – 2013 (tons/yr)

REGION	2000	2013
ADDIS ABABA	-	-
AFAR	1,905	214,677
AMHARA	-	1,083,524
BSG	3,787	34,953
DIREDAWA	-	7,841
GAMBELA	32	9,638
HARARI	-	8,656
OROMIYA	5,031	1,554,763
SNNPR	149	448,436
SOMALI	18,132	498,389
TIGRAY	19,545	271,996
TOTAL	**48,581**	**4,132,873**

(ii) Reasons behind Increase in Rural Charcoal Consumption

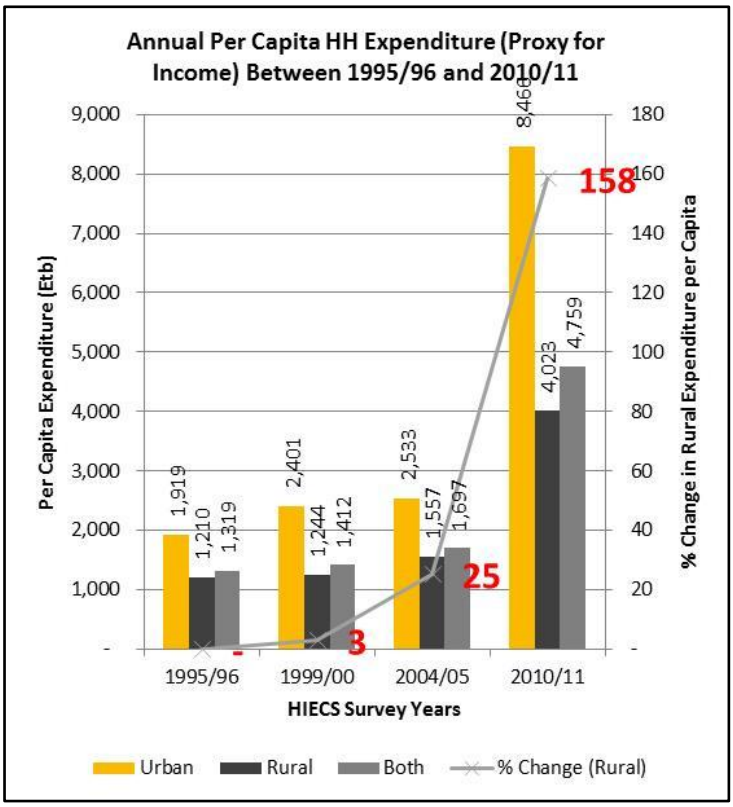
The reasons for this increase relate to a number of very significant changes that have taken place in the rural socio-economy in the past 15 years. These include:

- Significant increase in rural incomes;
- Proliferation of rural markets;
- Significant reduction in transport costs with improved road system and increase in rural accessibility;
- Land for tree growing reaching limits around cities or areas with growing demand.

(a) Significant Increase in Rural Incomes and Rural Monetisation

Rural incomes, measured using expenditure as a proxy, have been growing since 2004/05 and are **growing** exponential (**158%** in 2010/11 as compared to 2004/05) in recent years. Income from agriculture has risen considerably as a result of several favourable conditions (input supply, high-value crops, growing demand, technology, extension services, markets, rural finance, improved infrastructure [roads, transport services, market intelligence via mobile phones, etc.].

Figure 5 Annual Per Capita Household Expenditure Between 1995/96 and 2010/11



Apart from income from farming the opportunities for off-farm income have increased significantly:

- Petty trading;
- Services: Local liquor (tella, arake, tea, bread, etc.;
- Skilled labor e.g. carpentry, house construction;
- Casual labour landless labourers hired by landed farmers;

- Seasonal migration to cities and surplus growing areas;
- Brokering in the market, etc..

Remittances have become a significant income stream into rural areas from e.g. the Middle East and more recently the Sudan and Republic of South Africa. There are substantial amounts of cash entering the rural areas from the social safety net payments from the Productive Safety Net Programme (PSNP). This growing monetisation of the rural areas is reflected in consumer goods revolution – cellphones, radios, motorbikes, etc.

In the past 15 years there has been a substantial increase in government workers located at the kebelle level. These include:

- There are about 18,000 rural kebelles nationwide and almost every kebelle has an elementary school with 4 to 10 (sometimes more) teachers;
- Each rural kebelle has 2 to 4 extension workers;
- Each kebelle has at least one salaried kebelle manager;
- In each rural kebelle 2 to 5 public service employees working in woreda capitals but residing in rural kebelles.

Thus there are at least 200,000 salaried people throughout rural Ethiopia. This is equivalent to at least 11 salaried employees per rural kebelle. Each salaried person is bringing cash into their kebelle of residence contributing even further to the monetisation of the rural economy.

(b) Proliferation of Rural Markets

In the past 15 years in rural areas marketplaces are multiplying, but diminishing in size. For example in one woreda with 33 rural kebelles there are 16 markets, and 11 of these are of recent origin. This is equivalent to at least one market for every two rural kebelles or between 2 and 3 markets every day of the week.

Rural people travel to village markets at least twice a week and even more often during slack season. They are now the main source of livelihood for landless and near-landless rural men and women. Women and girls travel for trading. They buy goods and often sell them in the same market from the proceeds of which they purchase foodstuff such as coffee, salt, bread, pasta and fuels such as kerosene and **charcoal**. Not only goods but rural labour is also monetized, farm work is now carried for cash not as previously for one or more meals.

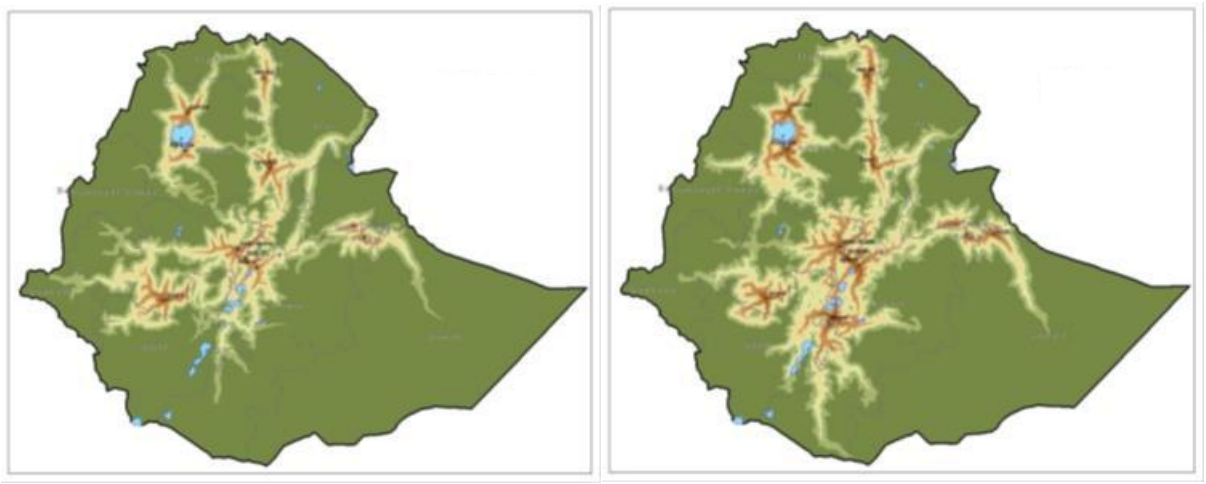
(c) Inter-Regional and Intra Rural Transport

By 2013 the Ethiopian Roads Authority has constructed over 16,500kms of rural roads. All regional and many zonal capitals are now connected by all-weather gravel or tarmac roads. This has reduced travel time for many rural communities as evidenced in the IFPRI Study (Schmidt & Mekamu Kedir, 2009)[8] and shown in the travel time maps for 1984, 1994 and 2007.

[8] Schmidt, E & Mekamu Kedir (2009) "Urbanisation and Spatial Connectivity in Ethiopia: Urban Growth Analysis Using GIS", Discussion Paper # ESSP2 003, IFPRI, Washington DC.

Figure 6 Travel Time Maps 1984, 1994 and 2007 (Source: Schmidt & Mekamu Kedir, 2009)

Travel Time 1984 **Travel time 1994**



Travel Time 2007

Historically travel and transport for rural inhabitants was confined to village level (95% of travel & transport effort). Due to improved infrastructure and concurrent improvements in transport services (isuzu trucks, mini-buses, horse carts, donkey carts, bicycles, motorbikes, etc.), no markets are anymore too far away to do business (figure 6).

