PLAN FOR DEVELOPMENT OF UGANDA'S BIOMASS ENERGY STRATEGY

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1. INTRODUCTION

This document presents a plan for development of a comprehensive national biomass energy strategy (NBES) for Uganda. Developing this plan was foreseen as an effective strategy for developing a NBES as it offers an opportunity to critically understand the institutional and other dynamics associated with the biomass energy cycle. The Ministry of Energy and Mineral Development (MEMD) has developed strategies for rural electrification, petroleum supply and energy efficiency. Despite the importance of biomass in the national energy balance – accounting for 93% of total energy consumption – there is no comprehensive biomass energy strategy. The study was undertaken within the framework of the Sustainable Energy Advisory Facility programme implemented by UNEP Collaborating Centre on Energy and Environment (UCCEE).

Wood is the predominant source of energy for cooking in both the residential and institutional sectors. Charcoal production and consumption is an important part of the economy, supplying most urban areas with cooking fuel and generating about 20,000 full-time jobs. It is believed that biomass resources are being depleted at a higher rate than production but data are insufficient to verify this. In addition, land under biomass production is regularly converted to farmland, which is sometimes devoid of trees. The MEMD and other actors have implemented isolated biomass projects.

In 1999 the MEMD began a process of formulating a new policy for the energy sector. The National Energy Policy for Uganda – Uganda 21 has been completed, and was approved by Cabinet in 2001. This energy policy is unique in that it includes a section on biomass energy. Revision of the forest policy began in 1998. The draft forest policy has been approved by Cabinet but is yet to be passed by Parliament. The forest sector has in addition developed a National Forest Plan. In developing this NBES plan these policies are taken into account.

The National Biomass Study (NBS) of the Forest Department has collected data on biomass distribution throughout the country since 1989. This information is useful for planning for biomass supply. In addition, information on crop distribution and acreage and on livestock stocking rates can be used to establish how much agricultural residues are available for energy production. The work undertaken by NBS has been extensively drawn upon in preparation of the NBES plan.

This NBES plan attempts to synchronize the energy strategies in the energy policy, the National Forest Plan and the National Environment Plan. The plan addresses elements relating to institutional framework, human resource capacity, mobilization of financial resources, and information accessibility. It is envisaged that this plan will be the basis for further development of a NBES.

This document is structured into seven sections. The following section presents the national policy goals and the woodfuel use dynamics. Section 3 reviews the draft energy and forest policies and plans, and also reviews the National Environment Action Plan. Section 4 provides a detailed review of biomass energy flows in Uganda. Section 5 reviews select biomass initiatives and discusses barriers to implementation. Section 6 presents a SWOT analysis of elements that need to be considered in developing the NBES. Section 7 looks provides an approach for developing the NBES. Conclusions are made in section 8.

2. BACKGROUND

Uganda's economic performance in the past decade has been impressive, at least on a macro-economic level. The average real rate of GDP growth has been 6.4% per annum since 1991, resulting in an annual 3.3% increase in real GDP per capita. Nevertheless, progress in social and human development has been relatively modest. 35% of the population still live below the poverty line, and significant regional disparities in poverty exist.

The Government of Uganda (GoU) has responded to the poverty challenges by preparing a comprehensive medium-term development strategy, the Poverty Eradication Action Plan (PEAP). Since 1997 the PEAP has guided government policies and expenditure allocation. Since 1997/98 GoU has used the Medium Term Expenditure Framework (MTEF) to align the allocation of public resources with spending priorities articulated in the PEAP. GoU's strategy for economic transformation and poverty reduction is based on four key pillars:

- creating an enabling environment for economic growth and structural transformation;
- ensuring good governance and security;
- directly increasing the ability of the poor to raise their incomes through rural development and expansion of non-farm activities; and
- directly increasing the quality of life of the poor through the provision of primary education, health care, and water and sanitation services.

There are still many issues making the country vulnerable: sustainability of economic growth; exports dependence on agriculture weakened by droughts; plant diseases and price fluctuations (coffee); corruption; weak tax administration; decentralization not properly operational; and inadequate financial services. The high population growth rate is a major obstacle to achieving the objectives of most of the development sectoral programmes.

The importance of energy for the poor and the development of Uganda is recognised in the revised PEAP 2000. Energy has a direct impact on poverty alleviation. Improved electricity supply is expected to further poverty alleviation goals, both through the promotion of private sector-driven economic growth and via direct poverty impacts. The link between energy and the introduction of new technologies for agro-processing in rural areas is especially relevant to Government's plan for modernisation of agriculture. The PEAP also highlights the link between energy and basic needs and notes that the dependence on fuelwood increases the burden on women's time and causes environmental degradation. It further observes that the first step in climbing the energy ladder is the use of improved cooking technologies and the introduction of more efficient methods for charcoal and lime production.

Wood as a source of energy has the following characteristics:

- Woodfuel is the major energy source in rural and urban areas and among the poor (only 1% of the rural population had access to electricity in 2000).
- Commercial woodfuel is very important for the national economy and the industrial sector; it employs tens of thousands of people, adds hundreds of millions of USh to local economies (revenues, taxes, and incomes). Local revenue authority collects about USh 2 billion on charcoal movement alone. The Forest Department collects between USh 2.3 and 5.3 billion in terms of permits and licences. This importance is not reflected in Uganda Revenue Authority policy documents, in Ministry of Finance, Planning and Economic Development (MFPED) policies or in Forest Department plans.
- Woodfuel is widely used in many industrial processes (brick- and tile-making, lime production, tea-drying and tobacco-curing, and food-processing) and in the majority of

institutions (prisons, schools, health centres) and commerce (restaurants, hotels and bakeries).

- Woodfuel saves the country tens of millions of US dollars in foreign exchange yearly. If all Ugandan industries now using wood converted to petroleum products, Uganda's import bill would increase by over US$ 150 million per year. Woodfuel supplies five times the value of electricity and petroleum utilised by Uganda's industrial sector; woodfuel accounts for USh 10 billion compared with USh 1 billion for electricity and USh 1 billion for petroleum.
- Woodfuel will continue to be the dominant source of energy in Uganda for the foreseeable future. Even if the entire hydroelectric potential in Uganda was fully utilized (about 2000 MW), wood would supply more than 75% of the total energy consumption in 2015.
- Charcoal production accounts for 15-20% of the wood supply in Uganda and is mainly consumed in urban areas. The production of charcoal in Uganda is based on simple methods with a very low efficiency (8-12% recovery).
- Woodfuel is mainly sourced from dry fallen logs and branches and as a by-product of land clearance for human settlement, crop or livestock development. When the wood from agricultural expansion is not utilized for charcoal, it is often burned on site.

Ugandan households generally utilize woody biomass inefficiently. The usage of improved wood stoves and other energy sources (LPG, solar energy, biogas, kerosene, electricity) is limited in most areas. A few institutions such as schools have converted from open fires to improved cooking stoves. However, no comprehensive analysis has been undertaken to evaluate the implications of this application switch. A few high-income households use LPG and electricity for cooking.

Different studies show that the relative prices of wood and charcoal have dropped vis-à-vis every major important urban household commodity. Relative to the urban household "consumer basket" of goods and services, charcoal's price has risen less than any other major commodity. In Kampala the market efficiently supplies the consumer with a steady, uninterrupted supply of fuelwood and charcoal at relatively low prices. However, these low prices are below economic cost, as fuelwood fiscal tax compliance rates are low, competition is high, and production costs are rarely taken into account since so much charcoal emanates from rapidly increasing land clearing. In the case of Mbarara, for example, the price of a charcoal bag has declined from USh 12,000 to Ush 8,000 in the last two years, following an increase in the number of charcoal traders – especially the wholesalers using lorries. Thus, economic incentives to conserve wood and charcoal have diminished over the past five years.

3. REVIEW OF ENERGY AND FORESTRY SECTOR POLICIES AND PLANS

3.1 Review of the National Energy Policy (2001)

The energy sector has historically placed emphasis on policies which address supply of commercial sources of energy, giving little attention to biomass which is the major source of energy in the country. The main goal of the new National Energy Policy is to meet the energy needs of the Ugandan population for social and economic development in an environmentally sustainable way; the second objective is to increase access to modern affordable and reliable energy services as a contribution to poverty eradication. On the demand side, the main objective for households and institutions is to provide affordable energy services for households and community. Basic services, including water supply and sanitation, health, education, public lighting and communication, improve the social welfare of the rural population.

The specific objectives for this sector are to:

- achieve a sustainable level of energy security for low-income households so as to reduce poverty at household level;
- improve efficiency in the use of biomass resources, recognizing that biomass will remain a dominant source of energy, especially in the rural areas, for the foreseeable future;
- specifically target provision of energy for productive activities such as rural-based industries in order to directly raise incomes; and
- sensitize women on energy source and technology choices in order to reduce the labour and health burdens associated with biomass energy use.

The National Energy Policy recognizes the role energy supply improvement in rural areas is likely to play – hence the need to include biomass in the realms of national energy planning. It also recognizes that woodfuel-harvesting contributes to degradation of forests as wood reserves are depleted at a rapid rate in many regions, to environmental impacts, and to the health of end-users and the burden of collecting firewood on women and children as a result of increased use of biomass energy. In some parts of the country woodfuel is now scarce. This could be addressed to some extent through demand-side management, which includes the use of energy-efficient devices and alternative sources.

There is insufficient data on demand and supply of biomass fuels in the country and a lack of awareness about the potential for biomass energy technologies. The policy views reinforcement of the database on biomass, especially demand, as a major thrust for planning purposes.

The policy recognizes the inadequacies within government institutions to plan for and monitor the sub-sector, and to conduct research and development. The energy policy plans to increase private sector participation through use of smart subsidies, particularly for improvement in efficiency and technology acquisition. Emphasis would be placed on improving efficiency of biomass use along the whole chain from production to end-use.

The energy policy proposes strategies to address demand-side sectors, namely household and institutions, industry and commerce, transport and agriculture. Energy efficiency is the major thrust in demand-side management. In addition, the policy proposes strategies to address supply sub-sectors, namely those for power, petroleum, and biomass and other renewable energy. The major objective of the biomass and other renewable energy strategy is to provide focused support for the development, promotion and use of renewable energy resources for both small- and large-scale applications.

The Energy Department has prepared strategies and plans for the other sub-sectors. This is the first initiative towards planning for a comprehensive the a strategy for biomass energy status. However, the MEMD already supports the implementation of biomass demand projects, one of which is described in section 5.

3.2 Review of the forestry policy and National Forest Plan

Uganda's forests and woodlands are viewed as vital in the three pillars of sustainable development: economic, social and environmental. The forestry policy recognizes that Uganda's forest resources provide energy, supplying 93% of national energy demand. Gazetted forest reserves, which cover about 40% of total forest area in the country are not the major source of biomass energy for current and future demand. About 35 million m^3 of fuelwood is consumed annually, which is way above the total annual allowable cut of 350,000 m^3 for all reserved forests. Since these forests still have growing stock, it implies that the bulk of biomass used for energy is mainly obtained from areas outside forest reserves. There is no reliable documentation on how much of the total fuelwood quantity is supplied by gazetted forests.