The implications for charcoal production, marketing and rural consumption are:

- Rapid commercialization of goods and services including firewood and charcoal;
- Improved efficiency due to reduced cost of doing business hence growing rural incomes;
- Rural farm households are no more only suppliers of traded wood fuels but also net buyers.

Wood deficit or surplus woredas are no longer localized as efficient transport networks have made supplies (bulk or small) cheap and simple.

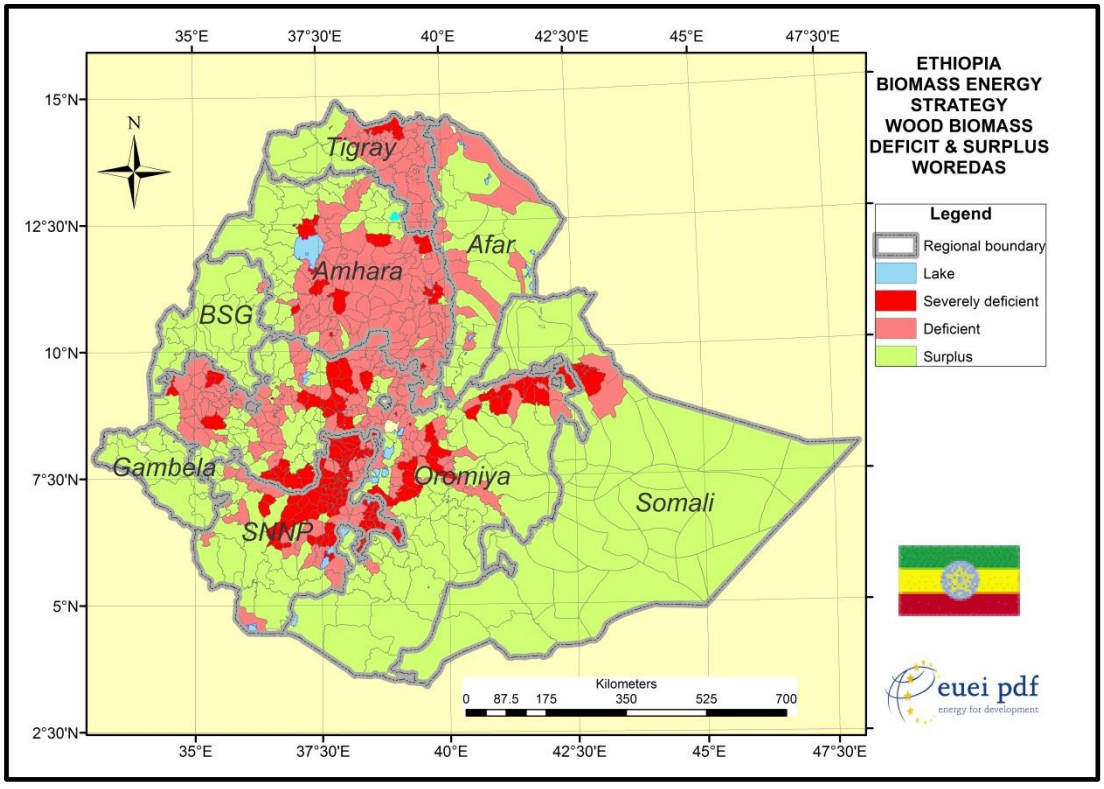
3.5 Biomass Energy Balance

The comparison of wood consumption (as round wood, BLT and wood as charcoal against the estimated sustainable supply permits an identification of the "hot spots" deficit woredas and those woredas with a positive sustainable supply.

The "hot spot" woredas are concentrated in parts of eastern Tigray, the Amhara highlands, the Hareghe and Arsi-Bale highlands, East and West Wellega and the Butajira, Chencha and Sidama highlands.

The sustainable surplus areas are mainly in the lowlands and the southwest forests and surround the deficit woredas. It is known that the expansion of agro-pastoralism in Afar, Somali and the Borena areas has significantly reduced tree vegetation and that field work revealed that these woredas are also experiencing a wood fuel deficit although they do not appear on the map as such. Also unknown is the extent of the expansion of medium and large scale commercial agriculture and the clearing of woodland vegetation in western Tigray, BSG, and Gambela regions, and the impact that this has had on local wood fuel balances.

Text Map 10 "Hot Spot" Wood Deficit Woredas and Positive Sustainable Wood Supply Woredas



4 Biomass Energy Strategy

4.1 Vision

"Biomass Energy is sustainable used for the socio-economic and environmental benefit of the Ethiopian people"

Biomass energy will be used over the coming decades. Thus it is important to increase sustainability. Total replacement by other fuels such as LPG, kerosene and bio-ethanol on a very large scale/rate is not realistic due to prices and availability. Electricity can be an option but may better be used for productive purposes (to fuel economic growth).

Available biomass energy resources have to be used in a sustainable way to strengthen the development of rural areas and to secure income for local people. Besides renewable energy sources reduce CO_2 emissions in comparison to the use of fossil fuels.

4.2 Strategy Goal

The Strategy Goal is:

"Improved access to sustainable and affordable biomass energy for all by 2030"

The BEST Goal is measured and verified through achievement of the BEST Objectives which have clear indicators and means of verification.

Biomass energy is obtained from sustainably managed forest resources and non-competing land uses and thus contributes to the growth of regional economy and the improvement of the living standards. This vision statement is in line with all government policies and strategies listed in chapter 2.

To become effective, the vision statement must be main-streamed into the implementation procedures from central to local level. The respective ministerial lead personnel in the fields of energy, forestry, environment and development are responsible for communicating the vision regularly, creating projects that illustrate the vision, setting short-term objectives compatible with the vision. These projects have to be implemented by the respective staff on regional and local level.

Table 14 The following section provides an overview on the differences of energy and agriculture related institutions on regional level.

Energy	Agriculture
Amhara National Regional State	
Rural Energy and Mines Resource Development Expansion Agency Energy Resource & Technology Development Core Process	**Agricultural Bureau** Natural Resource Department
Dire Dawa City Administration	
Rural Development Bureau **Water, Mines & Energy Office** **(3 Processes)**	**Rural Development Bureau** **Agriculture Development Office** **(3 Processes/ Departments)**

Water Resource Development Process Mines Resource Development Process Alternative Energy Development Process	Agriculture Extension, Agronomy and Crop Protection Animal (Livestock) Resource Development and Health (Veterinary) Natural Resource Development and Rural Land Administration Core Process
Harari National Regional State	
Trade, Industry & Urban Development Bureau Investment, Mines & Energy Core Process Investment and Mines Sub- Process Energy Sub-Process	**Bureau of Agriculture and Rural Development (4 Sections/Process)** Food Security & Disaster Prevention Natural Resource Development, Protection and Use Extension Agricultural Input
Somali National Regional State	
Environmental Protection, Mines & Energy Development Agency (3 Core Processes) Mining Administration Core Process Alternative Energy Resource and Promotion Environmental Protection Core Process	**Livestock, Crop & Rural Development Bureau (4 Departments/Process)** Livestock Development Natural Resources Conservation and Managements Extension Agricultural Product Marketing
Afar National Regional State	
Water Resource Development Bureau Water Resource Development Office Mines and Energy Resource Development Office Mines Resource Development Core Process Energy Resource & Technology Development Core Process	**Pastoral & Agricultural Development Bureau** Natural Resource Conservation, Utilization & Development Core Process
Oromia National Regional State	
Water, Mines & Energy Bureau (3 Sectors) Water Sector Irrigation Sector Mines & Energy Sector (2 Core Processes) Mines Core Process Energy Core Process (2 Core Processes) Bio-Energy Core Process Study & Construction of Electrification Core Process	

4.3 Strategy Objectives and Results

Objective 1. Biomass Energy Supply is sufficient to meet future demand in all areas

Rationale:

Although nationally the sustainable supply of wood biomass energy is in excess of demand with an estimated 2030 total annual demand for wood biomass of 151 million tons against an annual sustainable supply of 245 million tons, 201 woredas and large towns out 779 are biomass energy deficit. In practice, the woredas 'import' charcoal from the surrounding woredas, as charcoal is easy to transport. Removing the charcoal component from the consumption the number of deficit woredas and towns drops to 115. Total wood fuel deficit in 2030 in the deficit woredas assuming no increase in the current sustainable supply is 5.6 million tons per annum.

Results

Result 1.1 Expanded & improved production of fast growing wood in existing and new plantations. It is estimated that production on 108,000ha of open (low density planting) Regional and Community Plantations could be increased to produce 463,000 tons per annum and on 100,000ha of new plantations of Commercial Farms by 370,000tons per annum..

Result 1.2 Sustainable management and harvesting of approximately 1.0 million tons per annum wood biomass from 2 million ha Forest and Woodland Areas and enrichment planting of trees undertaken on 1 million ha degraded forests and woodlands through participatory forest management to produce 5.2 million tons per annum of wood.

Result 1.3 Sustainable supply of 210,000 tons per annum of wood is achieved through enrichment planting of 2 million ha of enclosed Communal Areas.

Result 1.4 On-farm tree planting expanded by 1 million ha to produce a sustainable supply of wood of 350,000 tons per annum.

Objective 2. Methods to increase efficiency of charcoal production identified, tested and extended to charcoal producers

Rationale

By 2030 it is estimated that the consumption of wood for charcoal burning will reach 42 million tons per year assuming current conversion efficiency of 15 percent. It is estimated that using improved methods of charcoal production conversion efficiency can be raised to 30 percent. This would reduce the amount of wood required for charcoal production by 21 million tons per annum.

Results

Result 2.1 Increased efficient charcoal production methods are identified, tested and promoted.

Result 2.2 Processing of charcoal dust, carbonised residues (sawdust, coffee husks, etc.) into biomass energy fuels by briquetting is tested and promoted.

Objective 3. Rural and urban Households and small biomass energy consuming enterprises use fuel efficient stoves and mitads

Rationale:

The traditional mitad, 3 stone fire and charcoal stove are extremely inefficient. A number of fuel efficient stoves and mitads have been developed. Constraints to large scale adoption have been lack of standardisation and consistent quality together with production and purchasing finance.

Results:

Result 3.1 Standard designs for fuel efficient stoves and mitads tested and approved.

Result 3.2 Revolving credit facilities for fuel efficient stove makers and potential buyers established through Micro Finance Institutions (MFI's) and Rural Credit and savings Cooperatives (RuSaCo's).

Result 3.3 Consumption of dung and agricultural residues for cooking is substituted by electricity and other renewable energy types.

Objective 4. Institutional capacity to manage the biomass energy sector effectively and implement the Strategy is strengthened

Rationale

The Stakeholder consultations and surveys revealed a number of requirements in increasing institutional capacity with regard to implementing the BEST. It also revealed a number of gaps with respect to obtaining accurate estimates of biomass energy supply and demand. This was particularly so with obtaining a detailed estimate of the locations and production methods, efficiencies and quantities of charcoal production and marketing. The uncertain legal status of charcoal production and marketing was identified as a key constraint to developing an efficient and cost effective system of charcoal production and marketing. Opportunities for carbon offset funding were identified as a potential significant incentive for sustainable forest and woodland management.

Results:

Result 4.1 Detailed capacity gap analysis undertaken as basis for Federal, Regional, Woreda and Community level capacity building programme to effectively implement BEST

Result 4.2 National Charcoal Policy in effect to place charcoal production and marketing onto a clear and transparent legal footing.

Objective 5. The BEST is fully integrated into National Energy Policy and the Climate Resilient and Green Economy Strategies

Rationale

Previous biomass energy strategies have not attracted sufficient support to ensure implementation. The Climate Resilient and Green Economy Strategy will guide development through to 2030. At the same time the Ministry of Water and Energy is developing a new National energy policy. The 2nd Draft of the Policy covers the sustainable production of bio-energy and its increasing and efficient end-use. It is vital that the BEST is clearly integrated into these two very important initiatives.

Results:

Result 5.1 Charcoal policy is developed and implemented effectively. The 2nd Draft of the national Energy Policy refers to "Enacting and Enforcing appropriate charcoal regulations and strategy. It is vital that a more positive approach to developing a sustainable and efficient charcoal production and marketing policy and strategy is included in the National energy Policy.

Result 5.2 BEST is integral component of the CRGE and BEST is integrated into the National Energy Policy

Result 5.3 Other relevant biomass energy issues substituting and/or complementing charcoal, especially fuelwood and briquetting of biomass residues are adequately adressed

4.4 Actions beyond the biomass energy strategy and action plan

Energy consumption is increasing fast due to population growth, economic development, and success in poverty alleviation. For decades, cooking will remain the most important purpose for energy consumption.

However, other consumers are becoming more important, such as office buildings due to a growing service sector, but also other large institutions such as universities and correction facilities. In this regard, there is a fast growing demand for electricity due to office and IT equipment, communication devices and workshops running on electricity.

In urban areas, electricity consumption is also increasing due to a shift from using wood fuels for cooking to using electricity. This shift is important to relieve the increasing pressure on biomass energy supplies.

Taking this into account, there are two important conclusions:

- Specific attention has to paid to increasing the efficiency of electricity use in general;
- The potential for substituting wood fuels for cooking by electricity is limited because electricity will be used first of all for running other electric devices and machinery and there is also the target to export electricity to improve the Ethiopian trade balance.

However, to expect that electricity will take the role (scale) of biomass in the near future is not realistic. Biomass will remain to play a dominant role in cooking energy.

4.5 The BEST Logframe

The Logical Framework ("LogFrame") is a dynamic thinking matrix that applies management principles and logic to formulate strategies. The simple "If-then" logic can clearly communicate a unified strategy. Using the "LogFrame" simplifies planning and accelerates execution of critical/complex projects.

Addressing these strategic questions helps implementing organisations develop sound solutions to complex issues.

1. What are we trying to accomplish and why?
2. How will we measure success?
3. What other conditions must exist?
4. How do we get there?

The BEST Logframe is set out below. At the top of the Hierarchy of Objectives is the BEST "**Goal**". This describes the development benefits that the Strategy as whole will produce. The "**Objectives**" describe the major changes required to achieve the "Goal". In the present Logframe there are five Objectives. These all constitute the **Biomass Energy Strategy**.

The "**Results**" are the direct goods, services and deliverables that contribute to the success of the Objectives. "**Activities**" are the inputs required to achieve the Results. These comprise the "**Action Plan**".

HIERARCHY OF OBJECTIVES	MEANS OF VERIFICATION	ASSUMPTIONS
BEST GOAL		
Improved access to sustainable and affordable biomass energy for all by 2030	BEST Strategy Baseline Survey 5 yearly National Biomass Energy Surveys Annual statistics of the Ministry of Energy Household statistics	National economy continues to grow at a constant rate There are no natural disasters such as long drought spells or catastrophic wildfires Biomass energy is widely accepted as a modern, renewable and environmental-friendly energy source Biomass energy can compete with other energy sources There are no market distortions favouring fossil fuels

HIERARCHY OF OBJECTIVES	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
BEST OBJECTIVES			
1. Biomass energy supply is sufficient to meet future demand	1. By 2030 sustainable supply of 5.7 million tons of wood for wood fuel and 6.6 million tons for efficient production of charcoal is achieved.	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Woreda statistics	Climate change (drought, storms) does not negatively affect biomass fuels production Population growth develops as is currently foreseen
2. Efficient use and processing of biomass along the supply chain	1. By 2020 75% of registered charcoal producers apply more efficient production methods (depending on the technology up to 100 % increase) and are organised in producer/marketing cooperatives	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Survey and reports of registered charcoal producers Publication of new charcoal production methods	Technological innovations will take place Charcoal producers are willing to apply new techniques and organise themselves Improved technologies are affordable and feasible (with reasonable pbt)
3. Rural and urban households and small biomass energy consuming enterprises use fuel efficient technologies	1. By 2030, 80% of rural and 5% of urban households and small biomass energy using enterprises use fuelwood efficient stoves and mitads 2. By 2030, the efficiency in wood fuel consumption by rural and urban households and small enterprises has increased up to 50 percent from present day levels 3. By 2030, the substitution of wood fuels by electricity for cooking and baking amounts to 5% / 55% reduction of fuelwood	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Household surveys Technical reports about the efficiency of fuel efficient stoves	Complementary CRGE targets influencing fuel efficient stove use are attained by 2030 Households are willing to use and invest in fuel efficient stoves Institutional environment is in place to enable scaling up fuel efficient stove programmes Supply of stoves is sufficient to meet demand for fuel efficient stoves Stoves are affordable/ have a reasonable pbt

	consumption in rural / urban areas		
4. Institutional capacity to manage the biomass energy sector effectively and implement the Strategy is strengthened	1. By 2014 a lead Government organisation is identified and taking over full responsibility for implementation of the Strategy 2. By 2015 responsible government organisations meet regularly to exchange information, also with private sector and civil society 3. By 2020 all organisations and institutions responsible for managing the biomass energy sector have sufficient number of qualified staff at all levels	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Organisational charts and job descriptions Minutes of meetings	Sufficient budget is made available by the Ethiopian Government and private sector to pay competitive salaries There is willingness for inter-sectoral cooperation There is a widespread and sincere understanding of the importance of biomass in all relevant governmental institutions
5. Supportive policy and regulatory framework for biomass energy is in place	1. By 2014 the BEST is an integral component of the CRGE 2. Forthcoming National Energy Policy refers to BEST	CRGE progress reports National Energy Policy	Current government policies and priorities do not change dramatically Harmonisation of policies and strategies is done