The forest policy views farm forestry as a major strategy in ensuring an adequate supply of biomass energy. The forest sector's role would be to provide adequate clean seed, and advisory services to extensionists based at sub-county level. The planned extension service (NAADS) is the major link to subsistence farmers thoroughout the country. The policy also plans to take advantage of GoU's commitment to promote and develop farm forestry through the Plan for Modernization of Agriculture.

The use of forestry waste as a source of energy is not addressed, but this may be implied, since there are no planned energy plantations yet forest reserves are expected to supply some fuelwood as outlined in the National Forest Authority Business Plan. The tops and branches from logging operations would be sold as fuel, which would be obtained from production working cycles as stipulated in the management plans for specific forest reserves.

The forest policy mentions collaboration with stakeholders but no clear strategy is highlighted. Stakeholders include the poor rural and urban populations, those working in wood industries, consumers of forest products, servants of the sector, and the wider national and international public. The policy specifies collaboration with the agriculture, land use, water, wildlife, industry and energy sectors. Energy issues are recognized as cutting across a number of sectors. Stakeholder participation has been used in preparation of the National Forest Action Plan, spearheaded by the Uganda Forest Sector Coordination Unit. For instance, working group 3, which addresses wood processing, plantations and biomass energy issues, includes stakeholders from other sectors including the Energy Department. The biomass energy aspects of the National Forest Plan concentrate on strategies for improving energy efficiency in the household, charcoal production, and industrial (where wood is a source of energy) sectors. It stipulates the need to develop a biomass energy strategy. If biomass energy supply is considered to be part and parcel of plantations, woodlots and farm forestry, this should be explicit in the plan.

3.3 Review of the National Environment Action Plan (NEAP)

The environment policy and the NEAP addresses all natural resources. The energy sector objective is "to meet national energy needs through increased use of hydropower, improved efficiency of energy use, increased use of alternative energy sources, increased production of (plantation and on-farm) trees and promotion of exploration and production of fossil fuels". The strategies outlined to achieve this objective include acquiring or developing, testing and disseminating appropriate alternative energy technologies; providing incentives (smart subsidies) for private and institutional fuelwood plantations; encouraging the private sector to establish energy plantations.

4. BIOMASS ENERGY FLOWS

In order to conceptualise the issue of biomass energy flows, it is pertinent to get data on general land cover (use) and biomass density; forestry; and agricultural crops and animal wastes. Data on the first two were provided by the National Biomass Study project, which has been assessing Uganda's woody biomass resource since 1989. Data on crop and animal production were obtained from the Ministry of Agriculture, Animal Industry and Fisheries.

4.1 Forestry

Woodfuel (firewood and charcoal), on both non-commercial and commercial bases, constitutes 88% of energy consumed in the country. Basically, any dry material can be used as a source of woodfuel. Sources of these dry materials are mainly trees and bushes, which occur in all types of land cover (use) – forests, woodlands, bushlands, agricultural farms, etc. Until recently, however, there has been no assessment of these land cover types and of production of biomass for energy. It was not until 1996 that the National Biomass Study project published the status of Uganda's land cover and woody biomass status. The results of this study formed the basis for calculating the supply side of the biomass energy flows for this NBES plan.

4.1.1 Land cover (use) distribution and biomass production

The National Biomass Study stratified Uganda's land cover (use) into 13 main strata, as listed in Figure 4-1.

Land Cover (use) Stratification System

Below is a full list of the land cover (use) stratification system as developed by NBS.

1. Hard wood Plantations (mainly Eucalyptus sp and indigenous sp e.g. Maesopsis eminii)
2. Softwood Plantation comprising of Pines and Cypress
3. Tropical High Forest normally stocked i.e. without human interference
4. Tropical High Forest depleted or degraded i.e. affected by human influence
5. Woodland more open and single storied than the tropical high forest normally above 5m.
6. Bushland crown cover over 40% and below 5m.
7. Grassland (dominant vegetation type is grass but occasionally there could be scattred trees).
8. Wetland (permanent covered by wetland grass e.g. papyrus or seasonal).
9. Subsistence farmland areas with settlements
10. Commercial Farmland (large scale farms e.g. sugarcane and tea plantation)
11. Built-up areas (urban centers, trading centers etc).
12. Water bodies such as lakes, ponds and rivers
13. Impediment areas where no biomass is expected such as rock outcrops and bare lands.

Note: Each of the above main class, contain subclasses based on the stocking density levels ranging from low, medium to high density sub-classes, although in the study, summaries of the data is restricted to the main classes only.

Figure 4-1: Land cover (use) stratification

These strata were mapped for the whole country based on remotely sensed data (SPOT satellite imageries) and geographical information system (GIS) techniques. The satellite imageries were of various dates ranging from 1989 to 1993.

Table 4-1 shows that, at a national level, subsistence farmland has the highest land acreage and production, followed by grasslands, tropical high forest, woodlands and degraded tropical high forests.

Table 4-1: National land cover (use) distribution and production

Land cover (use)	Area (km2)	Biomass (,000 t, Airdry)
Broadleaved Plantations Total	188.9	1,431.2
Built up areas Total	365.8	47.4
Bushlands Total	14,221.9	14,961.3
Grasslands Total	50,721.1	58,560.8
Impediments Total	37.4	0.0
Large scale Farmlands Total	684.5	0.6
Softwood Plantations Total	163.9	2,456.5
Subsistence farmlands Total	84,007.1	104,534.3
Tropical High Forest Total	6,511.1	145,847.8
Tropical High Forest (degraded) Total	2,730.6	30,855.5
Water Total	36,895.6	0.0
Wetlands Total	4,840.3	0.0
Woodlands Total	39,744.6	118,474.2
Grand Total	241,112.8	477,169.6

4.1.2 Woody biomass availability

The above gross biomass supply information assumes that all the biomass is accessible to the population. In reality, much of the biomass held in forests is inaccessible, either due to being too distant, or because of management restrictions in protected areas such as forest reserves, game reserves and national parks. For purpose of simplicity, if areas under protection are assumed to be unavailable or inaccessible, then the available supply of biomass for use would be reduced drastically, as presented in Table 4-2.

Table 4-2: Woody biomass availabilty

Land cover (use)	Gross	Protected	Available	Total Biomass	Protected	Available
	Area (km2)	Area (km2)	Area (km2)	(,000 t, Airdry)	(,000 t, Airdry)	(,000 t, Airdry)
Broadleaved Plantations Total	188.9	66.7	122.2	1,431.2	505.65	925.55
Built up areas Total	365.8	26.0	339.9	47.4	3.72	43.68
Bushlands Total	14,221.9	8,626.7	5,595.2	14,961.3	8,102.34	6,858.96
Grasslands Total	50,721.1	23,163.4	27,557.7	58,560.8	27,522.52	31,038.28
Impediments Total	37.4	11.4	26.0	0.0	0.00	0.00
Large scale Farmlands Total	684.5	22.6	662.0	0.6	0.00	0.60
Softwood Plantations Total	163.9	156.9	7.0	2,456.5	2,353.50	103.00
Subsistence farmlands Total	84,007.1	4,985.7	79,021.4	104,534.3	4,346.80	100,187.50
Tropical High Forest Total	6,511.1	4,763.4	1,747.7	145,847.8	106,700.83	39,146.97
Tropical High Forest (degraded	2,730.6	971.5	1,759.1	30,855.5	10,978.29	19,877.21
Water Total	36,895.6	270.5	36,625.1	0.0	0.00	0.00
Wetlands Total	4,840.3	535.8	4,304.5	0.0	0.00	0.00
Woodlands Total	39,744.6	13,726.5	26,018.1	118,474.2	40,728.35	77,745.85
Grand Total	**241,112.8**	**57,327.0**	**183,785.8**	**477,169.6**	**201,242.00**	**275,927.60**

At national level, the gross biomass supply of 477 million tons air dry would be reduced to almost half when the total amount of 201 million tons from all the protected areas is removed. Table 4-2 further gives the details of the distribution of the biomass per various land cover (use) types at the national level. Sources of wood used for fuelwood and other forest products can also be derived from these distribution patterns and land use types. For example, the nearest source for fuelwood would be the subsistence farmlands areas or the bushland located near settlement areas. Similarly, for sawn wood purposes one can deduce

that the supplies should ideally come from softwood plantations and the high tropical forests.

4.1.3 Mean annual increment and sustainable yields

Using preliminary mean annual increments estimates from the National Biomass Study for the various land cover (use) classes, the annual yields on a regional basis were calculated for both the gross biomass supply and the net (i.e. after removing the protected areas) to produce the available sustainable biomass yields. The results are presented in Table 4-3. The total sustainable yield after removing protected areas from the gross supply is about 14.4 million tons at national level. The details per each land cover on regional basis is given in annex C. The implications of this sustainable supplies in relation to consumption shall be further discussed in section below.

Table 4-3: Sustainable woody biomass supplies

Region	Gross Biomass	Gross Yield	Available (*)	Yield-Available (*)
	(,000 t, Airdry)	(,000 t/year)	(,000 t, Airdry)	(,000 t/year)
Central Total	111,214.7	4,789.9	85,772.8	4,054.8
Eastern Total	45,321.6	2,488.4	25,862.11	1,811.2
Northern Total	118,347.3	6,033.8	70,833.72	4,259.4
Western Total	202,286.0	7,129.7	93,458.96	4,334.7
Grand Total	477,169.6	20,441.8	275,927.60	14,460.1

(*) After removing the protected areas

4.2 Agriculture

Biomass energy from crops is derived from agricultural residues arising from the growing and harvesting of both food crops and cash crops. The commonest food crops grown in Uganda are plantains (green and sweet bananas); cereals (finger millet, maize, sorghum, rice and wheat); root crops (sweet potatoes, Irish potatoes and cassava); pulses (beans, field peas, soya beans and pigeon peas); groundnuts (sometimes called peanuts); and sim-sim. The cash crops grown are coffee, cotton, tea and sugar cane. The distributions of these crops in the country depend on specific crop requirements such as soils and climatic conditions. The following section presents the areas and production of the major crops in Uganda based on data from the Ministry of Agriculture (1995).

4.2.1 Crops: areas and production

For more details of crop areas and production at district, regional and national levels refer to annex D.

4.2.2 Agricultural residues (food and main cash crops)

Agricultural residues are the material left after harvesting or processing of crops. Data on residues are in most cases lacking, so the data for residues was derived by calculating the production figures of each crop with appropriate conversion factors (residue-production ratios). The conversion factors were obtained from a report for GHG inventories (1994). The results on national basis for the main crops are presented in Table 4-4.