HIERARCHY OF OBJECTIVES		INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
	BEST RESULTS			
1.1.	Increased biomass production in fast-growing timber and commercial agricultural plantations	By 2020, 100,000 ha of new plantations established under Public-Private Partnerships (Eukalyptus and Bamboo) By 2020 enrichment planting on 108,000ha of degraded regional and community plantation achieved	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Reports from the Federal Ministry of Environment and Forests and Regional Ministries	
1.2.	Increased utilisation and mobilisation of woody biomass from sustainably managed natural forests and woodlands	By 2025 2 million ha of forests & woodlands under participatory forest management (PFM) By 2025 enrichment planting on 1 million ha of degraded forest & woodland achieved		
1.3.	Improved management and biomass mobilisation from communal enclosures and areas affected by invasive tree species	By 2025 enrichment planting on 2 million ha of communal enclosures achieved Active management of 1,5 million ha of enclosures by 2025		
1.4.	Increased supply of biomass from on-farm tree planting	By 2020 in-farm tree planting on an additional 2 million ha	BEST Strategy Baseline Survey 5 yearly national biomass energy surveys Reports from the Ministry/ Bureaus of Agriculture	
1.5.	Increase efficiency in charcoal production	By 2025 75% of registered Charcoal Producers received training & support to implement efficient charcoal production methods		

HIERARCHY OF OBJECTIVES	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
1.6. Mobilise unused wood and agricultural residues along the supply chain and develop new products	By 2020 Briquetting of charcoal dust & other residues (cotton stalks or coffee husk) tested & promoted when feasible		
1.7. Fuelwood efficient stoves are disseminated and adopted	By 2030, 15.7 / 0.3 Million fuelwood efficient stoves are disseminated and used in rural / urban areas By 2030, 15% / 45% of fuelwood efficient stoves used are improved charcoal stoves in rural / urban areas	FES Customer surveys undertaken in all Regions 5 yearly national household energy consumption surveys	Fuelwood efficient stove programmes learn from past experience and increase effectiveness in implementation
1.8. Substitution of woody biomass by other renewable energy types and use of new biomass products is increased	By 2030, 5% / 61% of rural / urban households have switched from fuelwood to electric stove use for baking and cooking	5 yearly national household energy consumption surveys	Fuel-stacking behaviour does decrease until 2030 reliable and affordable power supply and increased efforts for household connections in rural and urban areas Household disposable income raises proportional to national GDP until 2030, which contributes to affordability of new fuel efficient stoves and to cope with price volatilities of electricity
1.9. Substitution of dung and agricultural residues by other renewable energy types is increased	By 2030, 50% of the use of dung and agricultural residues for cooking in 2013 is substituted by electricity and other renewable energy types	5 yearly national household energy consumption surveys	No increased competition with other uses of agricultural residues such as biodiesel production, improvement of the soil quality or carbon storage in soils (CRGE strategy)
1.10. Sufficient and qualified human resources on various levels are available	By 2015, Capacity needs report completed & capacity building designed Capacity building programme implemented and effective (2017)	Capacity Needs and Capacity Building Report	

HIERARCHY OF OBJECTIVES	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
1.11. Implementation arrangements for the Strategy are in place	BEST action plan part of the CRGE action plan BEST integrated within CRGE	CRGE Plan Document National Energy Policy Document	
1.12. Charcoal issues are addressed in the relevant sectoral policies		CRGE Plan Document National Energy Policy Document	
1.13. BEST is integrated in the forthcoming National Energy Policy and CRGE		CRGE Plan Document National Energy Policy Document	
1.14. Other relevant biomass energy issues substituting and/or complementing charcoal, especially fuelwood and briquetting of biomass residues are adequately adressed		CRGE Plan Document National Energy Policy Document	

5 Action plan

The action plan comprises of supply side and demand side actions, and this is reflected in the structure of the action plan. The action plan refers to aspects directly related with biomass supply and demand (such as forestry, fuel wood and charcoal production, cooking stoves) and to indirectly related aspects such as the more efficient utilisation and substitution of wood fuels in other sectors to increase the energy efficiency of the overall system und make wood fuels available where more urgently needed.

Achieving the status of a middle income country becomes visible in the form of better quality of life, represented by massive housing construction which has been on-going. Middle class income inhabitants need furniture, additional construction timber for separate buildings etc., and this non-energy utilisation of biomass puts more pressure on the biomass supply system. Research is on-going how to speed up housing construction and a prefabricated building has been developed which can be constructed in 10 days. All prefabricated parts come from domestic production and also wooden components are used more often. This system has the potential to create many jobs. However, this example also shows that the competition between energy use and non-energy use of biomass (food, feed and fibre) is getting very important. Therefore it is necessary to also investigate non-energy biomass utilisations in order to increase the efficiency of production and to ensure that residues are fed into energy utilisations.

It has to be mentioned that meanwhile there is a lot of experience within Ethiopia and many activities do not start from scratch but have been worked on already.

In addition it has to be stated that institutions, organisations and donors proposed to be the financing source for the respective activities have not made any commitment to do so but their objectives and programmes fit to the specific activities based on the consultant´s assessment.

5.1 Accompanying actions

The following actions are proposed:

5.1.1 Land use survey

Accurate estimates of sustainable woody biomass availability require accurate woody biomass inventory data for landcover types and accurate and detailed landcover mapping. The Woody Biomass Inventory and Strategic Planning Project (WBISPP) was supported under the World Bank Energy 1 and Energy 2 projects to undertake this.

The alleometric equations and woody biomass stocks determined by the WBISPP will remain valid for decades and there is no need to repeat these. However, landcover is far more dynamic.

The WBISPP undertook landcover mapping of the whole country in two phases: phase 1 between 1990 and 1995 and phase 2 between 1999 and 2003. Phase 1 covered the southwest quadrant of Ethiopia – south of 10° north and west of 40°15’ east, and phase 2 covered the remaining three quarters. The project’s phase 1 satellite images were for the years 1986 to 1989 whilst those of phase 2 were for the years 1995 to 2000. Thus the landcover data for southwestern quadrant is now 24 to 27 years old and that for phase 2 some 13 to 18 years old.

There is thus an urgent requirement to remap Ethiopia to obtain an up-to-date estimate of the woody biomass stocks both for biomass energy planning and also for national, regional and local REDD planning.

5.1.2 Regular up-date of data

The WBISPP undertook detailed surveys on household energy consumption covering the whole country. The present study has made revised estimates of the household biomass energy consumption. Given the fast changing character of rural and urban household energy consumption there is a need to update this information on a regular basis.

5.1.3 Development of a national charcoal policy

The baseline survey has revealed to very substantial increase in rural charcoal consumption. As indicated, charcoal continues to have a "semi illegal" status in Ethiopia. The new national energy policy of Ethiopia currently being developed by the Ministry of Water and Energy should place sustainably and efficiently manufactured charcoal on a proper legal basis. Currently, the 2nd Draft of the NEP refers to "Enacting and Enforcing appropriate charcoal regulations and strategy" rather than adopting a positive development approach to sustainable and efficient charcoal production on a proper legal basis through participatory woodland management, charcoal producer cooperatives and the promotion of efficient charcoal production methods. The present action plan outlines how sustainably and efficiently production of charcoal can be achieved.