Table 4-4: Agricultural residues

Crop type	Residues (t)	Availability for energy (%)	Availability for energy (t)
Cassava	667,200	0	0
Bananas	3,604,799	30	1,081,440
Beans	273,001	30	81,900
Cow peas	26,783	30	8,035
Field peas	9,599	30	2,880
Soya beans	55,299	30	16,590
Finger millet	695,200	0	0
Sorghum	478,802	30	143,641
Maize	913,002	30	273,901
Rice	108,445	30	32,534
Wheat	10,800	0	0
Sunflowers	22,251	0	0
Groundnuts	144,000	30	43,200
Sweet potatoes	666,900	0	0
Irish potatoes	155,726	0	0
Coffee	145,172	30	43,552
Tea	12,692	30	3,808
Tobacco	6,851	30	2,055
TOTAL	**7,996,522**	**-**	**1,733,536**

4.3 Livestock

There has been no recent detailed census carried out in the country, and the figures given in Table 4-5 are derived from the Ministry of Agriculture, Animal Industries and Fisheries statistical abstract (2000).

Table 4-5: Animal numbers and waste production (1995)

Animal	Number	DVS	Total Dry Matter	Available (5%)
	,000	kg/Head/day	,000 t/year	,000 t/year
Grazing Cattle	5233	1.7	3,247.1	162.4
Sheep	924	0.37	124.8	6.2
Goats	5545	0.49	991.7	49.6
Pigs	1343	0.41	201.0	10.0
Poultry	21832	0.02	159.4	8.0
Total			**4,723.9**	**236.2**

The indicated production potential from animals for fuel use should be treated with caution because a number of issues which affect the potential supply have not been factored in the estimates. For instance it is only possible to collect a fraction (estimated here as 5%) of the dung produced for fuel use since nearly all the cattle in Uganda graze in the grasslands and rangelands, rather than in organized ranches. It is not known what proportion of the animals are raised under intensive management (zero grazing). Besides, burning of animal wastes for fuel is considered to be a bad practice in agriculture since it denies the soils valuable mineral nutrients. Furthermore, the use of dung for fuels is not common in

Uganda except in a few areas with fuelwood scarcity. Therefore the figures should be taken as indicative potential availability of biomass from animal wastes.

4.4 Total biomass production and use

The overall potential stock of woody biomass in Uganda in 1995 was about 477.2 million tons air dry. However if the biomass from protected areas were removed from the gross national stock, the net available stock would be reduced to 275.9 million tons air dry. It should also be noted that in reality only small stems, twigs and branches are normally utilized. If this is taken into account, the available stock would be further reduced to about 30% (about 90 million tons of wood).

The total sustainable biomass production and consumption flows have been summarized at national level and are presented in Table 4-6. The concept of sustainability is that the annual outtake should not exceed the mean annual increment. The annual gross sustainable yield at national level is about 20.4 million t/year. However, if the available supply from non-protected areas is considered alone, then the yield will be reduced to about 14.5 million tons per year. As expected from the above presentations, the highest biomass supply was from trees (14.4 million tons/year, air-dry biomass above ground), followed by agricultural residues (1.7 million tons/year) and the rest were from animal wastes. On the consumption side, fuelwood consumed by households constitutes the greatest amount of biomass, followed by charcoal, fuelwood for commercial purposes, and residues. Only 50% of crop residues available for energy purpose are consumed. An increased supply from this source should be considered with care.

Table 4-6: Biomass energy flows at national level (1995)

	Category	Flow (,000 t/year)
Supply	Trees (above ground)	14,460.10
	Dung (Dry Volatile Solids)	236.20
	Crop residues	1,733.50
	Total Biomass Supply	**16,429.80**
Consumption	Charcoal	3,118.00
	Fuelwood (Households)	13,447.00
	Fuelwood (Commercial)	1,907.00
	Fuelwood (Industrial)	913.00
	Total Fuelwood Consumption	**19,385.00**
	Residue Consumption	850.00
	Total Biomass Consumption	**20,235.00**
Balance	**Supply - Consumption**	**-3,805.20**

4.5 Conclusion

The data on land cover (use) distribution, areas, standing stock (biomass density), agricultural crop areas and production and animal waste production were used to quantify the supply of biomass supply. Data on charcoal and firewood from available literature were used to determine the quantity of biomass consumed in 1995. On the supply side, Uganda had a total stock of 477.2 million tons of woody biomass in 1995. The total biomass yields were about 20.4 million t/year of wood (annual mean increment), 8.0 million t/year of agricultural crop residues and 4.7 million tons/year of animal wastes. The available (excluding protected areas) amounts for energy use were 275.9 million tons of wood as stock, 14.46 million tons of wood/year, 1.73 million tons of residues/year and 236,000 t of animal wastes as yields.

On the consumption side, the same year, a total of 20.2 million tons was consumed of which nearly 80.5 % was firewood for all purposes, 14.5 % charcoal and 4 % residue. Biomass flows based on these sustainable yields gave a negative balance of 3.8 million

tons/year in 1995. The deficit for woody biomass is even higher: 4.9 million tons/year for the same year.

Some gaps exist in the data, and the estimates should be treated with caution, since many issues that affect the gross supply and the consumption were not factored in. If one was to rely on the above analysis, the general conclusion is that with a negative balance of 3.8 million tons, serious challenges are posed to the sustainable use of this resource. In certain region and districts the situation is even worse. The future biomass supply for Uganda would thus be considered not sustainable because the demand for biomass resources would intensify as the population increases. Remedial actions have to be put in place before the situation worsens. It is, however, critical that the assumptions be adhered to when interpreting and using these results. The fact that woodfuel is still relatively easily available nationally implies the need to seriously take into account the unconventional sources, such as farmlands, when developing a strategy for biomass. Table 4-7 provide an idea about the evolution of the wood standing stock for the future.

Table 4-7: Evolution of the wood available stock

Available yield	0.052405
Wood consumption	+ 2.6%/year

Year	**Available wood stock**	**Available yearly yield**	**Woodfuel consumption**
	M t	M t/y	M t/y
1995	275.9	14.46	19.39
1996	271.0	14.20	19.89
1997	265.3	13.90	20.41
1998	258.8	13.56	20.94
1999	251.4	13.18	21.48
2000	243.1	12.74	22.04
2001	233.8	12.25	22.61
2002	223.5	11.71	23.20
2003	212.0	11.11	23.80
2004	199.3	10.44	24.42
2005	185.3	9.71	25.06
2006	170.0	8.91	25.71
2007	153.2	8.03	26.38
2008	134.8	7.07	27.06
2009	114.8	6.02	27.77
2010	93.1	4.88	28.49
2011	69.5	3.64	29.23
2012	43.9	2.30	29.99
2013	16.2	0.85	30.77
2014	-13.7	-0.72	31.57
2015	-46.0	-2.41	32.39

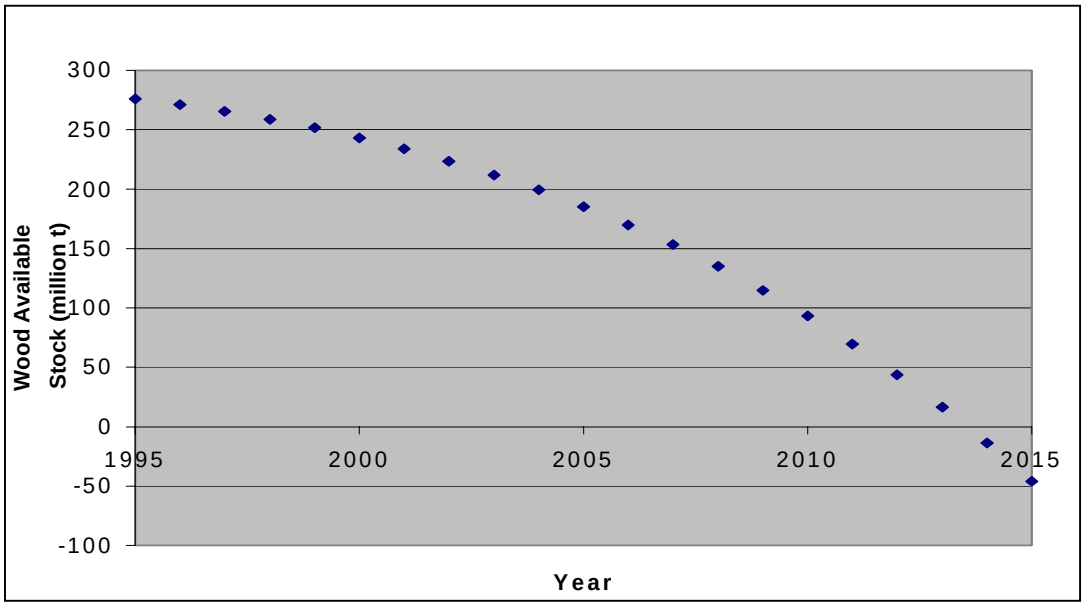


Figure 4-2: Evolution of the wood available stock

5. SELECTED BIOMASS ENERGY INITIATIVES AND BARRIERS

This section reviews some biomass energy initiatives in the country and examines some of the barriers to dissemination of biomass energy technologies. The initiatives mainly focus on creating awareness and dissemination of technologies for tree planting and energy efficiency, particularly improved stoves and improved charcoal production techniques. There are some activities addressing capacity building as well. Most NGO and public sector initiatives receive donor support while private sector activities are supported by the parent company.

5.1 Ministry of Energy and Mineral Development initiatives

The MEMD is implementing the Sustainable Energy Use in Households and Industry (SEUHI), a three-year project started in 1999 and supported by the Netherlands Government. The objective of this project was to improve efficiency in energy conversion and use in households and small-scale industry. The project promotes rural and urban household stoves in Kampala, Soroti, Adjumani, Kabale and Tororo; efficient charcoal production in Luwero, Nakasongola and Masindi; and lime production in Kasese, Kisoro and Tororo.

The following have been achieved.

- MEMD has disseminated improved cookstoves in 34 sub-counties in the districts of Kabale, Tororo, Soroti and Adjumani. Over 400 people have been trained and about 7,000 households now have acquired improved stoves.
- About 70 artisans were trained in production and marketing of improved charcoal stoves in Kampala and Kabale.
- Over 130 charcoal producers in Nakasongola, Luwero and Masindi districts were trained in improved charcoal production methods.
- Three charcoal producers associations were formed.
- Two charcoal producers associations benefited from a modest revolving fund through which they acquired the MAB-CASA kiln. In addition the MEMD facilitated the associations access to Kampala charcoal markets. The two associations have been operating stalls in Wandegeya and Namasuba Markets since August 2000.
- An improved lime kiln in Tororo was completed and launched and another lime kiln was built in Kisoro.
- Energy audits have been carried out in some biomass based industries.
- Eight tree nurseries were established in sub-counties in Kabale District.
- In collaboration with ACORD, MEMD planted over 500,000 seedlings in Adjumani District.
- MEMD established 20 biogas digesters and trained 20 artisans in biogas digester construction.

Under the Energy Advisory Project supported by the German Government, the MEMD prepared the national energy policy, sub-sector-strategies and an energy information system. Technical assistance was also provided to different NGO projects and the media. A Biomass Energy Development Programme (BEDP) was prepared, under which the MEMD plans to remove barriers to increase biomass energy efficiency in households and small-scale industries in rural and peri-urban areas. This will be done by promoting improved efficiency technologies and fuel substitution. High priority will be given to urban

households, institutions and small industries where there are management and motivation to cut fuel costs quickly.

5.2 Rwenzori Highlands Tea Company

Rwenzori Highlands Tea Company (RHTC) consists of six tea estates namely: Bugambe Tea Estate, Hoima District; Kisalu Tea Estate, Hoima District; Muzizi Tea Estate, Kibale District; Mwenge Tea Estate, Kabarole District; Kiko Tea Estate, Kabarole District and Ankole Tea Estate, Bushenyi District. The biomass initiative started in 1994 emphasises production and utilization of fuelwood. Three estates (Mwenge, Kiko and Ankole) have planted 465.6 ha of eucalyptus (excludes area planting before 1994) managed at a rotation of 6 to 8 years. Mature eucalyptus fuelwood produced 480 kg of made tea/m^3 of fuelwood, as compared to 320 kg of made tea/m^3 of fuelwood from a 6 years old crop. The company sold some of its fuelwood at USh 1,500 per m^3.

RHTC has introduced efficient wood-fired steam boilers in two estates (Mwenge and Ankole). The new boilers improved fuelwood consumption from 220kg of made tea/m^3 of fuelwood to 320-480 kg of made tea/m^3 of fuelwood, a 31% to 54% reduction in fuelwood consumption. The company also uses efficient wood-burning cookstoves to prepare food for factory workers. RHTC plans to introduce tree planting and use of efficient boilers and stoves in all its tea estates.

5.3 British American Tobacco/Universal Leaf Tobacco

Substantial amounts of energy are required to cure tobacco, a crucial step in the ultimate quality of the product. Subsistence farmers do 95% of the growing and curing of tobacco. British American Tobacco (BAT) supplies subscribed growers with agro inputs which include transportation of fuelwood and distribution of tree seedlings. Over 15 million seedlings were distributed in 1999 and 2000. However, since there is limited monitoring of tree planting, the number of trees surviving on farm land may be far less. In addition, BAT has decided not to buy tobacco from farmers who do not plant trees. The announcement made in June 2000 did not indicate how many trees each qualifying farmer should plant or even the share that should survive. Furthermore, the support provided by BAT to farmers such as clearing land and provision of agro inputs on credit makes this policy difficult to implement, since the farmer is in debt to BAT. BAT has introduced an energy efficient tobacco curing barn which uses 10 m^3 of fuelwood per 1,000 kg of cured tobacco as compared to the traditional method which uses 20 m^3 of fuelwood. Clearly this has implications for small-scale farmers generating smaller quantities.

5.4 Joint Energy and Environment Project (JEEP)

Since 1983, JEEP has been involved in energy and environment issues, concentrating on training and creating awareness on energy, environment and sustainable agriculture. JEEP has a membership of over 500, and 30 groups of youth, women and farmers. Currently JEEP's thrust is training of trainers in, among other topics, energy conservation and alternative fuels, construction of fuel-saving cookstoves, other energy saving household technologies, and tree-planting. Under a programme supported by Plan International, over 33,000 people have been sensitised and over 8,500 trainers trained in the districts of Mpigi, Kampala, Luwero and Tororo. Over 3,000 mud stoves were built in 2000. This implies that only one third of the trainers who attended the workshops have built a stove for themselves. During the same year, over 22,000 tree seedlings were planted. JEEP also constructs stoves for schools, health units, restaurants and prisons. Over 20 stoves have been constructed, although only 4 were built in 2000. JEEP sold 600 improved charcoal stoves in 2000.

JEEP plans to continue training of trainers and monitoring performance of trainers in the selected districts. In addition they plan lobby and advocacy work which aims at stimulating politicians to consider energy and environment issues in their development plans. In order to generate income to offset their overheads, JEEP plans to step up marketing institutional

stoves and improved charcoal stoves. JEEP has also acquired land where it plans to establish a training and demonstration centre, with improved stoves, tree planting and biogas being some of its key activities.

5.5 Integrated Rural Development Initiatives (IRDI)

Integrated Rural Development Initiatives was conceived in February 1994 by a group of people with experience and interest in environment conservation and rural and peri-urban development. The majority of the population resides in the rural and peri-urban areas where they depend on agriculture for their survival. Rural people also depend on biomass energy for their cooking and heating needs. IRDI therefore aims to reduce environmental degradation, promote sustainable utilization of natural resources and improve the social economic status of the communities, especially the marginalised groups. IRDI promotes the use of renewable energy technologies, with emphasis on training trainers in mud stove construction and use, use of a hay basket, and construction of biogas plants. IRDI currently operates in Kampala, Mpigi, Mukono, Rakai, Mbale and Kamuli. The work in Rakai is supported by Cross Border Biodiversity Project, Ministry of Water, Lands and Environment. IRDI achievements include the following:

- Over 30 training seminars and workshops, which include wood energy conservation, tree planting and biogas construction, have been held, with close to 700 farmers trained.
- 90 school children were trained in environmental conservation (includes wood energy conservation, tree planting).
- Newsletters produced in English, Luganda and one in Lumasaba on sustainable agriculture and energy conservation.
- Over 100 radio programmes in English, Luganda and Lumasaba.
- Six households were provided with heifers as part of an initiative towards sustainable agriculture and introduction of biogas technology.
- Over 8,000 improved stoves were constructed.
- Over 50 biogas digesters were constructed by farmers.
- 20 "backyard" tree nurseries were in operation.
- Over 300 farmers have planted trees.
- Two rural demonstration kitchens with improved stoves were constructed.

IRDI plans to:

- continue with on-going programmes;
- conduct research on kitchens;
- train farmers in kitchen construction;
- promote the use of fuel-efficient kilns (brick and charcoal);
- train a target group in tree nursery establishment, agro-forestry and woodlot establishment and management;
- establish a resource centre in Mukono district.

5.6 Renewable Energy Development Centre

The Renewable Energy Development Centre (REDC), in association with the UK-based consultancy firm Energy for Sustainable Development (ESD), has conducted a number of studies on renewable energy. These include:

- IGAD household energy project;
- improving efficient woody biomass energy production and utilization in Mukono and Masindi, and;
- poverty alleviation effects of improved stoves.

REDC (and ESD) is implementing the IGAD household energy project, which aims to improve standards of living by ensuring environmentally and economically sustainable household energy in the IGAD region. In Uganda, the IGAD project addresses commercialisation of improved charcoal stoves. Currently the project has conducted a number of consultant missions which identified the main areas of concern, namely business management and quality control. A selection of stoves on the Ugandan market has been tested for thermal efficiency and durability. The KCJ was selected based on thermal efficiency, durability and ease of production, and has been subjected to field tests (kitchen performance tests). The project will conduct training in business management and stove production for selected entrepreneurs in Kampala. In addition, the project will train artisans in kiln construction and use.

The DFID/KAR funded project on improving efficient woody biomass energy production and utilization in Mukono and Masindi has been completed. The main objective of the project was to demonstrate the important contribution of commercial woody biomass towards poverty alleviation and the national economy. The study established that there is considerable seasonal variation in forest gate prices for charcoal, and that wages and profits vary. Charcoal producers earn very little (23,000/= to 50,000/= per month) and sometimes operate at a loss. In comparison the monthly income of a transporter ranges from 600,000/= to 1,500,000/=. A charcoal retailer in Masindi earns 21,000/= per month, while one in Kampala earns about 158,000/= per month. The study also established that charcoal production and firewood harvesting are male-dominated activities. Most producers do not own the resource – they either enter into contract with the owners or produce charcoal illegally.

Another DFID/KAR project – poverty reduction impacts of improved stoves – is completed. The project aimed at mapping out the energy consumption patterns in different classes of society in Kampala. The study established that in Kampala there is a direct relationship between use of electricity for cooking and household income while use of kerosene was independent of income. Use of LPG was limited to 2% of the sample. Dependence on charcoal for cooking was high across all income groups. Use of charcoal instead of firewood represented an improvement in quality of life. Use of firewood for cooking was prevalent in the lowest income group. Statistical analysis showed that 21% of the reasons given for choice of fuel were related to income. In over 80% of the households, the family head chose the type of stove purchased and this was influenced by income, except for the kerosene stoves. It was also noted that none of the households in the high-income groups had an improved stove. Most households with an improved stove had used it for about two years; the longest time recorded was seven years.

5.7 Human resource mobilisation: training initiatives

With support from NORAD, Nyabyeya Forestry College established a Biomass Energy Resource and Training Centre, for training forestry technicians and graduate foresters. They also plan refresher courses for older technicians and short courses for extension workers. This aims at training target groups in producing different biomass technologies – particularly improved stoves. The college has established a training and demonstration unit with a wide range of technologies on display. Training of college staff and technicians in different aspects of biomass energy and stove production has been conducted. The college plans to begin training artisans and staff of CBOs and NGOs (short courses) and forestry technicians (module in forestry training).

The Faculty of Technology, Makerere University has established demonstration/training units for different technologies including biogas and improved cook stoves, and is planning to install a gasifier. A number of institutions (Nyabyeya Forestry College, Makerere Faculty of Technology) are planning to establish "Biomass Energy Centres" in different parts of the country. In addition, 12 Agricultural Research and Development Centres (former District Farm Institutes) currently under National Agricultural Research Organisation management and Agricultural Development Centres under local government management can be used as technology uptake pathways for biomass energy technologies. These efforts need to be coordinated to avoid duplication. Different small projects (IGAD, SEUHI) plan to provide training in both technical and business management skills for improved charcoal stove producers.

5.8 National Environment Management Authority

The National Environment Management Authority supports CBOs and NGOs involved in environment-related activities in Mbarara, Kabale, Kasese, Arua, Tororo, Busia and Mbale Districts. Support is provided at sub-county level. In Mbarara, six sub-counties planted over 126,000 seedlings (mainly eucalyptus). Each sub-county had a nursery with seedlings for the next planting season. In Kabale, over 30,000 seedlings of grevillea, sesbania and calliandra were planted in agroforestry farming systems, mainly for soil conservation. Trees planted in previous years were well managed. NEMA supports activities in seven sub-counties in Kabale District. In Mbale, over 200,000 trees (eucalyptus, grevillea, luceana, maesopsis, sesbania, other indigenous trees, and fruit trees) were planted in four sub-counties. Nurseries were well stocked in preparation for the next planting season. In Nakaloke sub-county 10 households built and used improved stoves. Over 280,000 trees were planted in six sub-conties of Tororo district. All nurseries were well stocked in preparation for the next planting season. In Rubongi, Mukuju and Kwapa sub-counties, 73 energy saving stoves were constructed. About 30,000 trees were planted in five sub-counties of Busia district. Iin Lunnyo sub-county 62 improved stoves were constructed. In Kasese, over 100,000 trees were planted in three sub-counties. Two sub-counties have well stocked nurseries. In Arua, 45 ha were planted in six sub-counties. A large number of seedlings were sold or distributed to the community. All sub-counties have well stocked nurseries.