5.1.4 Sustainable use of communal lands

The baseline survey indicated that since 2009 little on-farm tree planting has taken place due to the increasing shortage of land for crop production. Even the homestead garden ("guaro") has become valuable land for food production. Increasingly the communal lands open to uncontrolled livestock grazing are being enclosed. This provides an opportunity for both increased forage production and for increased wood production. Under a coppicing system tree production can be sustainable and productive.

5.1.5 Intensification of Agricultural Production

In many ways allied to sustainable use of communal lands is the need to intensify agricultural – both crop and livestock – production.

Objective 1:
Biomass energy supply is sufficient to meet future demand

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.1: Increased biomass production in fast-growing timber and commercial agricultural plantations**													**Priority:** **High**	**Lead Organization:** **Ministry of Environment & Forestry** **Ministry of Agriculture**	
#	Activity	Time frame (year 20..) – note: GC (Gregorian Calender)!												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.1.1	Improve plant material through genetic selection and cloning														Plant Research Centers, EARO, Wondo Genet Forestry College	Farmers, FUG, Forestry Enterprises, Agricultural Enterprises	MoEF, MoA
1.1.2	Allocate marginal land for afforestation by private sector														MoEF, MoA	Farmers, FUG, Forestry Enterprises, Agricultural Enterprises	MoEF, MoA
1.1.3	Provide subsidies/ incentives for afforestation/ reforestation														MoEF, MoA	Farmers, FUG, Forestry Enterprises, Agricultural Enterprises	MoEF, MoA
1.1.4	Establish new biomass energy														Agricultural Office, Forestry Office,	Farmers, FUG,	Private Sector,

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.1: Increased biomass production in fast-growing timber and commercial agricultural plantations**													**Priority:** **High**	**Lead Organization:** **Ministry of Environment & Forestry** **Ministry of Agriculture**	
#	Activity	Time frame (year 20..) – note: GC (Gregorian Calender)!												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
	plantations														Forestry and Agricultural Enterprises	Forestry Enterprises, Agricultural Enterprises	forestry enterprises, donors
1.1.5	Improve the management of existing plantations (thinning, pruning)														Agricultural Office, Forestry Office, Forestry enterprises	Farmers, FUG	Private Sector, forestry enterprises, MoEF, MoA
1.1.6	Introduce PFM and benefit-sharing schemes in plantation management														Agricultural Office, Forestry Office, Forestry enterprises	Farmers, FUG, PFM Groups	Private Sector, forestry enterprises, MoEF, MoA
1.1.7	Improve patrolling and protection of plantations														MoEF, Regional Forestry Bureaus / Offices	Farmers, Rural Communities, FUG, PFM Groups	MoEF, MoA, private sector

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.2: Increased utilisation and mobilisation of woody biomass from sustainably managed natural forests and woodlands**													**Priority: Medium/Low**	**Lead Organization: Ministry of Environment and Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.2.1	Plan and implement selective thinnings in natural forests														District Forestry Offices, Forestry Enterprises	Forestry enterprises, Forest user groups, PFM Groups	MoEF
1.2.2	Train PFM user groups in the mobilisation of woody biomass														MoEF Agricultural and Forestry Extension Offices, NGO	FUG, PFM Groups	MoEF
1.2.3	Introduce appropriate harvesting and transport technologies for woody biomass (incl. large diameter deadwood)														MoEF, Forestry Offices, Forestry Extension Offices	Forest Enterprise Staff, FUG, Contractors	MoEF, forestry enterprises
1.2.4	Assist in the preparation and implementation of basic management plans for communal woodlands														Forestry Offices, Agricultural Offices, Extension Offices	FUG, Forestry/ Agricultural Cooperatives, PFM groups	MoEF, forestry enterprises

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.2: Increased utilisation and mobilisation of woody biomass from sustainably managed natural forests and woodlands**													**Priority: Medium/Low**	**Lead Organization: Ministry of Environment and Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.2.5	Conduct enrichment plantings and reforestation of degraded natural forests and woodlands														Forestry Offices, Forestry Enterprises	FUG, Forestry/ Agricultural Cooperatives, PFM groups	MoEF, forestry enterprises
1.2.6	Improve law enforcement and patrolling														MoEF, Regional Forestry Bureaus / Offices	Farmers, Rural Communities, FUG, PFM Groups	MoEF

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.3: Improved management and biomass mobilisation from communal enclosures and areas affected by invasive tree species**													**Priority:** **Medium/Low**	**Lead Organization:** **Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.3.1	Set-aside new closures														MoEF (Regional environmental and land administration offices)	Local Communities, FUGs, PFM Groups	MoA
1.3.2	Assist user groups in preparing basic management plans for closures														Forestry Offices, Extension Offices, Forestry Enterprises	Local Communities, FUGs, PFM Groups	MoA
1.3.3	Train user groups in conducting thinnings and harvesting activities														Forestry Offices, Extension Offices, Forestry Enterprises	Local Communities, FUGs, PFM Groups	MoA
1.3.4	Introduce fees and royalties for producing biomass, which can be used for all energy purposes														MoEF, Regional Environmental / Forestry Offices	Forest enterprises, Local Communities, FUGs, PFM Groups	MoA

1.3.5	Assist user groups in the processing and marketing of biomass														MoEF, MoIT, SME Department, Forestry Extension Offices/Service	Local Communities, FUGs, PFM Groups	MoA
1.3.6	Establish demonstration plots and conduct exposure visits														Forestry Extension Offices	Local Communities, FUGs, PFM Groups	MoA
1.3.7	Carbon offset projects developed for community activities in sequestering CO2														MoEF, REDD+ Secretariat, Forestry Offices, NGOs, Consultants	Local Communities, FUGs, PFM Groups	Private Sector, Carbon Traders, MoA

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.4: Increased supply of biomass from on-farm tree planting**													**Priority: Medium**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.4.1	Support tree planting on marginal agricultural land														MoA, Extension Service	Farmers, Rural Communities, Farmer Associations/ Cooperatives	MoA, Farmers
1.4.2	Introduce agroforstry and intercropping techniques														MoA, Extension Service, Forestry Offices	Farmers, Rural Communities, Farmer Associations	MoA
1.4.3	Provide extension services to farmers														MoA, Extension Service, Forestry Offices	Farmers, Rural Communities, Farmer Associations	MoA
1.4.4	Improve plant material through genetic selection and cloning														Plant Research Centers, EARO, Wondo Genet Forestry College	Farmers, Rural Communities, Farmer Associations	MoA, Private Sector
1.4.5	Assist farmers in forming associations and in joint marketing														MoA, Extension Service, Forestry Offices	Farmers, Rural Communities, Farmer Associations	MoA

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 1: Biomass energy supply is sufficient to meet future demand **Result 1.4: Increased supply of biomass from on-farm tree planting**													**Priority: Medium**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
1.4.6	Assist farmers in collection, transport, partly processing and marketing of crop residues														MoA, Extension Service, Forestry Offices, SME Offices	Farmers, Rural Communities, Farmer Associations	MoA

Objective 2:
Efficient use and processing of biomass along the supply chain

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 2: Efficient use and processing of biomass along the supply chain **Result 2.1: Increase efficiency in charcoal production**													**Priority: Medium**	**Lead Organization: Ministry of Water. Irrigation and Energy**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
2.1.1	Assessment of current methods for charcoal making including experiences from neighboring countries														MoIT MoEF MoST MoA	Charcoal producers	MoWIE
2.1.2	Identify and test increased efficient charcoal production methods														MoWIE MoST Universities	Charcoal producers	MoWIE
2.1.3	Support research centers to optimise charcoal conversion methods														MoWIE MoST MoE		MoST, MoWIE
2.1.4	Establishment and institutional support of charcoal producer cooperatives and/or SMEs for improved charcoal marketing and quality control														MoIT MoF MoWIE	Charcoal producers Youth groups	

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 2: Efficient use and processing of biomass along the supply chain **Result 2.2: Mobilise unused wood and agricultural residues along the supply chain and develop new products**													**Priority: Medium**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
2.2.1	Market assessment on new products (e.g. briquettes or chips)														MoIT	Charcoal producers Briquettes producers Improved stoves producers	MoA
2.2.2	Research and development on best practise mixtures for new products (timber, straw etc.)														MoWIE MoST Universities	Private institutions related to this technology	MoST, MoA
2.2.3	Pilot testing of equipment and machinery														MoWIE MoEF	Community	MoWIE, MoEF, MoA
2.2.4	Elaboration and implementation of quality standards and control mechanisms for new products and their processing line														MoWIE	Charcoal producers Briquettes producers Improved stoves producers	MoWIE, MoA