5.9 Other biomass initiatives

Other agencies involved in tree planting and improved stove dissemination include VI Tree Planting (Masaka and Rakai), CARE (Kabale, Bushenyi), Africa 2000 (Kabale, Kasese, Tororo, Iganga), IUCN (Mount Elgon NP, Kibale NP), Africare (Kabale), Global Energy and Environment Consult (Kampala, Wakiso) and Black Power (Wakiso, Kampala). In addition most district environment offices have tree planting activities although the scale and numbers are limited. Larger companies like Sugar Cooperation of Uganda Limited and Kinyara Sugar Works generate power using biomass waste.

5.10 Key barriers to integration of biomass energy into mainstream energy system

Perception

The majority of people, including policy-makers, planners, decision-makers and political leaders, while acknowledging wide use of biomass energy, equate energy with high-grade forms of energy such as electricity and petroleum products. This understanding of the roles played by biomass energy, especially woodfuel, in different social and economic sectors of society is the major reason for the insufficient attention given to biomass energy in national policies, strategies, programmes and projects. The biomass energy sub-sector is accorded low priority compared to modern sources of energy. In some circles, it is perceived as a dirty fuel for the poor.

Financial

The biomass sub-sector largely functions and operates in the informal sector. It is therefore considered as poor business, with little attraction for large capital investment and little promise of rich revenues. The sub-sector is characterized by projects/businesses with long gestation periods and small profit margins. It is rarely attractive to large capital. Further, it is very difficult to convince financial institutions to finance biomass-related projects, which generally lack financial appeal compared to other sectors of the economy. In addition the relatively low price of biomass reduces the interest of households and other consumers and producers in buying and using advanced biomass energy technologies.

Lack of information

There is a lack of comprehensive and reliable data, especially on the consumption side. Biomass energy planning relies on a wide variety of information (both quantitative and qualitative) from different disciplines. The responsible institutions (Energy Department, Bureau of Statistics) are chronically handicapped in terms of financial and human resources and usually occupy a marginal role in the national planning context. Even basic data, such as the prices of woodfuel in different parts of the country, may be missing or inconsistent. Quite often, the discrepancies among independent estimates illustrate inconsistencies and unreliability of data sources, with obvious negative consequences for formulating or identifying priorities and defining policies and strategies. The figures and facts about the central role played by the sub-sector in terms of offering employment or its contribution to the country's GDP are not documented. If valid arguments are to be won in favour of the sub-sector – say, for more resource allocation – reliable facts and figures should obviously be there to support such arguments.

Technological

The sub-sector is characterized by few producers or manufacturers of proven biomass energy technologies. Many biomass products are worse than the "traditional" technologies in terms of efficiency, durability and other attributes. There is clear lack of quality control and regulation in the sub-sector, as well as a lack of knowledge about the availability of new technologies and their associated advantages and limits. Advanced biomass technologies such as gasification and modern brick kilns are unknown in the country.

Institutional

The key institutions in the biomass sub-sector – MEMD, MUK, Nyabyeya, UREA, NGOs and private companies – experience a shortage of qualified personnel and experts in the area of biomass. These organisations focus on many other issues and biomass is often just a small component of their activities and programmes. This situation is aggravated by the fact that the institutional linkages between the various actors are weak and in some cases non-existent. There is a need to enhance collaboration and exchange of experience between all the actors.

6. FRAMEWORK FOR A BIOMASS ENERGY STRATEGY

6.1 Objectives of the strategy

An ideal biomass energy strategy should ensure that resources are used without negative social, economic and environmental consequences. This requires balancing the supply and demand of biomass energy. While the energy sector is responsible for energy supply and demand, a number of other sectors are involved in biomass energy issues, including forestry, agriculture, environment, industry, health, population, gender and education. Various other stakeholders are involved in supply and demand aspects of biomass.

The Energy Department has developed a National Energy Policy. The major strategy for implementing the energy policy in end-use sectors is energy efficiency. The objective of the biomass (and other renewables) supply sub-sector is for "Government to provide focused support for development, promotion and use of renewable energy resource for both small- and large-scale applications". The policy provides a list of strategies which need to be developed further in order to be implemented. The National Forest Plan emphasises biomass energy conservation through "Developing a biomass energy strategy, improving uptake of energy efficient technologies and developing appropriate technologies for production, processing and energy consumption". The National Environment Action Plan also emphasises energy efficiency, increased production of trees, and increased use of alternative energy sources.

The major objective of this initiative is to synchronise and build on the strategies from different sectors that address biomass energy demand and ensure that stakeholders in the sub-sector play roles based on their comparative advantage in formulating and implementing the biomass energy strategy.

6.2 Options for a biomass energy strategy

A sustainable biomass energy strategy entails balancing supply with demand. Both supply-side and demand-side options can be implemented and the order of priority depends on effectiveness in meeting the objective, and on financial and human resource limitations. Information on demand, as well as on available biomass for energy, is a crucial part of the strategy. Projections of supply and demand derived using baseline data are useful in selection and prioritization of the options. The national development priorities are used as overall guiding principles in prioritization. The ranking of an option is based on pre-structured criteria which take into account the various aspects of sustainability and prevailing limitations in implementing the option. The criteria have the following general elements:

- ***Technological feasibility***. While in most options the technologies might have been tested or at least used elsewhere, their sustainability within the targeted context may not have been analysed.
- ***Institutional capability and sustainability.*** Can the option be sustainably implemented under the prevailing institutional framework?
- ***Financial viability***. Will the option sustain itself financially?
- ***Social acceptability.*** Will the targeted users accept the option over the long term?
- ***Environmental implications***. Does the option result in negative environmental impacts?
- ***National development priorities.*** Does the option contribute to the priorities?

To facilitate ranking for each option, the extent to which it furthers the objectives of each of the elements should be analysed. For example, is the option just marginally financially viable or is it solidly so? Obviously the lifetime or the planning time-frame affects the

competitiveness of the options. The time-frame may have to be set as per the national development plan framework.

Supply-side options
Supply options include establishment of biomass energy plantations, and afforestation and reforestation.

Demand-side options
These include energy efficiency, reduction through non-use, and fuel-switching or substitution.

The MEMD has been implementing some activities along the lines of demand-side options. Energy efficiency activities such as dissemination of improved cookstoves are also commonly undertaken by NGOs. The extent to which these options would address the biomass energy problem is unknown, however, and would have to be analysed within the context of the strategy. Thus while these activities may be undertaken as the strategy is further elaborated and completed, future priorities may shift, based on the findings of the strategy.

To design and implement a comprehensive biomass energy strategy requires human and financial resources. Due to the limited knowledge of what constitutes a sustainable biomass energy strategy and in particular its implications on overall national development goals, it is imperative that awareness be raised among policy makers from various energy sub-sectors and all other relevant sectors to leverage support. This should be done in a targeted manner among users, promoters, producers and traders on the roles they would play in implementing the strategy. Ensuring inclusion and ownership of the strategy by the stakeholders is an imperative aspect of assuring sustainability.

A sustainable strategy has to be designed and implemented within an existing or modified institutional framework, however, so one must consider the role of those institutions. To design and implement a sustainable biomass strategy the following elements need to considered:

- institutional framework;
- awareness raising;
- resource mobilization;
- key actors and their roles.

In analysing these elements, SWOT analysis method is applied to facilitate identification of areas which need strengthening and measures that could be adopted to serve this objective.

6.3 Institutional framework

- Biomass supply is under the mandate of Forestry, and demand under MEMD. Given this situation, effective collaboration and coordinated planning is required to ensure sustainability. The Department of Forestry is restructuring and some of its activities will be undertaken as public services while others will shift to the private sector. The extent to which forestry will remain a supplier of biomass energy is unclear.

    1. Strengths: (i) both departments recognize the synergies.
    2. Weaknesses: (i) The institutional links are informal and relatively weak. (ii) Current links are project- and not programme-based. (iii) There is no comprehensive common understanding on the actual implications of activities and policies of one department for the other. (iv) While strategies adopted by each department may be good in addressing biomass energy problems, their effectiveness is undermined by the isolated rather than coordinated approach

3. Opportunities: (i) Through the process of developing the National Forest Plan, the Forestry Department created some task forces and MEMD was included in one of these groups; as a result some level of collaboration has occurred and there is a framework on which an energy focus team could be developed; (ii) MEMD has a GTZ advisor who has experience in renewable energy while Forestry has a secretariat focusing on development of the forest action plan. These could be exploited in developing and implementing a strategy through integration of the issues into the forest action plan and energy policy and strategy.

- Biomass energy use is influenced by access to alternative energy carriers. Policies and activities undertaken by other energy sub-sectors thus affect the biomass energy situation and its sustainability. However, the responsibilities for the different energy carriers are split across different sub-divisions headed by assistant commissioners.

  1. Strengths: a guiding energy policy focusing on all the sub-divisions exists, and the national development priorities are outlined.

  2. Weaknesses: (i) Each assistant commissioner undertakes their responsibilities in isolation from the others. (ii) There is limited analysis and hence understanding of the implications of activities in the other sub-divisions on biomass energy. For example, it would be beneficial to analyse the implications of the rural electrification strategy on biomass, yet the strategies that could be implemented to address biomass issues fall within the responsibilities of these other sub-sections. (iii) Lack of awareness of the synergies across sub-divisions.

  3. Opportunities: The sub-divisions exist within the Energy Commission, so that a framework for collaboration does exist and could be easily strengthened. There are various synergies across the sub-divisions that could be exploited to achieve sustainability in biomass energy.

- Regulatory frameworks do not exist for biomass energy sector as may be the case in electrification. There are a vast number of actors, and sources of biomass are, for example, varied, with different ownership status, making a common approach to regulation difficult. Due to the absence or weakness of regulation in both supply and demand, various stakeholders take advantage of the opportunities without taking due responsibility for the measures required by sustainable development objectives. The local authorities have, for example, been generating revenue from wood although they play a limited role in planting or replenishing the resource. They stand to gain most in the longer term if they were to ensure or contribute to sustainable supply, and incentives to encourage them to regulate extraction of fuelwood should be considered. Charcoal dealers extracting wood from the farms do not pay the real economic production costs, since the sellers are unaware of the true value as they obtained the farms when the trees were already there. On the demand side, consumers are paying low prices for the fuel compared to other energy carriers whose entry costs are also high.

  1. Strengths: (i) The stakeholders are known. (ii) There are community groups who could facilitate implementation of regulation.

  2. Weaknesses: (i) Lack of awareness of value of resource. (ii) Lack of ownership. (iii) Communities who could facilitate implement some level of regulation have not been involved. (iv) Guidelines on a regulatory framework and how to implement it are absent.