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 2: Efficient use and processing of biomass along the supply chain **Result 2.2: Mobilise unused wood and agricultural residues along the supply chain and develop new products**													**Priority: Medium**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
2.2.5	Processing of wood and agricultural residues (charcoal dust, sawdust, coffee husks, etc.) into biomass fuels														MoWIE	MoWIE	MoWIE
2.2.6	Provide grants and loans for development of new products														MoFED MoST		MoST, Micro-finance, DBE, GEF

Objective 3:
Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.1: Fuelwood efficient stoves are disseminated and adopted**													**Priority: High**	**Lead Organization: Ministry of Environment & Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.1.1	Identification of on-going programmes, scaling up of best practice examples and acceptability/suitability assessment in regions with existing programmes														Federal Energy Directorate GIZ EPA		MoWIE, MoEF
3.1.2	Consumer Needs Assessment in emerging regions (which have not given priority to in the past)														Ministries down to woreda level	Institutions	Institutions
3.1.3	Nation-wide design and efficiency testing of new and existing stoves in laboratories and close cooperation with existing testing centres (e.g. CREEC Uganda or GACC testing facilities)														Federal Energy Directorate	Producers Distributors	MoWIE, MoEF, GIZ
3.1.4	Technical and business skills training for fuelwood efficient stoves makers and pilot production in emerging regions														MoWIE NGO Micro enterprises	Experts Producers	MoWIE, MoEF, GIZ

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.1: Fuelwood efficient stoves are disseminated and adopted**													**Priority: High**	**Lead Organization: Ministry of Environment & Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.1.5	Test-marketing and user acceptability assessment of fuelwood efficient stoves and mitads														MoWIE NGO Unions	Households Institutions	MoWIE, MoEF, Research Center
3.1.6	Nation-wide up-scaling support: provide 1. Access to finance, 2. Training to more producers,3. Production & marketing support by low interest loans														MoWIE NGO Micro Finance CRGE	Producers Users	"energy efficiency fund", MoEF and foreign donors , Green Climate Fund, PoA Succeeding program
3.1.7	Nation-wide complementary awareness raising and initiation of workshops on the benefit/costs of fuelwood efficient stoves following train-the-trainer concept														MoWIE NGO Mass media	Experts Producers Community	MoWIE, MoEF
3.1.8	Conduct sales monitoring, quality control & customer care														MoWIE NGO	Producers, Users, Households	MoWIE, MoEF

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.2: Substitution of woody biomass by other renewable energy types and use of new biomass products is increased**													**Priority: Medium**	**Lead Organization: Ministry of Environment & Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.2.1	R&D on the improvement of the efficiency of electric stoves and mitads														Private Sector NGO MoWIE	Market technology	MoWIE, MoEF
3.2.2	Nation-wide testing, approval and promotion of new standard designs for electric stoves and mitads														MoWIE CRGE	Producers Researchers Consultancy	MoWIE, MoEF, CRGE
3.2.3	Improve access to finance specifically for scaling up the production and marketing of electric stoves through providing affordable terms of payment														MoWIE CRGE NGO	Producers	MoWIE, MoEF, CRGE
3.2.4	Conduct awareness raising campaigns on the health, social and financial benefits (amortization time and cost advantages)														MoWIE NGO Mass media	Community	MoWIE, MoEF, CRGE
3.2.5	Initiation of R&D of new biomass products from wood residues (e.g. from wood processing industry)														MoWIE NGO	Technology Resource	MoWIE, MoEF

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.2: Substitution of woody biomass by other renewable energy types and use of new biomass products is increased**													**Priority: Medium**	**Lead Organization: Ministry of Environment & Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.2.6	Provide technical and business skills training to new device producers to enhance their capabilities to operate in a commercially self-sustaining manner														MoWIE NGO	Experts Producers	MoWIE, MoEF, CRGE
3.2.7	Pilot production and test marketing of new biomass product devices such as stoves, kilns and briquette presses														MoWIE NGO Private sector	Sample households	MoWIE, MoEF, CRGE
3.2.8	Assessment of consumer's acceptance of new biomass product devices in urban areas														MoWIE NGO	Users	MoWIE, MoEF
3.2.9	Conduct up-scaling and market promotioncampaigns to popularize new biomass products and devices														MoWIE NGO	Community	MoWIE, MoEF
3.2.10	Awareness raising, promotion and marketing campaign														MoWIE NGO Mass media	Experts Users Officials Stakeholders	MoWIE, MoEF

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.2: Substitution of woody biomass by other renewable energy types and use of new biomass products is increased**													**Priority: Medium**	**Lead Organization: Ministry of Environment & Forestry**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.2.11	Conduct sales monitoring, quality control & customer care														MoWIE NGO	Users	MoWIE, MoEF
3.2.12	Adaptation of legal framework conditions, if required (standardisation, market regulation, trade)														MoWIE	Community Private sector	MoWIE, MoEF

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.3: Substitution of dung and agricultural residues by other renewable fuels**													**Priority: Low**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.3.1	Conduct nation-wide research for region-specific SWOTs to acceptance of other renewable energy types														MoWIE Research Centers	Community	MoWIE, MoA
3.3.2	Pilot tests of fuelwood efficient and electric stove acceptance in areas of high dung and agricultural residue demand and areas that have not been effectively covered by such programmes in the past														MoWIE Development partners	Users	MoWIE, MoA
3.3.3	Scale-up of fuelwood efficient and electric stove programmes in areas of high dung and agricultural residue demand and areas that have not been effectively covered by such programmes in the past														MoWIE Relevant Stakeholders	Technical staff	MoWIE, MoA
3.3.4	Train extention personnel on demonstration of improved agro(pastoral) soil management and soil nutrient benefits resulting from fuel substitution (dung and residue by other renewable sources such as electricity and new woody biomass energy products)														MoA	Agropastoralists	MoWIE, MoA, CRGE

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 3: Rural and urban Households and small biomass energy consuming enterprises use fuel efficient technologies **Result 3.3: Substitution of dung and agricultural residues by other renewable fuels**													**Priority: Low**	**Lead Organization: Ministry of Agriculture**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
3.3.5	Scale up improved agro(pastoral) extention services on soil and nutrient management														MoA	Agropastoralists	MoWIE, MoA, CRGE

Objective 4:
Institutional capacity to manage the biomass energy sector effectively and implement the Strategy is strengthened

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 4: Institutional capacity to manage the biomass energy sector effectively and implement the Strategy is strengthened **Result 4.1: Sufficient and qualified human resources on various levels are available**													**Priority:** **High**	**Lead Organization:** **Ministry of Water, Irrigation and Energy**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
4.1.1	Detailed capacity needs assessment														MoEPFM MoA MoFMSE Forestry Research Institute MoT, MoI, Acadamia/universities	Implementing departments of the responsible sectors CBOs Private sector	Development partners, MoWIE
4.1.2	Develop organisational charts and job descriptions for governmental organisations on Federal, Regional and Woreda level														A committe selected from the respoonsible sectors mentioned above	Sectoral committe at all levels	Development partners, MoWIE
4.1.3	Recrute required staff														MoWIE	MoWIE	MoWIE
4.1.4	Conduct in-service training and other capacity building activities/technical assistance														MoWIE	MoWIE MoA Governmental institutions on local level	MoWIE

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 4: Institutional capacity to manage the biomass energy sector effectively and implement the Strategy is strengthened **Result 4.2: Implementation arrangements for the Strategy are in place**													**Priority: High**	**Lead Organization: Ministry of Water, Irrigation and Energy**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
4.2.1	Define a lead organisation for BEST implementation														MoWIE	MoEPFM MoA, MoEFMSE	MoWIE
4.2.2	Establish a intersectoral Biomass Coordination Office seated in Ministry of Water, Irrigation and Energy														MoWIE	MoEPFM MoA MoFMSE Forestry Research Institute MoT MoI Acadamia/ universities	Development partners, MoWIE
4.2.3	Conduct regularly coordination meetings among relevant institutions														MoWIE	MoWIE	Development partners, MoWIE
4.2.4	Conduct 5 yearly national biomass energy surveys for M&E of strategy implementation														MoWIE	MoWIE	Development partners, MoWIE