  3. Opportunities: (i) Local authority organizations exist, and have been involved in the biomass sector. (ii) Some examples on how to involve communities in resource management exist elsewhere, and this experience can be drawn upon in designing interventions.

- Multiple stakeholders have been involved in implementing various elements of a biomass energy strategy, although in an uncoordinated and intermittent manner, and

spread across a range of localities. As a result, impacts have been limited. It is important to harness such efforts, energy and resources and re-direct them onto a path that will enable sustainable development without undermining the role of the stakeholders but rather facilitating their effectiveness. This could be achieved through establishment a steering committee which guides the development path of biomass into a sustainable one. This will require understanding of the supply and demand options for biomass and alternative fuels, and their implementability within the national context.

1. Strengths: The stakeholders' experience can be drawn upon in implementing strategy.
2. Weaknesses: There is no framework on how the MEMD could collaborate with stakeholders and no criteria for evaluation of capabilities of the stakeholders.
3. Opportunities: The stakeholders' activities have been analysed and thus the role they could play in the steering committee could be easily investigated.

- Various activities have been undertaken to address biomass energy problems. As noted above, the level of impact has been limited. However, there is inadequate evaluation of the factors contributing to this status. Incoming institutions tend to undertake activities that had previously been done by other institutions, without consulting the other experienced institution. Most of the institutions that have been working on biomass do not just focus on it, nor do they work on it consistently. Information available from them is insufficient to establish the extent to which they can effectively participate in implementation of sustainable biomass energy strategy, so that some in-depth review of these institutions is needed.

  1. Strengths: Various options have been tested.
  2. Weakness: (i) A lack of evaluation of initiatives and institutions. (ii) A lack of resources to undertake evaluation, to monitor, and disseminate results. (iii) Poor collaboration across institutions. (iv) There is no framework to incooperate lessons learned into present and future activities and plans.
  3. Opportunities: (i) Evaluating the effectiveness of various options. (ii) Implementation of alternative options using the existing institutions and hence reducing transaction costs.

- Despite its significant contribution to the total energy consumption and 'hidden' GDP, biomass energy is still largely considered as a traditional fuel and so receives inadequate attention from policy makers, as is evident from the level of discussion in the Energy Policy. It is clear that for a sustainable biomass energy strategy to be implemented, key policy makers will have to be committed to it. For this to happen the policy makers will have to be sensitized to the role of biomass in long-term sustainable national development.

  1. Strengths: (i) A policy which can be used as a basis for improving the biomass energy situation exists. (ii) Biomass has received some attention, albeit inadequate.
  2. Weaknesses: (i) The traditional sector is not provided with adequate resources to enable it to make its full contribution towards sustainable development. (ii) Limited acknowledgement within the energy sector/commission on the importance of biomass energy.
  3. Opportunities: (i) Development of scenarios highlighting importance of biomass in the economy. (ii) The rural electrification strategy has been completed – this could be used as a basis for analysing the role of biomass.

6.4 Awareness raising

- To design and implement a sustainable biomass energy strategy will require financial and human resources. These resources will have to be mobilized and biomass energy will be competing against other development activities for the same pool of resources. As such it is imperative to raise awareness among policy makers of the importance of biomass energy. This will entail packaging in an accessible format the relevant facts on the role of biomass on the economy, alternative options, and long-term implications of biomass consumption on the environment under various scenarios. A variety of tools can be used in awareness raising: lobbying at varying levels and across sectors will be useful. Stakeholders targeting different audiences have used some awareness raising methods and, while their effectiveness is not supported by comprehensive analysis, it is evident that the activities are rather costly but also need to be repetitive, so that 'free' or piggy-back measures should be used if the process is to be sustainable.

    1. Strengths: (i) Some methods have been tested. (ii) The target group can be easily identified.
    2. Weaknesses: (i) Policy makers have multiple issues to deal with. (ii) Awareness raising has often been intermittent and not adequately focused. (iii) Assumptions that policy makers already know what they need to know. (iv) Lack of reliable information on effectiveness of awareness strategy.
    3. Opportunities: Some piggy-back options exist; for example, a number of agencies are actively involved in awareness and technology dissemination activities. particularly for improved cookstoves and tree planting.

- The biomass energy situation is not static but dynamic, warranting monitoring, re-evaluation and restructuring of strategies. To effectively perform these tasks a reliable database and analysis methods will need to be developed. More importantly, to plan and develop a long-term strategy requires reliable data; at present there is no such data, particularly on consumption patterns. Understanding the effectiveness of strategic options such as fuel-switching needs information on use patterns, among other relevant information.

    1. Strengths: (i) Understanding of the information needed exists. (ii) The NBS is well positioned to gather supply-related data.
    2. Weaknesses: (i) Lack of a centralized database location. (ii) Low priority on data gathering. (iii) High costs associated with data gathering.
    3. Opportunities: (i) National planning has a database which could be used as a basis for designing the database and staff could be used to manage the data. (ii) Integration of the data needs into the national statistics. (iii) Some institutions have been gathering some data, albeit sporadically, on some elements of consumption and could be used for gathering the relevant information.

6.5 Resource mobilization

- The design and implementation of biomass energy strategy requires financial and human resources. The bulk of the funding for the energy sector is mainly in the form of loans and some grants from multinational financing institutions and donors. Current rural electrification attests the extent to which Uganda is dependent on external funding for the implementation of energy sector policy and plans, putting the country in a vulnerable and unsustainable financial position. Only a small proportion flows to the biomass energy sector, however, despite the large share of the population supported by this sector. Isolated biomass pilot projects have been the focus of donors funding this sector. The biomass sector is largely dispersed in terms of returns on investment and thus appears relatively riskier to investors. On the other hand, unsustainable consumption of biomass is costing the country huge amounts and will continue to do

so. This justifies the need for diverting part of the grant funding to developing and implementing a biomass energy strategy.

1. Strengths: The MEMD has been a recipient of MFI and donor funding.
2. Weaknesses: The biomass sector not made attractive enough for MFIs and donors.
3. Opportunities: (i) Some donors have targeted sectoral assistance instead of project and programme funding. (ii) World Bank projects take biomass energy into account. (iii) An Energy Development Fund (see Ghana's experience, for example) could be established with contributions from a given percentage of tax revenue from all energy suppliers. (iv) Encouraging a system similar to one in Kenya (but targeting biomass technologies) where the petroleum company, Total Kenya, sold stamps to petrol station consumers until they accumulated sufficient stamps to cover the cost of a gas cylinder and burner.

- Human capacity within MEMD is limited and may not be sufficient to design and implement a biomass energy strategy. In addition, collaboration with the forestry sector is crucial, and staff supporting and understanding such as approach will be needed if the strategy is to be sustainable. There is need for capacity building while designing the strategy. At the same time, while there have been many initiatives relating to biomass energy, concentration has mainly been on improved cookstoves and, to a certain extent, tree planting. Even here it is unclear if the necessary expertise exists and if it would be sufficient, depending on the level of importance associated with this option within the strategy. There has been limited emphasis on fuel-switching for example, so that relevant expertise is limited and capacity would have to be build for implementation of the strategy.

  1. Strengths: (i) Acknowledgement of need for a biomass energy strategy. (ii) Recognition of need for capacity building.
  2. Weaknesses: Availability of experts outside the MEMD and the acknowledgement of existence of stakeholders who could provide some support.
  3. Opportunities: Need for support for capacity building identified in ongoing programmes such as the World Bank rural transformation project.

7. PROPOSED STRATEGY AND FUNDING REQUIREMENTS FOR DEVELOPMENT OF NBES

7.1 Proposed stakeholders for developing NBES

A functional analysis of agencies involved in biomass energy sector is used in identifying stakeholders who should participate in developing the NBES. The Ministry of Energy and Mineral Development (Energy Department, New and Renewable Energy Sources Division) is the lead agency in formulating and coordinating the implementation Energy policy, and so responsible for developing and implementing the NBES. However, there is need for a Steering Committee with representation from the MEMD, MFPED, MAAIF, MTTI, MoLG, MUK, MoES, NEMA, MWLE, and a representative of the private sector, which could be used to steer development of the strategy as it draws upon most relevant institutions. Expanding the committee to include more NGOs and the Uganda Bureau of Statistics, is recommended.

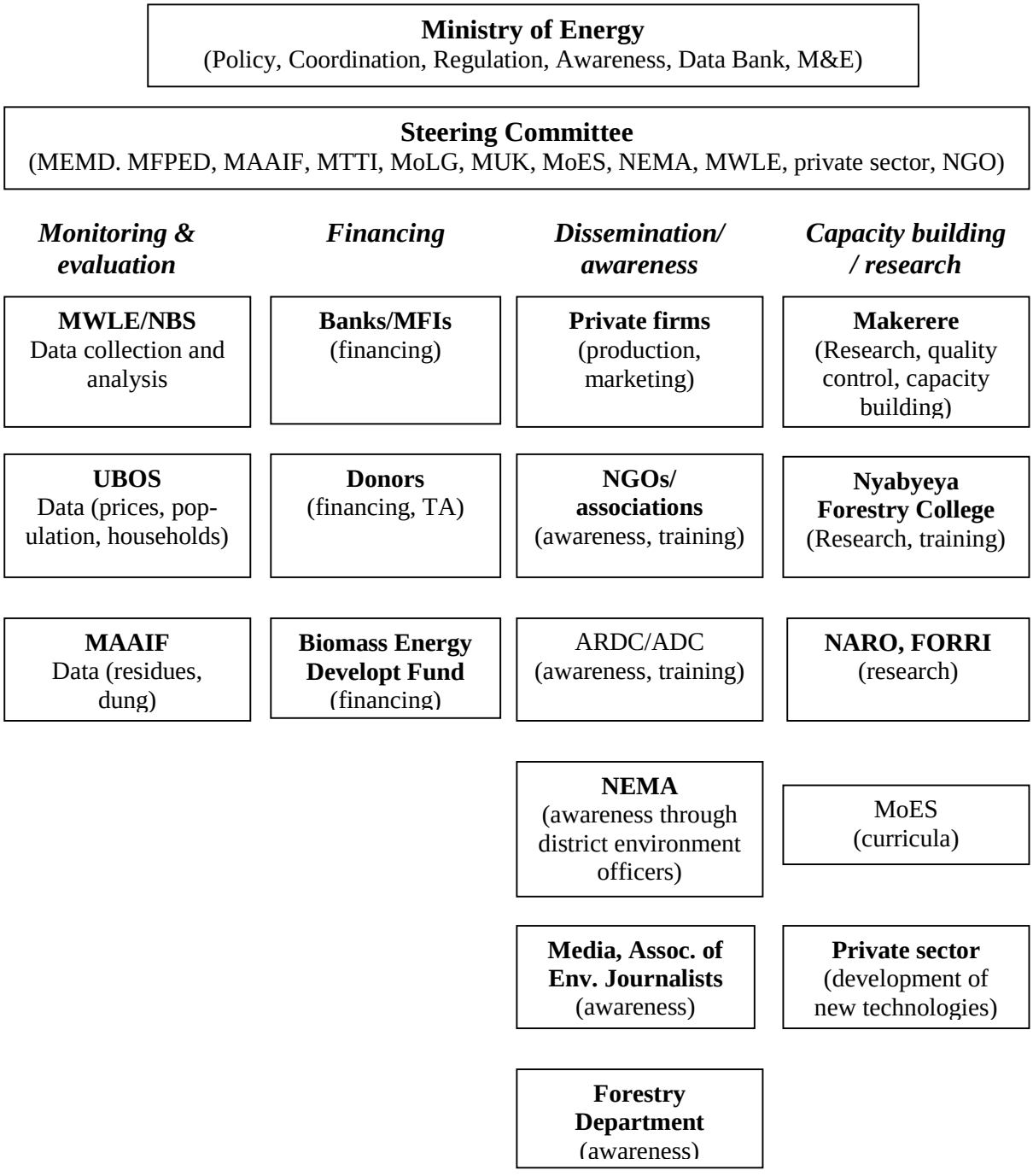
Within the Ministry of Water, Lands and Environment, the National Biomass Study Unit would be the major actor, providing requisite information on biomass distribution and balances in different parts of the country. The study has already provided some useful information for this strategy and would continue to update the database. Other sources of data would include the National Bureau of Statistics and the Ministry of Agriculture, Animal Industry and Fisheries. These would provide information on energy demand and supply; and, production and stocking rates in relation to use of agricultural waste for energy production respectively. The National Environment Management Authority would bring experience in supporting small-scale activities at sub-county level through district environment offices and incorporating energy issues in district environment plans.

Private firms, producers associations and NGOs acting as energy service companies will play a key role in the increased efficient use of biomass energy by households and small and medium enterprises through technology dissemination and creating awareness among biomass energy end-users. A NBES strategy will create a framework through which existing ESCOs will be strengthened and new ones can emerge.

The National Agricultural Research Organization (mainly Agricultural Engineering, Appropriate Technology Research Institute and Forestry Resources Research Institute) and Makerere University would play an important role in research addressing technology development and adaptation and any supply-side research issues that may arise. In addition, strong linkages would be built with ARDC and ADC through the country as one of the major technology uptake pathways.

Makerere University Faculty of Technology has acquired some basic testing equipment, but there is need to equip the workshop further to address a wider range of technologies. The faculty would be involved in capacity building and technology assessment. The Faculty of Forestry and Nature Conservation and the Nyabyeya Forestry College would play a key role in relevant capacity building since they already offer biomass energy related training programmes.

Figure 7-1: Proposed framework for development of NBES



The primary target of NBES is to ensure that production and consumption of biomass energy is balanced and hence sustainable. This would entail, among other activities, provision of energy-efficient technologies and fuel-switching. Table 7-1 shows estimated technologies disseminated in 2000.

Table 7-1: Estimate of technologies in year 2000

Rural population	18.6m
No. of rural households	3.8m
No. of households equipped with improved wood stoves (IWS)	40,000
Rural IWS equipment rate	1.1%
Urban population	3.4m
No. of urban households	0.8m
No. of urban households equipped with improved charcoal stoves (ICS)	80,000
No. of urban households equipped with gas/electric stoves (GES)	5,000
Urban ICS/GES equipment rate	10.6%
Total population	22m
Total no. of households	4.6m
Total no. of equipped (IWS/ICS) households	125,000
Total equipment (IWS/ICS/GES) rate	2.7%
Number of improved charcoal kilns	5
Number of institutions/commercial agencies using improved stoves	200
Number of improved biomass technologies	
- improved backeries	50
- improved bricks and tiles kilns	5
- improved tea driers	3
- improved barns (tobacco)	50
- improved lime kilns	7
- improved kilns for fish smoking	10
Number of solar water heaters	50
Number of solar cookers	10
Number of solar driers	10
Number of gasifiers	1
Number of densification units (briquettes)	2
Number of biogas plants	50
Number of pyrolisis plants	0

7.2 Activities towards developing NBES

The MEMD should re-convene and restructure the steering committee discussed above. The committee should identify a lead agency to develop the strategy. Preliminary work for the development of the strategy involves gathering reliable data on biomass production and production and organizing this into a usable format. The Forest Authority has already started this activity and hence any work should build on this. The Statistical Department in the Ministry of Finance, Planning and Economic Development has published data on wood consumption in the Statistical Abstract. The responsibility is now taken over by the Uganda Bureau of Statistics. Scenarios should then be prepared based on this data and future projections. Based on these scenarios recommendations on activities that need to be undertaken to ensure a sustainable biomass energy status should be made. Stakeholders

responsibilities in implementing recommendations should be clearly indicated. Resources needed for this implementation should be included.

7.3 Funding and time requirements for development of NBES

It is estimated that a total of US$ 0.5 million would be needed. This would be allocated as shown in Table 7-2.

Table 7-2: Budget for development of a NBES (in US$)

Data collection analysis	200,000
Scenario development	100,000
Database development and management	100,000
Consultations with stakeholders	50,000
Reviews workshops and Publications	50,000
Total	**500,000**

It is estimated that development of the strategy would take one year.

8. CONCLUSION

Uganda relies very heavily on biomass energy. At the same time, other alternative energy carriers are being used. An effective biomass energy strategy has to take this into consideration. Currently the energy sector is undergoing a process of reform – most notably in the power sector- but it should be noted that liberalisation of the petroleum sector has been undertaken. This reform is expected to have implications for biomass energy and should be considered when developing a strategy.

The supply side of biomass is as important as the demand side when designing a biomass energy strategy. It should be noted that the forest sector has been restructuring, with implications for biomass energy supply. It is already undertaking certain activities that could be particularly beneficial to, and could complement, a biomass energy strategy. It is imperative that this be taken into account.

Various biomass energy-related activities are being undertaken. Given the aim of NBES – to enhance sustainability – it is imperative that these activities be implemented with a view to restructuring them, based on recommendations in the strategy.

ANNEX A
NBES STAKEHOLDERS

1. The Ministry of Energy and Mineral Development
2. The Ministry of Water, Land and Environment
3. Ministry of Agriculture, Animal Industries and Fisheries
4. Ministry of Trade, Tourism and Industry
5. Ministry of Local Government
6. Ministry of Education and Sport
7. Ministry of Finance, Planning and Economic Development
8. The National Forestry Authority
9. The National Biomass Study
10. Forestry Resources Research Institute (FORRI)
11. The Uganda Manufacturers Association
12. The National Environment Management Authority
13. The Association of Environmental Journalists
14. The Private Enterprise Support Training and Organisational Development Project (PRESTO)
15. The Uganda Coffee Farmers Association
16. The Uganda Traders Federation
17. The Uganda National Bureau of Standards
18. The Private Sector Foundation
19. The Uganda National Farmers Association
20. The Business Uganda Development Scheme
21. The Federation of Uganda Consultants
22. The Uganda Electricity Board
23. NGOs that are involved in Energy matters e.g. ECA, JEEP, UREA, IRDI, ACORD etc.
24. Makerere University
25. Nyabyeya Forestry College
26. Agricultural Research and Development Centres (ARDC)
27. Agricultural Development Centres (ADC)
28. Ministry of Education
29. Youth Organisations
30. The media (press, radio, TV)
31. Sugar Industries
32. Tea Industries
33. Tobacco Industries
34. Oil companies

ANNEX B
LIST OF ABBREVIATIONS

ADC	Agricultural Development Centres
ARDC	Agricultural Research and Development Centres
BAT	British American Tobacco
BET	Biomass Energy Technologies
DFID	Department for International Development
DVS	Dry volatile solids
EA	Exploration areas
EAC	East African Community
ECA	Biomass Conserve Association
EE	Energy efficiency
ERA	Electricity Regulatory Authority
ERD	Energy Resources Department
ERT	Energy for rural transformation
ESCO	Energy service company
ESD	Energy for sustainable development
GDP	Gross development product
GHG	Greenhouse gases
GOU	Government of Uganda
GSMD	Geological Survey and Mines Department
HV	High voltage
IAEA	International Atomic Energy Agency
IGAD	Inter Governmental Agency for Development
IPP	Independent power producer
IRDI	Integrated rural development initiatives
JEEP	Joint Energy and Environment Project
KAR	Knowledge and research
KCJ	Kenya ceramic Jiko
LPG	Liquefied petroleum gas
MEMD	Ministry of Energy and Mineral Development
MFPED	Ministry of Finance, Planning and Economic Development
MoES	Ministry of Education and Sport
MoLG	Ministry of Local Government
MTEF	Medium term expenditure framework
MWLE	Ministry of Water, Land and Environment
Mio t	Million of tons

NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NBES	National Biomass Energy Strategy
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NGO	Non-governmental organisation
NRSE	New and renewable sources of energy
OF	Owen Falls
OFE	Owen Falls Extension
PEAP	Poverty Eradication Action Plan
PEPD	Petroleum Exploration and Production Department
PMA	Plan for Modernisation of Agriculture
PPA	Power purchase agreement
PSA	Production sharing agreement
PV	Photovoltaic
R&D	Research and development
RE	Renewable energy
REDC	Renewable Energy Development Centre
RET	Renewable energy technologies
RHTC	Rwenzori Highlands Tea Company (RHTC)
SEUHI	Sustainable Energy Use in Households and Industry
SHS	Solar home systems
SWH	Solar water heater
SWOT	Strengths, weaknesses, opportunities, threats
Toe	Ton of oil equivalent
UEB	Uganda Electricity Board
UMA	Uganda Manufacturers Association
UPE	Uganda Primary Education
UREA	Uganda Renewable Energy Association
URU	Utility Reform Unit
USh	Uganda Shilling (1 US$ = 1,800 UShs in March 2001)