Objective 5:
Supportive policy and regulatory framework for biomass energy is in place

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 5: Supportive policy and regulatory framework for biomass energy is in place **Result 5.1: Charcoal issues are adressed in the relevant sectoral policies**													**Priority:** **High**	**Lead Organization:** **Ministry of Water, Irrigation and Energy**	
#	Activity	Time frame (year 20.)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
5.1.1	Establish interministerial Task Force for policy, legal and regulatory review (same as 5.3.1)														MoWIE	MoEPFM MoA MoFMSE Forestry Research Institute MoT MoI Acadamia/ universities/ Private sectors in the charcoal business	MoWIE
5.1.2	Revision/amendmend of the sectoral policies, legal and regulatory review														MoWIE EEA	The same as above	Development partners, MoWIE

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 5: Supportive policy and regulatory framework for biomass energy is in place **Result 5.1: Charcoal issues are adressed in the relevant sectoral policies**													**Priority:** **High**	**Lead Organization:** **Ministry of Water, Irrigation and Energy**	
#	Activity	Time frame (year 20.)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
5.1.3	Dissemination of and public awareness rising about the new policy, legal and regulatory measures based thereup on														MoWIE, and the structure at all levels and EEA	General public Media Actors in the charcoal bussiness	Development partners, MoWIE

	Action Plan Biomass Energy Strategy (BEST) in Ethiopia															
	Objective 5: Supportive policy and regulatory framework for biomass energy is in place **Result 5.2: BEST is integrated in the forthcoming National Energy Policy and CRGE**													**Priority:** **High**	**Lead Organization:** **Ministry of Water, Irrigation and Energy**	
#	Activity	Time frame (year 20..)												Responsible	Target Group	Financing Source
		14	15	16	17	18	19	20	21	22	23	24	25	**30**			
5.2.1	Dissemination of and public awareness rising about the new National Energy Policy and adopted CRGE including the Charcoal Policy integrated into NEP using a more “positive” sustainable development and marketing approach replacing the negative “regulatory” approach currently in the 2nd draft													MoWIE, and the structure at all levels	Impleneters from the goverment Private sector and CBOs	Development partners, MoWIE

Annex 1: From baseline to a biomass energy strategy

The following tables provide a framework for prioritisation of the Strategy and Action Plan Activities at the Regional level.

1. Methodology of SWOT analysis and prioritization of strategic activities

Steps for regional analysis:

1) Identify criteria on the environment of the biomass energy sector for analyzing opportunities and threats to the biomass energy sector development
2) Identify strategic activities for analyzing strengths and weaknesses within the biomass energy sector
3) Identify regional evaluation indictors (e.g. available area, sustainable yield, minimum annual precipitation, available inputs to production, extent of ongoing improved stove programmes) and threshold values (where possible, e.g. from spatial data) to distinguish opportunities from threats and strengths from weaknesses, alternatively define qualitative values (e.g. from expert judgments)
4) In preparation to prioritization of activities by regions, points are allotted row-wise to weight indicators across regions for each activity to identify comparative advantages/disadvantages of regions within the biomass energy sector
5) Extend the row-wise allotting of points to the opportunities and threats of the biomass energy sector environment for regions which 1) show strengths in activities, 2) weaknesses in activities but opportunities
6) Make final prioritization of regions for activities based on
    - Opportunity / Strength: Top priority strategic activity
    - Opportunity / Weakness: What can be done to grasp the opportunity? How to overcome the weakness?
    - Threat / Strength: What is the threat/risk of failure? How can the strength be used to manage the threat/risk?
    - Threat / Weakness: Least priority strategic activity because of high threat/risk of failure
    - [Sum of points allotted to indicators of opportunities or threats / Sum of points allotted to indicators for strengths or weaknesses across results] in line with *Matrix of matching indicators of opportunities/threats with results (strengths/weaknesses)*

Opportunities: sufficiently available land resources, high sustainable yields, extensive road network, ongoing/planned electrification programme, low population density, high urbanization, high income in urban areas

Threats: opposite to opportunities

Strengths: ongoing/planned fuel efficient stove programmes, ongoing/planned programmes on new biomass products, ongoing/planned R&D on charcoal production efficiency, charcoal production hotspots (experience!), low dung consumption, low crop residue consumption (environmental and food security benefits!), low fuelwood consumption, high charcoal consumption (adoption!), wide spread use of other renewable energy types (health benefit!)

Weaknesses: opposite to strengths

2. Result of SWOT analysis of strategic activities in regions:

2.1 Environment to the Biomass Energy Sector

2.1.1 Opportunities

Criteria	No of indicator	Indicator	Afar	Amhara	BSG	Diredawa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
Agro-ecological condition	1.1	Quantity and reliability of precipitation		1 West	1 All		1 All		1 West, Central	1 All		
Land availability	2.1	Available area for expansion of plantations		2 Short: Communal areas	2 woody fallow land area		1 Communal areas		1 Communal areas: West	1 Communal areas		1 Short: Communal areas
	2.2	Available area of natural forest		3 Forest Priority Areas			2 highland forest areas		2 highland forest areas	1 highland forest areas		
	2.3	Available enclosure area		1			3			2		1
	2.4	Sustainable yield potential off-farm		1 West			1 All		2 South, West	1 North, East, West		
	2.5	Sustainable yield potential from trees on-farm		1 North, 3 East, South					1 North, South, West	1 North, East		
	2.6	Land use,	1	1	1				1	1		

Criteria	No of indicator	Indicator	Afar	Amhara	BSG	Diredawa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
		vegetation cover and management capability	Prosopis use for charcoal, potential for increase in charcoal production efficiency	Most intense on-farm tree planting	Increased on-farm tree planting				Intense on-farm tree planting	Well advanced on-farm tree planting from 1975 onwards		
Demographic and socio-economic	3.1	Rural population density 2030	1				3				2	
	3.2	Urban share 2030				3	1	2				
Infrastructure	4.1	All weather road density	1	2					2	1	1	1

Level of Opportunity:
Quantity and reliability of precipitation: 1: sufficient and reliable
Available area for expansion of plantations: 2: largest area in Ethiopia, 1: second largest area
Available area of natural forest: 3: highest share at total regional area, 2: second highest share at total regional area, 1: other (Table 45 Phase2 report)
Available enclosure area: 3: highest share at total regional area, 2: second highest share at total regional area, 1: other
Sustainable yield potential off-farm: 2: >5 tons/ha*yr-1, 1: >2.5 tons/ha*yr-1
Sustainable yield potential of trees on-farm: 2: >50000 tons/yr, 1: >25000 tons/yr
Land use, vegetation cover and management capability: 1: various
Rural population density 2030: 3: smallest pop. density in Ethiopia, 2: second smallest pop. density, 1: third smallest pop. density
Urban share 2030: 3: highest urban share in Ethiopia, 2: second : highest urban share, 1: third : highest urban share
All weather road density: 2: High, 1: Medium
Ongoing/planned electrification (programmes): 1: available

2.1.2 Threats

Criterion	No of ind.	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
Agro-ecological condition	1.1	Quantity and reliability of precipitation	-2	-1			-2 West	-2	-2 East, South	-2 South	-2	-1
Land availability	2.1	Available area for expansion of plantations				-1	-1	-1				
	2.2	Available area of natural forest				-1		-1				
	2.3	Available enclosure area				-1		-1				
	2.4	Sustainable yield potential off-farm	-2	-1 North, East, South	-1 South		-2 West		-2 North, -1 East	-1 South	-2	-2
	2.5	Sustainable yield potential of trees on-farm	-2	-2 West, -1 North, East	-2		-2		-2 East, South -1 North, West	-1 North -2 East, South, West	-2	-2
	2.6	Land use, vegetation cover and management	-1 Pastoral, not common to grow biomass	-1 North, West, commercial	-1 Threat of unsustainable use of wood		-1 North, East, South, agropastoral,			-1 South, agropastoral, not common	-1 North, West, Agropastor	

Criterion	No of ind.	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
		capability	plantation, competition with fodder production, Threat of unsustainable use of wood resources	farms, woody fallow: land use competition with commercial agriculture	resources		not common to grow biomass energy, competition with fodder production, Threat of unsustainable use of wood resources			to grow biomass energy, competition with fodder production	al, not common to grow biomass energy, competition with fodder production	
Demographic	3.1	Rural population density 2030						-3		-2		-1
	3.2	Urban share 2030		-1					-2	-3		
Infrastructure	4.1	All weather road density									-1	

Level of threat:
Mean annual temperature: -1: >2600 masl
Quantity and reliability of precipitation: -2: High frequency of drought, -1: Rainfall is variable and insufficient
Available area for expansion of plantations: -1: insignificant
Available area of natural forest: -1: insignificant
Available enclosure area: -1: insignificant
Sustainable yield potential off-farm: -2: <0.5 tons/ha*yr-1, -1: <1 tons/ha*yr-1
Sustainable yield potential of trees on-farm: -2: <5000 tons/yr, -1: <25000 tons/yr
Land use, vegetation cover and management capability: 1: various
Rural population density 2030: -3: largest pop. density in Ethiopia, -2: second largest pop. density, -1: third largest pop. density
Urban share 2030: -3: smallest urban share in Ethiopia, -2: second smallest urban share, -1: third smallest urban share
All weather road density: -1: Low

2.1.3 Strengths

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
1	1.1 Increased biomass production in fast-growing timber and commercial agricultural plantations	Existence of plantations with harvest of biomass and/or existing FMP		1	1				1			
		Annual crop residue supply as fuel	1	2	1				2			2
	1.2 Increased utilisation and mobilisation of woody biomass from sustainably managed natural forests and woodlands	Sustainable biomass yield off-farm		1 West			1		2 South, West	1 North, East, West		
		Existence of natural forest with harvest of biomass		1			1		1	1		
	1.3 Improved management and biomass mobilisation from communal	Sustainable biomass yield off-farm		1 West			1		2 South, West	1 North, East, West		

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
	enclosures and areas affected by invasive tree species											
	1.4 Increased supply of biomass from on-farm tree planting	Sustainable biomass yield potential from trees on-farm		1 North, 3 East, South					1 North, South, West	1 North, East		
2	2.1 Increase efficiency in charcoal production	Current charcoal production hotspots (proven experience in charcoal production as starting point for main activity)	1 South, West	1 West	1 West				1 North, East	1 North, East	1 North	
	2.2 Mobilise unused wood and agricultural residues along the supply chain and develop new products	Ongoing/planned programmes on new biomass products							1			
		Annual crop residue supply as fuel	1	2	1				2			2
3	3.1 Fuelwood efficient stoves are disseminated and adopted	Quantity of fuelwood consumption	2						2 East, South	1 South		2
		Quantity of			1		1		2	2		

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
		charcoal consumption							West			
		Ongoing/planned fuel efficient stove programmes		1	1				1	1		1
	3.2 Substitution of woody biomass by other renewable energy types and use of new biomass products is increased	Wide-spread use of other renewable energy types (health benefit!)			1 Urban	1	1	1	1 Urban	1	1	1
	3.3 Substitution of dung and agricultural residues by other renewable energy types is increased	Quantity of crop residue consumption (environmental and food security benefits!)	2	2 West			1		2 North, East, South	2 South	2	2
		Quantity of dung consumption	2	2 West			2		2 East, South	2 South, West	2	
		Supply-demand balance		2					2	2		

Level of Strength:
Area of existing biomass plantations: 3: largest area in Ethiopia, 2: second largest area, 1: third largest area
Existence of plantations with harvest of biomass and existing FMP: 1: Hotspot
Existence of natural forest with harvest of biomass and existing FMP: 1: Hotspot
Existence of enclosures with harvest of biomass and existing FMP: 1: Hotspot
Sustainable biomass yield off-farm: 2: >5 tons/ha*yr-1, 1: >2.5 tons/ha*yr-1
Sustainable biomass yield on-farm: 2: >50000 tons/yr, 1: >25000 tons/yr
Current charcoal production: 1: Hotspot
Ongoing/planned programmes on new biomass products: 1: Hotspot
Annual crop residue supply as fuel:
Quantity of fuelwood consumption: 2: <500 kgs/capita*yr-1, 1: <750 kgs/capita*yr-1
Quantity of charcoal consumption: 2: >1001 tons/yr, 1: >500 tons/yr
Ongoing/planned fuel efficient stove programmes: 1: Hotspot
Wide-spread use of other renewable energy types: 1: Hotspot
Quantity of crop residue consumption: 2: <5000 tons/yr, 1: <10000 tons/yr
Quantity of dung consumption: 2: <32000 tons/yr, 1: <100000 tons/yr
Current charcoal production hotspots: 1: Hotspot
Supply-demand balance: 2: significant surplus supply

2.1.4 Weaknesses

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
1	1.1 Increased biomass production in fast-growing timber and commercial agricultural plantations	Existence of plantations with harvest of biomass										
		Sustainable biomass yield off-farm	-2	-1 North, East, South	-1 South		-2 West		-2 North, -1 East	-1 South	-2	-2
		Annual crop residue supply as fuel					-2			-1		
	1.2 Increased utilisation and mobilisation of woody biomass from sustainably managed natural forests and woodlands	Sustainable biomass yield off-farm	-2	-1 North, East, South	-1 South		-2 West		-2 North, -1 East	-1 South	-2	-2
		Existence of natural forest with harvest of biomass and/or existing PFM					1		1	1		
	1.3 Improved	Sustainable	-2	-1	-1		-2		-2	-1	-2	-2

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
	management and biomass mobilisation from communal enclosures and areas affected by invasive tree species	biomass yield off-farm		North, East, South	South		West		North, -1 East	South		
		Existence of enclosures with harvest of biomass and/or existing FMP		1					1	1		1
	1.4 Increased supply of biomass from on-farm tree planting	Sustainable biomass yield potential from trees on-farm	-2	-2 West -1 North, East	-2		-2		-2 East, South -1 North, West	-1 North -2 East, South, West	-2	-2
2	2.1 Increase efficiency in charcoal production	Current charcoal production hotspots (proven experience in charcoal production as starting point for main activity)										
	2.2 Mobilise unused wood and agricultural residues along the supply chain	Ongoing/planned programmes on new biomass products										

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
	and develop new products											
		Annual crop residue supply as fuel					-2			-1		
3	3.1 Fuelwood efficient stoves are disseminated and adopted	Quantity of fuelwood consumption			-2		-1		-2 West	-2 North		
		Quantity of charcoal consumption	-2 North		-2 West		-1		-2 East	-2 South	-2 West	
		Ongoing/planned fuel efficient stove programmes									-1	
	3.2 Substitution of woody biomass by other renewable energy types and use of new biomass products is increased	Wide-spread use of other renewable energy types (health benefit!)										
	3.3 Substitution of dung and agricultural residues by other renewable energy types is increased	Quantity of crop residue consumption		-2	-1				-2	-2		

Objective	Result	Indicator	Afar	Amhara	BSG	Direwa	Gambela	Harari	Oromiya	SNNPR	Somali	Tigray
		Quantity of dung consumption		-2					-1	-1		-2
		Supply-demand balance	-2	-1			-1		-1			-2

Level of weakness:
Existence of plantations with harvest of biomass and/or existing FMP: -1: no evidence
Existence of natural forest with harvest of biomass and/or existing FMP: -1: no evidence
Existence of enclosures with harvest of biomass and/or existing FMP: -1: no evidence
Sustainable biomass yield off-farm: -2: <0.5 tons/ha*yr-1, -1: <1 tons/ha*yr-1
Sustainable biomass yield on-farm: -2: <5000 tons/yr, -1: <25000 tons/yr
Current charcoal production: -1: no evidence
Ongoing/planned programmes on new biomass products: -1: no evidence
Annual crop residue supply as fuel:
Quantity of fuelwood consumption: -2: >1251 kgs/capita*yr-1, -1: >1000 kgs/capita*yr-1
Quantity of charcoal consumption: -2: <100 tons/yr, -1: <250 tons/yr
Ongoing/planned fuel efficient stove programmes: -1: No evidence
Wide-spread use of other renewable energy types: -1: No evidence
Quantity of crop residue consumption: -2: >50000 tons/yr, -1: >25000 tons/yr
Quantity of dung consumption: -2: >50001 tons/yr, -1: >25001 tons/yr
Current charcoal production hotspots: -1: no evidence
Supply-demand balance: -2: deficit, -1: balanced

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