ANNEX C

Forestry Biomass resource per region

Region	Land cover (use)	Gross Area (Km2)	Protected Area (Km2)	Available Area (Km2)	Total Biomass (000, Tons, Airdry)	Protected (000, Tons, Airdry)	Available (000, Tons, Airdry)
Central	Broadleaved Plantations	43,9	14,0	29,9	332,8	105,94	226,9
Central	Softwood Plantations	27,5	26,0	1,5	412,0	390,15	21,9
Central	Tropical High Forest	1.378,3	751,9	626,4	30.874,1	16843,23	14.030,9
Central	Tropical High Forest (degraded)	1.332,2	311,5	1.020,7	15.053,7	3520,18	11.533,5
Central	Woodlands	7.154,5	658,6	6.495,9	22.841,6	2568,38	20.273,2
Central	Bushlands	2.301,3	141,5	2.159,8	3.303,2	325,38	2.977,8
Central	Grasslands	9.350,5	569,9	8.780,7	13.662,1	968,75	12.693,4
Central	Wetlands	1.407,5	29,1	1.378,4			0,0
Central	Subsistence farmlands	16.468,0	477,9	15.990,1	24.702,0	716,84	23.985,2
Central	Large scale Farmlands	230,3	4,2	226,1			0,0
Central	Built up areas	165,8	15,2	150,6	33,2	3,04	30,2
Central	Water	21.533,7	29,0	21.504,8			0,0
Central	Impediments	3,3	0,3	3,0			0,0
Central Total		61.396,8	3.029,0	58.367,8	111.214,7	25.441,89	85.772,81
Eastern	Broadleaved Plantations	48,7	36,3	12,5	369,1	274,70	94,40
Eastern	Softwood Plantations	21,4	20,1	1,3	321,1	301,20	19,90
Eastern	Tropical High Forest	299,9	294,9	5,0	6.716,6	6.605,31	111,29
Eastern	Tropical High Forest (degraded)	488,2	459,9	28,3	5.517,2	5.196,98	320,22
Eastern	Woodlands	1.788,3	671,0	1.117,4	5.365,0	2.616,71	2.748,29
Eastern	Bushlands	620,4	134,9	485,5	744,5	161,92	582,58
Eastern	Grasslands	5.725,7	2.066,5	3.659,2	5.725,7	3.513,12	2.212,58
Eastern	Wetlands	1.742,1	45,5	1.696,6			0,00
Eastern	Subsistence farmlands	19.050,0	798,0	18.252,0	20.561,2	789,52	19.771,68
Eastern	Large scale Farmlands	159,9	5,5	154,4			0,00
Eastern	Built up areas	88,4	2,3	86,1	1,2	0,03	1,17
Eastern	Water	9.442,1	10,0	9.432,2			0,00
Eastern	Impediments	4,0	0,6	3,4			0,00
Eastern Total		39.479,1	4.545,5	34.933,7	45.321,6	19.459,49	25.862,11

Northern	Broadleaved Plantations	26,4	8,3	18,1	200,0	62,57	137,43
Northern	Softwood Plantations	32,4	31,2	1,2	485,2	468,15	17,05
Northern	Tropical High Forest	14,6	14,6	0,0	326,7	325,92	0,78
Northern	Tropical High Forest (degraded)	0,1	0,0	0,1	0,6	0,00	0,60
Northern	Woodlands	22.403,1	8.454,4	13.948,7	58.204,5	20.850,18	37.354,32
Northern	Bushlands	8.717,5	7.762,3	955,2	7.535,2	6.414,51	1.120,69
Northern	Grasslands	22.403,1	17.069,3	5.333,8	21.383,6	17.401,33	3.982,27
Northern	Wetlands	632,7	194,0	438,7			0,00
Northern	Subsistence farmlands	29.115,6	3.143,4	25.972,2	30.210,9	1.990,84	28.220,06
Northern	Large scale Farmlands	31,3	3,9	27,4	0,6		0,60
Northern	Built up areas	46,5	5,6	40,9		0,08	-0,08
Northern	Water	1.520,0	136,1	1.383,9			0,00
Northern	Impediments	15,2	6,8	8,4			0,00
Northern Total		84.958,5	36.829,8	48.128,7	118.347,3	47.513,58	70.833,72
Western	Broadleaved Plantations	69,9	8,2	61,7	529,3	62,44	466,86
Western	Softwood Plantations	82,6	79,6	3,0	1.238,2	1.194,00	44,20
Western	Tropical High Forest	4.818,3	3.702,1	1.116,2	107.930,4	82.926,37	25.004,03
Western	Tropical High Forest (degraded)	910,1	200,1	710,0	10.284,0	2.261,13	8.022,87
Western	Woodlands	8.398,7	3.942,6	4.456,1	32.063,1	14.693,08	17.370,02
Western	Bushlands	2.582,7	587,9	1.994,8	3.378,4	1.200,53	2.177,87
Western	Grasslands	13.241,8	3.457,7	9.784,1	17.789,4	5.639,32	12.150,08
Western	Wetlands	1.058,0	267,2	790,8			0,00
Western	Subsistence farmlands	19.373,5	566,4	18.807,1	29.060,2	849,60	28.210,60
Western	Large scale Farmlands	263,0	8,9	254,1			0,00
Western	Built up areas	65,1	2,8	62,3	13,0	0,57	12,43
Western	Water	4.399,8	95,5	4.304,3			0,00
Western	Impediments	14,9	3,7	11,2			0,00
Western Total		55.278,4	12.922,8	42.355,6	202.286,0	108.827,04	93.458,96
Grand Total		241.112,8	57.327,0	183.785,8	477.169,6	201.242,00	275.927,60

ANNEX D

Crop area and production per region (1995)

Region	District	Cassava-Ha	Cassava-Ton	Banana-Ha	Banana-Ton	Beans-Ha	Beans-Ton	Sorghum-Ha	Sorghum-Ton	Maize-Ha	Maize-Ton	G-Nuts-Ha	G-Nuts-Ton
CENTRAL	Kalangala	19.927	18.005	868	5.631	188	129	54	82	430	856	139	85
CENTRAL	Kampala		-	-	-	-	-	-	-	-	-	-	-
CENTRAL	Kiboga	2.664	39.362	75.691	501.729	2.980	1.919	179	246	2.625	4.299	955	682
CENTRAL	Luwero	2.840	19.315	38.192	215.873	8.902	5.729	1.673	443	6.792	11.076	3.021	2.161
CENTRAL	Masaka	3.644	42.044	154.077	652.387	11.459	7.376	3.646	5.546	5.725	9.366	3.155	2.255
CENTRAL	Mpigi	10.425	70.894	61.800	336.601	10.307	6.634	1.203	1.829	8.282	13.551	1.250	893
CENTRAL	Mubende	207	3.279	50.460	334.485	4.470	2.878	349	482	6.133	10.026	1.431	1.023
CENTRAL	Mukono	11.636	79.134	59.579	358.512	14.768	9.505	1.412	2.147	4.758	7.781	1.737	1.242
CENTRAL	Rakai	3.540	24.072	118.105	500.080	18.592	11.966	3.044	4.633	11.283	18.453	2.778	1.986
CENTRAL Total		54.883	296.105	558.772	2.905.298	71.666	46.136	11.560	15.408	46.028	75.408	14.466	10.327
EASTERN	Iganga	24.456	166.318	35.891	219.266	14.738	9.488	6.633	10.091	40.735	66.607	8.309	5.948
EASTERN	Jinja	2.688	18.280	20.920	120.028	15.991	10.295	-	-	10.555	17.261	371	266
EASTERN	Kamuli	15.577	105.932	25.080	144.701	21.383	13.763	3.143	1.558	29.741	48.640	6.427	4.595
EASTERN	Kapchorwa	471	3.200	8.199	50.083	50.398	32.441	83	124	30.346	49.632	900	645
EASTERN	Kumi	16.925	115.101	9.376	54.079	13.415	8.635	11.292	17.180	15.019	24.566	13.765	9.842
EASTERN	Mbale	24.571	167.105	116.011	698.095	40.390	25.998	4.253	6.471	29.680	48.539	9.615	6.874
EASTERN	Pallisa	15.151	65.839	3.732	10.240	7.611	3.920	4.837	7.360	8.277	27.421	3.207	3.281
EASTERN	Soroti	12.249	83.304	536	3.090	14.049	9.042	16.135	24.552	12.413	20.184	9.144	6.537
EASTERN	Tororo	10.216	51.457	19.562	124.290	28.298	19.194	11.033	16.788	31.198	37.143	8.431	8.320
EASTERN Total		122.304	776.536	239.307	1.423.872	206.273	132.776	57.409	84.124	207.964	339.993	60.169	46.308
NORTHERN	Apac	20.145	138.837	13.773	84.142	37.632	24.223	10.681	16.252	28.015	44.261	11.934	8.692

NORTHERN	Arua	20.205	137.414	17.244	98.836	23.097	14.866	20.301	30.888	30.897	50.533	15.409	11.016
NORTHERN	Gulu	17.230	117.176	3.405	20.807	29.463	18.965	23.421	35.635	25.409	41.311	17.643	12.613
NORTHERN	Kitgum	19.566	123.252	437	2.679	25.797	17.697	21.636	32.916	21.345	42.480	18.198	15.778
NORTHERN	Kotido	140	953	-	-	845	544	18.947	28.829	9.437	5.742	2.747	1.963
NORTHERN	Lira	17.104	116.310	2.753	16.811	35.122	22.608	24.920	37.914	35.835	58.262	9.051	6.605
NORTHERN	Moroto	172	1.165	7	42	1.710	1.101	16.117	24.522	8.306	13.504	403	288
NORTHERN	Moyo	2.562	16.136	316	1.920	529	363	3.194	4.859	2.305	4.631	2.610	2.264
NORTHERN	Nebbi	14.561	99.028	10.405	63.566	8.086	5.206	7.358	11.195	13.407	21.926	8.235	5.886
NORTHERN Total		111.685	750.271	48.340	288.803	162.281	105.573	146.575	223.010	174.956	282.650	86.230	65.105
WESTERN	Bundibugyo	1.839	12.498	26.624	160.213	3.866	2.488	296	140	1.076	1.763	448	320
WESTERN	Bushenyi	3.207	21.811	199.645	1.201.360	11.132	7.167	4.839	7.363	11.436	18.716	2.562	1.839
WESTERN	Hoima	2.463	57.666	37.156	198.355	16.631	10.511	4.264	6.488	18.710	29.886	3.417	2.442
WESTERN	Kabale	2.806	19.085	23.403	203.034	28.305	20.275	10.208	15.530	24.827	22.261	347	248
WESTERN	Kabarole	13.814	93.949	65.505	344.568	26.790	17.247	6.117	9.306	16.639	27.225	6.196	4.431
WESTERN	Kasese	2.667	18.138	42.391	258.968	3.575	2.301	90	136	7.355	12.026	198	142
WESTERN	Kibaale	1.919	15.075	658	3.567	4.496	3.087	549	838	2.037	4.048	2.965	2.118
WESTERN	Kisoro		-	1.915	4.142	4.715	3.643	5.843	8.889	5.253	9.538	86	62
WESTERN	Masindi	4.073	94.398	29.360	179.360	27.540	17.726	1.529	2.328	31.029	50.753	4.526	3.235
WESTERN	Mbarara	9.183	62.445	191.978	1.630.583	27.448	17.669	13.552	20.619	18.328	29.973	8.306	5.935
WESTERN	Ntungamo		-	-	-	-	-	-	-	-	-	-	-
WESTERN	Rukungiri	886	6.023	46.947	209.874	5.285	3.403	3.170	4.823	5.364	8.769	2.083	1.488
WESTERN Total		42.857	401.088	665.582	4.394.024	159.783	105.517	50.457	76.460	142.054	214.958	31.134	22.260
Grand Total		331729	2224000	1512001	9011997	600003	390002	266001	399002	571002	913009	191999	144000